

# Proceedings

2<sup>nd</sup> African Operations Management Conference  
in partnership with the  
**Africa Automation Fair 2019**

Competitive Operations Management for  
Driving Automation in Africa Forward

**Be in the Front Line!**

4 – 6 June 2019  
Ticket Pro Dome  
Northriding, Johannesburg  
South Africa

# 2019



This work is based on the research supported wholly/  
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# PROCEEDINGS

of the

## 2<sup>nd</sup> African Operations Management Conference

*Competitive Operations Management for Driving Automation in  
Africa Forward*

4 – 6 June 2019

Ticket Pro Dome, Northriding, Johannesburg, South Africa

ISBN: 978-0-620-83393-6 (print)

ISBN: 978-0-620-83394-3 (e-book)

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E-Book ISBN: 978-0-620-83394-3

Book version ISBN: 978-0-620-83393-6



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## PREFACE

The world is changing right in front of us, new ways of communicating, and doing business, combined with real-time transactions across disparate geographies, and mind-boggling automation leverage our burgeoning understanding of the future of work. Operations management, supply chains, business models, regulation and governance of these emerging technologies and innovations need to keep pace, and indeed go a step further, and forecast what the future holds if we intend to harness the innovations and promote sustainable economic growth, while at the same time reducing the gap in livelihoods across the world. Risk scholars argue that the emerging technologies, innovations and new ways of design, fabrication, manufacturing, distribution, use and ultimate disposal of technologies, are creating an ecosystem of new risks, some of which we have not yet grasped in terms of the depth and breadth of their impact on society, individuals and the environment. These newly created risks can and will change the way we live, associate and interact with one another and the environment.

In line with this perspective and realisation, the University of South Africa's Department of Operations Management organised and presented the 2<sup>nd</sup> Operations Management Conference in partnership with Africa Automation Fair 2019 with the main theme of *Competitive Operations Management Driving Automation in Africa Forward*. The purpose of the conference was to provide a platform for researchers and practitioners from academia, government and industry to meet and share cutting-edge development in the field of operations management. The call for papers set out the following tracks: Production and Operations Management; Integrated SHERQ; Quality Management; Work Study; Project Management; Ethics, Information and Administrative Management; Sustainability; Competitive Intelligence; and the Internet of Things - Industry 4.0, Big Data Management, Machine Learning, Security and Privacy of IoT, Applications of IoT, and Learning approaches for IoT.

There is a growing dilemma for African countries on development trajectories and the choice of industrialisation routes, especially regarding critical issues such as Big Data, the Internet of Things, Automation, and Artificial Intelligence; especially as these are increasingly being combined in applications, thereby creating an unprecedented new future. To this end, the African Union crafted Agenda 2063- The Africa We Want that also places hope on the demographic dividend that the continent can reap from the youthful citizens and the emerging middle class. However as suggested earlier the types of jobs, skill sets and curricula required to meet this will inevitably be different from that of contemporary approaches. This workshop set out to focus on these, as well as current issues in trying to understand how transitions should be managed. The workshop brought together industries (Festo, SAP, ADM Engineers, LLMA, consultants, Eskom, Assupol, Lefa Coop, AACE International, Transnet, Anglo-American, Africa Automation Fair, Professionals South Africa, Denel, and the Innovation Hub), academia (University of Johannesburg, University of Pretoria, University of Kwazulu-Natal, Durban University of Technology, Tshwane University of Technology, Botswana International University of Science and Technology, University of Limpopo, Central University of Technology, the University of Witwatersrand, North-West University, Justice College, Landmark University Nigeria, Uganda Management Institute, Southern Business School, Atlantic International University, Edinburgh University (Scotland), Nottingham Trent University (UK), and Carleton University (Canada)), and government (Department of Trade and Industry, Department of Public Enterprises, CSIR, and Society for Automation, Instrumentation, Measurement, and Control (SAIMC), IFPTI—demonstrating a phenomenon that innovation scholars termed the triple helix framework. This mixture of experienced researchers and industrialists, as well as postgraduate students at various stages of their studies, enabled a purposive strategy for the cross-fertilisation of ideas across various disciplines. In the introductory speech of UNISA's Vice Chancellor called for research that addresses the need for diversified and resilient economic growth, which at the same time addresses the Sustainable Development Goals (SDGs).

Reflecting on the aforementioned issues, the selected papers in the proceedings span organisational performance, technology systems for land administration, currency management systems for cross border cross-currency infrastructure projects, mathematical models for improving supply chains, process optimisation in healthcare, proactive workplace risk management, cloud computing and collaborative supply chain management, amongst others. It is our hope that you will find these papers stimulating and that they pose new questions about operational management and the future of operations management in Africa in general.

The Editors

## ABOUT THE EDITORS

**Prof. Marcia Mkansi** is the former head of the Department of Operations Management at the University of South Africa (Unisa). She holds a PhD (University of Bolton), and is SAP certified. She is the author and co-author of three chapters of the Van Schaik book Strategic Logistics Management: A supply chain management approach. She also co-authored a chapter in the Acpi book Leading Issues in Business Research Methods. She is a Member of the British Computer Science (MBCS), Certified Fellow of the Chartered Institute of Logistics, and Member of the Premier Professional Association for Supply Chain Management (APICS), AFAM, and a Certified Fellow of the Institute of Operations Management (IOM). Her university-industrial alliances and experiences in the UK, Malaysia, Zambia, Malawi and South Africa bring a practical perspective to her research and teaching. Currently, she serve as an advisory board member for the Africa Resource Center, a Bill and Melinda Gates foundation aimed at improving health supply chain in Africa.

**Geoffrey Banda** is the Deputy-Director of the Innogen Institute (<http://www.innogen.ac.uk/>) and a Lecturer in Global Food Security in Innovation at the University of Edinburgh's Science Technology and Innovation Studies Group (<http://www.stis.ed.ac.uk/>). He is a multidisciplinary researcher on the social, practice and policy aspects of life sciences innovation, regulation and governance, especially emerging technologies. With early training in biological sciences and research experience in rapid diagnostics of Salmonella, and genetic fingerprinting in fish, he later gained food manufacturing quality assurance and laboratory management industrial experience. After postgraduate studies in biotechnology - virology and advanced plant genetic engineering, he made a mid-career change and joined the financial services industry. His experience as a corporate banker spans commercial lending, credit risk management, relationship management, structured trade finance, structured export finance and transactional banking. He crossed over to Social Sciences through his doctoral studies on finance, innovation, and industrial development focusing on the financing of Zimbabwe's local pharmaceutical industry's antiretroviral drug production. His post-doctoral work covered financing African local pharmaceutical production and industry development, and UK Cell Therapies and Regenerative Medicine business models and their commercialisation. Currently he is involved in two research projects; TIBA (Tackling Infection to Benefit Africa) <http://tiba-partnership.org/> and Innovation for Cancer Care in Africa (ICCA) <https://www.open.ac.uk/researchprojects/innovation-cancer-care-africa/>



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## KEYNOTE SPEAKERS

### Prof Tshilidzi Marwala

*Principal and Vice-Chancellor, University of Johannesburg*



Tshilidzi Marwala, born in Venda (Limpopo, South Africa), is the Vice-Chancellor and Principal of the University of Johannesburg beginning January 2018. Previously he was the Deputy Vice-Chancellor for Research and Internationalization and the Executive Dean of the Faculty of Engineering and the Built Environment both at the University of Johannesburg. From 2003 to 2008, he progressively held the positions of Associate Professor, Full Professor, the Carl and Emily Fuchs Chair of Systems and Control Engineering as well as the SARChI Chair of Systems Engineering at the Department of Electrical and Information Engineering at the University of the Witwatersrand. From 2001 to 2003, he was the Executive Assistant to the technical director at South African Breweries. From 2000 to 2001 he was a post-doctoral research associate at the Imperial College (then University of London). He holds a Bachelor of Science in Mechanical Engineering (magna cum laude) from Case Western Reserve University (USA) in 1995, a Master of Mechanical Engineering from the University of Pretoria in 1997 and a PhD specializing in Artificial Intelligence and Engineering from the University of Cambridge in 2000. Marwala completed the Advanced Management Program (AMP) at Columbia University Business School in 2017 and completed a Program for Leadership Development (PLD) at Harvard Business School in 2007. Tshilidzi is a registered professional engineer, a Fellow of TWAS (The World Academy of Sciences), the Academy of Science of South Africa, the African Academy of Sciences and the South African Academy of Engineering. He is a Senior Member of the IEEE (Institute of Electrical and Electronics Engineering) and a distinguished member of the ACM (Association for Computing Machinery). His research interests are multi-disciplinary and they include the theory and application of artificial intelligence to engineering, computer science, finance, social science and medicine. He has extensive track record in human capacity development having supervised 47 Master's and 28 Doctoral students to completion. Some of these students have proceeded with their doctoral and post-doctoral studies at leading universities such as Harvard, Oxford, Cambridge, British Columbia, Rutgers, Purdue, Chiba and Waseda. He has published 14 books in artificial intelligence, one of these has been translated into Chinese, over 300 papers in journals, proceedings, book chapters and magazines and holds four patents. He is an associate editor of the International Journal of Systems Science (Taylor and Francis Publishers). He has been a visiting scholar at Harvard University, University of California at Berkeley, Wolfson College of the University of Cambridge and Nanjing Tech University as well as member of the programming council of the Faculty of Electrical Engineering at the Silesian University of Technology in Poland. He has received more than 45 awards including the Order of Mapungubwe and was a delegate to the 1989 London International Youth Science Fortnight (LIYSF) when he was in high school. His writings and opinions have appeared in the magazines New Scientist, The Economist and Time Magazine.

## Alvin Paules

*Chief Technology Architect, SAP Africa*



Alvin Paules has been in the IT industry for 42 years. He has spent most of his career designing solutions that solve complex problems across multiple industries such as banking, manufacturing, public services, retail, health care, “oil and gas”, transportation, insurance, telecommunications, mobile commerce and mining. He has examples across these industries which demonstrate how the exploitation of technology enables transformation and makes a significant difference to an organization and, in many instances radically alters industry business models.

Alvin has held various senior roles in different organizations, from being the Chief Architect of a Global Oil & Gas Corporation, where the primary objective was to standardize IT applications and Business Processes across the group to the CIO of a large manufacturing organization where Information Systems was the key enabler in a “turnaround” strategy.

Alvin’s first major SAP project was in 1994 - the R/3 Global roll-out across the BOC Group . He was responsible for Group Enterprise Application Architecture. His primary focus was to ensure the successful global roll-out onto a single application landscape run out of the UK.

Alvin has been employed by SAP Africa since 2002, His focus is on helping organizations to understand the future technological landscape and how to exploit this in a localized African context with the current focus being on The Intelligent Enterprise, Industry 4.0 and IoT.

In his current role Alvin works closely with organizations, specifically SAP customers, helping them with their “roadmaps”, enterprise architecture, and technology exploitation initiatives towards Industry 4.0.

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## **ADOPTING OMNI-DISTRIBUTION SYSTEMS TO MANAGE DEMAND ORDER FULFILMENT: THE CASE OF THE CEEDEE GROUP**

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### **ABSTRACT**

The world of business is characterized by its own set of commercial dynamics. It is within this milieu that this study explored the emerging strategies that characterize the world of commerce with its myriad challenges. In the prevailing commercial environment, retailers are adopting the omni-channel approach as customers demand a more seamless shopping experience. The study aimed to determine the effects of omni-channel adoption by a retail apparel company, and to ascertain how demand-driven omni-distribution systems influence the order fulfilment frequencies in a designated supply chain network. An exploratory case study was conducted using a mixed-method approach and a survey and interviews were conducted to gather data to determine the interrelationships between variables. Univariate and bivariate methods were used for quantitative analysis, while thematic analysis was employed for the analysis of the qualitative data. The study found that the emergence of omni-channel retailing requires a visible supply chain with cross channel capabilities for frequent store fulfilment via the omni-channel distribution system. The findings further indicate that delivery of online orders to stores results in increased growth and sales.

**Key words:** Omni-channel distribution, demand-driven, order fulfilment

### **1 INTRODUCTION**

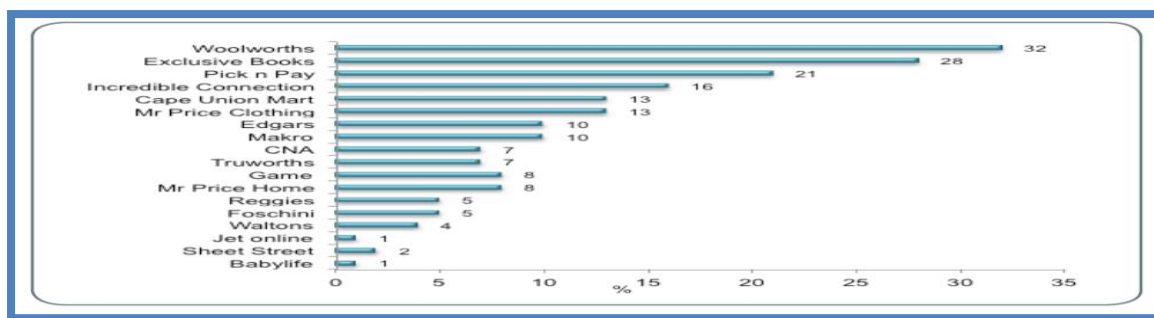
The advent of digital technology has given rise to connected consumers, also known as Generation C (ranging from 20 to 40 years old). This generation is more informed, extremely demanding, vigorously social and always connected (Turner, 2014:4). However, increased adoption of digital channels has also been reported among customers over the age of 55 with high levels of disposable income (Turner, 2014:4). According to Deloitte. (2014:9), connected consumers make frequent use of digital devices to seek out information and products. To keep pace with the expectations of new age customers, there has been a shift from brick and mortar to multi-channel retailing. The demand for a more seamless and flexible shopping experience has given rise to omni-channel retailing. "Omnis" is Latin for "every/all" and describes "integration of all physical channels (offline) and digital channels (online) for seamless and effortless provision of high-quality customer experiences occurring within and between contact and communication channels" (Butte, 2015). Channel refers to the method whereby customers interact with an organization and brand as "every-channel". Distribution refers to "the outbound flow (route along which a product and its title – ownership flow) of products that are geographically dispersed from the supplier to customers" (Bardi, Coyle & Novack, 2006:12). It includes "distribution facilities and organisations serving as supply and replenishment points for given product lines and specifying the lead times and transportation methods between those points" (Boateng, 2014:84). This study investigated how the adoption of all physical and online channels influences the

distribution network of products for quasi-real time fulfilment to create an innovative and unified customer experience. The apparel company CeeDee Group is a pseudonym for the retail group used as a case study. It was selected as it was rated by Deloitte as one of the top 10 retailers in Africa with an e-commerce and brick and mortar presence as well as one of the top three retailers in Africa with the highest growth rate (Dennis & Piatti, 2015:25-27).

In a multichannel distribution strategy, the customer is offered in-store and online purchase channels which are independent of each other and are serviced from traditional and virtual distribution centres, respectively (Foster, Lewsi & Whysall, 2014:44). The multichannel opens up channel choices and encourages customers to use the one most appropriate for their needs. Whilst online channels achieve inventory pooling for retailers due to the broader product assortment offered to customers compared to in-store inventory (Agatz, Fleischmann & Nunen, 2008:342). Kearney (2013:1) found that customers continue to enjoy shopping in-store as they acquire their items immediately rather than awaiting delivery of online orders. Online channels are also extending to brick and mortar platforms whereby online orders can be collected from dedicated brick and mortar stores servicing the online store (Agatz et al., 2008:343). Omni-channel retailing tracks customers across all channels and conveys a consistent brand message (Tetteh & Xu, 2014:3). Consumers have identified benefits such as additional choice and quick delivery.

## **2 BACKGROUND TO THE STUDY**

A study conducted by Deloitte. (2014:19) found that the European fashion industry has rapidly adopted omni-channel retailing and has experienced an increase in sales. The United Kingdom's (UK) fashion market has a strong online presence, with the majority of sales being made through electronic commerce (e-commerce), and mobile commerce (m-commerce) channels using omni-channel retailing (Deloitte., 2014:19). American companies also achieved sales growth by adopting an omni-channel approach (Tetteh & Xu, 2014:1). It has been reported that Japan is the leader in the m-commerce market, with 30% growth, followed by the UK, China and the United States (US) at 25%, 15% and 16%, respectively (IORMA, 2014:13). Prinsloo (2015:2) notes that Asia, North America and the UK are responsible for 90% of global e-commerce as a result of the evolution of omni-channel distribution and m-commerce using wireless mobile phones and tablets to conduct electronic business transactions via websites or smartphone applications (Levin & Taylor, 2014:759). Furthermore, the BRICS (Brazil, Russia, India, China and South Africa) countries are expected to experience growth of more than 200% in e-commerce by 2019 (Turner, 2014; Haus, 2014; Deloitte., 2014). In South Africa, there are barriers to progression in the retail e-commerce realm due to the high cost of broad band Internet (PWC, 2012:21). However, the number of online users has increased by 25% due to an increase in m-commerce (PWC, 2012:21). Edgars, Foschini and Mr Price, some of the largest retail chains in South Africa, are leading retail growth into neighbouring countries (Tempest, 2015). Although the number of online users has increased due to the growth of m-commerce, the electronic payment system via credit cards remains a challenge (Prinsloo, 2015:6). Figure 1 illustrates, that the most popular clothing sites used in South Africa in 2014, in descending order, were Woolworths, Mr Price, Edgars, Truworths, Foschini and Jet (Urban Studies, 2015:6). Two key findings by Urban Studies (2014) were that online shopping offers convenience, product range, security and speedy delivery, and that 46% of non-online shoppers in South Africa expected to utilize online channels. As in the UK and US, the adoption of omni-channel retailing offers potential for the South African retail industry to experience significant growth.



**Figure 1: Retail websites used by South African shoppers**  
 Source: Urban Studies. (2015)

### 3 THEORETICAL FRAMEWORK

The technology-organization-environment (TOE) framework was developed by Tornatzky and Fleischer (1990). It depicts that the adoption of omni-channel distribution systems within an interrelated distribution network of in-store and online stock is influenced by factors pertaining to the technological, organizational and internal and external environmental context. The framework describes the factors influencing technology adoption and the propensity to absorb online orders as well as how a firm’s adoption and implementation of omni-channel distribution innovations is influenced by the technological, organizational and environmental contexts. According to Lin (2014:80), the TOE framework is a major determinant of the decision to adopt an omni-channel distribution system as it is “enabled by the characteristics of information technology (IT) innovation itself”, while the extent of adoption is “driven by organisational readiness, and influenced by environmental factors”, especially the situation of suppliers, customers and competitors (Zhu, Dong, Xu & Kraemer, 2006:601). It should not be regarded as a theory; rather, Oliveira and Martins (2011:110) assert that it “should be treated as an ‘interactionism’ framework that demonstrates how various theories can be applied systematically and complementarily to explain an adoption phenomenon”. This study assumed that the “technological context describes the dependence adoption on the pool of technologies as well as relative network benefits and compatibility. As the organizational context captures the enterprise’s scope, culture and network architectural complexity, the environmental context relates to facilitating and inhibiting factors in areas of operations” (Kurnia, Karnali & Rahim, 2015). The technological phase, underpinned by the adoption theory, points out that “many innovations do not achieve the expected results for failure to satisfy the requirements of potential adopters” (Figueiredo, 2005). It is viewed as omni-channel information technology (IT) adoption that refers to “the adoption of new methods of order placement and fulfilment, integrated information, order and financial process capabilities, and/or proficient distribution network systems, to conduct value chain activities” (Liu, Ke, We, Gu & Chen, 2010).

#### 3.1 Research Problem and Objectives

In response to customer demand for a seamless shopping experience, retailers are adopting the omni-channel approach. Frequency of order fulfilment and volatility of customer demand are among the challenges facing today’s retail companies. The high degree of flexibility of virtual omni-channel distribution networks improves delivery clockspeed with shortened lead times and a detailed picture of inventory across channels. The study’s objectives were to determine the effects of retail apparel companies’ adoption of omni-channel systems to transform supply chain distribution systems, and to ascertain how demand-driven omni-distribution systems influence the frequency of order fulfilment in a designated supply chain network.

#### 3.2 The Nature of Omni-Channel Retailing

In response to customer demand for consistent, uniform, integrated service and experiences, the retail sector has witnessed a shift from a traditional cross, multi-channel model to an omni-channel

system (Piotrowicz & Cuthberton, 2014:8). Omni-channel systems narrow the difference between physical, offline and online practices. Customer migration to online channels enhances shareholder value, store sales, customer purchase behaviour, profitability and customer loyalty (Ansari, Mela & Neslin, 2008; Leeflang & Skiera 2012) and has resulted in significant changes in the retail environment (Rigby, 2011). Xu, Forman, Kim and Ittersum (2014) attribute the development of online channels to the utilization of mobile channels and applications (Apps), making it difficult for firms to control usage (Verhoef, Kanna & Inman, 2015). Beck and Rygl (2015:170) argue that the landscape of fragmented channels affects efficiency as customers can reserve goods online and collect in store depending on their device or location. Customers frequently search in store and on their mobile device for attractive offers and enticing prices while others seek information online and buy offline (a process described as webrooming) or purchase on another channel (Verhoef, Neslin & Vroomen, 2007; Verhoef et al., 2015).

### **3.3 Supply Chain Omni-Distribution Network Systems**

Fashion retailing is demand driven and requires agility and flexibility as key differentiators in the supply chain. According to Christopher (2005:122), agility involves “market sensitivity, virtual integration, process integration and networking”. The author adds that agile supply chains require a quick response with shorter cycle times. This can be achieved by reducing the length of the pipeline or speeding up the flow through the pipeline by removing bottlenecks, excessive inventory, utilizing sequential processing and maintaining visibility (Christopher, 2005:133). Omni-distribution is “the fulfilment of customer orders from a myriad of channels integrated by one system with visibility of the location of the item and delivery date at a price that is acceptable to the customer and profitable by the retailer” (McBeathe, 2014:2). Fortna (2015:2) defines omni-distribution as “the capability to fulfil orders from and accept return to distribution centres, stores and vendors whilst having complete visibility and flexibility to manage inventory across all channels”. Omni-distribution is an evolved form of multichannel distribution as distribution occurs from multiple channels due to the integration of the entire inventory system. According to Radovanovic and Zivotic (2013:281), within a distribution centre, inventory is “received, cross-docked or sorted, consolidated and delivered to stores as a single or full load with a faster inventory turnover”. Distribution is “facilitated through the cross-dock function of receiving, sorting and transfer of inventory between the inbound and outbound door usually within 24 hours” (Lahmar, 2008:154) to facilitate Just-in-Time (JIT) distribution scheduling.

Haus's (2014:13) study concluded that customers prefer to buy online and pick up in-store, followed by the option to buy in-store and have purchases delivered. Although the sequence of order fulfilment methods differs, there is commonality amongst the methods used by retailers. Haus's findings support those of Kilcourse and Rowen (2014:11). However, there is a gap between the order fulfilment methods that customers value and those offered by retailers. According to Conrad, Hagen and Kauffeld (2012:15) and Kilcourse and Rowen (2014:16), shorter delivery times such as two-day and overnight shipping will become increasingly necessary. Orders begin and end with the customer; hence, it is paramount to meet their expectations. Perfect order fulfilment reflects “a discrete measurement of the percentage of orders delivered to the right place, with the right product, at the right time, in the right condition, in the right package, in the right quantity, with the right documentation, to the right customer, with the correct invoice” (Dwyer, 2015:1). Besides product delivery, the customer service elements of on time delivery, order fill rate, product condition and accurate documentation are outputs from the demand driven supply chain for the customer. The multi-channel approach offered the benefits of each channel, yet inventory was limited to each channel due to a lack of system wide integration (Tetteh & Xu, 2014). Retailers are now expected to fulfil orders from and accept returns to distribution centres, stores and vendors whilst ensuring visibility and flexibility to manage inventory across all channels (Fortna, 2015:2). The inventory distribution function therefore plays a pivotal role in fulfilling orders whilst managing supply chain costs. Baker (2008: 4-6) defines a distribution centre as “an outbound node in the supply chain which



is responsible for the rapid sortation and movement of inventory from supplier to the customer using a centralisation, decentralisation or hybrid supply chain distribution strategy”.

### **3.4 Supply Chain Omni-channel Technological Systems**

Cloud-based technology and information systems are being used to create a unified database. Aydin (2015:27) defines cloud computing as “a dynamic computing environment which allows scalability and provides virtualized resources as a service through the Internet”. The author adds that the use of e-commerce through cloud computing allows businesses to rent hardware and software rather than buying it. RIS (2015:3) concurs that hardware costs are reduced whilst minimal integration and maintenance is required. According to RIS (2015:3), a cloud-based omni-channel provides seamless, real time visibility of data and offerings across all channels and enables businesses to respond faster to demand through information visibility and processing agility. Butte (2015) asserts that “those who get cloud wrong will simply miss the mark, measured in cost in the short term, but ultimately measured in customer satisfaction in the long run”. Aydin (2015:29) states that, due to concerns regarding information security, companies need to ensure that service providers abide by security standards and best practices to ensure that information is protected across all channels. An integrated order management system provides end-to-end control and a unified view of the entire process, dynamically linking network inventory with demand from supplier to consumer, and providing an accurate count of every stock keeping units’ (SKU) available to promise (ATP) number and the date the product needs to be delivered to the customer. ATP is a business function that calculates whether orders can be fulfilled based on stock on hand and stock in the pipeline. Cloud-based technology provides visibility of detailed data end-to-end, in real-time, from various sources across the chain via automated data collection such as radio frequency identification (RFID), barcode scanning, and point of sale (POS) devices (McBeath, 2012:5).

## **4 RESEARCH METHODOLOGY**

### **4.1 Research design**

Yin (2014:26) defines a research design as “a rationale that links the research questions to the data collected and conclusions drawn”. The purpose of conducting a case study is “to establish a complete picture of the entire situation through the examination of a real life example” (Hair, Page, Money & Samoul, 2007:203). The CeeDee Group’s apparel division was used as a case study and data was collected from experienced employees to understand how the Group is fulfilling customer orders through its distribution network and how information technology is used to fulfil orders and remain globally competitive. A cross sectional time horizon was utilized to establish current order fulfilment through omni-channel distribution in the company. According to Lewis, Saunders & Thornhill (2009:155), case studies are “well suited to cross sectional time horizons to acquire information at a point in time”. Omni-channel retailing is a contemporary topic and very little research has been conducted on this phenomenon, especially in a South African context. This exploratory study employed a mixed method approach. The study sites were Durban, the CeeDee Group head office, and the distribution centre and extended supply chain as well as the well-integrated third-party logistics (3PL) service provider situated in Durban.

### **4.2 Sampling**

Non-probability sampling is commonly used in business research case studies (Lewis et al., 2009:233). Purposive sampling ensures that the research questions are posed to the right people. Marsden and Wright (2010:85) define a target population as “the group of elements that the researcher intends to study”. The sample size for interviews varies based on the scope of the research and the proximity of the interviewer to the participants in the case of face-to-face interviews (Schindler & Cooper, 2008: 172). The qualitative part of the study comprised of 13 Directors and Senior Managers from the CeeDee Group and the 3PL provider. The sample size is dependent on the desired precision, which is translated into the confidence level and size, the dispersion of the population, the population size and

population homogeneity. Schindler and Cooper (2008:408) state that a 95% confidence level is frequently applied to quantitative research studies and Krejcie and Morgan's (1970:607) sample reference table assumes a standard error of 5%. The authors highlight that the sample size increase as the population increases at a diminishing rate up to the point of 380. Sekaran (2010:295) endorses this table. Based on a population of 333 managers (322 store managers and 11 area managers) from 161 stores and a standard error of 5%, 175 Store Managers, and Area Managers were surveyed for the quantitative component of the study.

#### **4.3 Survey Instrument and Administration**

A survey is "a system for collecting data based on the defined objectives with the intention of analysing the results and compiling findings in response to the research question" (Ritter & Sue, 2012: 3). The respondents were made aware of the study via e-mail communication. All participants and respondents were required to provide informed consent and were assured that they would remain anonymous. The funnelling approach was applied to gauge the respondents' views on omni-channel retailing, followed by more specific questions relating to the effect of omni-distribution on order fulfilment by the CeeDee Group (Dumay & Qu, 2011:249). The questions were semi-structured in a logical sequence following the study's themes in the qualitative strategy.

Surveys are "a useful tool to gain information from a large sample in a short space of time; however, the response rate may be a limitation if the survey questions are not clear and if the survey is not administered appropriately" (Rowley, 2014:314). The survey was self-administered electronically using a web-based questionnaire via Survey Monkey in a quantitative strategy. However, access to Store Managers, and Area Managers was limited. The respondents had the option of uploading the survey via the store interface, point-of-sale, or via e-mail. Owing to the IT department's resource constraints, the surveys were distributed via e-mail to every store in the sample. The e-mail addresses were acquired from the Networks Team subsequent to gatekeeper's permission from CeeDee group and ethical clearance being acquired from the University Ethics office. The Human Resource Executive and Omni-channel Manager advised stores of the survey. Thereafter, they received the e-mail link and were advised of the purpose of the study, and that the University and the company had granted permission for it to be conducted. The respondents were also informed that their identity would not be disclosed and that by clicking on the first page of the survey, they consented to participate in the survey. After the deadline had passed, the responses were downloaded from the Survey Monkey tool for analysis. The interviews were conducted after the survey as the latter revealed areas that required clarity and supplementary information. A hierarchical questioning structure which sequenced the broader questions at the beginning of the interview followed by specific questions, was used to put the participants at ease. Although an audio recording device was used, notes were also taken during the interviews. Greener and Martelli (2015:113) suggest that interviewees be given a copy of the interview questions in advance to facilitate a reflective response.

#### **4.4 Data analysis**

Quantitative and qualitative data were collected to establish how the use of omni-distribution channels is contributing to stock replenishment and in-store order fulfilment, as well how information systems facilitate an omni-distribution approach. Whilst the survey enabled an investigation of store operations, the interviews probed further to gain a more extensive understanding of the phenomenon. Abfalter, Muller and Raich (2014:737) distinguish between triangulation, mixed method and the hybrid approach by "identifying the focus of the study, data sets used, analysis methods and degree of integration of the methods". According to Davis and Golicic (2012:727), "a mixed method study combines quantitative and qualitative research approaches of a single study to fully understand phenomena and reduce bias associated with the use of a single method". A mixed method approach employs a moderate level of integration at the interpretation and conclusion stages of a study. Abfalter et al. (2014:737) concur with Davis and Golicic and add that triangulation "seeks to

combine different methods with the intention of unpacking complex relationships in the study either through a comparative, convergent, or sequential design". The authors are of the view that a combined approach should utilize intertwined analysis, known as the hybrid approach. Hence, the Statistical Package for the Social Sciences (SPSS) was used for the quantitative and NVIVO for the qualitative analysis. These were performed separately but the interpretation and conclusion were integrated. The quantitative and qualitative methods were conducted sequentially and carried equal weighting in the study. The timing of the methods and the weighting of each method are supported by the purpose of the study. "A sequential study entails the second method being conducted subsequent to the researcher acquiring the results of the first method" (Abfalter et al., 2014:737). The findings from the first method can guide the questions for the second method.

## **5 RESULTS**

### **5.1 Quantitative Results**

The sample comprised 175 respondents and the return rate was 85% (148 responses). Useable responses comprised 70%. Approximately 68% of the respondents had more than five years' managerial experience, of which 56% had more than 10 years' managerial experience, confirming the applicability of purposive sampling. Using SPSS, the average of the coefficient of all items scored 0.945 (on 61 items) using the Cronbach Alpha, implying that the sample was reliable. Frequency distribution of the results revealed that the majority (60%) of the respondents were of the view that incorporating online buying increased sales, while 14% felt that sales decreased, 22% said that they remained unchanged, and 4% were neutral on this issue. In terms of the current assortment of channels managed by the stores in the company's apparel division, 82% of the respondents opted for in-store purchases as a major channel for their branch. Brick and mortar functions are predominant within the brick and mortar operation and are being used to fulfil orders from other channels.

Seventy-nine per cent of the respondents agreed that the company offers online purchases and pick up in store capability, whilst 60% identified in-store customer orders, buy in-store and deliver to a preferred destination. Buy in store and pick up from the post office were not offered as purchase channels to customers. It was also found that the majority of cross channel buying (79%) is from online purchases and in-store pick up capacity. It appears that the majority of the stores are not aware of or not using other methods of cross channel buying such as buy in-store and deliver to preferred destination (89%,  $p < 0.05$ ); and buy online and pick up from the post office (82%,  $p < 0.05$ ); whilst buy in-store and pick up in-store resulted in 61% ( $p < 0.05$ ). The distribution centre (92%) remains the primary fulfilment centre, while depot and store fulfilment are secondary fulfilment centres for stock for the branch. With regard to synchronized distribution flow, 62% of the respondents agreed that the store receives notification of orders one to two days in advance, whilst 23.6% opted for three to four days, 1% for five to six days, 6% for seven days or more and 6% did not answer this question.

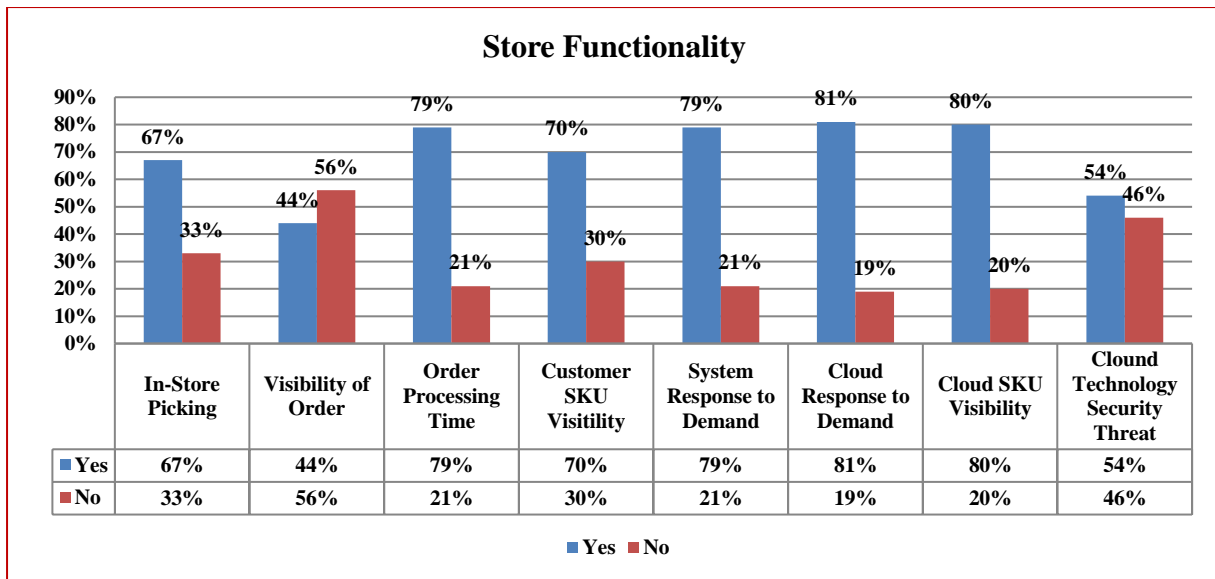


Figure 2: The Functionality of the Store

Sixty-seven per cent of the respondents were of the view that branches can successfully undertake the picking function for online and customer orders in addition to their daily functions. Operation process awareness depends on the number of orders the branches were expected to receive; 56% of the respondents indicated no visibility of orders. In terms of effective order processing time, 79% of the respondents agreed that branches have sufficient time to sort the order before it is due for pick up by the customer. Seventy per cent felt that SKUs are visible online at individual stores because the Redworld POS system (79%) provides real time visibility of stock movement at SKU level in order to respond to demand. Finally, 81% of the respondents agreed that the cloud based omni-channel enables businesses to respond to demand faster due to greater visibility; 79.9% were of the view that it provides real time information visibility and offers processing agility, and 54% felt that cloud technology poses a security threat in an omni-channel supply chain.

## 5.2 Descriptive Statistics

Table 1: Omni-distribution system - mean, standard deviation and t-test

Descriptive Statistics and Levels of Agreement							
	N	Mean	Std. Deviation	t	Df	Sig.	Level of Agreement
Channel Integration	123	4.45	1.034	15.524	122	0.000	87%
Cross channel buying	124	4.22	1.159	11.704	123	0.000	77%
Speed and Dependability	124	4.13	1.028	12.232	123	0.000	78%
Fast fashion	123	4.12	1.142	10.894	122	0.000	78%
Risk pooling	124	4.11	1.038	11.944	123	0.000	73%
Demand on, on time and in full	123	4.09	1.116	10.824	122	0.000	76%
Information system on, on time and in full	121	4.03	1.032	11.008	120	0.000	74%
JIT deliveries	122	3.99	1.168	9.381	121	0.000	71%
Order management system	124	3.95	1.058	10.015	123	0.000	70%
On-time and order fulfillment	124	3.94	1.01	10.313	123	0.000	73%
Cloud based technology	123	3.94	1.089	9.607	122	0.000	71%
Mass Distribution	125	3.93	1.094	9.486	124	0.000	69%
Pull supply chain	122	3.91	1.076	9.342	121	0.000	67%
Visibility and Information sharing	123	3.87	1.145	8.427	122	0.000	68%

Demand-on lead time and cycle time	123	3.84	1.003	9.259	122	0.000	65%
Adoption of omni-channel systems	123	3.8	1.121	7.963	122	0.000	60%
Decoupling Point on fill rate	123	3.75	1.157	7.173	122	0.000	54%

The standard deviation measures the variability in data by calculating the square root of the difference in the mean and observation in interval and ration scaled data (Lewis et al., 2009:318). The mean, standard deviation and t-test statistic was used to analyse the data. The result of the t-test in table 1 establishes that  $p < 0.05$  for all statements; hence, there is a very significant level of agreement. Sixty per cent of the respondents agreed that the adoption of many retail channels influences the supply chain retail distribution system. The results also show that 76% of the respondents felt that the magnitude of customer demand (mean value =4.09) influences 'in full' and 'on time' order fulfilment in the overall distribution system. Sixty-five percent were of the view that change in demand influences fulfilment lead time and cycle time in the distribution network. The results show that an integrated information system, with a mean value of 4.03, improves in full and on time order fulfilment (74%) by enhancing information sharing and visibility within the virtual distribution network (68%). Channels therefore need to be integrated (highest mean value =4.45) to provide an excellent customer experience (87%). Seventy-eight per cent of the respondents agreed that the omni-channel distribution network enhances the speed and dependability of customer service, while 73% concurred that it supports order fulfilment through on time delivery and order fill rate. Seventy-eight per cent of the respondents agreed that fast fashion retailing channels (mean value =4.13) require agile supply chains with a quick response strategy and shorter cycle times; 77% indicated that the company has adapted its distribution network for cross channel buying (with the second highest mean value of 4.22) to fulfil the needs of customers, and 67% said that the omni-distribution system aims to pull supply chain activities from demand driven orders to reduce system inventory, with cloud-based technology providing visibility of detailed data in real-time, from various sources across the chain (71%) and by delivering stock in small frequent loads JIT to improve response to changes in demand (71%). However, when demand is unknown, the supply chain can be decoupled to respond to forecast orders until stock reaches the distribution point and is then distributed based on known demand (56%) by pulling supply chain activities in the omni-distribution system (67.2%). Finally, 69% of the respondents agreed that the use of a main distribution centre and multiple smaller distribution facilities benefits mass distribution; 73% were of the view that online channels offer improved product variety to customers whilst reducing the risk due to risk pooling; and 70% felt that an order management system unifies order processing across the retailer's network of physical stores.

### 5.3 Qualitative Results

As noted previously, the findings from the survey informed the questions posed in the interviews, which enabled more in-depth understanding of the phenomenon under study. The qualitative research explored each department's contribution to fulfilling customers' orders on time and in full. Thematic analysis was employed and the following themes were identified: Omni-channel Retailing Diffusion (Propensity to Support and Local market delivery); Omni-channel Retail Adoption (Omni-distribution system, Risk pooling and Order fulfilment on Lead time and Cycle time); Last mile and 3PL order fulfilment (Inventory visibility and delivery); and Integrated Information system (DOM). This study confirmed Braun and Clarke's (2006:77) observation that "it is appropriate to choose a method of analysis that is driven by both research questions and theoretical assumptions".

### 5.4 Omni-channel Retailing Diffusion

The majority of the respondents were of the view that omni-channel retailing has gained momentum in the South African retail industry.

**Propensity to Support:** A respondent stated that: *“The ... rate of growth across various channels has increased for local retailers but not to the same extent as international retailers. There are shoppers utilizing online channels rather than brick and mortar for convenience and the greater assortment available online”*. In terms of 3PL, it was noted that, *“a proportion of retailers has avidly espoused it ... whilst some South African retailers display pejorative behaviour on omni-channel retailing with parochial oversight, as others migrated to online order placement and fulfilment”*. It was also stated that South African fast-moving consumer goods and apparel retailers are showing considerable interest in using an omni-channel approach: *“The system exposes the retailer’s stock and there is currently a lack of visibility of stock in real time which poses a challenge. Stock accuracy in store hasn’t been a key driver in South African retail since retailers are still following push processes in comparison to similar retailers in the rest of the world”*. These findings suggest that retailers are not ready for diffusion of the omni-channel approach.

**Local Market on delivery:** In probing how the company utilizes omni-channel retailing in the context of the local market and current economic climate, it was argued that: *“South Africa is in a pennywise, cost aware climate and the CeeDee group has tried to manage the cost ... by offering various cost options such as lead days, express option, economy option for delivery to store over a longer period rather than only offering the door to door delivery method”*. It was also noted that South African retailers need to adapt the omni-distribution strategy to suit the local market in respect of order processing and delivery. *“The South African landscape is less dense and more rural with more distance to travel between points, which results in higher transport costs. It remains questionable as to whether door-to-door deliveries are viable for the business. Many retailers are moving to multistore fulfilment capacity which puts a big emphasis on understanding omni-channel global capacity”*. While international retailers have progressed with click and collect due to the delivery process being more mature, the omni-channel offers the option of deliveries to outlying areas. *“South African retailers have not worked well on click and collect but it would suit the South African terrain if the retailer could partner with a local petrol station, spaza grocery or airtime shop, where post boxes are used to drop off orders. As rule, the business does not permit delivery to hotspots in the country as courier vehicles are inclined to hijackings”*. These predicaments are expected to persist, challenging the viability and efficacy of omni-channel distribution networks and delivery reliability. The local market is fragmented and inclined to stick to extant delivery methods rather than unorthodox but innovative ones.

## 5.5 Omni-channel retail Adoption

**Omni-channel Distribution System:** In response to the question on how retail supply chain distribution systems influence omni-channel adoption, a respondent said that, *“A centralized distribution centre will always be used but near source fulfilment for e-com using stores as a fulfilment centre is an advancement on the traditional model”*. This model offers speed to delivery for same day or next day delivery of orders. With regard to the use of fulfilment stores that spread the stock across the network based on demand, it was noted that: *“The centralized fulfilment centre would function like a distribution centre rather than as a massive warehouse due to the stock being distributed across the network to fulfilment stores based on demand. The assortment is different in each store but is dependent on centralized distribution”*. If store fulfilment is the only method used, it will be difficult to manage inventory in the business using stock in stores.

**Risk pooling:** The respondents were asked whether the distribution network was achieving risk pooling. One responded: *“Stock levels are managed more efficiently in a centralized facility as opposed to a decentralized facility due to existence of risk pooling in a central facility. Furthermore, the excessive costs associated with a decentralized facility are negated in a centralized facility through risk pooling. The planner and allocator establish what quantities of SKUs need to be available in the DC and stock is allocated from the DC based on demand”*. The centralized model has the capability of reducing the stock holding in the network.

**Order Fulfilment cycle time and lead time:** In terms of how their department was contributing to reducing cycle time and lead time in the supply chain, a respondent stated that: *“Every department in the DC and transport operation is responsible for optimizing the throughput rate to minimise cycle time and lead time. Stock sourced from local suppliers is finalized 48 hours before delivery to the DC. If there are any changes the merchant has the flexibility to change the packing instructions and finalize the order. Stock sourced internationally is delivered to the DC in the Open to Buy (OTB week). In some instances, the merchant may request a specific container based on demand”*. The distribution centre has the ability to prioritize the container based on the merchant’s requirements to shorten both the cycle time and lead time.

## 5.6 Last mile and 3PL Order Fulfilment

**Inventory Visibility and Delivery:** The level of visibility of inventory and orders and the service level agreement between the retailer and 3PL have implications for the final last mile for store replenishment and order fulfilment. It was noted that, *“The allocation to the online store and fulfilment store is based on demand and the cost of transportation. This strategy was adopted to reduce courier costs and lead days of delivery from store through close-to-source deliveries”*. Furthermore, *“The online store has adapted their system for consumer fulfilment which requires fine picking in comparison to full case picking. On the last mile, the in-house logistics management system (LMS) is integrated with many preselected couriers based on courier cost optimization using a predefined algorithm to select the cheapest courier that can deliver the order the fastest. Door-to-door orders are prioritized first, followed by store economy and store express. The associate reviews if the SKUs are available on the system. The online store picks and packs within 24 hours and can achieve same day delivery for areas in close proximity to the facility”*. The fulfilment store plays a similar role to the online store but is able to provide same day and/or next day delivery in the region in which the store is situated.

A respondent also pointed out that, *“The 3PL developed a track and trace software like the Uber model whereby there is visibility of the parcel and delivery vehicle. Other couriers contracted with them also use similar applications to gain visibility and achieve route optimisation”*. Store fulfilment is pivotal in achieving on time delivery and it was noted that the objective of an omni-channel is to exceed the customer’s expectations. 3PL innovation elevates the level of visibility of inventory and orders to ensure the achievement of service level agreements on frequency of order fulfilment in time and in full. Omni-channel retailing exposes stock accuracy as online orders need to be fulfilled at SKU level. Stock inaccuracies are detected at stores during scheduled stock takes whilst fulfilment stores reconcile inventory on a daily basis. A respondent stated that, *“Most inaccuracies occur due to the EFT process in comparison to payment via credit card as a result of the delay in using EFT”*. In this regard, improved integration of EFT is required as every step in the process should be integrated for successful omni-channel execution.

## 5.7 Integrated Information Systems

**Order Management System:** Integrated information systems enhance information sharing and visibility and have the potential to produce a virtual omni-distribution network. A respondent noted that, *“The supply chain comprises of multiple sub-systems which are linked from the point of sale and operations hub until stock is delivered to the store; however, the subsystems are not integrated in real time, nor is there visibility of the last mile. An integrated system like a Distribution Order Management System (DOM) such as the Manhattan programme provides real time updates with a view of global stock on hand”*. A DOM also integrates demand and indicates the most appropriate location for such demand to be fulfilled based on customer proximity.

## **6. DISCUSSION OF THE RESULTS**

Omni-channel retailing offers customers a seamless and customized shopping experience. Growth across various channels in South Africa has increased sales but not to the same extent as international retailers. The omni-channel approach is new to the South African market and retailers are adapting to it differently. Customers are shifting to buying online instead of via stores as this is more convenient, but there has not been a significant increase in market share across the omni-channel. The increase in online sales and sales across brick and mortar and the adoption of multiple purchase channels has steadily increased retail sales. In addition, e-commerce is increasing store sales as customers collect online orders in store and purchase more items whilst there. Click and collect thus utilises brick and mortar for in store collection and also generates additional in-store sales.

Demand for a more seamless and flexible shopping experience has put pressure on retailers to realign operations within their supply chains to become more digitised and integrated (Fortna, 2015:2). The emergence of omni-channel retailing requires visibility across the supply chain with multiple channel capabilities that can fulfil orders from anywhere via the omni-distribution system. The study's findings show that, although door-to-door deliveries were the most commonly used delivery method, delivery of online orders to stores grew at a faster rate than delivery of online orders to the post office. However, the use of a combined distribution centre may be limited by long lead times since there is a greater distance between a central distribution centre and the destination than that between multiple decentralised distribution centres and the destination (McCrea, 2014:57). Ninety-two per cent of the respondents agreed that the distribution centre remains a primary fulfilment centre, followed by store fulfilment, while 60% were of the view that the adoption of many retail channels influences the retail supply chain distribution system. In the case of the CeeDee Group, 77% of the respondents concurred that it has adapted its distribution network for multiple channel buying to fulfil the needs of customers.

The increase in the number of purchase channels has led to a concomitant increase in the number of fulfilment channels and centres. Additional channels call for additional processing by the distribution centre, transporter and stores as well as more stringent stock management across the supply chain. It can be argued that a hybrid distribution strategy is a sound option since store fulfilment functions are carried out by a decentralized supply chain network. The CeeDee Group model reaps the benefits of a centralized and decentralized supply chain strategy due to transshipment between facilities. This means that stock is held in close proximity to the central distribution centre; however, long in-transit times can potentially inhibit service delivery. Nevertheless, the adoption of omni-channels, even in the case of fast fashion retailing, has resulted in the proliferation of fulfilment centres and channels in the distribution network to enhance speed and agility for same day and next day deliveries. Order cycle time refers to the variance between the customer order date and the date the order was shipped from the warehouse and distribution centre (Arnold and Reese, 2015:2), whilst lead time is inclusive of in-transit time as it is measured up to the point that the order reaches the customer (Olhager, 2012:40). The distribution centre plays a pivotal role in processing inventory for dispatch to brick and mortar, online and fulfilment stores and influences lead time and cycle time. Agile supply chains require a quick response with shorter cycle times. This is achieved by reducing the length of the pipeline or speeding up the flow through the pipeline by removing bottlenecks, excessive inventory, utilizing sequential processing and maintaining visibility (Christopher, 2005:133). In a facility that serves as a cross dock and warehouse, the cross-dock process enables JIT distribution scheduling to reduce inventory cost, inventory levels and lead time. In a facility that conducts item picking, and item put away, the location of SKUs impacts the cycle time as efficient pulling facilitates faster throughput of stock, as in the case of grouping (Lahmar, 2008:24).

The distribution centre has built in flexibility to prioritize containers at the receiving department based on demand. The use of cross dock and flow-through processes facilitates faster throughput of stock



to the courier and the pick face, respectively and the print and apply (PANDA) machine allows the allocation of a cross dock box to be changed, based on demand. The rate of location usage is a key contributor to cycle time as the workflow of activities and the layout influence the efficiency of stock movement. Order fulfilment frequencies are dependent on the shipping method used as the last mile influences the likelihood of order fulfilment. The fulfilment store was rated by the majority of the respondents as being effective to highly effective in fulfilling orders in full. However, the fulfilment frequency for door-to-door deliveries and deliveries via post remains unknown. A successful omni-channel supply chain is dependent on the information system and inventory management system's planning and execution capabilities as well as the extent of system visibility through an integrated platform across business units. Integrated information systems support better decisions by encompassing visibility, traceability, accountability and profitability. Ease of access to data is integral to quick decision making in fast-paced supply chains as it assists businesses to cope with the volatile and rapidly changing retail chain. Prinsloo (2015:6) reports that whilst the number of online users in South Africa has increased due to the growth of m-commerce, the electronic payment system via credit card remains a challenge. One of the e-com. managers noted that inaccuracies also occur due to the EFT process in comparison to payment via credit card as a result of the delay in using EFT. The respondent added that more integration is required for EFT as every step in the process needs to be integrated for successful omni-channel execution. The 3PL provider also noted that the retailer and logistics provider are both running call centres as the customer service department and 3PL attend to customers' queries. The lack of visibility in the last mile and poor transfer of information inhibits the order fulfilment process. There is no visibility of the last mile in the business, between the order being shipped and delivered, and as a result there is no end-to-end visibility of every touch point. Transfer of information needs to be addressed to ensure that there is visibility due to integration. The majority of the respondents noted that the Order Management System unifies order processing across the retailer's distribution network of physical stores (70.2%,  $p < 0.025$ ). There was consensus amongst the respondents that an integrated system is required for improved visibility and more informed decision making.

### **6.1 Reliability and validity of instruments**

Measurement tools are considered to be reliable and valid when they exhibit precise measurement procedures and are characterized as being fit for purpose (Schindler & Cooper, 2008: 289). Reliability can be measured using test-retest, split-half reliability and Cronbach Alpha for quantitative data (Hair et al., 2007: 242). The Cronbach Alpha (0.945 out of 61 items) is used to test reliability, as the level of homogeneity of the questions in the instrument is tested scientifically. Thomas (2010: 318) elaborates that quality is reflected by the trustworthiness of the research through credibility, transferability, dependability and confirmability. The credibility of the research is the extent to which its findings match reality. It establishes if there is a match between the constructed realities of respondents and those represented by the researcher (Ghauri, Penz and Sinkovics, 2008: 699). Transferability is the extent to which the findings can be generalized. Although this is considered a challenge in qualitative data analysis due to its subjective nature, justification of the methodological approach and a detailed description of critical processes and procedures associate meanings with phenomena (Thomas, 2010: 320). A detailed breakdown of the interview process, transcription of audio recorded interviews and thematic analysis justifies the transferability of the research. The instrument is dependable when the steps followed during the course of a research study can be verified through examination and reduction of data. The transparency and a detailed record of interviews facilitates future corroboration of the results. Reliability of the qualitative instrument is also assessed through the similarity of words and phrases using category reliability or inter-judge reliability (Sekaran, 2010:384). Confirmability involves corroboration of the findings by personnel such as auditors or others doing similar research as well as through triangulation. It is achieved through a methodological account of how the research was conducted and by archiving data for future investigation (Thomas, 2010: 322).

The use of multi-method research promotes the credibility, dependability and confirmability of the overall research findings, ensuring the data is trustworthy and reliable.

Validity indicates if the instrument measures the concepts being studied (Marsden & Wright, 2010:372). It is measured by means of content validity, construct validity and criterion validity. Content validity requires a sample of experts to be consulted to assess the suitability of the items representing a construct on the instrument (Schindler & Cooper, 2008:290). This study was based on established supply chain concepts; hence content validity was ensured by consulting with supply chain experts and academics for the quantitative and qualitative data collection. Content validity of the survey instrument was also achieved by reviewing the relevant literature. In addition, the correspondence with the respondents as well as the survey document was approved by supply chain experts such as the regional omni-channel manager and the omni-channel director prior to distribution. The survey was also piloted by sending it to 10 stores in the Durban region. The feedback was that supervisors and store associates would not cope with the level of the questions and that it should rather be administered to store management and area managers. The survey was subsequently distributed to store managers and area managers in Durban.

## **6.2 Managerial Implications**

Online buying is slowly gaining momentum in South Africa despite the high cost of broadband. The growth of m-commerce, competition between cellular providers and provision of free Wi-Fi in malls, libraries and certain municipalities through project Isizwe promotes research and shopping using mobile websites and applications as well as e-commerce channels. The spectrum of cost conscious and service focussed customers in South Africa warrants service offerings that are based on cost and product assortment. However, unlike international companies such as Zara where delivery costs are subsidized by higher price points, the South African retailer has to be able to minimize costs at the current price point offered to customers. The omni-channel encompasses the management of brick and mortar as well as digital channels to maintain sustainable supply chains. Although centralized distribution achieves global optimization and risk pooling by reducing demand variability and pooling stock in a central distribution centre, a decentralized facility permits near source deliveries and risk diversification. The hybrid strategy achieves risk pooling and close to source delivery and transshipment can occur between facilities if there is visibility and information sharing. However, there is an associated cost of managing multiple distribution facilities as opposed to a central facility. The omni-channel requires economies of scale and close to source deliveries to minimize costs and achieve order fulfilment. The short transit time in the service level agreement and long distance between the online store and delivery point inhibits on time delivery. The use of close to proximity routing directs the order to the nearest fulfilment store.

## **7 CONCLUDING REMARKS**

While modern consumers require a seamless shopping experience, South African retailers need to manage the costs associated with the proliferation of channels and fulfilment centres in the supply chain. Unlike their international counterparts that are servicing a larger online throughput and are able to manage or absorb the costs of distribution due to higher volumes, the South African retailer has to create even leaner operations. A centralized distribution centre promotes cost efficiency through high volumes whilst managing inventory for all channels at SKU level through inventory pooling using the omni-distribution approach. Adoption of delayed distribution manages volatility in demand by matching supply to demand closer to when demand is known. Information visibility is necessary through the implementation of a unified system for informed decision making. The last mile is a cost differentiator for brick and mortar and online deliveries. The South African customer base is still in the early stages of omni-channel retailing, particularly in the case of global retailing because there is a spectrum of cost conscious and convenience focused customers. The additional cost of the omni-channel falls on the customer in the last mile if the retailer is not willing to absorb it. An

integrated information system for informed decision making is essential to achieve perfect order fulfilment. Given the paucity of research on omni-distribution in the South African context, an exploratory case study using judgement sampling was deemed appropriate to obtain detailed information from experienced individuals. The study sought to understand how South African retailers have adapted their distribution networks to fulfil volatile customer orders having adopted omni-channel retailing in the fast fashion demand-driven market. It found that there is a lack of visibility of online orders in the last mile which has implications for order fulfilment and customer service. This calls for further exploration of distribution order management in the South African landscape. Furthermore, the growth of e-commerce attributable to free Wi-Fi as well as technological advancements will trigger further change in the South African retail sector.

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## **SOCIAL-MEDIA SCANNING AND TEXT-ANALYSING APP THAT HELPS THE MUNICIPALITY ATTEND TO SERVICE REQUESTS**

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### **ABSTRACT**

Service delivery is a one of the fundamental requirements for each and every municipality to fulfil under the democratic, autocratic and or any form of government or rulership. Be it clean running water or electricity. These are basic human rights and are necessary for the human race to be at its best and well of course putting to good use tax-payer's money. With that said, the world we live in is forever changing and new ecosystems emerge, one of such is social media which is a virtual world where people express their thoughts, emotions and opinions liberally. Social media has taken over societies and has been infused into the culture of the general public and through its people express their grief and challenges they or other people may be facing. With the focus being on twitter, this project aims to intercept, analyze and classify posts, that expresses a negative sentiment towards municipal-services and process them as actional query tickets/tasks.

**Keywords:** Sentiment analysis, Social media, Service Delivery, Data collection, Location services

### **1 INTRODUCTION**

Having observed that since the emergence of social media platforms they have become a first point of reference or interaction for communication or sending a message across. After all human beings are naturally social beings. They have always been so from the inception of time, either through speech, actions or another means they have always wanted to share our stories with others and hear the thoughts and stories of others near or far. In the core of human beings is the nature, desire and willingness to express one's thoughts, opinions and be heard. Social media is nothing new to humans it's just a platform for exchanging information. In line with the statement above, it is my observation that people tend to express themselves better on social media than in person, I call this "keyboard courage".

The advancements of the internet in recent years have made new systems available to businesses, governments, institutions and organizations with social media or online communities being a good example (Lu & Hsiao, 2010). The availability of the internet has given individuals the opportunity to use platforms like Twitter and Facebook to interact without the need for physical meetings (Razia Sulthana, Jaithunbi & Sai Ramesh, 2018). Since the emergence of these social networking sites, they have been key tools for news among others and exposing content to the public.

When people express their thoughts online through social-media postings, the proposed system will run through the posted messages with high-end interception technology to read and analyze posts for words that matches a specific set of tag lines with the specified location parameter being within the

city of Pretoria. word for word the text will be analysed and assigned a sentiment score which will determine for us if a post is negative or positive and where it was derived from. When the text has been read and deemed negative the system will proceed to create a ticket or issue task for that specific user and to make things better the initial user who posted will get a response message from the municipality telling them that the issue is being investigated.

Technology has shown a rapid and exponential growth by introducing and continually advancing the over the head communication platforms formally referred to as social media platforms. These are a cheaper and easily accessible way for people, organizations and institutions known and faceless to have a voice and expression-ground in the digital societies by contributing their thoughts, ideas, opinions, fears and ambitions just to mention a few to an intangible society, a digital world of unending possibilities.

## **2 SOCIAL MEDIA SCANNING AND SENTIMENT ANALYSIS**

Sentiment analysis refers to the task of natural language processing to determine whether a piece of text contains subjective information and the kind of subjective information it expresses. The subjective information represents the attitude behind the text: positive, negative or neutral (Borruto, 2019). Understanding the opinions behind user-generated content automatically is of great concern. Therefore reading, analyzing and classifying Realtime data from several tweets posted within the city of Tshwane region and classifying the polarity of words, sentences or entire posts will help the municipality to a faster turnaround to service requests. sentiment analysis is another valuable source of information that can help with making better decisions and enabling an organization to evaluate the performance of its employees.

Online social network platforms, with their large repositories of user-generated content, can provide unique opportunities to gain insights into the emotional “pulse of the citizens”, and the community at large (Sheela, 2016). Before diving into what other people or institutions have done along these lines, here are a few words and definitions that will be used every often in laying down what other researchers have both focused on and uncovered.

Social media sites have become a day to day routine for people. Social media has been mainly defined to refer to “the many relatively inexpensive and widely accessible electronic tools that facilitate anyone to publish and access information, collaborate on a common effort, or build relationship” (Social Computing, 2019). Therefore, social media is becoming part of our society, changing social norms and culture (Hashim, Al-Sharqi & Kutbi 2016). With 15 million users on social media accounts, 13 million of these users accessing them purely from the mobile devices (2019) and over 33.9 million South African accounts spread across Facebook, Twitter, LinkedIn and Instagram. With most of these accounts the number usage is for (i) News and Politics, (ii) Entertainment, (iii) Music, (iv) People & Blogs and (v) Education. with such stats this goes to show that current news (complains inclusive) are a number one factor on the lips of South Africa’s on social media account.

The advancement in social media has been facilitated by Web 2.0 technology, which has allowed an advancement that has transferred the internet to a social environment by introducing platforms like Twitter, Facebook and Linked-In where individuals can interact and generate content online (Mueller, Hutter, Fueller & Matzler, 2010). Not only has web 2.0 allowed for a more open field for developers and designers of content that is easy to share and download using single-page application technology and hybrid mobile apps. It has emerged to give users easier interconnectivity and participation on the web (Gruzd, Wellman & Takhteyev 2011).

With regards to service delivery in its broad context, people will express their frustrations, anger and disappointments over the internet or through social media since making calls to the service providers



takes such a long time to be attended to. **#LoadShedding #Eskom #Nolights**, are some of the things being posted by people online. This study aims to counter these frustrations with an immediate response to ease their nerves and to show them that they are important and that their thoughts are also important and matter to the advancements of their society.

This study aims to investigate the following needs that the public can be faced with Traffic Lights, Potholes and Road safety, Garbage collection, Load shedding and Street lights, Accidents, Bust water pipes and Sewage blocks, Uncut grass, Police intervention and patrols, Crime awareness, Protests, Ambulance services, Common theft areas, Fire, Disaster incident.

With a ticket or an issue logged within any of the listed area of investigation, the ticket will then be assigned to a predefined service provider, if not an internal team within the locality to resolve the problem and report on its progress. This is intended to be a fully automated system that request little or less human intervention.

To help the municipalities have a faster turnaround to service requests, posts get analyzed and assigned as tickets in Realtime based on its classification and location. The posts are analyzed and processed based on the user semantic-behavior, language and Geo location or in close proximity to the municipal offices or as per geopathic demarcation e.g. “the city of Tshwane”. This study also identifies the information contained in post as emojis and hashtags also taking into account the images attached, through the aid of technologies like image-processing we can be able to also classify the basis of the post at hand and the physical objects the captured image.

### **3 RELATED WORK**

#### **3.1 Analyzing Twitter Sentiment of the 2016 Presidential Candidates**

Conducted research on the Prediction of the USA Election 2016, downloading over 300 000 tweets from within America using the following keywords (politics, political candidates and or the full name of each presidential candidate) with 3000 tweets carrying an Emojis.

For both testing and training input, they used as input the text of tweets stripped of the emojis. using the text of the tweet they stripped off from the Emoji posts to avoid overfitting and not wanting to use emojis as the base of their prediction of the text sentiment. Classifying emojis into the below sentiment by defaulting each emoji to a category not undertaking the context of the message of which I have a problem with because it does not accurately cover sarcasm people can use emojis to send out a different meaning depending on the context, this is a drawback.

#### **3.2 Sentiment Analysis of Tweets to Gain Insights into the 2016 US Election**

With their methodology to predict the American Presidential election outcome that composed of collecting tweets and associated metadata from Twitter and performing a sentiment analysis on each tweet. They developed a few algorithms and implemented them using the Java and Perl programming languages to access the tweets, clean them, perform a sentiment analysis and aggregate the results. To collect data, they developed an algorithm that implemented the Twitter4J library.

After collecting a total of 1,752.298 tweets about the US presidential election and analyzing them by state/demographics to determine how people viewed the two candidates, we saw that the sentiment according to Twitter was somewhat accurate. If sentiment analysis algorithms are improved and further developed, they could be used to predict election results in the future (Hamling and Agrawal, 2016).

### 3.3 Twitter as a Corpus for Sentiment Analysis and Opinion Mining

Have done similar work but classify the tweets as objective, positive and negative. To use twitter as a corpus for sentiment analysis and opinion mining. With all information recorded In Proceedings of the Seventh Conference on International Language Resources and Evaluation. They used twitter to collect a corpus of objective posts, they retrieved text messages from Twitter accounts of popular newspapers and magazine, such as “New York Times”, “Washington Posts” etc. Their classifier is based on the multinomial Naïve Bayes classifier that uses N-gram and POS-tags as features (Pak & Paroubek, 2010).

Applying sentiment analysis on Twitter is the upcoming trend with researchers recognizing the scientific trials and its potential applications. The challenges unique to this problem area are largely attributed to the dominantly informal tone of the micro blogging. The use microblogging and more particularly Twitter as a corpus for sentiment analysis (Hamling & Agrawal, 2016) They cited:

- Microblogging platforms are used by different people to express their opinion about different topics. Thus, it is a valuable source of people’s opinions.
- Twitter contains an enormous number of text posts and it grows every day. The collected
- corpus can be arbitrarily large.
- Twitter’s audience varies from regular users to celebrities, company representatives, politicians, and even country presidents. Therefore, it is possible to collect text posts of users from different social and interest groups.
- Twitter’s audience is represented by users from many countries.

Using the Naïve bigram model and a Maximum Entropy model to classify tweet R. Parikh and M. Movassate found that the Naive Bayes classifiers worked much better than the Maximum Entropy model (Pak & Paroubek, 2010)

### 3 THE PROCEDURE & DATA COLLECTION

#### a. Sampling(Probability)

Having a subset of the population to be selected for this study. The subjects will be selected from a group of people with different events, behaviour and attributes to accurately reflect the time it takes to municipal services requests to be delivered or rather resolved.

The sampling type of simple random sampling will reflect to us a fair and equal chance of each subject to chosen. the sampling size will be determined using the Slovin’s 1960 formula

$$n = \frac{N}{1 + Ne^2}$$

n is the sample size

N is the population

E is the margin of error

1 is a constant variable

The sampling based on probability will focus on the area, total population, sample-size (obtained above) and the number of respondents willing to contribute towards the data required in this study.

#### b. Interviews and Questionnaires

Conduct unstructured interviews which are rich in data collection, have a verbal exchange with the proposed user of the system gaining insight into their thoughts and intents getting idea of what and how the desire the system to be designed in a way that can suite their needs.

Design a questionnaire with a set of questions based on three methodologies

- **Closed questions** – Yes/No/Maybe are the only expected answers
- **Open response** – The participant can explain and share his thoughts
- **Likert/Rating scales** – The participant may express his thoughts on a view from a scale of 1-10

This will be provided to a large population of participants through different methods paper, email and online web polling application.

In the view of Kumeckpor, “social survey may be said to be an objective, quantitative approach to the study of the social processes within a well-defined area at a given time through one or more institutions by means of an interview schedule, a questionnaire, and the data thus obtained related statistically” (“Methods Of Sampling From A Population” 2019). with this in mind the study aims at understand some specific problems at a particular time and so study opinion attitudes towards major social, economic and political problems that contribute towards the municipal service delivery.

*c. Simulation & Quality Assurance*

**Functional & Automation Attributes**

The system prototype will be designed in such a way that it depicts the real time environment with real-time database updates each time a change is made. The system will have three parts:

- A mobile Application
- A web-app – tickets management
- A web-app – sentiment analysis engine

The web-apps will comprise of the following functionality and or features.

- Management of Tickets, Service Types, Contractors, Locations.
- Social media API’s consumption for data-collection and processing.
- Sentiment Analytics engine.
- Task tracking and updating.
- User notifications.
- Users & Roles Management.

With the mobile app comprising of the following features

- User authentication & authorization.
- Contractor Profile.
- History tickets & Report mechanism.
- Task update and commenting.

The functionality of the system will be handled by independent Quality Assurance Functional personnel to test operational behavior of the systems both the web-app and mobile-app. While observing the operational behavior other factors to be looked at are the social-media system will interface with our system.

To make the testing process faster and more accurate the web-app’s functionality will be automated using the Selenium web-driver which is an open source tool for automating web applications across different browsers.

The usage of mobile emulators can also be taken into account to lower the cost of the application. we will use genymotion to emulate our mobile app across different android platforms.

### NoneFunctional Attributes

Performance testing has to be done, against the system to ensure that the following points are addressed.

- Speed of the system is at its peak for max transaction processing,
- Scalability, to manage the resources the system should be able to release or increase resources as an when required to.
- Stability, the stability of the system is paramount as what we are feeding from “social media” is always up and running.
- Reliability, the integrity of the data collected and saved must be reliable with the system having 24/7 up time, no down times.

To ensure the responsive of the application is at its best at all times the following quality assurance techniques have to be signed off before shipping to production.

**Load testing** – to determine and understand the behaviour of the system under a specific load. resulting in measuring transactions and load on the database, application server.

**Stress testing** - performed to find the upper limit capacity of the system and also to determine how the system performs if the current load goes well above the expected maximum.

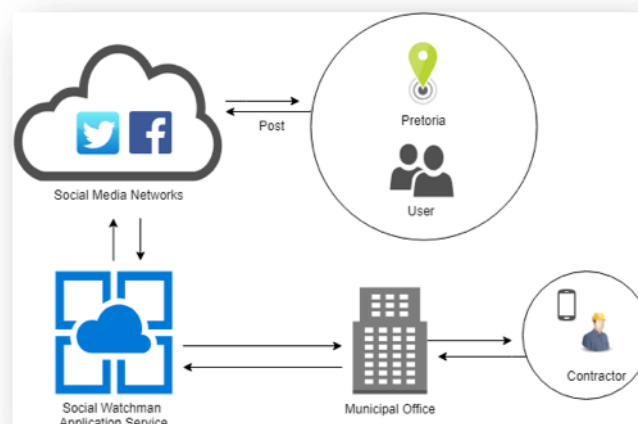
**Soak testing** – to determine the endurance of the system. The main aim is to discover the system's performance under sustained use, which will reveal how long can the system go on for without falling over.

**Spike testing** – to suddenly hit the serves with a large number of transactions and measure the performance of the system to determine whether the system will be able to sustain the workload.

### UAT Quality Assurance

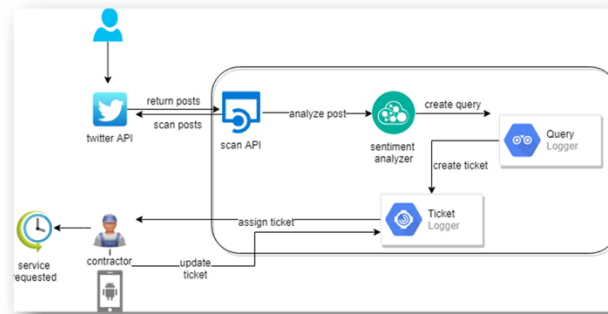
For alpha testing a handful number of contractors & civilians will be appointed by the place of interest to the test the operational behavior of the mobile-app and the integration of the social-media platforms involved.

This is intended to be a fully automated system that request little or less human intervention.



**Figure 1: A High-Level depiction of how the app will process the information.**

The diagram below show's us a high-level description of how the different component will interact in a real live world when being implemented and how the different components will interact with one another.



**Figure 2: Technical workflow system design**

*d. Modelling - AI Knowledge-Based Expert Systems*

A good standard definition of knowledge-based expert systems (KBES) is the following: knowledge-based expert systems are interactive computer programs incorporating judgment, experience, rules of thumb, intuition, and other expertise to provide knowledgeable advice about a variety of tasks (Anon, 2018).

Many computer-aided engineering professionals initially react to this definition with boredom and impatience. After all, conventional computer programs for engineering applications have become increasingly interactive. They have always incorporated expertise in the form of limitations, assumptions, and approximations, as discussed above, and their output has long ago been accepted as advice, not as "the answer" to a problem.

There is a need, therefore, to add an operational definition to distinguish the new wave of KBES from conventional algorithmic programs that incorporate substantial amounts of heuristics about a particular application area. The distinction should not be based on implementation languages or on the absolute separation between domain-dependent knowledge and generic inference engine. The principal distinction lies in the use of knowledge.

A traditional algorithmic application is organized into two parts: data and program. An expert system separates the program into an explicit knowledge base describing the problem-solving knowledge and a control program or inference engine that manipulates the knowledge base. The data portion or context describes the problem and the current state of the solution process. Such an approach is denoted as knowledge based (Anon, 2018).

**4 RESULTS AND DISCUSSION**

*a. Sampling Results*

By sampling, this process was done by selecting a unit of people from the general population of interest, so that studying the sample we can have an idea of the dynamics involved.

**Simple Random Sampling**

In this case everyone is chosen entirely by chance and each member of the population has an equal chance, or probability, of being selected. One way of obtaining a random sample is to give everyone in a population a number, and then use a table of random numbers to decide which individuals to include ("Methods Of Sampling From A Population" 2019).

**Systematic sampling**

Systematic sampling is often more convenient than simple random sampling, and it is easy to administer. However, it may also lead to bias, for example if there are underlying patterns in the

order of the individuals in the sampling frame, such that the sampling technique coincides with the periodicity of the underlying pattern (“Methods Of Sampling From A Population” 2019).

From a population of 100 people across all race’s areas and beliefs where selected and by Simple Random Sampling 30 people were randomly selected to participate and by Systematic sampling which is more bias and convenient 20 people were selected to participate.

**General population:** 100

**Simple Random Sampling:** 30

**Systematic Sampling:** 20

*b. Interview and Questionnaires Results*

The questions made up of opened, closed and rating-scale questions. The online questionnaire can be accessed from the link below.

<https://goo.gl/forms/gqIFOeWWVle1nGiw1>

With the questions posed aimed at getting of a feel of the following characteristics response, latency, relevance, pioneering, ministrations, contentment, endorsement and a general feeling of the society towards the municipal services.

- 33% somewhat neutral to the municipal services
- 40% feel the quality of services is neither high/low
- 40% saying the police response is not so quick
- 46.7% saying waste collection is somewhat quick
- 46.7% attributing to sewage and water being somewhat quickly resolved
- 20% feels technicians very quick when called upon
- 40% feel potholes are never addressed on time
- 40% suggested that they do really need the services of the municipality
- 53.3% feel that the municipality is not innovative in addressing or resolving its problems
- 40% of the society feel they are not getting the tax’s worth of services
- 53.3% never feel the need to report an issue to the municipality as they feel is a waste of time and resources.
- 33.3% feel their municipality is highly unreliable

The following shows us the graphical representation of the response from the people who tested the system and gave us verdict on their thoughts.

The questions that were posed are the following:

- Should this application be **implemented**?
- Is this a **better** solution compared to the current?
- Does this promote **innovate** and spark other new ideas?
- Is this proposed system **efficient**?
- Is this proposed system **effective**?

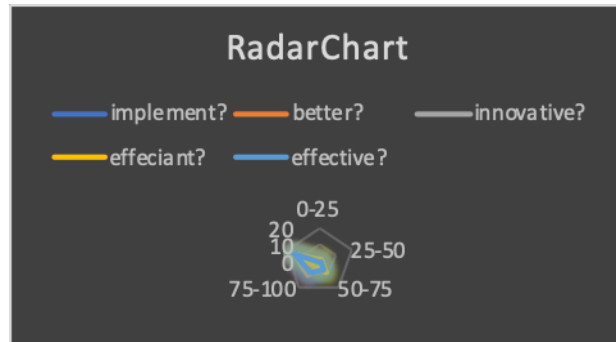


Figure 3 - Radar Chart

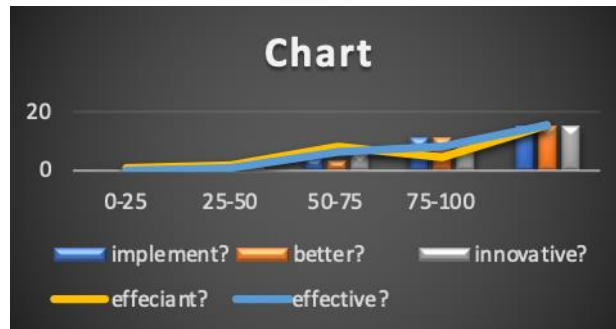


Figure 4 - Bar Chart

## 5 CONCLUSION

### Ethical Clearance

This research will be fully compliant to the Protection of Personal Information (POPI) act. All personal details provided by our clients and testers will only be made available to any other party by or through a valid court permit/order. We are therefore obligated by the POPI act for the user/client to adhere to the below:

- Only collect information that you need for a specific purpose.
- Apply reasonable security measures to protect it.
- Ensure it is relevant and up to date.
- Only hold as much as you need, and only for as long as you need it.
- Allow the subject of the information to see it upon request.

### Practical Solution Expectations

As a result of this research I expected the following output:

- A fully functional **mobile application**, that can communicate with our cloud services for data exchange
- A fully functional web-application system that will help us to maintain the application and have an administrative right of the system
- A fully functional backend-service system that will help us to capture, read, analyse and execute sentiment analysis on the posts and create a case/task
- A seamless integration between the mobile app and the two (2) systems mentioned earlier.

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## **SUSTAINABLE DEVELOPMENT, BUSINESS AND EDUCATION: STUDENTS' PERSPECTIVES FROM BLOEMFONTEIN, SOUTH AFRICA**

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### **ABSTRACT**

Sustainable development has become a global concern in recent years. This has led to the formation of global goals which aim to end poverty, protect the planet, and ensure that all people have peace and prosperity by the year 2030. For these goals to be achieved, stakeholders such as businesses and the education sector are required to take positive action towards the environment, society and the economy. It is fundamental to create awareness of these goals by teachers as they hold the mantle in embedding sustainability principles in their classes, in their quest as they train future business leaders and entrepreneurs. This study aimed to explore the level of familiarity of sustainable development concepts and perception on the role of business in the sustainable development agenda among Business Management student teachers at an institution of higher learning in Bloemfontein, South Africa. This exploratory study adopted a quantitative method, where open- and closed-ended questionnaires were used. The findings revealed that the students' explanation of sustainable development lacked understanding and depth. Concerning the role of business in sustainable development, there was agreement that business can play a leading role in addressing environmental and social issues.

**Keywords:** Business, Education, South Africa, Sustainable Development Goals.

### **1 INTRODUCTION**

Throughout history, societies and cultures have perceived the world to consist of infinite resources. Over time, it has been understood that the world is planetary in scale, and its vast resources are finite and diminishing (Robertson, 2014). Increasing human population and human activity has put growing pressure on the ecosystem in order to deliver services. The concern for environmental degradation and overexploitation of natural resources, coupled with unsustainable living conditions, has spurred a wide range of global and local stakeholders to address this issue. This has led to the formulation of Sustainable Development Goals (SDGs) by the United Nations, aimed to be achieved by the year 2030. The SDGs cover seventeen areas, all which are relevant to businesses.

One of the main avenues to ensure that SDGs are achieved is through Education for Sustainable Development (ESD). ESD is commonly understood as education that encourages changes in knowledge, skills, values and attitudes to enable a more sustainable and just society for all (Leicht, Heiss, & Byun, 2018). ESD forms part of Target 4.7 of Sustainable Development Goal 4 which seeks to ensure that all learners acquire the knowledge and skills needed to promote sustainable development; it includes ESD and sustainable lifestyles as strategies, among others, and cuts across all the other SDGs (Buckler & Creech, 2014). Researchers (Orr, 1991; Jones, Selby, & Sterling, 2010) have argued that higher education institutions of the world have played a significant role in making the world

unsustainable through producing corporate leaders with unsustainable behaviours. To correct this, higher education should use the opportunity it has to train teachers on ESD. Training teachers will help future business leaders and entrepreneurs through the transfer of knowledge, skills and values for future sustainability (Robertson, 2014).

Leicht et al. (2018) argue that key sustainability issues such as climate change, poverty and unsustainable production which are caused primarily by business activities should be addressed through ESD. ESD promotes integration of these critical sustainability issues, in local and global contexts, into the curriculum to prepare learners to understand and respond to the changing world. ESD aims to produce learning outcomes that include core competencies such as critical and systemic thinking, collaborative decision-making, and taking responsibility for present and future generations (Leicht et al., 2018). The rationale of the research is that comprehending the student teachers' understanding of SD concepts is crucial for incorporation of SD in the curriculum at university level. Although there has been extensive research on ESD, there is a void in how the curriculum can be integrated with business unsustainability practices and ESD. Consequently, the present paper pursues the central research question: What level of knowledge do Business Management student teachers have on SD, businesses and ESD? In order to tackle this subject, this study explores the levels of understanding of SD concept among Business management student teachers at a university of technology in South Africa. In this way, in terms of theoretical contribution, the study hopes to create a better understanding and to enhance the knowledge in explaining the level of knowledge of SD concepts and the influence of businesses on sustainability among student teachers.

Against this background, the study aims to achieve the following objectives:

- To find out the level of familiarity of sustainable development concepts among Business Management student teachers
- To establish Business Management student teachers' attitudes towards the natural environment and society
- To identify the role of business in sustainable development

## **2 LITERATURE REVIEW**

### **2.1 Sustainable Development and business**

Sustainable development (SD) has numerous definitions and there has not been consensus on any acceptable universal definition. The most widely used definition is found in the Brundtland Report which says that sustainable development is "development that meets the needs of the present without compromising the ability of future generations to meet their own demands" (Signitzer & Prexl, 2008:1). The Brundtland report emanates from the Brundtland Commission established by the United Nations (UN); its task was to come up with strategies which would be used by all countries in the pursuit of sustainable development (WCED, 1987).

According to Steurer, Lager, Konrad & Martinuzzi (2005:264), sustainable development is an "integrative concept aiming to balance environmental and economic issues in a mutually beneficial way". Thus, SD is a model that recognizes the spheres as interrelated and interconnected, and that they depend on one another. Rogers, Jalal & Boyd (2012) further add that SD is about integrating three spheres (economic, social and environmental) and developing the world in a way that benefits the widest possible range of sectors, across borders, and even between generations. In addition, any actions taken will have impacts elsewhere and, on the future, underlining the importance of SD. The setting up of SDGs in 2015 as indicators to be met by the year 2030, by all countries in the world, under the guidance of the UN, aimed at ensuring equity and balance in the interests and groups of people within and among the same generation, by ending poverty, protecting the planet, and ensuring prosperity for all (UN 2018).

Although it is the collective responsibility of all stakeholders to work towards sustainability, the role of business in SD cannot be overlooked. Businesses have an impact on the natural environment, employees and society at large and therefore they affect sustainability of the planet and society (Doesendorf, 2001). Through producing goods and services, they use the earth's resources as if they were inexhaustible. Sustainable development aims to address this issue by advocating that the future should be a better and healthier place than it is at present. It warrants an attitude of mind that welcomes change, difference, creativity, and a desire and capacity to learn (Blewitt, 2008). Businesses can help achieve these SDGs by working towards the achievement of Goal 12 directly. This goal aims to ensure sustainable consumption and production patterns by ensuring that businesses use resources well, while taking into consideration their impacts on the planet and people (Doesendorf, 2001).

Business case for sustainability is a "situation where economic success is increased while performing well in social and environmental issues" (Schaltegger & Ludeke-Freund, 2012:2). Businesses therefore engage in voluntary social and environmental practices in the hope that they will create a benefit to the company. The involvement of the business in social and environmental practices is aimed at solving societal or environmental issues. Several researchers suggest that reducing the environmental impact of the private sector is likely to have significant social returns (Stern, 2008; Jorgenson, Alekseyko & Giedraitis, 2014). Some of the examples mentioned include the fact that reducing the use of fossil fuel-based energy and hence of carbon dioxide emissions reduces the risk of climate change and using fewer raw materials and adopting more sustainable fishing or farming practices reduces pressure on the world's eco-systems.

Garner (2002), however, says that there are several myths that have hindered the advancement of sustainability principles in the world of business. The most damaging one being that sustainability makes sense for rich companies in developed nations but not for the private sector in the emerging market. In conclusion, Washington (2015) says that real people do not make entirely economic decisions. Most decisions made by real people are social, ethical and economic. However, corporations do make purely economic decisions because corporations are not real people. Ultimately, all economic value comes from nature by means of society. Therefore, to sustain economies, corporations must protect the productive capacity of nature and society.

## **2.2 Education for Sustainable Development**

There is growing consensus about the need for new educational approaches to fight sustainability challenges in socio-political and economic arenas (Yoko & Tarime, 2016). A revised form of education is required for transforming the thinking and mind-sets of the society and cultivating a cultural shift towards a more sustainable way of life (Clarke 2013). This requires discovering new ways of thinking and solving problems, through thinking, acting and understanding the relationships between society and the environment as an immediate need. Therefore, it is imperative that the unsustainable present is dealt with immediately through ESD, in order to create a better prospect for tomorrow. ESD is an approach that involves incorporating key themes of sustainability such as poverty alleviation, human rights, equity, health and environmental protection into all education systems (Vladimirova & Le Blanc, 2016).

Clarke (2013) argues that the starting point for ESD is to ensure that there is an understanding of why and how we care for our planet, to understand the need to care for each other in order to live harmoniously, and to understand that there is a need to care for ourselves, and therefore to re-design our consumption patterns. Gaugh and Scott (2003), on the other hand, argue that ESD brings together all that has been learned in formal and informal settings through learning to know, learning to do, learning to live together and learning to be. Both approaches indicate clearly that there is a need for knowledge about SD.

However, Clement and Caravita (2013) argue that attitudes and values are more important than knowledge and understanding and therefore should be the focus, instead of knowledge impartation. Their main emphasis is that ESD should change students' attitudes and beliefs and not simply transfer knowledge. To do this, teachers are required to have the knowledge to be able to influence behaviour and attitudinal change. In contradiction, they also argue that teachers are not well prepared for teaching of ESD due to lack of content knowledge of ESD outside their normal disciplinary training (Clement & Caravita, 2013).

Clarke (2013) advocates for knowledge before attitudes and behaviour. He argues that changes in attitudes and behaviour towards SD begin with awareness brought about by learning to see things through existing forms of instruction and knowledge transfer. The ability for people to start acting in a sustainable manner is a consequence of their awareness of how to act sustainably. This consequently leads to a mind shift from reductive understanding towards complex understanding.

Researchers (Sterling, 2010; Tilbury, 2004; Vare & Scott, 2007; Tilbury & Wortman, 2004) argue that ESD requires a focus on the future and the ability to create a sustainable future, less emphasis on seeing people as the problem but as agents of change, and less emphasis on awareness-raising approaches and more emphasis on critical reflection and systemic thinking. Learning about ESD is intended to help individuals and organizations to search for knowledge and competencies that enable them to deal with dilemmas in complex settings (Rieckmann, 2012). ESD provides individuals and organizations with a way of understanding both global and local issues in a coherent manner since it adopts a range of pedagogical approaches, with the aim that learners must be able to apply their knowledge within a practical multidisciplinary and interdisciplinary context. Due to the challenges affecting the world as a result of unsustainable behaviour, there is a challenge for higher education to embed equity in the curriculum in order to advocate for transformative shifts in realising sustainable development. (Yoko & Tarime, 2016). Universities need to provide tools and forums for students to think through their ethical duties and morality concerning the society and environment (Yoko & Tarime, 2016).

ESD has had impacts all over the world. Countries such as Finland, Norway, Sweden and Denmark have incorporated ESD into their curricula and this has led to innovative thinking. In Australia, the consequences of climate change are already well known among communities, and the knowledge has been incorporated into the curricula (Clarke, 2013). In contrast, a study conducted by Clement and Caravita in 2014 showed that teachers of less developed countries displayed minor awareness of the limitation of resources on the planet. The importance of ESD cannot be neglected in this era. ESD empowers learners to take informed decisions for environmental integrity, a just society and economic wellbeing, and it is a lifelong process. It is aimed at empowering learners for social transformation through equipping learners with knowledge as well as motivating people to adopt sustainable lifestyles (Buckler & Heather, 2014).

According to Cebrian and Juyent (2015), transformative social learning is imperative in leading to a shift of thinking, from knowledge and understanding to experiencing and sharing views on values, beliefs and attitudes about action on SD issues. Sustainability should be thought of as a lifelong process. It requires embedding qualities of learning to know, learning to do, learning to live together, and learning to create learning communities in SD (Cebrian & Juyent, 2015). Educators are key agents in advocating for change in SD and for them to be effective; they must acquire the necessary skills, knowledge and attitudes towards sustainability. One priority action area where this can be accomplished is through integrating ESD into pre-service and in-service teacher education (UNESCO, 2018).

Theron (2016) argues that ESD has been neglected in teacher education innovations in South Africa. National studies in SD skills in SA indicate the need to improve South Africa’s teachers’ knowledge and pedagogical content in teaching sustainability and SD. The argument is that the Department of Basic Education concentrates on areas of academic literacy and numeracy skills at the expense of SD knowledge (Theron, 2016). Studies published on university students’ understanding, perceptions, knowledge and attitudes towards SD (Azapagic, Perdan & Shallcross, 2005; Kagawa 2007; Daryson et al., 2013) provide evidence of increased interest in SD (Cebrian & Juyent, 2015).

### 3 METHODOLOGY

#### 3.1 Research Methods and Instruments

The methodology used in this research was the quantitative method. The method was suitable because the relationship between the researcher and participant is negligible and contact is brief and is guided by theories and prior research findings (Bryman, 2012). The data are deemed to be objective, precise and reliable (Struwig, 2013:16). The research instrument used was a questionnaire. It consisted three sections. Section A consisted of open-ended questions and aimed to find out the respondents’ level of understanding of SD concepts. The open-ended questions were important in order not to limit the students’ responses, and to get more objective answers. Section B aimed at finding out the respondents’ attitudes towards the environment and society. It consisted of both open ended and closed questions and questions with four-point Likert scales ranging from strongly disagree to strongly agree. Section C aimed at finding out the respondents’ knowledge on the role of business in SD. The closed ended results were analysed statistically using means while the open-ended questions’ responses were grouped into themes based on the responses.

#### 3.2 Population and Sample

A population is the total collection of elements about which one wishes to make some inferences (Maree, 2016). The population in this study was student teachers specializing in Business Management studies. Simple random sampling was done where questionnaires were distributed to students in their classes. Out of a total population of 80 students, responses were received from 56 students.

### 4 RESULTS AND INTERPRETATION

The questionnaire was divided into four sections. The results are discussed based on each section and question.

#### *Section A - level of familiarity of SD concepts*

This section aimed at finding the students’ level of knowledge on sustainable development concepts. The section consisted of three questions.

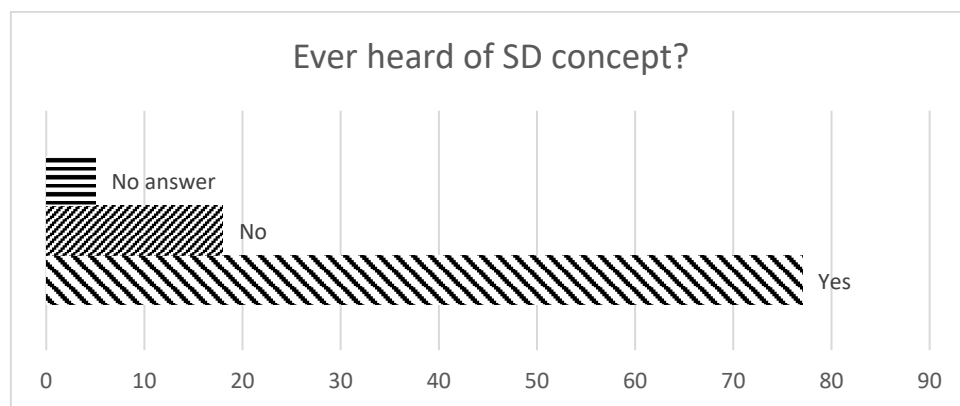


Figure 1: Familiarity of the concept of Sustainable Development.

The results indicate that most of the students had heard of the concept of SD (76.8%), while 17.9 % indicated they have never heard of the concept, and 5.4 % of the respondents did not answer the question.

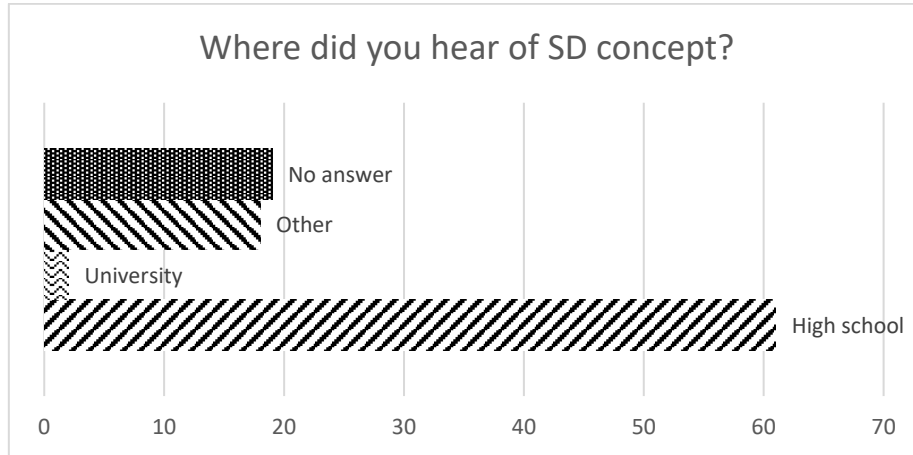


Figure 2: Indicate where you heard of the concept of SD?

Most (60.7 %) indicated that they had heard about the concept of SD in high school, 1.8 % at university, and 17.9 % indicated other places.

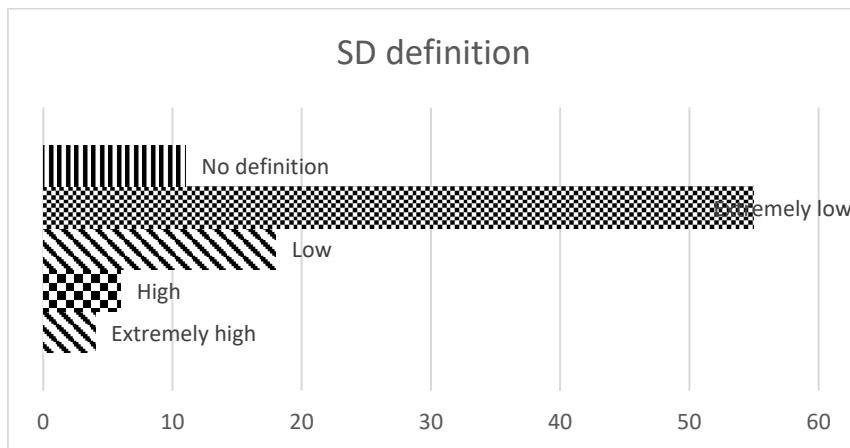


Figure 3: Definition of SD

The results indicate that responses eliciting extremely high definitions were 3.6 % of the total responses, high definition responses showed 12.5 % of the total responses, low responses were 17.9%, extremely low definitions were 55.4 %, and no definition, 10.7 %.

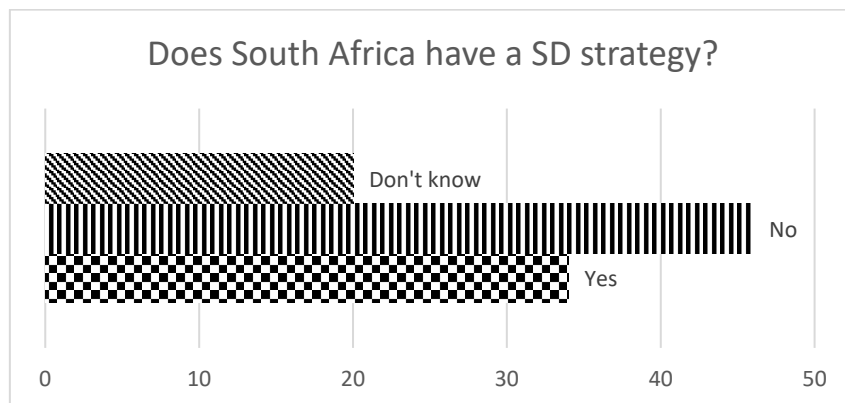


Figure 4: Does South Africa have a sustainable development strategy?

Results indicate that 33.9 % said yes, 46.4 % indicated no, while 19.6 % said that they do not know. However, there were no responses for their priority areas.

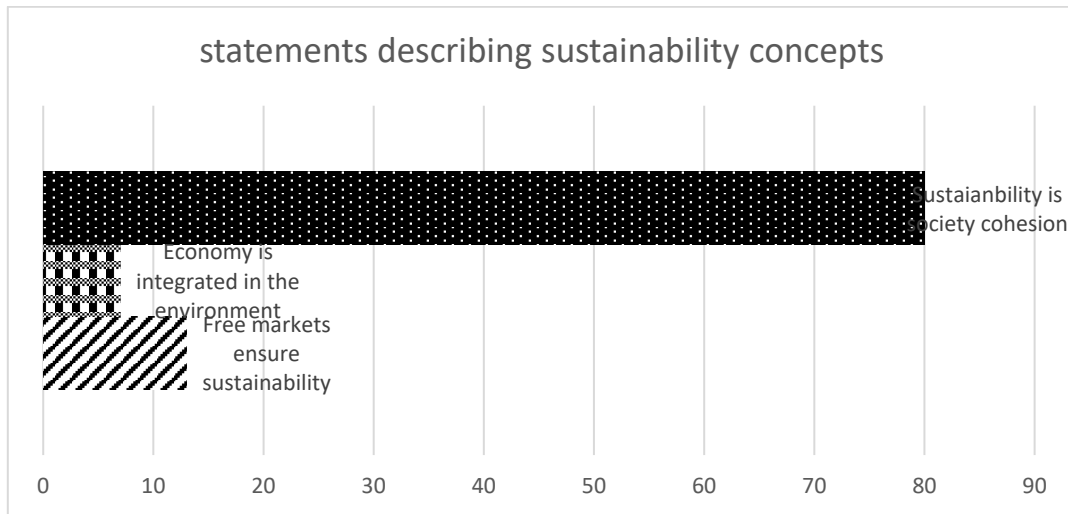


Figure 5: Statement describing the concept of sustainability.

Results show that 80.4 % indicated sustainability means the cohesion of society and its ability to work towards common social goals; 12.5 % indicated that free and open markets ensure sustainability; and 7.1 % indicated the statement closest in meaning to sustainability is that the economy is an inextricably integrated and dependent subsystem of the ecosphere/ natural environment and the society.

**Section B - Attitudes towards the environment and society**

This section aimed to investigate how students view society and the environment around them.

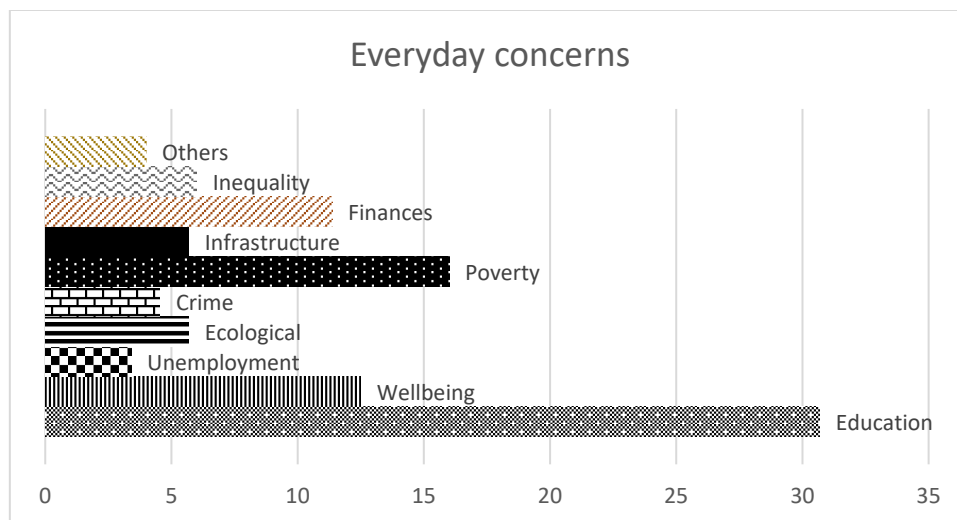


Figure 6: Difficulties and problems faced individually in the students' daily lives.

The question was open-ended, and the results indicate that education is a major concern for the everyday life of the respondents with 31 %, followed closely by poverty with 16 %, wellbeing of students with 13 %, lack of finances at 11 %, inequality, ecological, and infrastructure with 6 % each, crime at 5 %, unemployment at 3 %, and others, 4 %. The most common answers under “other” included answers such as lack of Wi-Fi, social media, technology, and not knowing how to communicate. Other interesting answers included ‘having unending family responsibilities’, ‘each day

I have to hustle for money so that I can eat’, ‘I walk to school’, ‘I struggle with transport’, ‘thinking what to do for my parents’, and ‘I miss classes sometimes because I don't have money’.

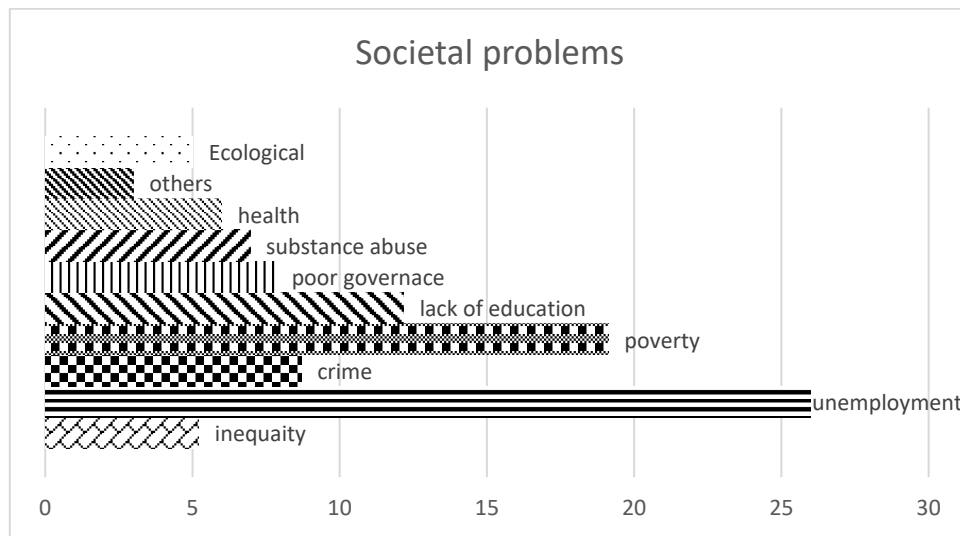


Figure 7: Problems affecting the society.

The results indicated that unemployment was the biggest problem affecting the society with 26 %, followed by poverty with 19 %, lack of education (12 %), crime (9 %), poor governance (8 %), substance abuse (7 %), health (6 %), inequity and ecological (each 5 %), and others (3 %). ‘Others’ in this case included answers such as decision making, time management, and understanding each other’s culture. Various other responses that were of interest were answers such as being exploited every day and corruption.

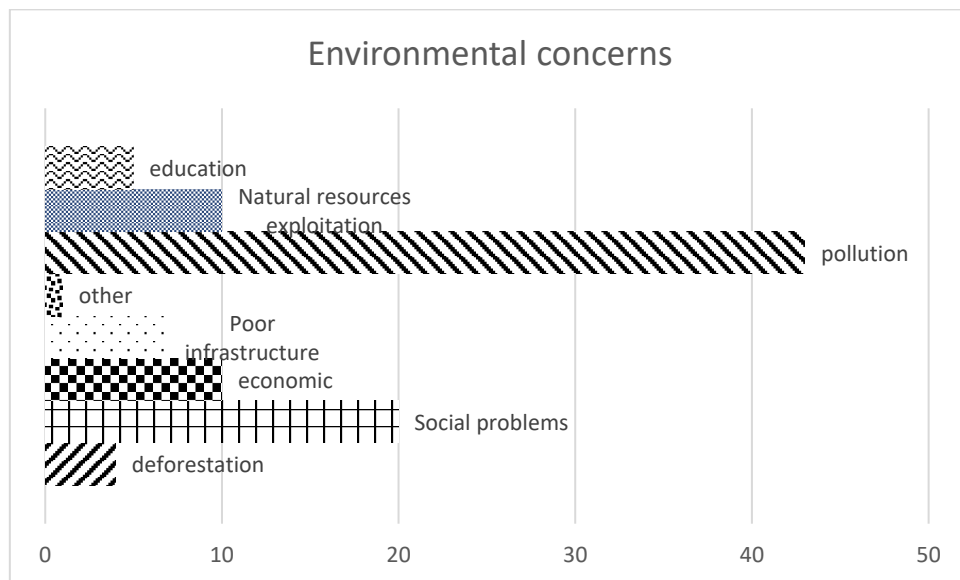


Figure 8: Concerns about the environment.

Results indicate that pollution received the highest responses with 43 %, followed by exploitation of natural resources (10 %), and deforestation (4%). The other responses showed social problems (20 %), economic problems (10%), poor infrastructure (7 %), education (5 %), and others (1 %).



	N	Mean	Std deviation
Threats to the environment are not my business	56	1.71	0.847
I believe that concept of sustainable development can help to solve environmental problems.	56	3.34	0.859
Developed countries should take responsibility for the environmental problems of the world.	56	3.18	0.917
Changing our way of living can contribute to solving environmental problems	56	3.55	0.819
Environmental problems are exaggerated	56	2.13	0.810
I am a part of the ecosystem and I can influence what happens with the environment	56	3.20	0.818
I am eager to contribute my time/energy to solve environmental problems	56	3.11	0.846

**Figure 9: Environment related statements**

The results indicate the students agreed that changing the way of living can help address environmental problems, with a mean of 3.55. There was also agreement that the concept of SD can help solve environmental problems, with a mean of 3.34. There was agreement that the students are part of the ecosystem and they can influence what happens in the environment. There seems to be a disagreement about environmental problems being exaggerated. With a mean of 2.13, it indicates that almost half of the students agree while the other half disagree. The students however agreed that developed countries should take responsibility for the environmental problems of the world.

	N	Mean	Std deviation
Achieve high economic growth	56	7.46	2.537
Eliminate gender disparity and empower women	56	7.30	2.642
Improve access to education and its quality	56	8.63	2.187
Protect natural reserves	56	7.48	2.343
Strong focus on health (child health, maternal, combating HIV/AIDS, tuberculosis).	56	8.25	2.242
Protect natural resources against overexploitation	56	7.48	2.404
Address population growth challenges	56	6.96	2.327
Address economic inequalities	56	7.61	2.302
Address the special needs of least developed countries.	56	7.11	2.735

**Figure 10: Importance of goals for human society**

This question aimed to find the students' ranking of the importance of statements which indicate goals for the human society. The rankings were from 0-10 where 0 indicated least important and 10 most important.

The results indicate that all the goals were important to the students. Improving access to education and its quality received the highest emphasis while addressing the population growth challenge was the lowest.

### **Section C - Role of business in SD**

This question intended to establish students' opinions on the role of business in sustainability. The respondents were required to indicate their level of agreement on statements by use of a Likert scale. The scale was based on four points, from strongly disagree to strongly agree. The results are presented through the means that represent an average level of agreement in table 3 below.

	N	Mean	Std dev.
Businesses contribute the largest part of environmental problems	56	3.07	0.735
Businesses are a leading factor in contributing towards social problems	56	2.41	0.804
Businesses can play a leading role in addressing environmental and social issues	56	3.23	0.853

**Figure 11: Role of business in SD**

The results indicate that there was agreement that businesses contribute the largest part of environmental problems with a mean of 3.07; on the contrary, the level of agreement on the impact of businesses on social problems was lower at 2.41. There was agreement that businesses can play a leading role in addressing environmental and social issues.

## **5 DISCUSSION**

### ***Level of familiarity of SD concepts***

Results showed that most students had heard of the concept of SD. This is a positive indication of the strides taken to create awareness especially in high school education as the majority said that they had heard of it in their high school years. The South Africa curriculum and CAPS advocates and incorporates sustainability in all the Economic and Management Sciences subjects. On the other hand, results indicated that majority of the students could not define the term SD, while only very few could give a definition which was related to SD or sustainability concepts. This contrasts with studies carried out on university students' knowledge of SD (Azapagic et al., 2005; Kagawa 2007; Daryson et al., 2013, Kimanzi, 2019). Lack of knowledge and understanding of SD by the students is evidenced in the respondents' explanation of SD. Out of the three statements, most of the responses chose the option that explained sustainability as "the cohesion of society and its ability to work towards common social goals (such as those for health and well-being, nutrition, shelter, education and cultural expression) be maintained". Although this definition refers to one facet of sustainability, the other options offered better explanations of sustainability. Once again, the definition of sustainability and SD by the respondents indicated their lack of knowledge about SD. The least mentioned aspect which said that the "economy is an inextricably integrated and dependent subsystem of the ecosphere/ natural environment" gave the best definition of sustainability, which most of the students ignored. According to Strange and Bayley (2008), SD is about integrating the three spheres (economic, social and environmental) and developing the world in a way that benefits the widest possible range of sectors. This means that the students should be taught on the interconnectedness of all the three spheres of SD, as they prepare to go and impart the knowledge to future businesspeople and entrepreneurs.

### ***Attitudes towards the environment and society***

There was agreement among all the respondents concerning all the statements that the environment is a concern, as each question had a mean of over 3. This is a positive indicator of people's changing attitudes and values towards sustainability. The result concurs with Clarke (2012) who advocates for knowledge before addressing attitudes and behaviour and argues that changes in attitudes and behaviour towards SD begin with awareness brought about by learning to see things through existing forms of instruction and knowledge transfer. In addition, a study by Kimanzi (2019), showed that the students are concerned about SD and that they have increase interests in learning more about sustainability. In contrast, students however agreed that developed countries should take responsibility for the environmental problems of the world. This is cause for concern in that environmental problems are the responsibility of everybody in the world.

Regarding the students' concerns about the environment, the responses showed that pollution was the highest concern in the responses, followed by exploitation of natural resources. This contrasts with a study that was carried out by Clement and Caravita in 2014 which showed that student teachers of less developed countries displayed minor awareness of the limitation of resources on the planet. However, lack of more responses concerning issues such as the ozone layer and other environmental problems indicated a lack of knowledge on environmental issues affecting South Africa, and the planet in general. ESD should be incorporated in order to address complex SD global problems.

All societal goals were important to the students. Improving access to education and its quality received the highest emphasis while addressing population growth challenges was the lowest. This shows that the respondents are keen to get a good and quality education, and it is important to them.

This is an encouraging result in that although the students are worried about the quality and access to education, they are concerned about a better future, one which can be achieved through education. Education is seen as the gateway to ending problems in the world. In addition, unemployment was cited as the biggest societal problem, followed by poverty. These two social problems are related in that one is the cause of the other; lack of employment leads to poverty, while lack of access to education, leads to unemployment. Goal 8 of the SDGs aims for everybody to have productive employment and decent work. However, that this emerges as the biggest societal problem indicates that it is a concern that affects all people involved, including the students. Ending poverty is the first goal of the SDGs. This is an indication that it is the biggest concern globally. Business sector can play a big part in addressing the issue of unemployment through creating more opportunities for jobs, as well as promoting their current employees to improve in their education through avenues created by the government such as the skills development fund.

### ***Role of business in SD***

The results indicate agreement that businesses contribute most to environmental problems. Again, this concern for the role of business and them being the biggest contributor to environmental degradation in the world shows that respondents are aware of what is happening in the area of sustainability. This concurs with Doesendorf (2001) who argued that businesses impact the natural environment, employees and society at large and therefore they affect sustainability of the planet and society. On the contrary, the level of agreement on the impact of business on social problems was lower. This is a clear indication in the perception of these students, societal problems such as poverty and unemployment are not being caused by business, but by other causes.

## **6 CONCLUSIONS AND RECOMMENDATIONS**

### ***Level of familiarity with SD concepts***

The students' level of familiarity with SD concepts was extremely low. Although they indicated they had come across the concept of SD in their high school years, they could not explain the concepts well. It is recommended that SD be presented as a topic for Business Management teachers to handle individually within their own subject specialist perspectives, or opportunities be offered in the curriculum to address sustainability more comprehensively.

### ***Attitudes towards the environment and society***

Students are concerned about the natural environment and they agree that they can play a big part in changing the natural environment. The lack of global issues mentioned in their responses, such as climate change and depletion of the ozone layer, requires the incorporation of ESD into the school curriculum, with an aim of looking at broader sustainability problems affecting the whole planet, and the relationships with businesses. Students indicated that all the societal goals are important for development, though education and its quality was their top priority. The relevant sectors of businesses, government, education and other stakeholders should be made aware of these concerns, and work towards bridging the gaps identified.

### ***Role of business in society***

Students indicated that businesses can play an important role in SD in all spheres. This information is relevant to the corporate world so that they advocate for changes in their business operations. In addition, the concept of SD should be incorporated into the curricula, programs, strategies and priorities of universities, colleges and institutions that are producing business leaders.

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## **ORGANISATIONAL PERFORMANCE TO SUSTAIN COMPETITIVENESS IN MANUFACTURING AND SERVICE SECTORS**

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### **ABSTRACT**

**Background:** Value creation in customer relations is vital for the survival of organisations in competitive markets. Companies in vulnerable situations are forced to either downsize or even face closure when they lose their organisational image. Such moves force organisations to position themselves and create more value for their customers using new product development based on customers' knowledge of the market. This effort reduces customer uncertainties in switching over to competitors' products as it forces organisations to create a culture for sustainability and growth.

**Objectives:** This study sought to determine and provide literature guides on how the development of new products, in collaboration with customer relations and supplier relations, can create a culture for organisational performance specific to manufacturing and service organisations.

**Method:** An extensive literature review was conducted on the determinants of organisational performance. Relevant models and frameworks were explored and applied to conceptually align customer relations, new product development and supplier relations in formulating the organisational performance framework.

**Results:** The results showed a need for an organisational performance framework. It was found that a strong organisational culture of employee willingness to participate will improve customer relations and that customer knowledge is the main input for new product development. It appeared that organisations performed better when customer service, better quality products, shorter lead times, lower costs and agile responsiveness to customer needs were achieved.

**Originality/Value:** Customer knowledge seems critical for customer relations to design new products for manufacturing and service organisations in order to create value to improve costs and efficiency for better organisational performance.

**Keywords:** customer knowledge, customer relations, organisational culture, organisational performance, supplier relations.

## **1 INTRODUCTION**

The competitive and dynamic marketplace involves a continual search for organisations to harness opportunities in order to improve their performance to gain competitive advantage (Oyewobi, Windapo, Bamidele, Rotimi & Jimoh, 2016). This is because the responsiveness of an organisation (Rudd, Greenley & Beastson, 2008) changes the competitive environment to become highly dependent on how well they align their characteristics to organisational performance. Hence the need to merge suppliers and customers in order to coordinate relationships between them has become an important determinant in maintaining a competitive advantage (Danese & Romano, 2011). It is mainly for this reason that organisational performance – a multifaceted concept – is measured through productivity, growth and creativity (Katou, 2015).

The competitive pressures and advances in technology (Mia & Winata, 2014) in the current global market have forced manufacturers to improve the provision of products and associated services. This is done by adopting fool proof manufacturing strategies to constantly achieve customer satisfaction. Strategies such as lean systems (Flumerfelt, Siriban-Manalang & Kahlen, 2012) create value for the customer as and when process improvement occurs. Quite often, improvement solutions lead to the standardisation of best practices and a streamlined flow of customer demand. Therefore, productivity includes the effectiveness of the organisation to meet its objectives, while efficiency is achieved when the organisation uses the fewest possible resources to meet its objectives. Hence growth is used to develop capacity to meet the future opportunities and challenges to satisfy all the stakeholders: employees, customers, & shareholders (Katou, 2015).

Factors that are central to organisational performance are the technical and the human factors (Habtoor, 2016). In agile manufacturing (Flumerfelt et al., 2012), lead times are shorter and if product quality is of high importance and the demand is unpredictable and rising, the lead time of production will inevitably be too long, which makes it impossible to exploit the market demand. Therefore, in agile manufacturing processes technologies are structured in ways in which they are easily configured to produce different types of products. Essentially, as Song, Su, Liu and Wang (2012) emphasise, there are technical factors where a group focuses on tools and work processes such as new product design (NPD). Lin and Huang (2013) add that process and statistics, supplier relationship management systems (SRMS), customer relationship management systems (CRM), just-in-time, continuous improvement, and control or feedback are technical system interventions used for organisational performance (Goetsch, 2014). Conversely, human factors focus on leadership, employee involvement, training and education, teamwork and communication (Habtoor, 2016). Flumerfelt et al., 2012) have also pointed out that the flexibility of machines and people enables systems to respond quickly to the changing specifications of customers. This is a culture that allows the swift response, close integration and the coordination of the internal and external elements within the supply chain.

This study contributes significantly to the supply chain body of knowledge. In times of economic uncertainty, organisations struggle to stay abreast of their competitors in service quality, profits, sustainability and growth. This literature study formulates mechanisms for manufacturing and services to tackle economic uncertainty and create value in organisations for growth and sustainability. As this research addresses the performance criteria for organisational value it could add value to the relevant discipline.

This research paper is defined as a compilation of substantive research of different previously published scholarly works pertaining to “Organisational performance to sustain competitiveness in manufacturing and service sectors”. It involves methodological and theoretical contributions to this specific topic representing ideas by different scholars gathered and moulded into a single paper.



The theoretical context based on literature dealing with organisational culture, organisational performance, customer knowledge, SRMS, NPD, and CRM.

## **2 LITERATURE REVIEW**

### **2.1 Organisational Performance**

Organisational performance is guided by leadership and management. According to Nienaber and Svensson (2013), this construct involves a number of interrelated tasks and activities which need to be executed in order for the organisation to attain the desired or pre-planned performance. Leadership or the top management of the organisation formulate the policy or strategy of the organisation (Summers, 2009; Nienaber & Svensson, 2013), whereas middle management (Goetsch, 2014; Nienaber & Svensson, 2013) are involved in the translation of the strategy, and front line managers execute the policy or strategy in an effort to achieve the (desired or pre-planned) goals of the organisation, deemed to be organisational performance.

Organisational performance is also generally associated with goal achievement and more specifically financial gain (Nienaber & Svensson, 2013). In light of financial gains, companies strive to stay profitable and overtake their competitors, but they face different internal and external challenges (Eidizadeh, Salehzadeh & Esfahani, 2017). In the external environment organisations are faced with opportunities and threats in growing the domestic and global competitive markets. Customers are increasingly more informed and have higher expectations as technology rapidly advances. In the internal environment, however, the pressures are to reduce costs, increase efficiency and promote more customer value for better organisational performance (Eidizadeh et al., 2017).

Authors such as Qasrawi, Almahamid, Soud, Qasrawi and Tareq (2017) indicate that the adoption of a managerial philosophy to focus on customers and service quality is an important requirement (also see Foster, 2014). Such a philosophy is particularly vital in environments characterised by dramatic changes in customer needs and expectations, competitor behaviours, widespread use of information technology and smart applications for organisational performance. However, Kohtamaki, Hakala, Partanen, Parida & Wincent (2015) have shown that where an organisation is not service oriented, it risks using misdirected service-giving practices, processes and procedures to offer integrated product services to its customers and thus its performance does not improve. Service offerings are defined as the range of services which are actively offered in conjunction with industrial products, representing a reflection of an industrial organisation's service strategy (Lightfoot & Gebauer, 2011). Organisational performance, on the other hand, as Kohtamaki et al. (2015) suggest, is determined by the implications of the manufacturing company's roles in the development of service offerings. A service strategy based on an organisation's sales and profit performance is a structural factor; therefore, service orientation is an important component of organisational structure as it manifests itself in employees' behaviour which affects customers' perceptions of the value created by the organisation (Kohtamaki et al., 2015).

Although a number of applied and theoretical studies have investigated the relationship between market orientation, learning orientation and their combined effect on organisational performance, there appears to be a dearth of knowledge within the context of emerging markets (Beneke, Blampied, Dewar & Soriano, 2016). Hence the concept of agile manufacturing is characterised by the ability to meet volatile business requirements through adaptability (Flumerfelt et al., 2012). Furthermore, agility is described as the capability to respond to and manage unpredictable change together with the ability to take on unforeseen opportunities and readiness to fulfil future needs and solve probable problems to improve organisational performance. For instance, Baird and Su (2018) suggest that managers should consider the following four control systems: belief, boundary,

interactive and diagnostic when designing a control system. These control systems measure the effectiveness of organisational performance in terms of cost, delivery and flexibility.

As change is suggested as the ultimate aim of organisational performance (Nienaber & Svensson, 2013), it ensures the survival and growth of the organisation in the long term; hence the objective of organisational performance is to start with improvements involving work processes that are performed efficiently and rapidly. It is continuous improvement processes in accordance with the value streams, the sequences of activities, the reduction of time frames, the elimination of waste and the increased process flexibility that are necessary for organisational competitiveness (De Castro, Freitas, Do Carmo, De Menezes & Siebenrok, 2018). Hence, for organisational performance to be effective, an evaluation process is required. Such a process aims to evaluate the work and the actions within the system regarding the capability, competence, efficiency and effectiveness of the continuous improvements that are meant to achieve certain organisational objectives (Sangwa & Sangwan, 2018).

In highly turbulent environments of hyper competition, especially in cases where organisational flexibility and adaptability are vital, learning organisations realise that excellent organisational performance is a competitive advantage in competitive markets (Hills, 2015). This is because organisations cannot draw on ready-made solutions for pre-defined problems as it requires flexibility to compete more effectively. Organisational flexibility is thus defined as the degree to which an organisation has a variety of managerial capabilities and the speed at which they can be activated (Hills, 2015; Putnik, 2012). Such flexibility increases the control capacity of management to improve the controllability of the organisation's performance. Putnik (2012) suggests that, in a decision approach, companies are allowed to face continuous changes and disturbances with agility, i.e. the ability to react quickly to technical or unpredictable environmental problems or difficulties which require organisations in such environments to have proactive workforces that are able, ready and motivated to think and suggest improvements for better organisational performance. Such responsiveness eventually creates a culture of agility with a positive approach towards organisational performance to sustain organisational competitiveness.

There are organisations where improvement is continuous, and the decision-making helps to create sustainable quality improvement. Hence, decision-making should be measured and considered when implementing quality improvement programmes. It is evident, therefore, that organisational decision-making is a product of individual decision-making and the context where individuals make decisions is highly constrained by the task they are doing (Simons, Bergs, Marneffe & Vandijck, 2016). Knapp (2015) argues that culture creates an organisation-wide empowerment atmosphere that is usually combined with accountability.

Such indications of negativity need to be reversed to achieve an environment of positivity that supports empowerment where employees become motivated to participate and endure risk taking as individual initiatives for better organisational performance (Goetsch, 2014). Risk taking, as pointed out by Summers (2009), should translate business processes to that which is critical to meet customers' needs and wants. This approach should also be aligned to the organisation's approach towards better performance.

For organisations to perform better, a historical paradigm shift in marketing has, in the past, shifted many companies' quests for market leadership to be dominated by production efficiency (Nguyen & Mutum, 2012). The aim was to cut down on operational costs per unit produced, which resulted in the company's ability to sell products and services at lower prices. However, this strategy was often not sustainable as those strategies were easily imitated by competitors in a short period of time.

## **2.2 Organisational culture**

Organisational culture, as pointed out by Robbins, Odendaal and Roodt (2007), is a set of seven primary characteristics that organisations value:

1. *Innovation and risk taking* - the extent to which employees are encouraged to take risks and be innovative
2. *Attention to detail* - the extent to which employees are expected to exhibit precision analysis and attention to detail
3. *Outcomes orientation* - the extent to which management focuses on results rather than the techniques and processes used to achieve the outcomes
4. *People orientation* - the extent to which management take decisions to consider the effect of outcomes on people within the organisation
5. *Team orientation* - the extent to which work is organised around teams instead of individuals
6. *Aggressiveness* - the extent to which people are aggressive and competitive rather than easy going
7. *Stability* - the extent to which the status quo is maintained in the context of growth

Organisational culture can be defined as the collective programming of the employees' mind that distinguishes members of one organisation from those of other organisations (Wiengarten, Gimenez, Fynes & Ferdows, 2015). Organisational culture is also the reflection of the systems and structures where people give meaning to their work and organisational life. Snyder, Ingelsson and Bäckström (2016) broadly define culture thus as a world of shared and learned experiences with meanings, values and understandings that inform people to express, reproduce and communicate better. Organisational culture is also seen as a belief system that members of an organisation share. It includes ways of working, traditions, stories and acceptable methods to achieve goals to achieve organisational performance (Pakdil & Leonard, 2015). Culture is also manifested by cultural artefacts of stories told by workers, customers and leaders who communicate the values and purpose of the organisation (Snyder et al., 2016). Culture is cumulative as it evolves over time and people share their experiences and adapt to similar conditions by dealing with their physical and social environments.

A cultural process, as indicated by Abdelhadi (2016), may be incorporated into lean manufacturing which has become an integrated system that includes highly inter-related elements of a culture of wide management practices such as just-in-time, quality systems, work teams and cellular manufacturing. Organisational performance and organisational culture, in relation to quality management, are linked to the rapid changes in technology and in other words these two aspects are essential when organisations update their employees' skills levels (Goyal, Samalia & Verma, 2017). Abdelhadi (2016) emphasises that organisational culture is directed at increasing productivity, reducing lead time and cost, and improving quality. In utilising organisational culture, organisation concentrates on continuously training employees to be competent in their capabilities to perform at their level best in order to cope with changes in manufacturing. The aim is to achieve the best service, best quality and acceptable products to meet the customer's requirements (Goyal et al., 2017).

It is in the favour of the customer where the organisational culture regards lean production as more than just tools and techniques (Abdelhadi, 2016). Lean thinking is a culture that forces an organisation to focus on real value from the customer's viewpoint and it aligns all processes toward that end. Lean thinking is therefore a culture that has been broadly accepted in many manufacturing operations and has been applied successfully across many other service disciplines. In lean manufacturing, the organisation reflects a culture that focuses first on people and on processes where respect for people leads the strategy followed by continuous process improvement (Flumerfelt et al., 2012). The two main pillars of lean manufacturing (LM) are continuous

improvement and respect for the entire group of people, including all employees, supply partners and customers.

It is mainly for this reason that the culture of an organisation has a strong impact on the organisation's performance and the maintenance of the organisational performance implemented by the organisation. If any organisational improvements are implemented and they do not align with the organisational culture, the organisation will not be successful and sustainable in the long run (Paro & Gerolamo, 2017). Hence culture is tacit, it is socially constructed, and it operates on an unconscious level which emphasises the organisation's shared values that are essential to efficiency as they help members choose which behaviours they will exhibit in order to excel (Pakdil & Leonard, 2015). The greatest value to the customer and for better organisational performance is to eliminate waste through a cultural process of human design elements (Abdelhadi, 2016). Continual training not only boosts the employees' morale, but also makes them self-motivated toward achieving the goals and objectives of the whole organisation (Goyal et al., 2017).

### **2.3 Customer Knowledge**

Constant changes in consumer needs and expectations are inevitable. Such changes require superior high-quality products of value and suggest that market orientation and learning orientation be used cohesively in order to provide the superior value and effectively enhance performance (Beneke et al., 2016). To sustain competitiveness, organisations tend to adopt new strategies where they become dependent on customer knowledge. This refers to an organisation's understanding of its customers' current and future needs and preferences (Tseng & Wu, 2014). Sharing customer knowledge about product or service, technology and problems are positively related to the customer's satisfaction where it could also facilitate the development of innovative services (Lin, Pekkarinen & Ma, 2015). Organisations acquire customer knowledge by creating interactions and dialogues with customers by observing how customers use the company's products or experience their service. They analyse the customers' usage of products in order to forecast customer requirements more accurately. Using customer data for the benefit and better utilisation of the organisations' input to resources and better organisational performance forms customer knowledge (Saarijärvi, Karjaluoto & Kuusela, 2013). Thus, a culture of CRM activities is developed by the organisation where cross-selling, customised marketing communications or segmentation and the value of the potential of customer data are captured, allowing companies to sell more products and manage their resources better to sustain competitiveness. Moreover, word of mouth plays a major role in customer decision-making when it comes to purchasing behaviour because customer-to-customer communications are more credible and trustworthy than any other traditional promotional mediums like advertising (Shin & Ellinger, 2013).

Competitive markets today are increasingly considering it vital for the survival of organisations to involve customers in participating in NPD activities to create customer knowledge (Lin and Huang, 2013). Customer participation is the degree to which the customer is involved in a manufacturer's NPD activity. Furthermore, a long-term orientation needs to be recognised as an important issue in business-to-business relationships between buyers and suppliers (Song et al., 2012). Such customer knowledge-sharing capability creates superior customer value that is important for a supplier's long-term survival and success (Lin & Huang, 2013). When buyers are satisfied with a company's products or services that offer them value, they will remain loyal to the supplier and develop good business relationships with the organisation. Therefore, the business-to-business market customer participation to build on customer knowledge positively impacts on NPD. This participation accelerates the performance, reduces time and costs, and improves product quality to benefit the customer (Lin & Huang, 2013).

### **2.4 Supplier relationship management systems and new product development**

The traditional culture seems to be that organisations keep suppliers at arm's length (Goetsch, 2014). This approach has an adversarial effect on the supplier where the maximum pressure is exerted on suppliers to drop prices and speed up deliveries. Buyers should rather develop close relationships with their main suppliers to create and maintain a cooperative relationship (Song et al., 2012). Politis, Giovanis and Binioris (2014) emphasise that it is better to create customer and supplier value through service performance in order to increase market share, as this would enable mass customisation through response-based systems. So, supplier SRMS do the sourcing, procurements, payments and performance monitoring of suppliers (Foster, 2015). Developing a set of beneficial relationships with suppliers makes it essential for buyers to be able to recognise and assess the important characteristics and capabilities of alternative suppliers. The focus of buyer-supplier relationships proposes the concept of relationship value to investigate business relationships (Song et al., 2012).

Relationship value is a significant concept in the area of marketing as well as in purchasing and supply management (Song et al., 2012). Although customer participation in NPD offers many benefits, it also creates many potential problems. A particular problem is the customer's willingness to share knowledge may risk leaking sensitive knowledge to rivals particularly for companies whose knowledge is a source of their dominance. Once companies perceive that their knowledge resources are jeopardised by knowledge spill-overs, they may decide not to share valuable knowledge. Other problems include the difficulty of articulating more advanced needs and the problems with transferring vital knowledge to others due to the complex and unstructured nature of such tacit knowledge. The most important reason customers have played a limited role in NPD may be the poor connectivity between customers and manufacturers (Lin & Huang, 2013).

## **2.5 Customer relationship management**

The landscape in which customers, manufacturers and services interact has changed. This is evidenced by the fact that companies today are centring their attention on transaction-based selling platforms rather than on a more relational-based approach. Indeed, according to Nguyen and Mutum (2012), the relationship marketing paradigm suggests that a particular business should be defined by its customers through an on-going relationship. The sole purpose of businesses, according to Akroush, Dahiyat, Gharaibeh and Abu-Lail (2011), is to create and keep customers. This business philosophy has become an operationalised strategy known as CRM. So, when CRM is adopted, organisations often argue that, as a result of CRM investment, consumer behaviour changes in a positive way and leads to increased revenues from increased sales or savings through efficiency (Nguyen & Waring, 2013). Therefore, business organisations of different sizes are motivated to adopt CRM to create and manage the relationships with their customers more effectively. An enhanced relationship with one's customers can ultimately lead to greater customer loyalty and retention as well as profitability (Akroush et al., 2011). Venturini and Benito (2015) define CRM as a set of business activities which are supported by both technology and processes that is directed by a strategy and are designed to improve business performance in an area of customer management.

Akroush et al. (2011) have indicated that the rapid advancements in communications technology greatly transformed the way relationships between companies and their customers are managed. In social network theory, strong network ties are more likely enhance the transfer of knowledge because of their closeness, trust and mutual reciprocity. Such ties enable customers not only to convey sensitive knowledge but also to know better how to transmit knowledge (Lin & Huang, 2013). Despite such an interest in the beneficial application of CRM, there is a serious limitation inhibiting the generalisability of the CRM scale to other economies or settings. This means if a business focuses its efforts on product innovation, operational efficiency and low price or customer intimacy, the business must still have customers or it is no longer a business but a hobby. For

instance, Battor and Battour (2013) suggest that CRM creates and manages close customer relationships. Accordingly, Shin and Ellinger (2013) explain that opportunities arise for businesses to build robust reputations to provide exceptional customer service by the great customer service stories they share. Hence it emphasises a long-held view that retaining customers can lead to dramatic enhancements in organisational performance. Thus suggesting loyal customers are the source of most of the organisation's profits, and that the organisation should continually seek to improve long-term customer relationships. The idea of creating a unique relationship with customers based on quality, dialogue, innovation and learning is regarded as a more sustainable strategy and could be seen as largely inimitable by competitors – in essence it is a strategy that could create a long-term competitive advantage (Nguyen & Mutum (2012).

The long-term success of a business depends on a strong customer base where increasing numbers of customers repurchase consistently for longer periods. Shin and Ellinger (2013) argue that consumers are active co-producers of communication, by whom market messages and meanings do not flow uni-directionally but are rather exchanged among members of their own consumer network. The customer voice describes the general level of comfort that a customer experiences in the process of complaining to the service provider when problems arise (Lacey, 2012). A strong customer base helps companies keep a strong presence in the market to further impact positively on the organisation's long-term financial performance (Singh & Saini, 2016). Lacey (2012) considers the customer voice to be a behavioural response to customer dissatisfaction as an alternative to defection. The main driver behind the surge of interest in CRM, according to Akroush et al. (2011), are advances in information technology and the increasing prominence of customer orientation as a fundamental business philosophy. Hence, Vaittinen, Martinsuo and Ortt (2018) emphasise the need to move from basic transaction-based exchanges to relationship-based customer contacts. This means being able to provide more effective and profitable solutions to customers to improve the organisation's performance. CRM has received increased attention, which has culminated in the development of a scale to measure the various dimensions of the concept. However, Battor and Battour (2013) point out that the focus on learning effectively and understanding the processes of satisfying customers should be understood first. Customer needs expressed in new products, services and ways of doing business should lead to superior outcomes of product success, superior customer retention and superior profitability. It is inevitable that even the best service providers who consistently provide excellent service experience problems in meeting customer needs (Lacey, 2012).

When customers are comfortable in dealing with service providers, they are more than willing to complain when service failures occur; yet, most customers choose not to complain to the service provider (Lacey, 2012). However, the conceptual and empirical link to between service quality and customer satisfaction has turned it into a core marketing instrument as it is widely accepted that there is a strong, positive relationship between service quality and improved supply chain performance (Politis et al., 2014). As such, service organisations have a strategic imperative to pursue both improved productivity/efficiency and enhanced customer satisfaction. Various means of achieving this goal have been proposed, including improving processes through technology, continuous training, and learning to cope with stressful service encounters to further emphasise the better management of frontline resources to increase employee productivity (Lee, Patterson & Ngo, 2017). More specifically, customer service is a proper way to satisfy customer needs by providing them with the required products and services (Janahi & Al Mubarak, 2017).

It is, therefore, important to understand the dynamics of the customer in sustaining business competitiveness. Singh and Saini (2016) explain that loyalty is important and a complex aspect of marketing. This emphasises customer loyalty, which deserves special attention from the marketers for the success of the business. The question is, how can customer loyalty be understood? It requires

positive responses towards brand, service, channel, product categories and activities (Shin and Ellinger, 2013). Furthermore, Lacey (2012) supports the notion of the customer's voice where defensive marketing strategies are mainly aimed at keeping customers from defecting and reducing the negative word of mouth communication to others. In the instances where service providers respond effectively to customer complaints this complaining behaviour helps the service provider turn the dissatisfied customers into satisfied customers, consequently preserving, and in some cases strengthening, existing customer relationships.

Another dimension of CRM is customer integration, which occurs when the company works closely with the customer, viewing this relationship as an important component of the supply chain. It considers practices of frequent contacts with customers and the organisation's engagement and its active participation in improving the customers' activities to ensure high product quality and low costs, even enhancing operational effectiveness. Finally, customer integration is seen as interaction with customers to gain feedback on the output that is delivered. The crucial role of customer integration is to drive the improvement actions to increase customer satisfaction (Danese & Romano, 2013).

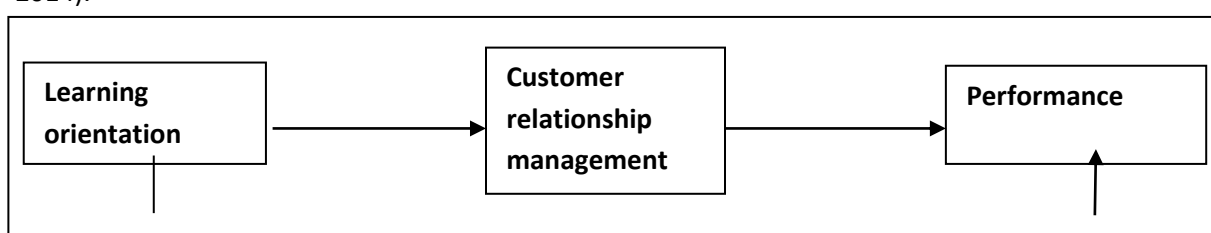
Peppers and Rogers (2013:33) point out that to have a trustable business in a successful and more transparent way and in a hyper-interactive world, there are three basic principles of extreme trust to follow:

1. *Do things right.* Be competent. Manage the functions, processes, and details right from the beginning to make it easy for customers to do business with you, and pay attention to the customer's experience and not just the company's immediate financial gain.
2. *Do the right thing.* Ensure that the way your organisation makes money aligns with the needs and best interests of your customers. You cannot be trustable if you are entirely focused on the short term. To forge enduring customer relationships, link short-term actions to long-term value.
3. *Be proactive.* Knowing that a customer's interest is not being well served and doing nothing about it is not trustable. Not knowing is incompetent.

By creating effective customer response-based systems positively, as suggested by Politis et al. (2014), customer satisfaction is enhanced. In turn, organisational performance to provide a differentiating competitive advantage and segment customers builds more customer confidence and trust.

## 2.6 Customer relationship management and performance

The learning orientation, CRM and firm performance framework adapted from Battor and Battour (2013) is an indication on how CRM processes are designed to turn customer data into customer relationships. This happens by collecting information from customers and translating the information into active results to formulate processes to improve customer services and relationships. Figure 1 below indicates how, if detailed and up-to-date customer information or data are collected and analysed, organisations can introduce the right product to the right customer at the right time through the right channel to satisfy the customer's evolving demands (Summers, 2009). Such organisations are more likely able to build long-term relationships with their customers and manage their customer relationships effectively while increasing their retention rates (Goetsch, 2014).



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**Figure 1: Learning orientation, CRM and firm performance**

**2.7 Adapted from Battor and Battour (2013).**

The positive consequences of enhanced long-term relationships with customers are increased revenue, reduced customer acquisition costs, and lower costs of serving repeat purchasers and this leads to greater profitability (Battor & Battour, 2013). The learning orientation depicted in Figure 1 above is a process that accounts for and uses existing long-term customers who will buy more from the company and are cheaper to serve. It takes less of a company's time, and existing customers are less inclined to move to competing brands. They also provide new referrals through positive word of mouth and buy other products that are offered by the company. All this contributes to better organisational performance.

Figure 1 shows that organisations with a superior CRM capability are more likely to understand the value of the customer. They are able to identify the profitability of each customer, and distinguish the more profitable customers from the less profitable ones. Companies are able to manage individual customer relationships more effectively, thus channelling the contribution of these relationships to the profitability of the company.

Ample empirical work has emphasised the positive impact of CRM on organisational performance. For example, Day and Van den Bulte (2002) found that CRM is an important determinant of superior organisational performance. Hooley, Greenley, Cadogan and Fahy (2005) reported similar results, while other researchers also found that CRM activities are associated with higher profits (Thomas & Sullivan 2005), greater customer retention (Jayachandran, Sharma, Kaufman & Raman, 2005), and increased customer knowledge which, in turn, is associated with greater customer satisfaction (Mithas, Krishnan & Fornell, 2005).

**3 FINDINGS**

The findings of this literature study point at the opportunities and threats posed in the external environment where markets are competitive. They show that customers are more informed and have higher expectations as technology rapidly advances. However, the internal environment is pressured to reduce costs, increase efficiency and promote more customer value for better organisational performance.

The whole process revealed in the findings starts with leadership's direction to formulate the policy and strategy to guide the next level of middle management to achieve the organisation's desired goals. However non-service-oriented organisations risk non-performance. This is manifested by poor employee behaviour which affects customer perceptions in creating value for the organisation.

Not meeting the goals does not mean the organisation will head for failure. Instead, poor results are used to investigate losses and create opportunities for the organisation to strive towards and enhance profitability and create new opportunities to stay ahead of their competitors.

The findings show customers' dire need to increase their expectations in growing markets and advanced technology. Advanced technology is a benefit for organisations to reduce costs and increase efficiency to add customer value. Furthermore, information technology and smart application tools are used to capture customers' needs, monitor competitors' behaviour and elaborate on customer expectations.

In this study it was found that *customer knowledge* was significant in the first dimension for organisational performance. It was also emphasised in the second dimension that a strong



*organisational culture* was important to create customer value for exceptional organisational performance. The third dimension, *customer relationship management (CRM)* was identified as the most important dimension for organisational performance as the gateway to the fourth dimension, *new product development (NPD)*. New products can only be developed when customer relationships provide input to create customer knowledge based on market requirements. Finally, in the fifth dimension, *supplier relationship management system (SRMS)* is used to achieve competitiveness to ensure reliable quality products, service, cost efficiency and adaptability. Based on these findings some recommendations follow on how to achieve organisational performance to sustain competitiveness in manufacturing and service organisations.

#### **4 RECOMMENDATIONS**

In order to sustain competitiveness in an organisation, information technology is an important tool to capture information, extract reports and analyse information to formulate competent strategies. This is a process of extracting historical reports from the CRM system to draw captured information from the historical data of customer orders. The data must be analysed and used to forecast future customer needs per item and formulate strategies to service the market needs effectively.

The author suggests that analysing customer demand per item manufactured or service provided can be done using the Pareto (ABC analysis) tool to differentiate high value items from low value items, where A items are considered high-value items consisting of 80% of the value of inventory and B items are medium-value items consisting 15% of value of inventory and C value items consist of low-value items at 5% of inventory value. Once the ABC items are established the next step is to extract a frequency analysis report from the system to establish how frequently and in what volumes each item from the A items, B items and C items are sold. This information is used to establish the frequency of finished items sales, raw material usage, machine consumables usage, and tooling and parts usage. In services it would be the frequency of services, and also the frequency of resources such as service providers, consumables, equipment and tooling.

The frequency report becomes an analytical tool to define which 80% of the items or services sold should always be available to provide speedy service to the customer and ensure product availability. The analytical tool also becomes a decision-making tool for the organisation to determine which B items and C items have a shorter lifespan and whether they should be kept in stock or whether the service should be provided from elsewhere.

There is also the challenge of changes in markets where product items phase out and new products are required. In this case, market research needs to be conducted on market requirements. This process requires customer knowledge of market requirements. Markets nowadays are determined by new technology in services and fashion in products. Some products have short and continual innovative lifespans while others have continual long-term lifespans. It is recommended that organisations communicate regularly with their customers and develop new products to service customers' needs. It is imperative that NPD be communicated with suppliers in order to determine the quality, costs, lead times and availability.

#### **5 CONCLUSION**

Creating customer value engages the organisation's active participation in improving customers' activities with the objective of positive organisational performance, hence high product quality, low costs, and even enhancing operational effectiveness. In the final instance, organisational performance for organisational competitiveness is obtained from the interactions with and feedback received from customers and suppliers, in other words the external influences that have an impact on the organisation. The internal factors are influenced by the organisation's culture where agility, continuous improvement, reduction in costs and enhancing profits are in place for positive

outcomes. This crucial integrated role drives the improvement actions to increase customer satisfaction and most importantly organisational performance for value creation and customer relations.

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## **SOCIAL STRUCTURES INFLUENCING QUALITY IN HIGHER EDUCATION AND TECHNOLOGY: A HIGHER EDUCATION PERSPECTIVE**

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### **ABSTRACT**

Socialisation in South Africa was underpinned by white minority rule since 1652. In 1948 SA experienced the implementation of the apartheid system which segregated the people of SA under racial lines. During the advent of democracy under Nelson Mandela, transformation was brought about in all spheres. Democracy brought about equity as the primary dimension of the transformation agenda. All practices, values and institutions had to be rethought for a new democracy. Higher education was deemed an important arena for social, cultural, economic, and political transformation in terms of addressing inequalities of the past and creating a new social order. The education system in SA was seriously impacted by the apartheid regime. The National Government enforced separate development, which entailed separate facilities for whites and blacks. The education system was separated for Blacks, Whites, Coloureds and Indians and so were the higher education institutions. Students progressed to White and Black Universities and Technikons into defined programmes for the different social groupings. Research was geared to support the white population while the black population was totally ignored. In addition, historically black institutions obtained limited funding and resources when compared to historically white institutions. This paper aims to highlight the disparity experienced by non-whites through a case study of a South African institution and highlights that the decisions of the past significantly influence the future in terms of innovation and entrepreneurship. A quantitative methodology through a case study analysis is chosen to discuss the regulatory framework for higher education in SA from an open distance learning perspective.

**Keywords:** socialization, higher education, quality management, performance improvement

### **1 INTRODUCTION AND BACKGROUND**

The education system in SA was seriously impacted by the apartheid regime. The National Government enforced separate development, which entailed separate facilities for whites and blacks (Bozalek & Boughey, 2012; DoE, 1997). The education system was separated for Blacks, Whites, Coloureds and Indians and so were the higher education institutions. Students progressed to White and Black Universities and Technikons into defined programmes for the different social groupings. Research was geared to support the white population while the black population was totally ignored (Bawa & Mouton, 2001; Badat, 2010; Barnett, 2000). In addition, historically black institutions (HBIs) obtained limited funding and resources when compared to historically white institutions (Bunting, 2006). The poor design and architecture of the buildings impede movement in times of unrest and continue to influence the learning environment. In addition, the geographical location of the HBIs influenced the academic stature of the graduate who was forced

to endure overcrowding and poverty as well as an inferior academic life. Universities and Technikons are still influenced in many ways by the apartheid regime (Archer, 1996). A fractured system of education with innumerable disparities was inherited by the new democratically elected government in 1994. The divisions of the social groups impacted the quality of education that was made available. Policy development since 1994 targeted a single coherent system with the aim of access, equity and quality education for all South Africans (Bunting, 2006; Quality enhancement project: the process for public higher education institutions, 2014). The belief that a skilled workforce impacts the economic stature of a country cannot be denied as exploratory information informs this to be factual. Numerous policies were implemented since 1994, towards addressing societal inequalities and the provision of opportunities for social mobility, strengthening social justice and democracy (Belawati & Zuhairi, 2007; Boud, 1999; Bunting, 2006). Lessons of the past may be able to create a better future if the different people of SA can work together.

## **2 METHODOLOGY**

Principally the qualitative approach was adopted as it enables the researcher to focus in a particular area and gather information through various means. In this case study, data was collected through the review of existing literature and triangulated with informal and telephonic discussions. Further to this, discussion forums were held to solicit information regarding continuous learning in a transforming environment. The qualitative method involves interacting with the group of people being investigated, and sometimes may even require living within the group. The current study adopted the qualitative methodology; hence a case study was conducted using snowballing as a technique. Individuals were selected and spoken to gain their input on the aspect of the impact of socialization in their tasks at the university. A total of 100 colleagues were spoken to within the department on a very informal basis.

## **3 LITERATURE REVIEW**

### **3.1 The impact of globalisation on higher education in SA**

Luckett and Sutherland (2000) espouse two significant factors that influence higher education globally. The first factor is globalisation (Teferra & Altbach, 2004). Globalisation enables intensive interaction and collaboration that is driven by trade and investment aided by information and communication technologies. In the context of higher education (HE), it enables South Africans to study and work internationally. The second factor is massification. It is experienced through open access of education nationally and internationally. Both factors provide opportunities and challenges. The opportunities are that SA would be able to attract international students to the universities (Teferra & Altbach, 2004; Whitchurch, 2010; Yorke & Longden, 2007). The challenge is the cultural and diversity related matters as well as curricula that need to be internationally accepted.

The massification of higher education, in particular the growth in student numbers at Unisa is placing major strain on all staff in the entire teaching and learning process. Student numbers have increased significantly in the last decade (Choudaha & Contreras, 2014). The open distance learning (ODL) system is not geared for such large numbers and this growth has impacted the entire teaching and learning spectrum. Both academic and support staff face logistical difficulties of managing large volumes of students. The university has introduced tutors and e-tutors to assist in the teaching and learning process to aid lecturers. However, many problems are being experienced as tutors and etutors do not deliver as per their contract. The University is in discussion regarding the implementation of MOOCs and I do not think that this route would be taken anytime soon (<http://www.unisa.ac.za/140/index.php/history>, 2015).

### **3.2 Redefining value in higher education**

Choudaha and Contreras (2014) mention that higher education internationally is pressured to offer value, not only because of funding and regulatory requirements, but also because learning is driven by costs in terms of government funding. Globalisation has forced higher education institutions to re-evaluate funding frameworks, technology-enhanced learning, new paradigms in teaching and learning, quality of the student experience, value for money and transformation as some of the elements for efficiency and effectiveness (Fairbanks, Duffy, Faircloth, He, Levin, Rohr, & Stein, 2009; Fenwick, 2001; Laurillard, 2008).

### **3.3 Higher Education in Context in SA**

The function of universities is to meet the educational needs of the country by providing “quality” education and skills for the labour market. Universities produce new knowledge and also reproduce existing knowledge through curricula. The Education White Paper 3 provides a comprehensive framework that is intended to transform higher education into a synchronized system that provides for the educational requirements of all South Africans (DoE, 1997).

The starting point from a structural perspective is the Higher Education Act of 1997 which is the cornerstone for regulating the provision of higher education through the formation of the Council on Higher Education (CHE), which promotes quality and supports development. The Department of Higher Education and Training (DHET) is the central body from which emanates the higher education quality council (HEQC), the South African Qualifications Authority (SAQA), the Council on Higher Education (CHE) which serve several purposes in the higher education landscape (DoE, 1997).

The CHE (2013) provides an explicit explanation into the aims of higher education as follows:

- Higher education is designed to make provision for epistemological access to the knowledge, skills and attributes in the educational process of aspiring individuals to enable the development of intellectual ability and aptitude. This enables individuals to apply their talents and achieve equity in opportunity.
- Higher education is designed to provide high level competency-based education in order to provide for a knowledge-driven and dependant society that requires specialised vocations that promotes development and opulence.
- Higher education promotes the socialisation of citizens that enables critical reflexion in the process of renewal.
- Higher education provides a platform for academic scholarship and knowledgeable investigation into all spheres of human understanding through teaching, learning and research (Bawa & Mouton, 2001; Badat, 2010; DoE, 1997).

Badat, (2010) portrays a university through four core characteristics, namely:

- “A university produces and disseminates knowledge which advances our understanding of our natural and social worlds and enriches our accumulated ‘cultural inheritances’ and heritage.
- A university cultivates and forms the cognitive character of students so that they: ‘can think effectively and critically’; have ‘achieved depth in some field of knowledge’; have a ‘critical appreciation of the ways in which we gain knowledge and understanding of the universe, of society, and of ourselves’.
- A university is committed ‘to the spirit of truth’, and allows intellectual inquiry ‘to go where it will’ without any ‘boundaries’ (Fairbanks et al., 2009; Fenwick, 2001; Fenwick, 2004) and

- A university possesses the necessary academic freedom, appropriate self-rule by academics, and institutional autonomy to effectively produce and disseminate knowledge.”

These two paragraphs underpin the proposed objectives of higher education since 1994. However, the aspirations of both the University as espoused by Badat (2010) and the DHET as outlined in the White Paper of 1997 are limited in terms of achieving access with success.

### **3.4 Categorising HE institutions**

The Minister of Higher Education Prof Kader Asmal categorised public higher education institutions in SA into three broad types in order to address equity and transform higher education after 1994. They are as follows:

- Traditional universities – research focussed
- Universities of Technology: more career orientated education
- Comprehensives: combination of traditional and career orientated institutions (Bozalek & Boughey, 2012)

Bozalek and Boughey (2012) allude to an important perspective that the differentiation in institutional types has a direct bearing on the quality of teaching and learning in the context of the institution where it is said that “a student from the University of the Witwatersrand is of a better ‘quality’ when compared to a student from the University of Johannesburg”. I argue that this may be the opinion of many South Africans but would like to differ because most of the students at Unisa are working in the field of Industrial Engineering hold senior positions. I am a product of the Technikon and believe that I have made a significant contribution in the lives of many of my students.

The re-configuration of universities and technikons led to widespread uneasiness among all staff. The notion of the “us and them” scenario still prevails today where university staff dominate technikon staff. It is now realised that some of these mergers did not work but is difficult to change. Disgruntled staff in merged institutions reflect on their experiences as being “undervalued” and “incompetent” when compared to “university staff” who have university degrees (Kilfoil, 2014; Luckett & Sutherland, 2000). The researcher argues that individuals with technikon qualifications are performing well in comparison to their counterparts.

The objective of the introduction of comprehensive universities was twofold: the first is to address the issues of access and opportunity and second was that they will bring diverse kinds of learning programmes under one roof. From experience it was found that Unisa has eliminated a number of vocational technikon type programmes that had large student numbers. The question asked at this stage is “has the objectives of the merger been realised” (Fairbanks et al., 2009; Fenwick, 2001; Gosling, 2009). There is perception among observers that access and equity have been addressed but this is in contradiction to success rates currently experienced. Politicians have failed to provide additional resources in the expansion of higher education.

The CHE as a body promulgates that HE achieves the said objectives through regular communicate. At this stage there is much contestation regarding higher education perspectives, but I am confident that Badat and the CHE provide sufficient reasoning on the SA context of HE with which I am in agreement. The progress that has been made in the last two decades is curtailed by factors such as funding, access, academic staff capacity, economic growth as well as the current student protest in SA (DoE, 1997).



The researcher is convinced that HE shapes the social, cultural, economic and political values of South African society to a larger extent. Racial tensions continue to impact the HE landscape in terms of enrolments, pass rates, language and the like. The central question prevalent is what form should our higher education system take and how should it be differentiated? The researcher points out that there should be differentiation in terms of the different target markets, but the focus of higher education should be for personal, social, economic and cultural development.

Transformation is a prominent discourse in terms of higher education in South Africa which revolves around three important areas, namely equality of access for all, efficiency of higher education and responsiveness to economic & social needs of SA society (Badat, 2010; Fenwick 2001; Gosling, 2009). Gravani (2007) proposes that the rhetoric of Africanisation and transformation that is associated with the application of business principles to knowledge production which looks at input, process and output and the division of labour as the fundamental means of transformation. Lockett (2000) proposes that Africanisation and transformation as drivers of curriculum change are not functioning synergistically with which the researcher is in agreement. The researcher is of the sense that if the areas mentioned above are addressed effectively, transformation will automatically come to the fore. The concern is that current dialogue regarding transformation is misconstrued in many ways.

### **3.5 Professional identity**

Higher education in South Africa is complex and changing continuously. Thus, the academic's professional identity is complex and molded by circumstantial factors. Rhoades (2008) in Clark, Hyde and Drennan (2013) mentions that there is insufficient research of professional identity in higher education. Also, there is no clear definition of professional identity. Rhoades (2008) also mentions that in order to get a better understanding, one needs to study the relationships, conditions and experiences in an organization that is multi-professioned. Whitchurch, (Lockett & Sutherland, 2000) in Clark Hyde and Drennan (2013) has categorized professional identity into sections: "1. Bounded professionals who perform clear and prescribed roles. 2. Cross Boundary professionals who perform transactional functions and contribute to capacity building. 3. Unbounded professionals who contribute to projects across the university and 4. Blended professionals who contribute to both professional and academic areas" (Clarke, Hyde & Drennan, 2013). The categorization of people into these four simple areas simplifies the complexity of professional identity in higher education. Thus, professional identity may be seen as an ongoing developmental process similar to life-long learning that is a never-ending journey of development. Professional identity is molded by structure, culture, and agency throughout the lifespan of the individual and the sociological factors that surround the individual (Archer, 1996; Cooper-Thomas & Anderson, 2006; D'Andrea & Gosling, 2005; Dall'Alba & Sandberg, 2006).

Sociology may be defined as the study of society which entails its complexity. It is the relationships and behaviour that exist between all persons living in a group that make up the community. This entails the hierarchy in status of persons and the rules and regulations that govern the behaviour of people through both theoretical and empirical perspectives. Social institutions eventually come together to form society. Social structures have an impact on human experience in a given society. Thus, socialisation may be seen as a developmental process in which people assimilate knowledge, skills and attributes that enable them to function effectively in society. Graduates receive and decode information through communication strategies that enable them to reflect and imbibe knowledge that is applied in their transition to become academic professionals (D'Andrea & Gosling, 2005; Danielson, 2004; Day, 1999).

Social structures inform institutions about education and challenge societal norms. Norms create social order and determine the behavior of individuals. Social structures, institutions and norms together with physical structures provide societal structures that encompass society. Children are socialized through educational institutions that reinforce societal practices. Thus, we are all products of the structures, and when there are problems, we work around them to lessen the impact (Raskoff, 2009).

Agency looks at the self, and the way people behave, as people are molded by societal norms. In a democratic society like SA, there are two major sides of the coin, one following the path of righteousness and the other totally unrighteous as people have the “good” and the “bad” that is part of human DNA. However, people have a mind to think on the path people should follow (Raskoff, 2009; Rhoades, 2008). There are consequences for whatever path man follows, as according to the Bhagavad-gītā. As It Is, the path of righteousness would lead one to attain spiritual enlightenment and reap the benefits of “karma.” “Like karma, the concept of dharma also mainly comprised fulfilling role-related responsibilities and duties. Integrating both the concepts, it can be said that dharma is the larger framework within the peripheries of which individual karma operates. The concepts of karma and dharma seem to provide a background template for deciphering right and wrong human behavior/conduct in the Indian context” (Bhangaokar & Kapadia, 2009).

Culture may be defined as a value system that results in an environment that is conducive to the establishment of principles, values and beliefs that promote societal interaction and acceptance. Cultures don't just happen but have been developing over time. All aspects of policies, practices, and traditions that govern existing culture may now seem questionable but were implemented under the circumstances. Culture cannot be changed overnight. Learning the existing culture in time and place would provide a good foundation for changes that can be made (Goetch & Davis, 2014). In the process of teaching and learning, we quite often forget the most important component, the student and it is quite often the student that would either adapt into a “culture” or make changes to transform the current culture (Goetsch & Davis, 2014; Knight, 2002; Laurillard, 2008).

### **3.6 Higher Education Act of 1997**

The Higher Education Act of 1997 is the cornerstone for regulating the provision of higher education through the formation of the Council on Higher Education which promotes quality and supports development.

The vision of DHET is the provision of a differentiated post-school system that allows access to all persons who meet the relevant requirements into relevant post-school education and training. This provision would enable participation and contribution of all South Africans to society. Higher education serves several purposes, from the promotion of citizenship through the production of knowledge, skills, attitudes and behaviour to the production of research of inventions. In the process of teaching and learning, which is the core function of HEI, there is dialogue that is multidisciplinary in nature which aims to prepare people to be “good” human beings that would add value to their lives and society. This provision of education and training is aimed at moulding (transforming) people to be able to apply both “soft and hard” skills in the economy (Dearing, 1997; DoE, 1997).

The HEQCs definition of quality in higher education focuses on three specific areas: namely,

- Fitness for purpose – an evaluation of how well an organization fulfils its stated mission

- Value for money – is judged on the basis of efficiency and effectiveness in the provision of teaching and learning
- Transformation – the development of the learner through teaching and learning that meets the needs for social and economic growth. This is underpinned by quality assurance mechanisms for the need of quality education and a fair chance of academic success (DoE, 1997; Scardamalia & Bereiter, 2006; Tang & Choi, 2009).

The structural changes came in the form of mergers of institutions and policies to govern all aspects of higher education. The agency of the CHE came in the form of institutional audits and the quality enhancement project (QEP) (2014). The experiences of the audit have been demeaning to a number of institutions, while others used this as a learning process to improve all factors that were recommended.

The researcher views the CHE as limited in terms of attaining its objectives because of the following reasons:

- Institutions do not embrace a culture of quality
- Audits were demeaning and considered a “monster”

This has since changed to the QEP. As a peer-reviewer of the CHE, the researcher would like to promote and help instil a culture of quality. The “student revolution” may provide the impetus to re-evaluate the way things are done.

### **3.7 Challenges in higher education**

There are numerous challenges in the South African Higher Education (SAHE) system. One of the more prominent ones is the current debacle on #feesmustfall campaign and the language policy that has impacted universities (Lockett & Sutherland, 2000). This amplifies the fiscal constraints to an already ailing economy as students demand free education. Other forces impacting the academic arena are emergent ICT, focus on research as an avenue for the generation of funds, diverse student body, low pass rates of particularly black students and the demand for accountability in higher education. In addition, governmental policies are attempting to create an integrated society through the prioritisation of the development of a new democratic dispensation (Scardamalia & Bereiter, 2006; Tang & Choi, 2009; Trowler & Knight, 2000). The fundamental transformative agenda is centred around “equity” of access and success, representativity in terms of student, staff and governance, financial support structures for disadvantaged students, and relevant curricular that would enable job opportunities and the focus on teaching and learning processes. Badat (2010) alludes to the engagement with overarching structural challenges at national level in higher education. The conclusion to this dilemma is to deal with it through discipline, law and order, and the end of corruption and dishonesty. Also, the researcher believes that racism will always be experienced and has to be dealt with accordingly.

The conclusion to the higher education debate is the mentioning that while the transformation agenda is limited in its effect, higher education will continue to face challenges until the leadership of government creates an enabling environment for higher education. Lastly, there are numerous challenges in higher education and clearly there is no point to argue about it any further. The researcher would do only what is in capacity through engagement with university policies, encouraging staff to participate in academic development initiatives.

## **4 RESULTS AND DISCUSSION**

### **4.1 The organisation in context**

At this stage the organisation is positioned within the broader HE context. The discussion follows the historical factors that sculptured the institutional identity.

Founded in 1873 UNISA was the only distance education institution that offered a wide spectrum of qualifications. It was impacted with a merger in 2005. There are approximately 360 000 students in its 8 colleges. As a large distance education institution that was the sole provider of distance education in the country and is required to meet the changing demands of students, staff and technology, while improving throughput and providing a quality service. In 2014, the Minister of Higher Education and Training mentioned that it would no longer be the sole provider of distance education in the public domain as other universities are now permitted to provide distance education. The institution took on the reigns of the open distance learning (ODL) character through major efforts in the integration of ODL technologies (<http://www.unisa.ac.za/140/index.php/history/>).

Although a number of contact institutions have “jumped onto the distance education bandwagon,” the institution is at an advantage due to its long standing in open distance learning (ODL) education. It offers a wide spectrum of qualifications as it is a comprehensive university. This status and the wealth of experience in and knowledge of distance education delivery lend considerable competitive advantage to the institution. Its dedicated distance education infrastructure for the production and dispatch of materials as well as its sophisticated registration and examinations systems make it capable of serving efficiently, a large, geographically dispersed student population. It is important to mention that teaching and learning is the core function at the institution, and to this end is supported by numerous other departments without which teaching and learning would be difficult. Due to the fact socialization within the institution is a very sensitive issue, only certain points are highlighted.

- The impact of the merger

Many staff were disillusioned by the mergers that took place in higher education and impacted staff tremendously. Many were left without jobs while others were forced to travel long distances.

- Impact of transformation

The university was predominantly white male driven. With the advent of democracy, and BEE, universities were forced to employ blacks. The challenges revolved around socialization among colleagues, knowledge transfer.

- Lack of knowledge and skills – technology transfer

Experienced academics were reluctant to share their knowledge and skills with their young counterparts. They became overwhelmed by their experiences in academia and many left for industry related jobs.

- Impact on students

This impacted on students greatly as they were now taught by inexperienced staff. Higher education experiences many challenges in terms of pass rates, retention and equity.

- Lack of socialization

Many academics create groups that are impenetrable as thus leave out the younger academics. This leads to a lack of sharing of knowledge and skills.

- Managing diversity

Diversity interventions frequently fail or have limited impact because the experience cannot be translated into a workplace in which nothing has changed. It is thus important that these interventions do not happen in isolation, but along with the other types of interventions (values linked to behaviours, communication, envisioning a transformed institution), as well as the creation of systems and processes that support change.

Managing diversity is as much about good people management as it is about managing diversity specifically. Management competence is quickly highlighted in diverse teams. It is thus important that management engage to create harmonious relationships in throughout the organisation.

#### 4.2 A definition of ODL pedagogy

For the purpose of this assessment, I propose a basic definition of ODL pedagogy to be as follows: The choices we make when deciding *what* to teach, *how* to teach it, which technologies as well as which strategies we will use. These choices are informed, inter alia, by the purpose of the module, our African context, our student profile and the particular background, values, prior knowledge and skills sets of both lecturers and students. An ODL pedagogy can therefore be *described* as the intentional *teaching* strategies and enactment (delivery) of these strategies to contribute to and bring out learning in bridging multiple distances ranging from the epistemological (how knowledge is constructed) distances between disciplines and/or lecturers and students, ontological (how we see the world and make meaning) distances; to differences between the aspirations, aims, access to resources and a range of other distances between students and lecturers and/or disciplines (Scardamalia & Bereiter, 2006; Tang & Choi, 2009).

These strategies and delivery of teaching are multidimensional, flexible, holistic, integrated and linked to and dependent on the discipline context, the expertise and understanding of lecturers, the prior knowledge of students, the availability and appropriate use of a variety of resources (such as open educational resources and prescribed/additional materials), tuition periods and effective and integrated institutional processes, systems and procedures (Teferra & Altbachl, 2004).

Due to the various components inherent in pedagogy in an ODL context it is therefore appropriate to mention that ODL pedagogies acknowledge the reality that what works in one module may not be appropriate in another context or module. Successful ODL pedagogy can therefore be judged on the extent to which pedagogies attempt to bridge these various distances; how these pedagogies are holistically designed and integrated into the prior knowledge and histories of learning of students; how flexible these pedagogies are; how the workloads for both students and lecturers are structured and to what extent an enabling environment is created for both students *and* lecturers.

The institution encourages all staff to develop a culture on ODL that would create an enabling environment for students to develop their talents. The following points provide a general guiding background for the proposed principles to guide and shape pedagogy at the institution.

- Empathy - a particular attitude that promotes an environment of teaching and learning
- Clarity of focus – clearly stated purpose and objectives to avoid ambiguity
- Tempo and workload – guard against overload and maintain the tempo of teaching and learning
- Pedagogy as development - a lecturer's enthusiasm and attitude directly influences the quality of a student's enthusiasm and attitude

- Awakening curiosity - authentic teaching and learning through understanding the students
- Planning and structure - balanced coherence and integration of the entire teaching and learning process
- Monitoring and evaluation – thoughtful and planned assessment opportunities (<http://www.unisa.ac.za/140/index.php/history/>)

### **4.3 Theoretical Underpinning of ODL pedagogy**

The ODL philosophy attempts to assimilate characteristics from the spheres of learning, that is andragogy (adult learning), heutagogy (self-determined learning) and pedagogy (science of teaching) (Fenwick, 2004). Critical analysis of adult learning premised five assumptions that differentiate adult learning from child learning, that is self-concept, experience, readiness to learn, orientation to learn and motivation. These concepts play a major role in student learning at the institution. The notion of heutagogy is based on competencies and outcomes that are pertinent to current students (Gosling, 2009).

The development of distance education into the ODL strategy was premised on the notion of provision of education for the working classes. This philosophy encourages the engagement of students in the workplace as well as the creating of communities of practice (COP) where professional discussions enable learning through listening and speaking where common insights are shared. The researcher believes that the industrial engineering should be applied to the education process to reduce inefficiencies and promote productivity measurement.

Gosling (2009) indicates that although traditional literature on the different generations of distance education focus almost exclusively on the impact of technology, a richer picture emerges when the different generations of distance education are also interrogated with regard to how curricula, pedagogies, delivery, storage and ownership changed over these years. It is also important to note that particular choices of teaching strategies or pedagogies are based on epistemological beliefs and assumptions regarding how learning takes place, ranging from teaching as transmission, to transactional to transformational. Embedded in these three meta-frameworks are different learning theories such as behaviourism/empiricism, cognitivism or rationalism, constructivism, constructionism, social constructivism, connectivism, and other hybrids. The aim is not to denigrate any of these learning theories, but to provide general broad principles which should be considered when lecturers decide on particular teaching strategies.

Transitions in thinking about learning have many implications for existing theories of learning. According to more recent theories of learning and cognition, drawing on socio-cultural, psycho-analytic, linguistic and complexity theories, mainstream conceptions of working knowledge and learning should be questioned (Fenwick, 2004; Gosling, 2009). One argument is that these conceptions are informed by theoretical explanations of learning that are too simplistic. New insights argue that learning takes place at the intersection of intervention, identity and environment, and should be taken into consideration when designing programmes, because they hold heuristic value for understanding knowledge production and subjectivity in these contested sites of work (Fenwick, 2001).

Aspects that need consideration to address the challenges above:

- Organisational learning must be theorised as fully embodied. In other words, the mainstream thinking of learning as a process of critical rational reflection that follows after experience should be questioned and replaced with theories that acknowledge that

learning and knowing are not exclusively cognitive and something that we possess, but something that unfolds over time and something that is about who we are and therefore has to include an understanding of the transformation of the self;

- Individuals and the meaning that they make of experiences are completely immersed in communities created through relationships and texts or discourses;
- Knowledge (or skilful knowing) is inherently present in networks of action, and not necessarily in individuals' heads, often referred to as connectionism, a learning theory for the digital age;
- The conscious reflective minds of individuals are more limited than organisational learning and action learning methods acknowledge. Individuals often actively resist even their own knowing and desire within the complex processes of collective meaning making;
- The environment and professional identities co-emerge in enactment of cognition and learning (Fenwick, 2001; Fenwick, 2004; Fenwick, 2001).

It is assumed that communities of practice (COP) or any grouping discussing particular issues cultivate shared meaning and understanding of issues. This is of particular significance in ODL as learning is seen as taking place (as assumed) in the workplace of the student. Especially in ODL, students are seen to be in a community where specialised discourses occur in varying degrees. This is done through the etutor system where students are allocated to tutors and form groups (COP) sharing a common concern. Thus, knowledge is built through shared meaning (Gravani, 2007; Knight, 2002). Students participate both vicariously, as listeners and readers, as well as generatively, as speakers and writers in order to develop an identity for themselves. This enables students from diverse backgrounds to share their insights on the subject matter.

These new insights into how learning happens in work contexts have contributed to a surge of research in the domain of higher education. Dall'Alba and Sandberg (2006), for example, who have for many years been involved in the formal training of higher education teachers and the research of those practices, have made valuable contributions on how these new insights on learning can be implemented in both formal and informal initiatives. They argue that skilful practice lies at the core of good teaching. Therefore, a deep understanding of what it entails and how it is learned is necessary to plan meaningful learning experiences. They agree that knowledge and skills are important for professional performance but are convinced that mere knowledge and skills are insufficient for skilful practices and for the transformation of the self that is integral to achieving such practice.

Researchers have also argued that we need to take the ontological dimension into account, and focus on the subjectivity, the agency and the transformation of the professional identity. Dall'Alba and Sandberg (2006) propose that mainstream thinking about professional learning that focuses on rational question such as "What should students know?" and "What should they be able to do?", in other words, an epistemological point of departure should be questioned on the basis of the belief that professional education needs to be reconfigured as a process of being and becoming.

## **5 RECOMMENDATION AND CONCLUSION**

### **5.1 Continuous Professional Development (CPD)**

Primarily, CPD is a process of dynamic socialisation embedded in individual and organisational relationships and the shaping of individual professional and organisational identity and agency. CPD has more to do with the professionalisation and the careers of individuals over time. Day (1999) says it well: "(CPD) is taken to refer to the broader changes that may take place over a

longer period of time, resulting in qualitative shifts in aspects of teachers professionalism” (1994:4).

As a natural result leading off from Day’s definition of continuous professional *learning*, continuous professional *development* (CPD) is much more than just increasing the competencies of employees in service of organisational goals. While CPD has a focus on the well-being of the individual, it is also crucial that the organisation takes responsibility for the support that it can offer. In this way, both the individual and organisation benefit.

Another important distinction is that CPD also targets *all* academic workers within an educational institution. Therefore, the need for and the provision of quality CPD must be applied to academics, professional and support personnel in the institution, in an on-going, sustained manner.

## **5.2 Capacity development**

Capacity development is the process by which individuals, and the organisation develop the appropriate capabilities (individually and collectively) to perform functions, solve problems, and set and achieve objectives/goals. To improve the capacity of organisations to perform well, the notions of capable and capability are important. Capable people are more likely to be able to deal effectively with the turbulent and complex environment in which they live. They are more than competent because they are able to see beyond the “normal” solutions to think creatively and innovatively on a daily basis. Capability and capacity is also more than knowledge and skills and is defined in the following way:

For these authors, capable organisations show the following characteristics:

- The complexity and ongoing nature of organisational change is recognised by all levels of staff;
- “Leaders”, rather than “managers” who have the capability of managing the complexity of change and its impact on people should be in positions that drive academic development;
- Members of the organisation take responsibility for their own work and are empowered and valued in the organization;
- A clear focus and commitment to learning.

The development of a capable organisation and capable individuals requires a holistic systemic approach in the development of strategies and interventions in capacity development that would impact academic development in all its contexts, thereby contributing to organizational effectiveness.

## **5.3 Knowledge building**

In order to counter-act obsolescence, an important aspect of organisational well-being in turbulent times, is the collective responsibility and capability of all workers to co-create organisational knowing -- in other words, what constitutes ODL in our context. This implies a culture of innovation and an environment that is continuously changing.

In situations such as ours -- where social change is the norm -- an organisation cannot depend on existing practices. Rather, we need to be able to re-invent the collective understanding of the organisation; this is known as contextual knowledge building. Knowledge building, according to Scardamalia & Bereiter (2006) is the creation of ideas and the improvement of ideas that have a life out in the world where they are subject to social processes of evaluating, revision and application.



Within such an organisational culture, learning refers to ongoing creative work which brings innovation closer to the central work of an organisation. This, in turn, leads to a shared community in which an individual contributes to the shared intellectual property of the organisation as a whole. Therefore, learning is necessitated by this process and integral to it. The resulting community knowledge is a form of new information that other community members can all build on together. There is continual movement beyond current understanding and best practice toward “lifelong innovativeness”. Thus, capacity development and knowledge building involve everyone in the institution, not only the academics.

#### **5.4 Dealing with changing social demands**

In order to avoid obsolescence, the organisation needs to be able to adapt to challenging social demands by fostering a culture of organisational learning and knowledge building. Thus, planned CPD is necessary because change is inevitable.

Changing conditions in higher education have influenced universities to become even more complex working environments in which academic workers have to adapt to new demands and often unfamiliar challenges. Gosling (2009; 2009) has positioned himself with many other voices who argue that earlier conceptions of academic development cannot survive the influences of the current social conditions of academic development, and that radical uncertainty and super-complexity have had a tremendous impact on the rejection of these conceptions of academic development. He argues that academic practices are in a process of radical re-making because teaching and learning have become objects of scrutiny and surveillance by not only managerial processes, but also by the agendas of governments.

Because of these conditions and demands, CPD “needs to be both broader in its conception and more centrally located within institutional decision-making processes if it is to meet the challenges facing higher education today” (Gosling, 2009).

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## **COMPARATIVE STUDY ON FACTORS CAUSING CHANGE ORDERS IN CONSTRUCTION PROJECTS – THE CASE OF 5 AFRICAN COUNTRIES**

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### **ABSTRACT**

**Problem statement:** Change orders in construction of projects have resulted in the increase of project budgets by between 5 and 15%. This has become a chronic problem that always result in claims, disputes, disruptions and delays in project completion amongst many other effects. Therefore, this article aims to identify and compare the causes of change orders in construction projects of five African countries.

**Research Approach:** A comprehensive literature review was, conducted to establish the root causes of change orders with reference to five African countries.

**Findings:** Twenty-five factors that cause change orders were, identified through literature. Owner's request for additional works is the most influential factor that cause change orders in construction projects of all the five African countries. Other factors include; errors, differing site conditions, weather and lack of coordination, identified by four out of the five countries. The discovery indicates the need for further empirical study on owners, as the factor is out of an organization's control.

**Conclusion:** This article contributes to the body of knowledge by identifying and comparing the causes of change orders. This outcome can eventually improve the performance of many projects by offering construction practitioners with a thorough insight of what causes change orders.

**Key words:** change orders, construction projects, African countries

## **1 INTRODUCTION**

### **1.1 Background of the study**

The construction of projects often results in increases of between 5-15% in contract price due to change orders that occur during construction (Serag, Oloufa, Malone & Radwan, 2010; Uskonen & Tenhiala, 2012; Alaryan, Emadelbetagi, Elshahat & Dawwod, 2014). Therefore, this increases the total cost of a project and causing the project to go beyond the budgeted costs all the time. This has made change orders to become an integral part of most construction projects, as it is now almost impossible to complete projects without any changes. Change orders are also a controversial issue (Soares, 2012), and this makes it extremely difficult to manage construction projects. However, change orders are not always as harmful as they can enhance the performance, quality and other functions of a project. On the other hand, change orders strain relationships of construction parties involved in the construction process. Not only relationships are strained by change orders but also other negative effects such as schedule delays, disputes, and cost overruns (Alnuaimi, Ramzi, Mohammed, & Ali, 2010) and project

abandonment (Babalola, 2013). The biggest problem with change orders is that it affects other unconnected projects by securing resources that were meant to be spent elsewhere.

Change orders are defined as additional work added to or deleted from the original scope of work of a contract which alters the original contract amount or completion date (Zawawi, Azman & Kamar 2010). Change orders are also referred to as variation orders by a number of studies, therefore the term is used interchangeably in construction of projects. However, the naming of these is not significant as the issue being raised about the construction of projects is the same. Change orders in construction are at times necessary for the success of a project. According to Alnuaimi et al. (2010), change orders are issued to correct or modify the original design or scope of work. However, there are consequences involved in allowing these to take place because it is risky to deviate from initially planned outcomes. For example, change orders have been reported to be the major cause of overruns (Taylor, Uddin, Goodrum, McCoy & Shan, 2012; Ijaola & Iyagba, 2012; Alaryan et al., 2014), claims and disputes (Ijaola & Iyagba, 2012; Assbeihat & Sweis, 2015) disruptions (Kolawole, Kamau & Munala, 2016) and dissatisfactions. These effects of change orders are not beneficial for the business and therefore, should be identified and managed effectively and efficiently. The problem of change orders in construction industry is a worldwide problem though it is more common in developing countries. Most of these developing countries are in Africa. However, the reasons for change orders differ from one country to another or even between one project and another. Therefore, this article aims to identify and compare change orders from five African countries.

Research endeavours have identified the causes of changes orders to be namely; major variations in the quantities, and changes in the design (Ezeldin & El-Sadek, 2016) defects, differing underground conditions (Halwatura & Ranasinghe, 2013; Oloo, Munala & Githae, 2014), poor estimation, political pressure (Halwatura & Ranasinghe, 2013) and misinterpretation of documents (Mhando, Mlinga & Alinaitwe, 2017) amongst others. Other studies on change orders focused on effects of variation orders (Memon, Rahman & Hasan, 2014), frequency of change orders (Anastasopoulos, Labi, Bhargava, Bordat & Mannering, 2010), quantifying the impact (Serag et al., 2010) and the prediction of losses caused (Cheng, Wibowo, Prayogo & Roy, 2015) and the change order process (Kolawole, Kamau & Munala, 2016) amongst others.

## **1.2 Problem statement and research gap**

Change orders are the single most important factor in construction that is impossible to ignore. However since they continue to cause serious challenges within the construction of projects, more attention should be given to the causes of change orders. Change orders increase the cost of a project by between 5-15% of the contract price (Uskonen & Tenhiala, 2012) and these results in a domino effects causing overruns and affecting the performance of the project in many ways. Five African countries construction industries have been experiencing a high rate of change orders in many different projects due to various causes. This has led to poor project performance and the trend has continued unabated. Faced with this trap, curiosity has been mounting among various stakeholders to come up with ways to eliminate change orders in the construction of projects. Therefore, reconsidering the causes of change orders in the construction of projects has been identified as the only option. According to (Soares, 2012), change orders are amongst the most controversial issue in the construction of projects, reflecting their importance in project performance. There is, however, a dearth of information about causes of change orders amongst the five African countries nations making it difficult to eliminate change orders and to improve project performance in construction. The study aims to identify the causes of change orders and compare these amongst the five African countries to enable construction practitioners to formulate appropriate intervention strategies towards any type of change order in any of project in the construction of projects.

### **1.3 Contribution of the paper**

The growing and ever developing literature on the causes of change orders has realistically ignored change orders amongst the five African countries nations. However, a number of construction companies still experience change orders on most projects regardless of the type, location or experience of project managers. To this point, there has been no proper analysis on the causes of change orders and comparison of these amongst the five African countries. Thus, the objective of this article is to identify and compare the causes of change orders amongst the five African countries' construction projects. So that effective ways can be established to deal with any type of change orders that occur amongst these countries. This article contributes to the body of knowledge in the by identifying and comparing the causes of change orders amongst the five African nations. The identification and comparison of these change orders can eventually help in improving project performance in the industries of the five African nations. This is because this would have provided construction practitioners with an in-depth understanding of what change orders and therefore devise ways to mitigate these causes.

### **1.4 Organisation of the paper**

This article is arranged and presented in the following order; literature on change orders in the construction of projects, causes of change orders in construction projects and amongst the five African countries. Comparison of change orders in five African countries between the periods of 2012 to 2017. These change orders are then discussed country by country and presented in a graphical presentation form. This is followed by the challenges and trends that can be seen to have developed in terms of this phenomenon and thereafter it's the conclusion.

## **2 LITERATURE REVIEW**

This section of the article explores the different philosophies on change orders in construction projects.

### **2.1 Change orders in the construction of projects**

Construction process is complex and is associated with many various changes that can take place at any stage of the process and are sometimes unavoidable. Change is a consequence that results in the need to alter the original plan. Change can be found at either an organisational or project level. According to Kolawole et al. (2016), change at organisational level deals with managing how to introduce making improvements to the organisation effectively and efficiently. Whereas, at project level the focus is on trying to cope with the modification that occur in the project due to internal and external reasons. Internal changes may be due to design change, design errors, omissions, inappropriate site conditions, unsatisfactory ground conditions (Suleiman & Luvara, 2016; Seddeeq, Assaf, Abdallah & Hassanain, 2019). External causes involve changes in client's need, policies, government decisions and policy change, a nation's economic environment, economic condition of stakeholders, nation's political situation and technological change.

Change orders in the construction industry, can commence from a number of sources including the owner, architect, contractor of the project itself (Rashid et al., 2012). As mentioned earlier, change in construction projects is a worldwide problem and is evidenced in the following discussion. Developing and developed countries have both reported various types of changes in construction projects. The occurrences and the impact of change orders may differ from country to country (Halwatura & Ranasinghe, 2013) or from project to project. It is generally agreed that change orders are common and cause performance problems in construction. For example, among developed countries, change orders have been testified in countries like United States of America (USA), Saudi Arabia United Kingdom amongst others. In USA, Indiana for instance, Anastasopoulos et al. (2010) investigated the frequency of change orders in the construction of highways. The study found that incremental increases in contract amount produced sharp increases in change order frequency. Whereas, large

contract incremental increases in contract amount produced smaller changes in change order frequency. In Saudi Arabia, Ibn-Homaid, Eldosouky and Al-Ghamdi (2011) examined the causes, impact and control of change orders. That study was conducted through a questionnaire survey and its results indicated 11 important causes and 7 impacts of change orders in construction.

In developing countries, change orders has been related through a number of studies. For example, in Sri Lanka, Malaysia, Jordan and Palestine amongst others. In Sri Lanka, Halwatura and Ranasinghe (2013), investigated variation orders in road construction projects. The study focused on 11 road construction projects and employed the use of both a questionnaire and literature review to unearth the causes of variation orders in construction. The results indicated that, poor estimation, unforeseen site conditions, political pressure, poor investigating and client-initiated variations are the most influential causes. In Malaysia, Memon et al. (2014) investigated the causes and effects of variation orders in construction projects. A structured questionnaire consisting of 18 causes and 9 effects of variation orders identified through literature and employed. The top three causes of variation orders were identified by this study as, the unavailability of equipment, poor workmanship and design complexity. Another study from Malaysia by Staiti, Othman and Jaaron (2016), found that change orders has the following 11 impacts on construction, time and cost overruns, disputes, delay in payment, additional specialist equipment, professional reputation, health and safety equipment, quality standards, degradation of health and safety and additional personnel. In Jordan, Assbeihat and Sweis (2015), identified factors affecting change orders through an open conversation system. The study revealed that owners instructions to modify and add works, as the leading factors affecting change orders in public projects.

## **2.2 Causes of change orders in construction projects in Africa**

Literature revealed a number of causes of change orders from different countries and different projects. However, this article is mostly concerned with change orders amongst African countries. Table 1 portrays the causes of change orders from five African countries between the periods of 2012 and 2017.

**Table 1: Causes of change orders within 5 African countries’ construction industry, the periods of 2012-2017**

<b>Causes of change orders</b>	<b>Ghana</b>	<b>Kenya</b>	<b>Tanzania</b>	<b>Nigeria</b>	<b>South Africa</b>
Owner request for additional works	Asamaoh et al. (2013) Asiedu et al. (2014) Offei-Nyako et al (2016)	Oloo et al. (2014)	Mhando et al. (order2017)	Ijaola et al. (2012) Alnuaimi et a.l (2010) Muhammad et a.l (2015)	Smith (2014)
Design discrepancies and complexity	Asamaoh et al. (2013) Offei-Nyako et al. (2016)		Mhando et al. (2017) Malekela et al. (2017)		Ngwepe et al. (2014)
Change in specifications	Asamaoh et al. (2013)				Ngwepe et al. (2014) Smith (2014) CIDB (2012)
Omissions		Oloo et al. (2014)		Kolawole et al. (2016) Muhammad et al. (2015) <u>Oyewobi</u> et al. (2016)	Ngwepe et al. (2014) Smith (2014)



Errors		Oloo et al. (2014)	Malekela et al. (2017)	Muhammad et al. (2015)	Ngwepe et al. (2014)
Inadequate drawings	Asamaoh et al. (2013)				Ngwepe et al. (2014) CIDB (2012)
Fluctuations	Offei-Nyako et al. (2016)				Windapo et al. (2013)
Correct interpretation				<u>Oyewobi</u> et al. (2016)	
Poor technology application				<u>Oyewobi</u> et al. (2016)	
Unavailability and substitute of materials & equipment	Offei-Nyako et al. (2016)	Oloo et al. (2014)		Muhammad et al. (2015)	
Delay in land acquisition		Oloo et al. (2014)			
Differing site conditions	Asamaoh et al. (2013) Asiedu et al. (2014) Offei-Nyako et al. (2016)	Oloo et al. (2014)		Muhammad et al. (2015)	Ngwepe et al. (2014)
Lack of experience			Malekela et al. (2017)		
Lack of financial resources	Asamaoh et al. (2013)		Malekela et al. (2017)		
Lack of clarity			Malekela et al. (2017)		
Lack of coordination	Asamaoh et al. (2013)	Oloo et al. (2014)	Malekela et al. (2017)		
Weather conditions	Offei-Nyako et al. (2016)	Oloo et al. (2014)	Mhando et al. (2017)		Ngwepe et al. (2014) Smith (2014)
Conflict between contract documents		Oloo et al. (2014)	Mhando et al. (2017); Malekela et al. (2017)	Muhammad et al. (2015)	Windapo et al. (2013)
Health and safety considerations					Ngwepe et al. (2014)
Industrial strike action					Smith (2014)
Government regulations	Offei-Nyako et al. (2016)			Muhammad et al. (2015)	Ngwepe et al. (2014)
New information					CIDB (2012)
Defective material				<u>Oyewobi</u> et al. (2016)	
Inaccurate briefing				<u>Oyewobi</u> et al. (2016)	

The literature revealed that change orders in construction industry is considered common and that it occurred on almost all projects. This is evidenced by table 1, above which depicts 25 causes of change orders against five African countries. Based on table 1, it can be perceived that the causes of change orders in Africa are similar in other countries but not in all African countries.

### **3 RESEARCH METHODOLOGY**

The methodology involved an extensive and comprehensive literature review of change orders amongst in construction projects. Focus was on the chosen five African countries in different type of projects. Peer reviewed articles were sought from Google for the periods between 2012 and 2019 for each country. Fifteen (15) articles were, found to be relevant for this study and therefore, formed the foundation of this article. Fifteen (15) articles reported directly on the causes of change orders whereas seventeen (17) were more general articles that did not report directly but mentioned issues on change orders in construction.

A number of key words that were, used to search for the articles on Google scholar included the following; construction projects, change orders, change orders in construction, causes of change orders, factors affecting change orders and impact of change orders. Twenty-five (25) causes of change orders were, identified from the literature and these were listed and criss-crossed against country studies that identified that particular cause of change order in construction. A total, of 25 causes of change orders put up against each country were, used to find out, which were more influential in each country. Therefore, this article reports exclusively on the findings of the causes of change orders in the five African countries.

### **4 FINDINGS AND DISCUSSION**

The next section of the article discusses the causes of change orders in construction of projects amongst the five African countries

#### **4.1 Causes of change orders in Ghana**

The literature on change orders on construction projects in Ghana is not enough as only three articles were located which reported directly on change orders between the periods of 2012 and 2017. Therefore, more research is needed in order to have studies that are more recent on change orders. A total of nine articles on Ghana was retrieved of these three focused on change orders directly while 6 were general articles on construction projects in Ghana. From a total of 25 causes of change orders, the top three most influential factors that cause change orders in Ghana are owner request for additional work, differing site conditions and design discrepancies. However, new information, poor technology and lack of experience are amongst a number of factors that do not feature in the Ghanaian studies and therefore, these factors have not been considered by a number of studies as causing change orders in the construction of projects in the given periods. This discovery suggests that the factors not identified are not much of a problem regarding change orders of this country. However, most of these factors are internal and therefore construction companies in that country deal with these better since the factors are within the companies' control. Compared to a country in the same region with Ghana for example Nigeria has owner request for additional works as its most influential cause of change orders. Therefore, the leading cause of change orders in Ghana is the same as that in Nigeria. This then can suggest that the most influential cause of change orders is similar in some countries on the same continent. However, this is inconsistent with Ahady, Gupta and Malik (2017), who concluded that not all factors are similar to every project in developing countries.

#### **4.2 Causes of change orders in Kenya**

Only one article that directly reported on change orders on construction projects in Kenya between the periods of 2012 and 2017 was located. Therefore, there are extremely few studies on change orders in Kenya to this however; the study found was detailed and comprehensive study such that it could be used for the causes and comparison for this study to be successful. Hence, more studies are required to update the situation on change orders. A total of two articles that were retrieved were general articles and did not focus directly on the subject of change orders. However, the article found had identified a total of 9 causes of change orders from a total of 25 causes of change orders, identified from literature. The mentioned factors are owner request for additional works, omissions, errors,

unavailability and substitute of materials and equipment, differing site conditions, delay in land acquisition, lack of coordination, weather conditions and conflict between contract documents. However, 16 factors are not recognised in the study. This finding of only internal factors alludes to that the factor that change orders are mostly are perfectly within the control of the organisation.

#### **4.3 Causes of change orders in Tanzania**

Literature on change orders in the Tanzanian construction industry is insufficient, as this is evidenced by only two articles that were ascertained from between the periods of 2012 and 2017. Consequently, more studies are needed in this field in Tanzania in order to ensure that there are more recent studies on change orders. Since five articles that were obtained on Tanzania, only two focused directly on change orders while only three were general articles on construction projects. A total of 25 causes of change orders that originated from the literature, the most influential factors that cause change orders in Tanzania are design discrepancies and conflict between contract documents. However, factors such as omissions inadequate drawings and delay in land acquisition are amongst factors that do not feature in the studies carried out in Tanzanian therefore, it can be concluded that these factors were probably not a problem in this country during the specified periods. This exposure implies that the factors not identified are almost always properly dealt with in such a manner that there is no problem. However, most of these factors are also internal and therefore construction companies in that country can be able to deal with these since the factors are within the companies' control. On the other hand, comparing the causes of change orders of Tanzania to a country in the same region as South Africa indicates that the most influential causes of change orders are not similar. According to the literature sources, South Africa's most influential cause of change orders is change specifications. Therefore, the two neighbouring countries do not share the same cause as the leading cause of change orders unlike Ghana and Nigeria. This then can insinuate that the causes of change orders are not similar in developing countries, a view also shared by Ahady, Gupta and Malik (2017).

#### **4.4 Causes of change orders in Nigeria**

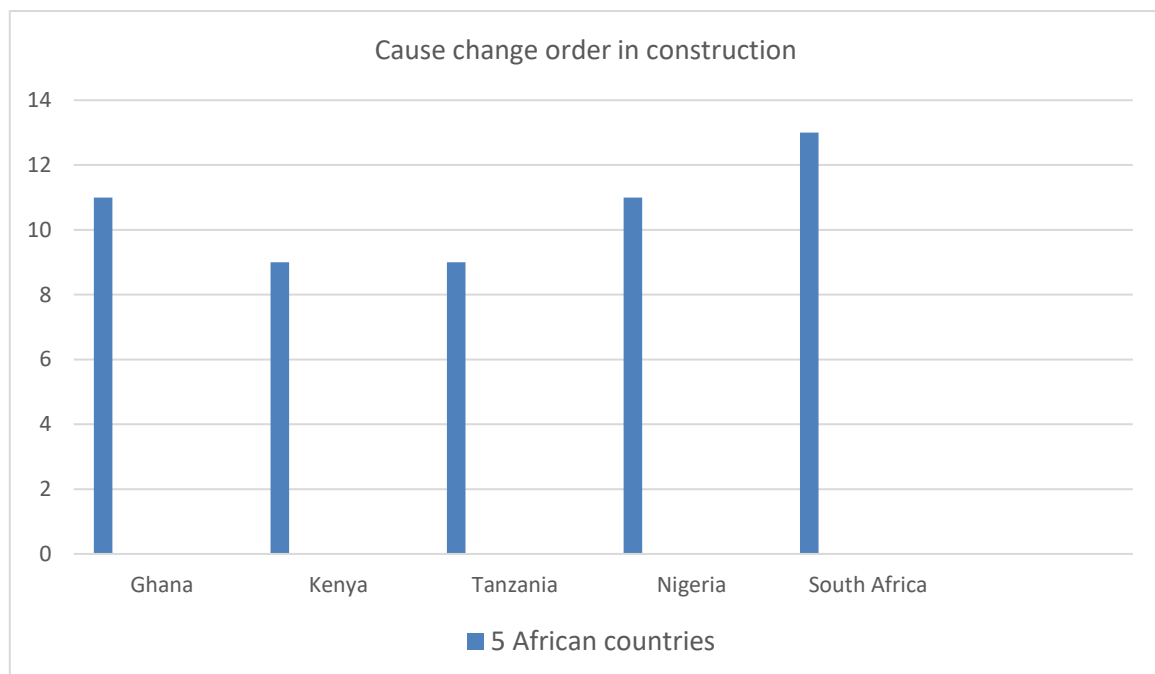
Nigerian literature on change orders provided nine articles from the period of 2012 to 2017. However, only five of these related clearly on change orders in the construction of projects. From a list of 25 causes of change orders, identified in literature, the top three most influential factors that cause change orders in Nigeria are owner request for additional work, and omissions. However, new information, poor technology, defective material, inaccurate briefing and correct interpretation are factors that identified only in Nigeria and not the other four countries. This exposure suggests that, there are many factors both internal and external that cause change orders in the construction of projects in Nigeria than any of the other four countries. However, delay in land acquisition, health and safety and industrial strike action are factors not mentioned by Nigerian studies as causing change orders in the construction of projects.

#### **4.5 Causes of change orders in South Africa**

In the South African literature on change orders, only four articles are detected which reported precisely on change orders between the periods of 2012 and 2017. Eight articles focused on other issues on change orders and not the causes, therefore, more articles are necessary in order to bridge the gap on information on change orders. Change in specifications, inadequate drawings omissions and weather conditions are the most influential causes of change orders in South African construction. Thirteen, out of 25 causes of change orders were identified as recurring in the industry; this is more than half of the identified causes from literature. The other unidentified causes include; lack of financial resources, lack of experience, correct interpretation, poor technology, unavailability and substitute of materials and equipment, delay in land acquisition, inaccurate briefing and defective material. This discovery suggests that the factors not identified are not much of a problem concerning change orders of this country. However, these factors are both internal, external factors therefore might be a problem in the future, and steps should be taken to prepare for these in advance.

In summary, the five African countries in this study all have problems concerning change orders in construction of projects. However, more articles on change orders on all these five countries are required in huge quantities because very few studies from 2012 to 2017 are available. Literature revealed the topmost influential causes of change orders amongst the five countries as follows; owner's request for additional works followed by errors, differing site conditions, weather conditions and conflict between contract documents respectively. However, South Africa, Ghana and Nigeria seem to experience many causes of change orders than the other two countries. Therefore, this suggests and indicates that countries with bigger economies and lots of infrastructure development experience change orders in many different projects. Therefore, findings on these five African countries may not be completely applicable to other countries as the political, economic, socio-cultural, technological, physical and legislative environment may differ from country to country. On the other hand, the same findings could be relevant to other developing countries whose construction sectors and environments are similar.

The following section of the article summarises the findings in a graphical presentation depicted as figure 1.



**Figure 1. Causes of change orders in construction projects of five African countries**

Figure 1 depicts an overall picture of the causes of change orders in construction of projects of five African countries. South Africa portrays to have the highest number of change orders in the construction of projects amongst the five countries, while Kenya and Tanzania have the least number of change orders. This also shows that amongst the developing countries, there are those that are more developed than the others and creating a gap amongst the countries themselves. Therefore, the developing countries in Africa need to establish policies to curb change orders in construction of projects.

Most of construction projects all over the world and not only in developing countries are subject to change orders. Change orders continue to pose serious challenges to owners, contractors and the construction industry at large, with the biggest challenge being that of overruns. Change orders are an immense problem that is unavoidable and a mammoth task to manage. It brings about many challenges in the construction industry especially. This is because change orders occur more frequently in the construction of projects (Staiti, Othman & Jaaron, 2016; Guin-Xiang, Ming, Chan, Liu

and Zhao, 2019) and this causes huge financial impact to the owner. Owners request is a challenge that must not be ignored as it has been evidenced from the study that it is the most influential cause of change orders. The problem with this cause is that since the owner is paying for the project, he or she has the right to demand what he or she is paying for. It is, therefore, a challenge for construction practitioners to request owners of the project to stick to original plans as well as for designers to provide right designs at the right time for the first time.

## **5 CONCLUSION**

This article has identified 25 causes of change orders in the different construction projects of five African countries. A comprehensive literature review was conducted based on five African countries namely: Ghana, Kenya, Tanzania, Nigeria and South Africa to achieve the objective of this article. The most influential cause of change orders for all the five countries was revealed to be the owner's request for additional works. This finding is consistent with many other studies, for example that of Staiti, Othman and Jaaron (2016), however, it is also inconsistent with other studies. Halwatura and Ranasinghe (2013), for instance found that the main cause of change order is poor estimation and not owner's request for additional works. Other influential causes are, errors, differing site conditions, weather and lack of coordination, which were, identified by four out of the five countries. The finding implies that the different reasons for the causes of change orders between countries are due to different experiences, and different environments in construction of projects.

Although, the research is restricted to the five countries, the findings of construction management problems are common to other countries. The major impact of this article to the global construction management community is the identification of the causes of change orders. The causes of change orders in the construction of projects might be prevented through an understanding of the issues. However, the problem remains that change orders are still very common and though at times controversial and complicated are required for the successful completion of a project. Some construction companies still do not know how best to deal with change orders however, some have taken steps to deal with these in the best way possible.

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## **EXPLORING THE EFFECTS OF INTEGRATED QUALITY MANAGEMENT SYSTEM (IQMS) AND THE IMPACT ON EMPLOYEE PERFORMANCE AT CENTRAL JOHANNESBURG TVET COLLEGE: A CASE STUDY OF ALEXANDRA CAMPUS**

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### **ABSTRACT**

The Integrated Quality Management System (IQMS) was formed by Schedule 1 of the Employment of Educators Act (76 of 1998). It is the outcome of an agreement that was reached by the Education Labor Relations Council (ELRC) in 2003. The IQMS was introduced in order to enhance the delivery process of quality education in South African Schools. This paper explores the effects of IQMS and its impact on employee performance at Central Johannesburg TVET College (CJC), in Alexandra campus. The paper also attempts to explore the implementation of IQMS and demonstrate how all stakeholders view the system. In this study, the shortcomings of IQMS implementation at Alexandra campus have been outlined. A qualitative approach was used to conduct the study. Primary data was gathered through oral interviews with the campus manager and heads of department (HODs). Secondary data was gathered using the departmental IQMS document analysis and a questionnaire from college employees, which in this case infer lecturers. The secondary data gathered was instrumental in complementing the data gathered from the campus manager and HODs. The findings reveal that IQMS was not entirely implemented. The implementation lacked the developmental aspect of IQMS. To a certain extent, IQMS has not had a tangible positive impact on the professional growth and development of the CJC Alexandra campus college employees. It is hoped that institutions would use this study as a reference point so that assessors, educators and supervisors would undertake education and training to create an enabling environment to make IQMS efficient and useful.

**Keywords:** Integrated Quality Management System (IQMS), performance management, employee performance, performance measurement, educator development

### **1 INTRODUCTION AND BACKGROUND**

Many evaluation research studies from the department of education indicate that educator performance in South African institutions remain low and contribute significantly to poor learners' results in the two decades (DeClercq, 2008). DeClercq further asserts that studies of factors contributing to poor learner achievements in developing countries include factors such as the socio-economic background of learners and their communities, the context of schooling, inadequate leadership and quality resources. However, they also point to the importance of quality teaching. The school effectiveness and improvement literature concurs that, at school level, teaching quality is one of the most important variables which influences learner achievement (Scheerens, 2016). What is less

agreed upon is how educators are best monitored and assisted to improve their teaching and thereby enhance learner's achievements.

The IQMS was introduced in order to enhance the delivery process of quality education in South African Schools. Government viewed the policy as a shift from the system of inspection to a system of self-evaluation and external evaluation. The policy attempts to locate educators in their working environment rather than judging their performance in isolation to their working environment (ELRC 8, 2003).

The IQMS has been one of the most misunderstood and outspoken systems to the majority of Central Johannesburg TVET College employees including the Alexandra campus. Management at CJC in Alexandra campus have not made enough effort to explain and motivate the merits of IQMS to college employees. To further compound the situation, the management is not transparent to subordinates as to how they appraise college employees and award points/scores. In administering IQMS, supervisors lack uniformity and as a result, some employees despise the system since it is not transparent.

Furthermore, the HODs leave IQMS appraisals uncompleted up to the last term of the year. Instead of visiting all employees one by one at the beginning of the year to set targets and goals, HODs leave it until it is too late. As a result, both the employees and the HODs end up literally transcribing information from the previous year. In order to avoid confrontation, the HODs tend to allocate average scores or above average scores. By so doing they reduce the IQMS to an instrument that only seeks to motivate salary increments. The approach of the HODs runs against the policy of IQMS appraisals as stipulated by the ELRC document, (ELRC, 2005).

This paper examines the implementation of IQMS and demonstrates how the campus manager, HODs and college employees at CJC in Alexandra campus view the system. The study is important in that it exposes IQMS shortcomings at CJC and further suggests ways of eradicating the IQMS shortcomings to ensure improvement in the system.

## **2 LITERATURE REVIEW**

### **2.1 A Global Outlook at the Early Educator Appraisal Systems**

The interest in educator appraisal emanates from two sources namely: 'a call for greater accountability and control of schools and educators, secondly, as educators' work and responsibility evolved, appraisal became an essential ingredient of education institutional development in Europe and America', **Educator Appraisal**.

Over the years there has been a large number of appraisal systems planned by Local education Authorities (LEAs). More systems are developed by individual schools that are influenced by management, while others that have been part of official pilot studies (Horne & Pierce, 2013).

These various influences combined to create a case for educator appraisal. The movement towards appraisal was given further momentum when the Department of Education and Science (DES) funded a study carried out by the Suffolk LEA. The study made recommendations on those principles and processes that appraisal should ideally encompass (Horne & Pierce, 2013). During the period 1987 to 1989, the DES funded the School Teacher Appraisal Pilot Study, piloting teacher appraisal in six LEAs. The outcome of this pilot was a National Framework for Appraisal, which in 1989 proposed the introduction of a national appraisal system concerned with the professional development of teachers and the good professional management of schools, (Neuman, 2013).

This began with awareness raising of the aims, processes and links with school development plans. Educators thereafter engaged in broad self-evaluation using job descriptions. This process afforded educators an opportunity to introspect concerning their practices. After self-evaluation, appraisers and appraisees met at a pre-observation conference to set ground rules for the process, agree on dates and decide on focus areas. This was followed by classroom observation, which was compulsory (Newton, 2002; Turner & Clift, 1988).

After the classroom observation, an appraisal interview was held to set targets for future development, appraisees and appraisers met often thereafter to review progress on the targets (Ntshewula, 2012). This form of appraisal helped to improve communication in schools and led to a greater sense of coherence and mutual understanding. It also encouraged educators to work on and improve specific areas of their teaching, to the benefit of their learners. (Ntshewula, 2012).

## **2.2 References to old Employee Performance**

If performance is to be improved, the HODs must sit down with their subordinates/college employees to set goals that will determine the direction for everyone as a way of complementing the team. The goals should be mutually agreed upon and decisions uniform. Once goals are set, it becomes imperative to measure performance. This is about taking record of where you are now in relation to where you would like to be. The employees should not be left having doubts regarding their performance level at the point of discussion. Employees need to be assisted to see whether their expectations conform to the expectations of the HOD and the employer. If they do not, an intensive effort needs to be made to assist them raise their standards. Within these discussions, the employer should be a willing listener and sympathize with the employee wherever necessary. The HOD is required to show appreciation of efforts done by the employee while at the same time encouraging them to aspire for high performance levels and improvements (Shang, 2008).

Various options are proposed as a way of moving forward but the employee and the employer need to ensure that the options chosen are viable and are the most effective options. The options may include training, coaching, mentoring, research and personal reading, increasing education level, increasing experience level and job enhancement.

## **2.3 The Goals of Performance Appraisals**

Dick (2006) ascribes the following goals to performance appraisals: to improve the company's productivity, to make informed personnel decisions regarding promotion, job changes and termination, to identify what is required to perform a job (goals and responsibilities of a job) and to assess the employee's performance against these goals.

It is also imperative to work to improve the employee's performance by naming specific areas for improvement and developing a plan aimed at improving these areas. A deliberate effort to support the employee's attempts at improvement should be made through feedback and assistance, and ensuring the employee's involvement and commitment to improving his or her performance (Hill & Hupe, 2009).

## **2.4 South African Institutions before the Introduction of IQMS**

There were various innovations that the government initiated in South Africa that eventually rendered existing knowledge obsolete and redundant and had to be updated. Therefore, due to the rapid development of knowledge in the country, significant changes took place in the education system every year (Dippenaar, 2015). The significant changes forced employees inevitably, to continually develop themselves professionally. According to (Dippenaar, 2015), prior to the introduction of IQMS in the mid-1990s, there were three separate quality management programmes used in public institutions. These quality management programmes were focused on the appraisal of both educator

performance and development. These programmes comprised: the Developmental Appraisal System (DAS), the Performance Measurement System (PMS); and the Whole School Evaluation (WSE). The application of these programmes had minimal linkages between them. They apparently did not complement one another, as a result, employees perceived them as instruments used to promote “a blaming culture within public institutions’ (Dippenaar, 2015). During the collective bargaining process in 2003, at the Education Labour Relations Council (ELRC), the resolution was made to combine DAS, PMS and WSE into one quality management system. This resolution gave birth to the establishment of the Integrated Quality Management System (IQMS) which will be elaborated in this paper.

### **3 METHODOLOGY**

This paper is concerned about unfolding the current state of IQMS at CJC and exploring IQMS effects and its impact on the performance of CJC employees. As a result, this study adopted a phenomenological approach. This approach focuses on qualitative methodology. This approach was chosen in order to describe the current state of IQMS at CJC, explore the views and the impact of IQMS on employee performance using unstructured oral interviews.

Yilmaz (2013) defines qualitative research as ‘an emergent, inductive, interpretive, and naturalistic approach to the study of people, cases, phenomena, social situations and processes in their natural settings in order to disclose in descriptive terms the meanings that people attach to their experiences of the world’. The qualitative methodology uses participants’ observation, in-depth interviews, document analysis and focus groups (Yilmaz, 2013).

Although the study used a qualitative approach to gather data from HODs through oral interviews, the researcher felt that because the target population size is small, the views of college employees (lecturers), through a questionnaire should complement the data gathered from HODs’ interviews.

#### **3.1 Population**

According to Mtapuri (2014), a population consists of objects which may be individuals, groups, organizations, human products and events, or the conditions to which they are exposed. In order to obtain rich information, the researcher identified CJC (Alexandra campus) to conduct the study. The researchers’ familiarity with the college campus informed the decision to focus on this campus rather than other campuses. The campus was purposively selected because of its accessibility to the researcher. The employee population in Alexandra campus is sixty-two (62) employees, comprising of the campus manager, five HODs, thirty lecturers and twenty-six support staff and general employees. The target population for this study was the campus manager, five HODs and twenty six ordinary college employees.

#### **3.2 The Research Instrument**

According to Leedy and Ormrod (2014), the data collection approaches require a researcher to consider utilizing specific measuring instruments. One primary instrument and two secondary instruments were used to gather data in this study. The primary instrument used was unstructured oral interview questions that were meant to gather rich-information from college HODs and the campus manager. A structured questionnaire and document analysis were used as secondary instruments to gather supporting data from college employees (lecturers) and departmental documents respectively. The supporting data gathered from the questionnaire and the departmental documents were meant to complement the information gathered from the campus manager and HODs during interviews.

The first instrument used in this research was unstructured oral interview questions that were meant to gather rich-information from all five college HODs and the campus manager. Unstructured oral interviews provide in-depth information about respondents’ thoughts, belief, feelings and

perspectives about the issue under research (Arfo, 2015). This method allows the respondents to contribute detailed and rich information as they wish and allows the researcher to ask probing questions as a way of follow-up (Turner III, 2010). Face-face interviews allow the researcher to immediately verify data or aspects that are not clear to both the interviewer and the interviewee (Arfo, 2015). This instrument was suitable for attaining college managements' views and perspectives of IQMS, and because the interview was unstructured, it allowed new ideas to be brought up during the interviews.

The second instrument used was the structured questionnaire which was meant to gather supporting data from college employees/lecturers. The supporting data gathered from the questionnaire was meant to complement the information gathered from the campus manager and college HODs' during interviews. Considering that the campus has one campus manager and five HODs, the researcher felt that the views of ordinary college employees were needed to support the information gathered through interviews. The researcher hoped that the views of college employees would assist the study to avoid yielding a biased outcome due to a small population size of HODs.

The third instrument used was the analysis of departmental documents (Kaplan & Maxwell, 2005) points out that documents are principal sources of data for qualitative researchers, as does (Bowen, 2009), who cites document analysis as data collection instrument. In this research, IQMS policies were analyzed in order to collect information, to understand the nature of IQMS and to find out the underlying reason behind the establishment of IQMS.

#### **4 RESULTS AND DISCUSSION**

**Please note that for the purposes of this paper, only certain tables are shown.**

##### **4.1 The Current State of IQMS at CJC**

These are responses gathered from the interviews the campus manager and five HODs from CJC in Alexandra campus. 17% of HODs approved of what is going on regarding the IQMS, confirming that the system is working well. The 17% believed employees were properly trained on IQMS when it commenced. The 17% in question has however confirmed that training on IQMS has not been ongoing. The discontinuance of training eventually demotivated other employees.

33% of HODs indicated that IQMS is going well in as far as the filling of forms for the recommendation to get the 1 % annual notch increased. They indicated that this is however done improperly since no lesson observations are carried during the employee appraisal. As such, scores allocated to employees to motivate the notch are allocated without justification.

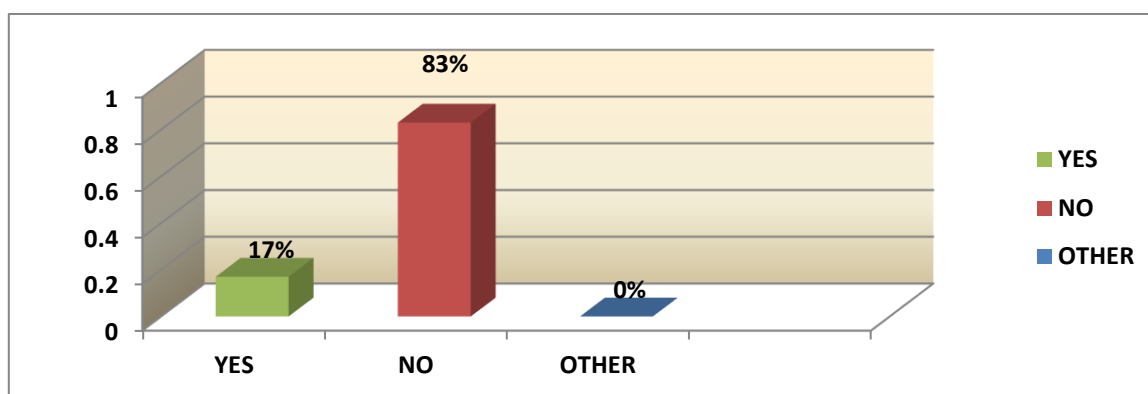
No HOD gets to the classroom to assess the employees perform their duty. The criteria used to separate good performers and poor performers are non-existent because the IQMS rules and regulations spelled out in the ELRC document of 2003 are not followed. Therefore, the HODs resort to giving all and allocate a score that would earn each employee the 1 % notch increase and avoid finger pointing by subordinates. The findings imply that the HODs are aware that they are cheating the system by not adhering to IQMS rules that are stipulated in the ELRC document.

50 % of HODs indicated that all is not well in as far as the IQMS is concerned because people just do it to ensure they earn the 1 % annual notch increase. The rules associated with it are not respected and no personal growth for employees is targeted. The HODs in question mentioned there has been no effort at CJC at the moment to implement the other aspects of IQMS like helping employees to develop, grow, as well as help them design meaningful PGPs.

(Mtapuri, 2014) asserts some of the purposes of IQMS are to identify specific needs for support and development of educators, to provide support for continued growth and to monitor an institution’s overall effectiveness and to evaluate an educator’s performance. The findings imply that all college stakeholders are missing out on the full benefits of IQMS, as cited by (Mtapuri, 2014) and this again expose negligence of duty from the college management.

Table1, shows responses gathered from college employees using a questionnaire. The number of respondents that ticked a NO regarding the functioning well of IQMS constitutes 83 % of the employees. 17 % of respondents ticked a YES response, meaning all is well with the current state of IQMS. These findings show that college employees have through the NO responses that are in the majority, ultimately made a statement that IQMS is not working well at the college.

The views of 83% of college employees are in line with the views of 50% of HODs.



**Figure Table 1: Percentage representations of responses.**

#### **4.2 The Views from the HODs of Central Johannesburg TVET College in Alexandra campus on IQMS.**

17 % of HOD respondents felt IQMS has created frustration and disappointment on employees who despondently carry out their job routines with little or no sense of purpose. The low moral according to the HOD leads to workers producing very little output to take the institution forward. It has left employees groping in the dark as to how best to improve their wellbeing and the results of learners as well as other important aspects of their job descriptions.

33 % of HODs view the IQMS as an instrument that has had a positive effect on employees; in as far as remuneration is concerned. The 33 % mentioned that employees have managed to yearly get 1% notches increase because of the IQMS. To them though the 1% is insignificant, the cumulative effect of this 1 % that an employee enjoys after about 5 years is something an employee should be pleased about. The HODs in question mentioned that employees must be thankful because this increment is awarded to them by selfless HODs.

On the other hand, 50 % of HODs felt IQMS has so far not assisted employees understand their job better. The 50 % HODs acknowledged the 1 % notch increase that employees gained but believed there is more to IQMS than the money. The HODs in question further revealed that the instrument has affected workers negatively since it has not been holistically implemented. As a result of this most workers have not been assisted to grow professionally.

Table 2 shows responses gathered from college employees using a questionnaire. 13 % of respondents, ticked a YES response, indicating that they have been positively affected by IQMS, the respondents cited that IQMS gives them a 1 % annual notch increase. Majority of respondents ticked

a NO response, the majority constituted 78 %, indicating IQMS has not positively affected their work performance. Employees constituting 9% ticked OTHER, indicating that they are unsure of whether IQMS may have affected them in one way or another. The views of the college employees is in line with that of the HODs that the research outcomes revealed previously, where HODs emphasized that the only effect of IQMS has been the 1 % notch increase.

The NO responses shown in figure 2 make it evident that the IQMS has not fully satisfied the majority of college employees, and it is a concern that college employees have never demanded its full exhibition.

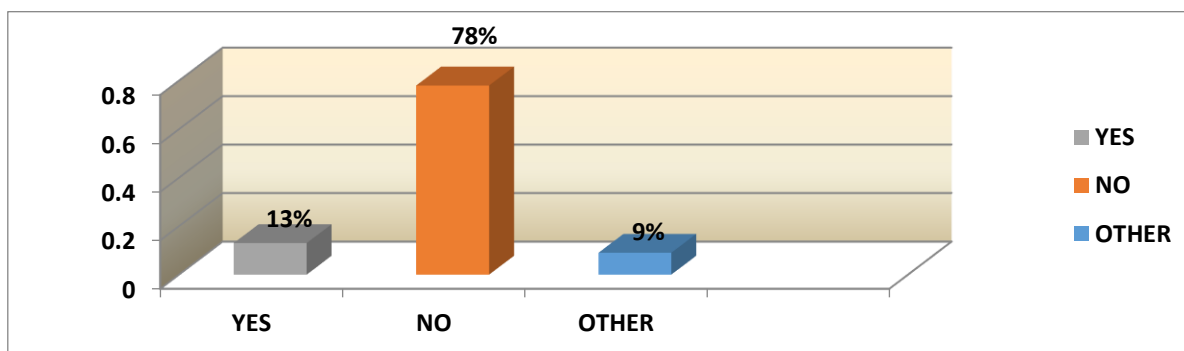


Figure 2 Percentage representations of responses.

#### 4.3 The Impact of IQMS on Employees' Performance at Central Johannesburg TVET College in Alexandra campus?

17 % of HODs indicated that the IQMS has had a positive impact in as far as personal growth of employees is concerned. The 17 % HODs indicated that IQMS has enabled the HODs to identify the weaknesses of their subordinates within their departments. This shows that only 17 % is satisfied with the IQMS instrument and only 17 % of HODs have seen the positive impact of IQMS on employees/subordinates. Steyn (2012), emphasize the IQMS aims is to determine the areas of performance and assess strengths and weaknesses.

On the other hand, 67 % of HODs indicated that the only impact of the IQMS has been ensuring that employees under their supervision got the 1 % annual notch increment. Maliehe (2011), emphasizes that good performance management may result in good performance of learners. However, if HODs at CJC only focus on affirmatively appraising employees to get the increase, regardless of whether the employee performance has improved or not, it poses a serious challenge on the performance of learners of CJC, hence the ongoing poor results every year.

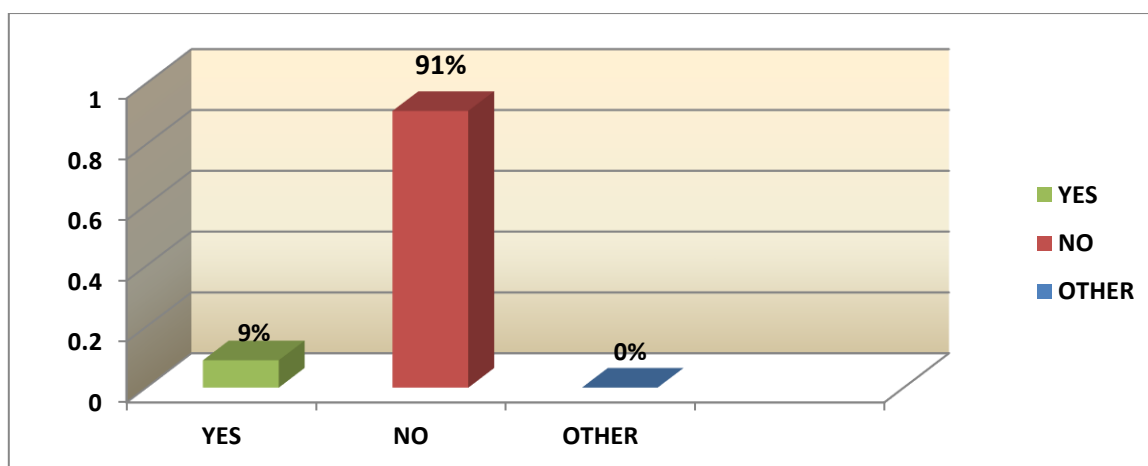
ELRC 5 (2005) emphasize that the purpose of developmental appraisal instrument is to appraise individual educators in a transparent manner with a view to determining areas of strength and weakness, and to draw up programmes for individual development. At CJC, recommendations to get the notch increase were done even though the HODs had never carried out lesson observation to facilitate personal development on their subordinates. Other than the 1 % gain, 67 % of HODs could not point out any other impact on employee performance at the Alexandra campus of Central Johannesburg TVET College.

The findings reveal that majority of HODs do not carry out lesson observation on their subordinates, and this implies that HODs have neglected the developmental aspect of the IQMS instrument and chose to only focus on the performance measurement aspect, which is the 1 % increase. As a result, employees/subordinates are denied an opportunity to develop and further improve their performance.

Another 17 % of HODs indicated there was no positive gain derived from the IQMS, thus to the HOD, the IQMS has had no positive impact at all on employee performance at CJC. According to Mtapuri (2014), IQMS aims to determine competence, areas of improvement, promote transparency and accountability and monitor the effectiveness of the entire institution. 17 % HODs further indicated that the performance of employees regardless of the introduction of the IQMS is still a far cry from what an institution would project or contemplate its dream workforce to be. These findings imply that the IQMS has only created a dissatisfied and an unhappy employee force within the college and IQMS have not positively impacted the performance of employees at CJC.

Findings shown in table 3 show 91 % ticked a NO response, this indicate that majority of employees think management is not providing enough support to college employees. 9 % ticked a YES, implying that management provides support to all employees. An honest evaluation of the strengths and weaknesses as management would suggest rebuilding the approach to the IQMS.

With regards to the impact of IQMS, the views of the majority of college employees support the views of the majority of HODs that the research findings have revealed in this research. Both the majority HODs and the majority of college employees indicated that IQMS have not had any positive impact on their performance or personal growth.



**Figure Table 3: Percentage representations of responses.**

#### **4.4 Recommendations to Ensure IQMS has a Positive Impact on Employees’ Performance**

All HODs felt that there is a need to go back to the drawing board and work out how best the IQMS can be made to work in the best interest of the college employees. Four of the five HODs and the campus manager felt the IQMS was quite a good employee development and appraisal system. They felt that the IQMS only needed to be understood by all who were to be appraised using it.

17 % of HOD respondents however felt the IQMS is paid lip service to and is yet to be properly put into place. The 17 % said the sooner this is done the better for all stake holders. All HODs agreed that there is a need for both supervisors and the rest of the college employees to get further training on the complete functions and benefits of the IQMS instrument.

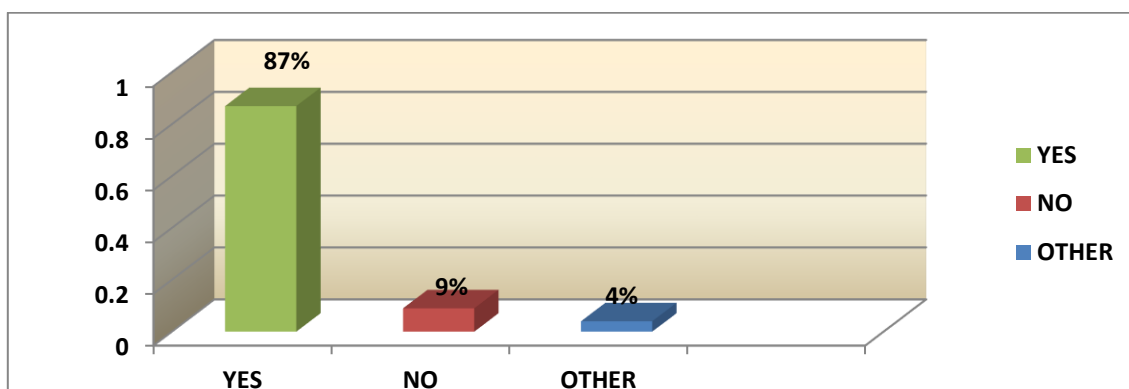
All HODs felt IQMS should not be confined to simply recommending employees to get the 1 % annual salary notch increase that is attached to it. Furthermore, 83 % of HODs emphasized that employees must see IQMS helping them grow within their job descriptions thereby enhancing their performance in whatever given job task. 17 % of HODs emphasized that by simply awarding an increment notch, the HODs would be contradicting the spirit of IQMS.



The IQMS policy document states categorically that IQMS as an instrument seeks to ‘promote an educator driven professional development plan with detailed information on areas and targets for educators’ development,’ (ELRC, 2003). Reducing IQMS to the role of appraising employees so that they get a 1 % notch increase is not the design of government and the department of higher education but a failure of duty by the HODs and management at large. 83% of the HODs accepted the fact that they have not used the IQMS anywhere else except recommending a notch increase and their departmental records prove just that. 17% of the HODs suggested there is a need for a clear implementation plan and strategies within departments to ensure coordination and results leading to maximum development.

Table 4 show that 87% of employees ticked a YES, implying that something has to be done to improve IQMS. 9% of respondents ticked a NO, implying that they are satisfied with the current state of IQMS and 4% of respondents ticked on OTHER, meaning that they are neither for change nor maintenance of the existing state of IQMS, they are undecided.

This means that majority of employees are not resisting change, therefore, the responsibility lies with college management to ensure the implementation of all aspects of IQMS for the benefits of all stakeholders. This might also end the perceptions and arguments cited by (Dhlamini, 2009), revealing that it has been argued by some educators that the IQMS system makes assumptions that are problematic, pertaining to educator quality and improvement.



**Figure 4 Table 4 Percentage representations of responses.**

The findings reveal that the majority HODs and college employees are of the view that more needs to be done at CJC to improve IQMS and make it a success for the benefits of the college, the employees and the learners.

#### **4.5 Analysis of Departmental IQMS**

All the HODs at Alexandra campus who were respondents to this research allowed the researcher access to the departmental IQMS documents. The documents included the assessment records and other records pertaining to IQMS. All the records from the HODs did not reflect an extension of IQMS instrument used to issues like employee assessment and eventual development as indicated by the needs exposed by the lesson observation. The records of HODs do not reveal one on one meetings with departmental members to discuss their individual problems and how best to assist employee development mature and deliver better performance.

These records prove true the assertion made during literature review that most institutions in South Africa lacked experienced and effective internal appraisers. The records of HODs reflected there is no formal tool to assess employee development. Though the IQMS document is also supposed to monitor employees for development, the HODs seem not to utilize it for developmental purposes.

What HODs did at Alexandra Campus is similar to what most institutions in South Africa were found to have done when the Department of Education undertook a commissioned review of the implementation of IQMS. The review was code named the “Marneweck presentation, Class Act, 2007”. The review exposed that the process through which most ‘employees in government institutions, were assessed and given ratings was unreliable and invalid’ (Marneweck, 2007).

In all the files of the HODs there were no lesson observation critique form found. The files did not reflect any suggestions on the part of all the HODs to ensure quality teaching by reviewing their subordinates. Again the failure to critique subordinates contradicts the principles of IQMS and the educational principles that stipulate that lesson observation are a ‘prerequisite if quality teaching and learning is to be attained’ (Rabichund, 2011).

The HODs’ files and records did not reflect any ability on their part to gather sufficient information to interpret the appraisal system and instrument effectively. Consequently, the HODs records did not reflect the ability to reflect properly on the practice of their subordinates as well as areas where subordinates need to develop. Only one among all HODs had meaningful development plans for the employees.

## **5 RECOMMENDATION AND CONCLUSION**

The outcomes of the research have provided useful information that points to indisputable fact that the current state of IQMS in Alexandra campus is not ideal for employee development. The outcomes also revealed that there is no sufficient critical mass amongst Campus leadership to ensure that the instrument is implemented correctly to benefit the employees of the college. Outcomes prove that the only positive gain has been the 1% notch increase that employees gain every year.

There has not been any positive impact of IQMS on employee performance in Alexandra campus. The findings have shown that the instrument has not had any impact on the professional growth and development of the majority of college employees. As a result, the IQMS instrument has not satisfied the employees of CJC. This is indicated in the findings where 91 % of all college employees admitted that IQMS has not impacted positively on their job performance.

The findings therefore inform the following recommendations:

- That both Department of Higher Education and Training and Management of TVET Colleges should view the IQMS as an instrument to manage and continuously improve that status of education and training.
- That there is a need for management to brainstorm on how to best make IQMS a success at the College. Action, therefore, should be taken to swiftly ensure IQMS is implemented.
- That the College Principal assume responsibility together with entire management team effectively and efficiently implement IQMS.

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## **THE DESIGN AND OPTIMIZATION OF PROCESS PARAMETERS FOR THE PRODUCTION OF CAUSTIC POTASH FROM COCOA POD HUSK**

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### **ABSTRACT**

Caustic pod husk is an agricultural residue with great potential for the production of caustic potash. In this study, the design and optimization of the production process for optimum conversion of the caustic potash from the cocoa pod husk was carried out. The Computer Aided Design (CAD) was carried out using the Autodesk Inventor 2018 and the plant comprises of nine sections integrated for the production of caustic potash. The numerical experiment was carried out using the Response Surface Methodology (RSM) and the Central Composite Design (CCD) for critical parameters in the following range: reaction temperature (40-120°C), stir speed (100-120 rpm) and leaching time (10-40 min.) while the physical experiment was carried out on a laboratory scale. Taking the percent yield of caustic potash as the response of the numerical experiment, the statistical analysis of the results obtained produced a predictive model for determining the yield of the caustic potash as a function of the independent process parameters. The results obtained validated the direct relationship between the yield of caustic potash and the process parameters. This forms the basis for the optimization of the cost, material and energy requirement of the process.

**Keywords:** Caustic potash, model, process parameters, residue, yield

### **1 INTRODUCTION**

Cocoa pod husk is an agricultural residue produced after the removal of the cocoa bean from its fruit. Over the years, its indiscriminate disposal has constituted a threat to the environment, hence, researchers have made significant effort to develop processes for the conversion of the agricultural waste to wealth. The harnessing of cocoa pod husk finds application in the production of pulp and paper (Daud, Mohd Kassim, Aripin, Awang & Hatta, 2013), caustic potash (Daniyan, Adeodu, & Adewumi, 2014), catalyst for biodiesel production (Ofori-Boateng & Lee, 2013; Khanahmadi, Yusof, Amid, Mahmud & Mahat, 2015; Khanahmad, Yusof, Ong, Amid & Shah, 2016), livestock feed (Aregheore, 2002), fertilizers (Isika, Nsa & Ozung, 2012), absorbent for material removal (Cruz, Pirlä, Huuhtanen, Carrión, Alvarenga & Keiski, 2012) and industrially as a natural filler for polymer composites reinforcement, thus, providing economic advantage and environmental solution to its disposal problems (Mansur, Tago, Masuda & Abimanyu, 2014; El-Shekeil, Sapuan & Algrafi, 2014; Sanyang, Sapuan & Haron, 2017). Due to the abundant generation of cocoa pod husk as agricultural residue in many countries especially in the African continent and particularly its potentials as well as the increasing demand for raw materials for the production of pulp and paper, caustic potash, livestock feed etc., its proper harnessing will represent a viable option in the quest for material and

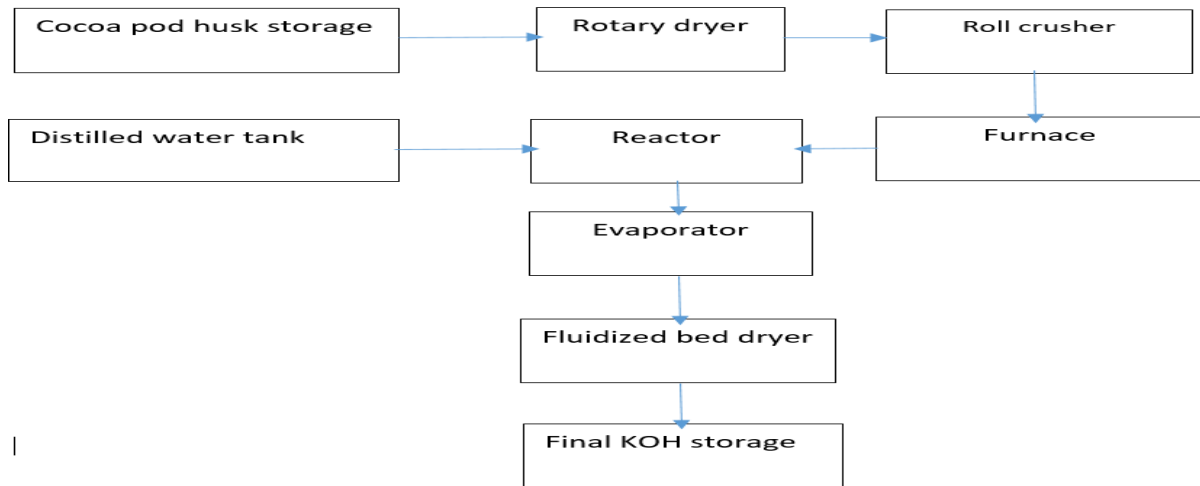
economic sustainability. In addition, it will reduce its indiscriminate disposal and the resulting environmental pollution (Babayemi, Dauda, Nwude & Kayode, 2010). However, only a well-designed process could ensure optimum conversion of the residue to a useful product. The optimum conversion of cocoa pod husk depends on the nature of the conversion process, input raw material, the optimum combination of process parameters such as the stir speed, reactor temperature, volume of water for dilution process, leaching time amongst others. The preliminary report given by Syamsiro, Saptoadi, Tambunan and Pambudi (2012), indicated that cocoa pod husk is a suitable biomass for sustainable energy development. This finding agrees significantly with the reports of Mansur *et al.* (2014) and Rocio, Karen, Nieto-Figueroa and Oomah (2018) on the suitability of cocoa pod husk as biomass for energy generation. In a bid to improve the conversion process of the cocoa pod husk to caustic potash, efforts have been made over the years to develop a predictive model for the correlation of the process parameters. For instance, Kumar (2013) performed the optimization of process parameters for caustic potash production. This work employs the Response Surface Methodology (RSM) and the Central Composite Design (CCD) for the determination of the most feasible process conditions that will result in high yield of caustic potash. The integration of process design and engineering for the production of caustic potash from cocoa pod husk has not been sufficiently highlighted by existing literature. Hence, this work provides a comprehensive role of process design and optimization in the production of caustic potash, which will assist in the determination of the cost, material and energy requirement of the process. The process optimization will also assist in the selection of the feasible combinations of the process parameters and conditions that will promote the yield of the caustic potash thereby helping to project the overall process efficiency and productivity. This will aid decision-making process relating to the economics of the overall process as process parameters can be ranked in the order of their influence on the yield of caustic potash for proper monitoring.

## **2 MATERIALS AND METHOD**

The process plant for caustic potash production comprises of nine major sections namely; the cocoa pod husk storage, the rotary dryer, roll crusher, furnace, distilled water tank, reactor, evaporator, fluidized bed dryer and final KOH storage. The cocoa pod husk and the process flow diagram for its conversion into caustic potash is shown in Figures 1 and 2 respectively. The cocoa pod husk storage serves as the reservoir while the rotary dryer is employed to remove volatile materials present in the husk. The size of the husk is further reduced by compression after drying for the purpose of homogeneity and reaction surface reduction using the roll crusher. The next unit is the furnace where ashing of the crushed cocoa pod husk takes place at elevated temperature between 700-1000°C. Upon cooling, the ashed material is moved to the reactor where leaching takes place. Distilled water from the water tank is added to the reactor and the mixture is stirred continuously in the reaction chamber for an average time of 40 minutes. The ashed material then dissolves in the water and stirred continuously before soluble KOH is leached out. With the aid of the evaporator and the fluidized bed dryer, the leached soluble KOH is concentrated and sent to the KOH storage.

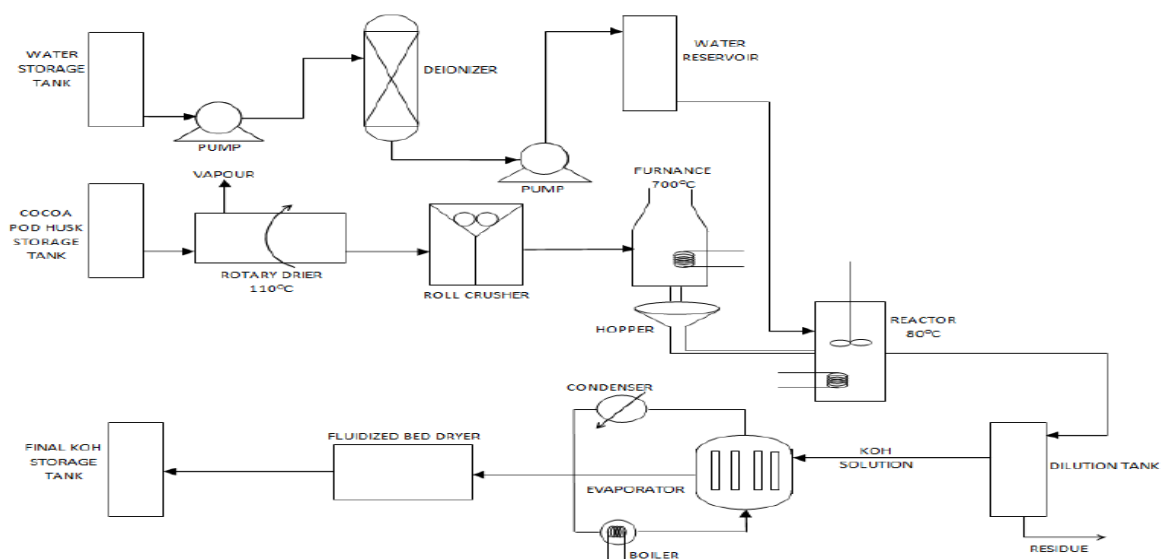


**Figure 1: The cocoa pod husk**



**Figure 2: Process flow diagram for KOH production**

The optimization of the production process will assist the KOH production industry to gain a competitive edge through increased productivity. By understudying the range of the critical parameters, that influences the yield of KOH, the process monitoring and control will improve significantly in a bid to keep the parameters within their optimum range. In addition, Many industries relies on the rule of the thumb for the determination of high yield of KOH, this work provides a scientific basis for the selection of the process parameters that will bring about optimum use of the production time and input raw materials for increased productivity. In addition, the work provides a reliable process design data that will assist in quick decision making to avoid, identify and rectify process or operational errors. The process design data is essential in keeping production schedules within a realistic forecast, thus, improving production efficiency. The process optimization and the predictive ability of the developed model will also assist in the process performance forecasting, monitoring and measurement. Productivity tends to increase significantly when the process performance is monitored and measured. Hence, this optimized solution proposed for the KOH production industry will pave way for the development of high-quality products and timely delivery of the products and services, which will help the industry build a stronger reputation with improved profit margins at optimum production cost. The integration of all equipment and nine sections necessary to process caustic potash from the cocoa pod husk is shown in Figure 3.



**Figure 3: Integration of process equipment**  
(Daniyan *et al.*, 2014)

The CAD and the integration of all equipment necessary to process KOH from cocoa pod (KOH production plant) is shown in Figures 4 and 5 respectively.

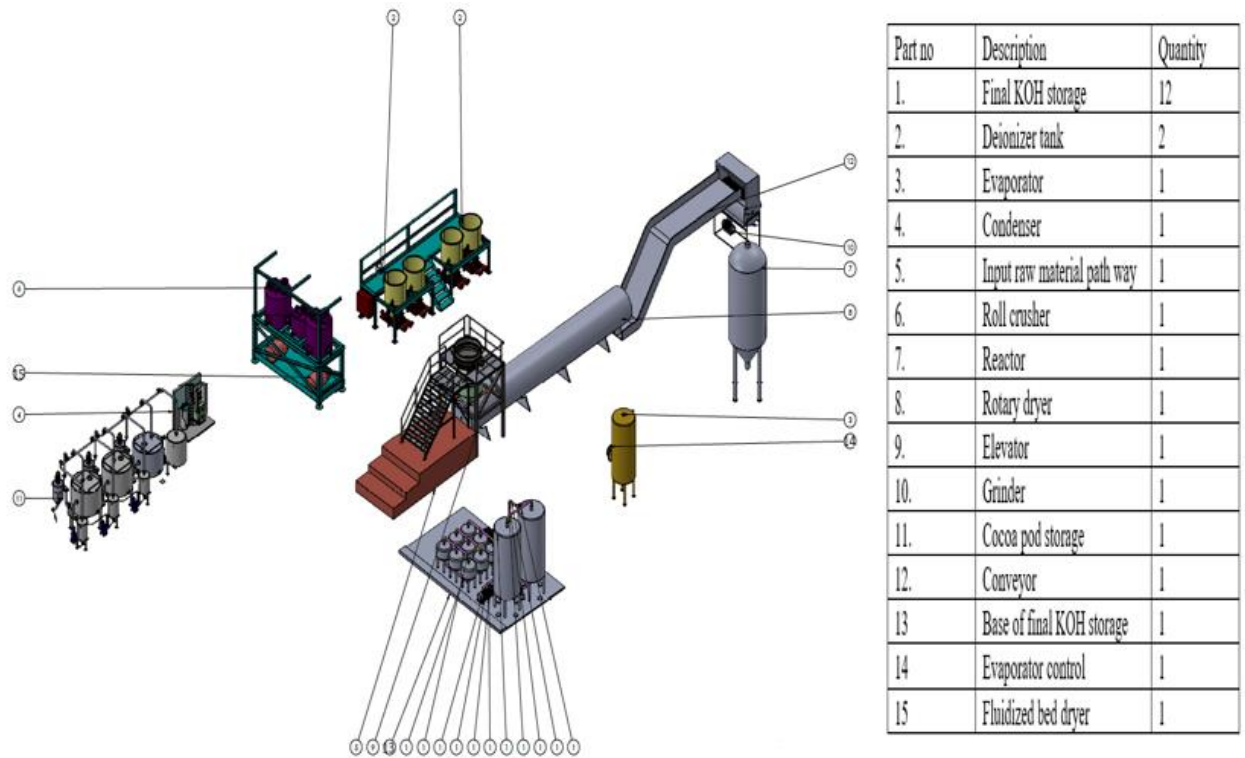


Figure 4: Computed Aided Design of the process equipment

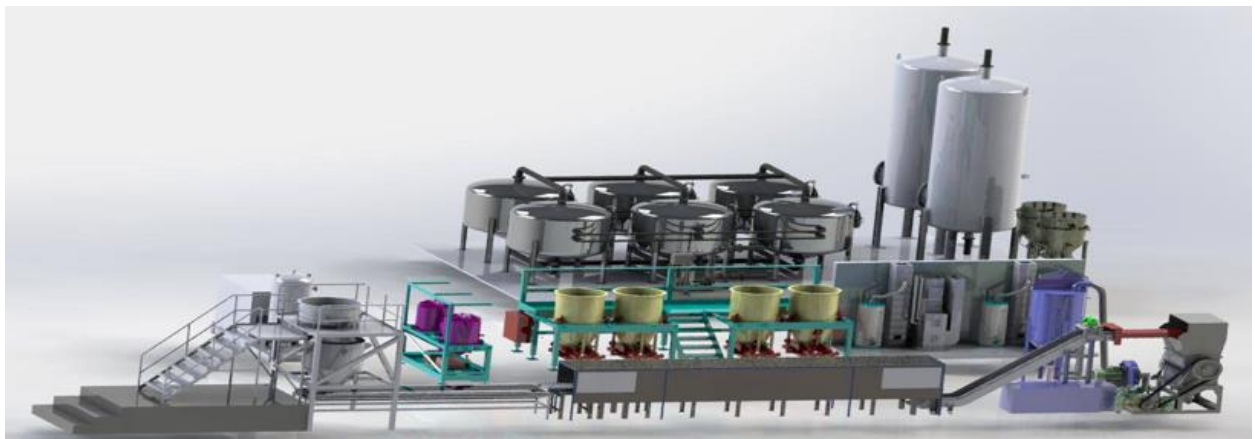


Figure 5: The KOH production plant

The reaction kinetics of the conversion process of cocoa pod husk to caustic potash is expressed as Equation 1 to 3.



$$k_1 = 2.0 \times 10^{60}, k_2 = 2.07, k_3 = 0.99$$

The proximate analysis of the chemical composition of the cocoa pod husk is presented in Table 1.



**Table 1: Chemical composition of the cocoa pod husk**

S/N	Constituents of Cocoa pod husk	% composition of constituents
1.	Water	57.75
2.	Total dry matter	42.25
	Total	100
1.	Crude protein	8.69
2.	Pure protein	-
3.	Fatty substance	0.15
4.	Ash (SIO free)	10.80
5	Crude fibre	33.90
6.	Nitrogen free extracts	41.21
7.	Glucose	1.16
8.	Sucrose	0.18
9.	Pectin	3.71
10	Theobromine	0.20

Source: (Curlin, Bommaiju & Hansson, 1991)

The numerical experiment for the optimization of the process parameters was carried out using the Response Surface Methodology (RSM) and Central Composite Design (CCD). The critical parameters are in the following range: reaction temperature (40-120°C), stir speed (100-120 rpm) and leaching time (10-40 min.) while the physical experiment was carried out on a laboratory scale using the leaching process. Taking the percent yield of caustic potash as the response of the numerical experiment, the statistical analysis of the results obtained produced a predictive model for determining the yield of the caustic potash as a function of the independent process variable. The results obtained validated the relationship between the yield of caustic potash and the process parameters.

### 3 RESULTS AND DISCUSSION

The results from both the physical and numerical experimentation is presented in Table 2.

**Table 2: Results from physical and numerical experimentation**

Run	Temperature (°C)	Stir speed (rpm)	Leaching time (min)	Actual yield (%)	Predicted yield
1	120	80	10	55	54.201
2	80	173.86	35	60	62.233
3	120	80	60	63	61.999
4	80	115	40	65	66.010
5	80	120	35	64	64.099
6	120	150	60	67	66.987
7	147.27	100	10	58	57.234
8	40	90	50	59	60.209
9	80	115	60	60	61.431
10	40	120	75	71	68.480
11	110	140	20	75	75.001
12	40	70	35	74	73.889
13	80	65	55	62	62.997
14	50	120	60	70	71.506
15	80	120	35	58	57.096
16	80	58	50	74	75.668
17	60	90	60	78	77.257

18	70	65	65	63	64.872
19	90	70	70	61	60.875
20	120	80	35	60	61.999

The results obtained in Table 2 was analysed statistically to obtain a predictive model that correlates process parameters namely; temperature, stir speed, and leaching time as a function of the yield of caustic potash (Equation 4)

$$Yield = +64.85 - 2.66A - 0.91B + 1.33C + 3.63A \times B + 3.13A \times C - 1.87B \times C \quad (4)$$

Where; *A* is the temperature (°C), *B* is the stir speed (rpm) and *C* is the leaching time (mins)

Figure 6 shows the difference between the actual values of the percent yield of caustic potash from the laboratory experimentation and the predicted percent yield from the numerical experimentation. Since both graphs have similar data points and plots, thus, there is high degree of agreement between the results from physical and numerical experimentations. It also implies that the terms of the model is highly significant for predictive purposes.

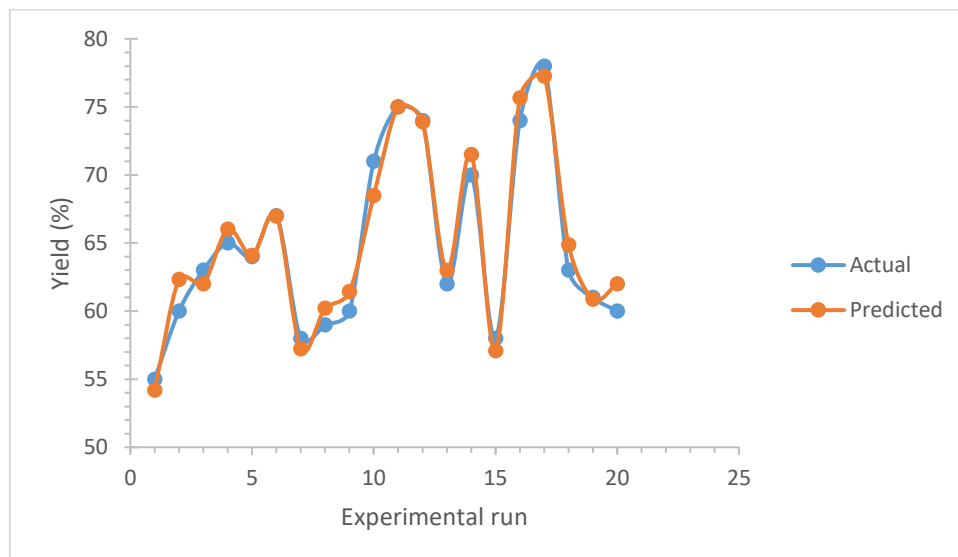


Figure 6: Plots of percent yield for both the physical and the numerical experiments

In addition, Tables 3 and 4 show the results from the Analysis of Variance (ANOVA) for the developed model. The model terms comprise of six factors terms namely; A, B C, AB, AC, BC which are highly significant because of their influence on the percentage yield of caustic potash. At 95% confidence level of significance, the F-value was low ( $> 0.05$ ). The F- values is an indication of the F distribution value used to compare the variances. It is the ratio of the model mean to the appropriate error mean square. When the value of F-value is less than 0.05, it implies that the effects of model terms on the response (percent yield of KOH) are statistically significant. The coefficient of correlation; R-squared ( $R^2$ ) which measures of the magnitude of variation in the mean and the reduction of response variability gave (0.9760). This shows that 97.60 % of the total variance in the percentage yield is influenced by the experimental parameters evaluated. The closer the value of the R-squared to 1, the more significant the model. Also, the adjusted R-squared which measures the overall variation in the data as indicated by the model gave 0.9660. This indicates that the model is significant without the need for the consideration of additional terms. Furthermore, the standard deviation, which is a function of the variances within the model, was  $5.506 \times 10^{-4}$ . The smaller value of standard deviation, the greater the significance of the model terms and vice versa. The difference between the predicted

R-squared (0.9760) and the adjusted R-squared (0.9660) is less than 0.2. For a good model, the values of its adjusted R-squared and the R-squared should be close to 1 and within 0.2 of each other.

**Table 3: Analysis of variance (ANOVA) for the developed model**

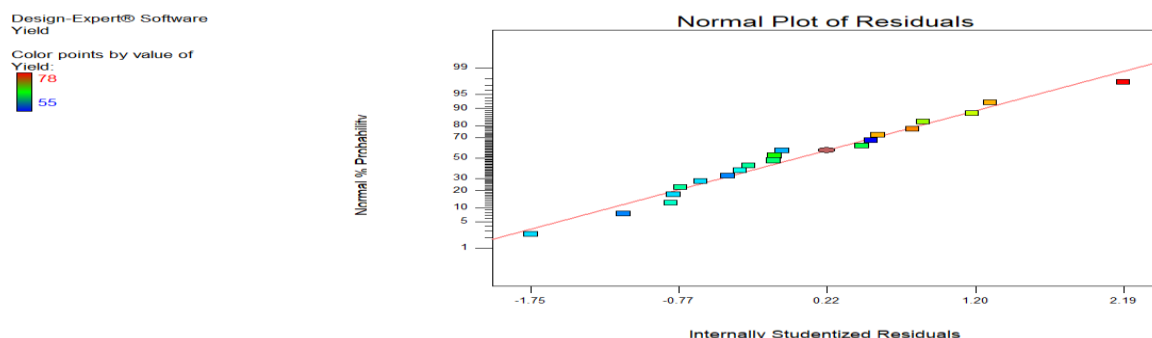
Source	sum of squares	df	Mean square	F value	Prob.>F
Model	1.232 ×10 <sup>-4</sup>	4	2.000×10 <sup>-4</sup>	90.10	<0.0001 significant
A-Tempt	1.276×10 <sup>-4</sup>	1	1.232 ×10 <sup>-4</sup>	238.60	<0.0001
B-Stir Speed	2.000×10 <sup>-4</sup>	1	2.040 ×10 <sup>-5</sup>	70.35	0.0001
C-Time					
AB	1.800×10 <sup>-6</sup>	1	2.600×10 <sup>-6</sup>	0.80	0.0200
AC	2.999×10 <sup>-6</sup>	1	7.271×10 <sup>-6</sup>	24.00	0.0020
BC	2.340×10 <sup>-6</sup>	1	2.468×10 <sup>-6</sup>	4.00	0.0400
Residual	4.000×10 <sup>-6</sup>	6	3.357×10 <sup>-6</sup>		
Lack of fit	2.401×10 <sup>-6</sup>	3	5.096×10 <sup>-6</sup>		
Pure Error	0.000	4	0.000		
Cor. Total	1.240×10 <sup>-4</sup>	10			

R<sup>2</sup>, 0.9760; R<sup>2</sup> adj, 0.9660; Adequate Precision, 40.232

**Table 4: Statistical parameters of the developed model**

Type of variable	Value
Standard Deviation (SD)	5.506×10 <sup>-4</sup>
Mean	1.26
Coefficient of variation C.V (%)	0.045
Prediction error sum of square (PRESS)	2.014×10 <sup>-5</sup>
R-squared	0.9760
Adjusted R-squared	0.9660
Pred. R- Squared	0.9224
Adequate Precision	40.232

Figure 7 also shows the stochastic error and plot of residual errors as well as the actual values of the percent yield of KOH and corresponding predicted values. This is used to test the normality of the data to determine that the statistical analysis underlying the data analysis are significant. The plot is normally distributed and presence of lack of fit up to 6 and indicates the adequacy of the model for predictive purpose.



**Figure 7: The normal plot of residual errors**

Figures 8 and 9 show the 2D and 3D plots of the effect of stir speed and reaction temperature on the percent yield of caustic potash. The percent yield of the caustic potash was observed to decrease with increase in the stir speed and temperature up to about 95 rpm and 55°C respectively. The optimum yield of caustic potash at this speed and temperature was found to be 69.9471%. Lower values of the

stir speed, and leaching temperature favours the leaching process, and the percent yield of caustic potash and vice versa. An increase in the stir speed and temperature beyond this optimum point results in significant increase in the energy and material requirement of the process with resulting decrease in the yield of caustic potash. This may be due to the fact that beyond 55°C, the distilled water gradually approaches its evaporating temperature, and evaporation may decrease the amount of water needed for the leaching process thereby reducing the yield. Similarly, below 55°C and 95 rpm, the values of the process parameters may be insufficient to drive the leaching process to completion, thus, reducing solubility of KOH, and subsequent the percent yield of the caustic potash.

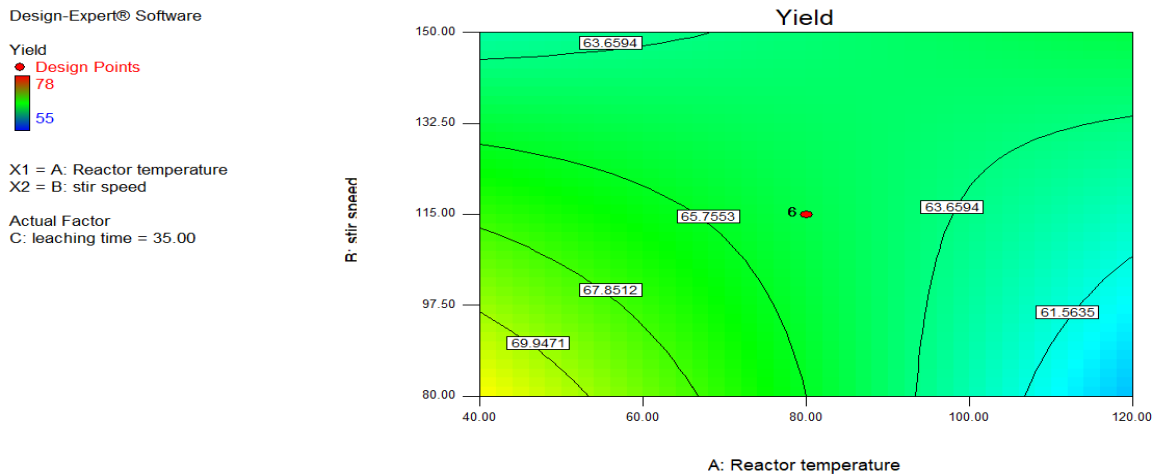


Figure 8: 2D plot of the effect of stir speed and reaction temperature on the percent yield of caustic potash

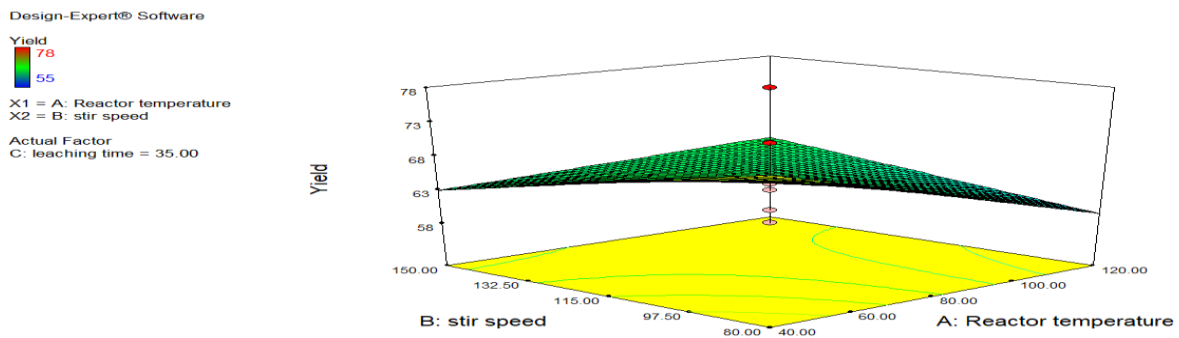


Figure 9: 3D plot of the effect of stir speed and reaction temperature on the percent yield of caustic potash

Figures 10 and 11 show the 2D and 3D plots of the effect of leaching time and temperature on the percent yield of caustic potash. Lower values of the leaching time and temperature favours the leaching process, thus, resulting in an increase in the percent yield of the caustic potash. The optimum value of the percent yield of caustic potash was 67.3805% at a leaching time of 36 minutes and temperature of 55°C. Further increase or decrease in the leaching time and temperature beyond this point favours the backward reaction and gradual reduction in the percent yield of the caustic potash.

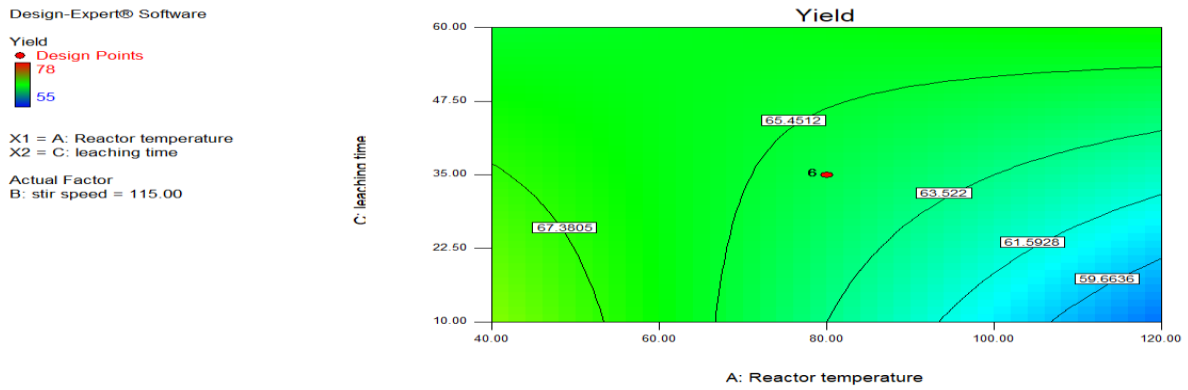


Figure 10: 2D plot of the effect of leaching time and temperature on the percent yield of caustic potash

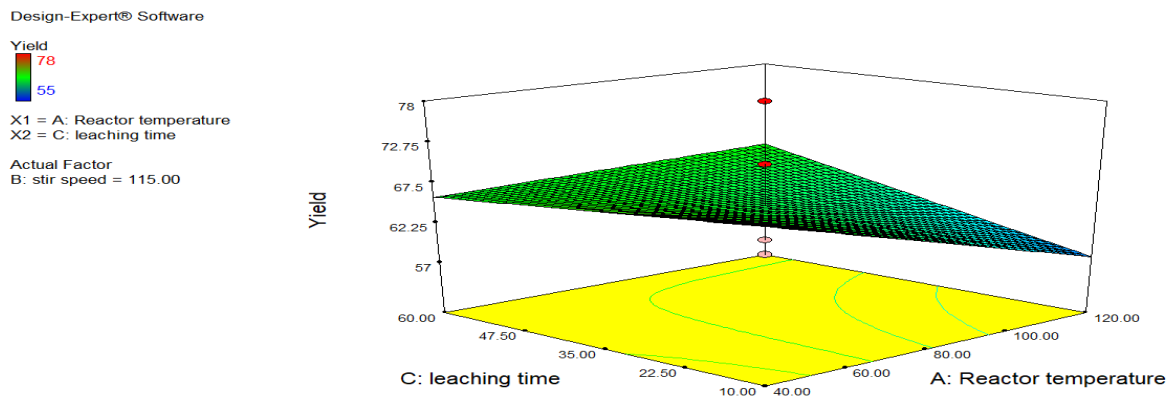


Figure 11: 3D plot of the effect of leaching time and temperature on the percent yield of caustic potash

Figures 12 and 13 show the 2D and 3D plots of the effect of leaching time and stir speed on the percent yield of caustic potash. An increase in the reaction time and stir speed increases the percent yield of caustic potash up to the optimum point and vice versa. The optimum value of the percent yield of caustic potash is 67.8906 at 35 minutes leaching time and 90 rpm stir speed. This is because an increase in the leaching time and stir speed up to their optimum values favours the solubility and leaching of KOH and vice versa.

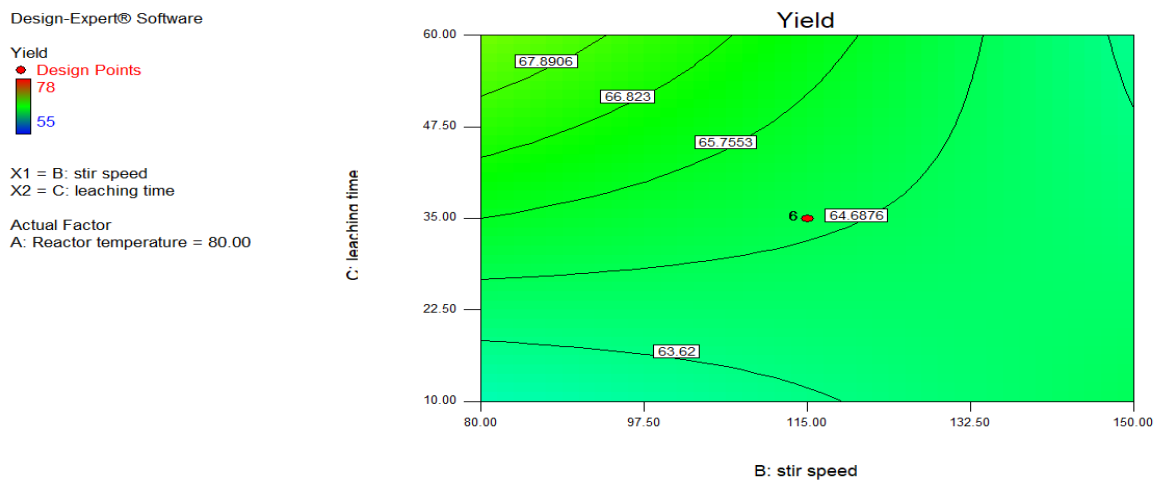


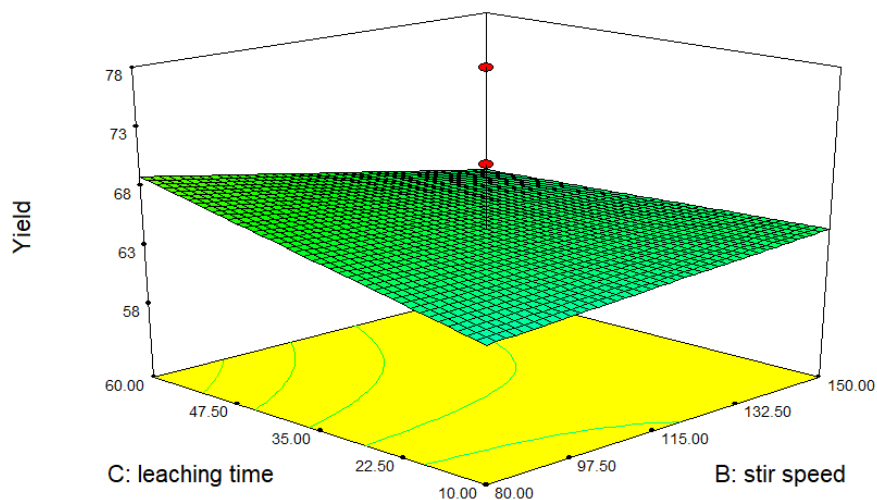
Figure 12: 2D plot of the effect of leaching time and stir speed on the percent yield of caustic potash

Design-Expert® Software



X1 = B: stir speed  
X2 = C: leaching time

Actual Factor  
A: Reactor temperature = 80.00



**Figure 13: 3D plot of the effect of leaching time and stir speed on the percent yield of caustic potash**

#### 4 CONCLUSION

The design and optimization of the production process for optimum conversion of the caustic potash from the cocoa pod husk was carried out. The conceptual framework as well as the process flow diagram to produce KOH from cocoa pod husk was also presented. The Computer Aided Design of the production plant comprising of the integration of all the units to produce KOH from the cocoa pod husk was done using the Autodesk Inventor 2018. The results of the both the numerical experiments carried out using the response surface methodology and the physical experiments carried out on the laboratory scale agrees significantly. This is an indication that the developed model is highly significant for the correlation of the process parameters for the prediction of the yield of caustic potash. The optimum value of the percent yield of caustic potash was found to be 69.9471% at a stir speed of 95 rpm, reaction time of 55°C and leaching time of 35 minutes. The combination of stir speed and temperature was found to be the most significant process parameter that influences the yield of caustic potash, hence, the determination of the optimum values of caustic potash yield and process parameters will assist in efficient monitoring, control and management of the production process. This will enhance a better understanding of the business processes and provide an insight into the input and expected output ratio, the energy requirement as well as the cost-effectiveness of the process. In addition, the work provides a suitable platform for the close monitoring of the overall production of KOH from cocoa pod husk in order to ascertain whether the production parameters are combined in the right ratio for optimum KOH yield, thus, providing a suitable framework for error identification and corrective actions.

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## **DEVELOPMENT OF A FRAMEWORK FOR IMPROVING THE QUALITY AND CONFORMITY OF CARBON STEEL AISI 1070 FOR RAIL CAR APPLICATIONS**

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### **ABSTRACT**

The performance and reliability of a product are often determined by the quality of the product and its degree of conformity to standards. This work considers the development of a framework for improving the quality and conformity of carbon steel AISI 1070 for rail car applications under varying heat treatment conditions for different diameters and thickness samples. The physical experimentation involves the determination of the hardness and toughness of the material via the Brinell's hardness test and Charpy impact test respectively for varying thicknesses of 2 mm, 3 mm and 4 mm. The statistical analytical tools employed include the chi-square and t-distribution for evaluating the degree of products conformity as well as its quality. The results obtained indicated that the degree of products conformity increases with increase in temperature, thus, indicating that the degree of machinability, malleability and ductility can be significantly influenced with temperature variations. The results obtained also provides an insight for the improvement and quality control of carbon steel AISI 1070 compared to existing standards in order to improve its service performance.

**Keywords:** Carbon steel, Conformity, Standard, Quality

### **1 INTRODUCTION**

The performance and reliability of the product is a function of its quality and degree of conformity to standards and specifications. Products are developed to meet set of standards and specifications for ease of replacement, maintenance purposes and to ensure its satisfactory performance in service. The products' quality and degree of conformity are often determined by the degree of variation of its critical parameters (Salleh, Yusop & Rosdi, 2013; Arlazarov, Gouné, Bouaziz, Hazotte, Petitgand & Barges, 2015; Ahmed & Frhan, 2018). Incessant failure of mechanical components is one of the causes of accidents, fatalities, products unavailability and negative feedbacks from customers, hence, the need to design a framework for the improvement of the quality and conformity of products to enhance its useful life and safety (Kadhim, 2016; Jha, 2017). This will also improve the durability of the product and promote the reputation of manufacturing companies while enhancing positive feedback from customers (Verma & Kumar, 2013; Jha & Balakumar, 2015; Chandan & Ramesha, 2017). The Brinell's hardness test is a method of measuring the hardness of a material by pressing a chromium-steel or tungsten-carbide ball against the smooth material surface under standard test conditions (generally between 300 to 3000 kilograms of force for 5 to 30 seconds). On the other hand, the Charpy impact test, also known as the Charpy V-notch test, is a standardized high strain-rate test, which determines the amount of energy absorbed by a material during fracture. This absorbed energy is a measure of a

given material's notch toughness and acts as a tool to understudy its temperature-dependent ductile-brittle transition. It is widely applied in industry, since it is easy to conduct and results can be obtained quickly and cheaply. The quantitative result of the impact tests the energy needed to fracture a material and can be used to measure the toughness of the material (Hariprasad, Dharmalingam & Praveen, 2013; Kaynar, Gunduz & Turkmen, 2013). There is a connection to the yield strength but it cannot be expressed by a standard formula. Also, the strain rate may be studied and analyzed for its effect on fracture. Abdulrazzaq (2016) investigated the mechanical properties of low carbon steel after surface hardening by carburizing with the hardness observed to increase with an increase in temperature. In addition, Nafsin and Rashed (2013) studied the effect of copper and magnesium on phase formation modeling and mechanical behavior in Al-Cu-Mg alloys with emphasis on the relationship between tempering and fatigue strength. Odusote, Ajiboye and Rabi (2016) and Murugan and Mathews (2013) from their research findings, established that the strength and hardness of medium carbon steel increases with attendant decrease in the modulus of elasticity following heat treatment and subsequent quenching in oil and water. In addition, Equibal Alam, Ohdar, Anand and Alam (2016) studied the effect of cooling rate on the microstructure of medium carbon steel. The results obtained however showed that the microstructures of all forging and cooling conditions are dominated by ferrite and pearlite phases with different morphologies and grain sizes according to various cooling rate. Carbon steel AISI 1070 is a high carbon steel consisting carbon in the range of 0.65-0.75% by weight which finds application in the manufacture of springs, rail car wheels, rail coaches etc. hence, the need to investigate the extent to which the strength, impact and hardness of different samples of carbon steel AISI 1070 respond to increase in temperature. The evaluation of the quality and conformity of carbon steel AISI 1070 for rail car applications has not been sufficiently highlighted by the literature, hence, this work focusses on the investigation of its mechanical properties, which is a function of the quality, and conformity of carbon steel 1070 under varying heat treatment conditions. The study will bring about the determination of suitability of the material for the required service condition and its projected performance in service. This will ensure the development of product with high integrity while ensuring effective quality control. It will also provide a suitable framework for strict adherence to design specifications in terms of uniformity and quality with respect to acceptable standards and product specifications.

## 2 MATERIALS AND METHOD

Figure 1 shows the framework for the improving the quality and conformity of carbon steel AISI 1070.

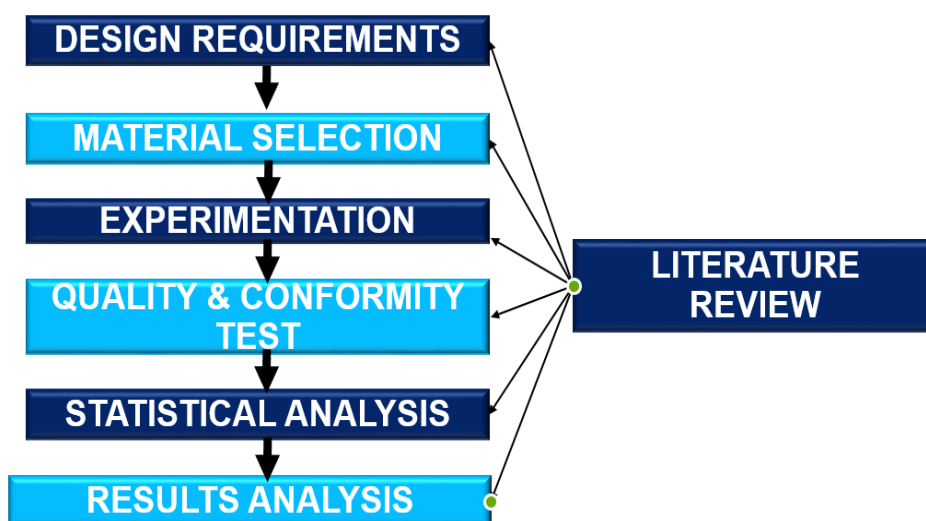


Figure 1: The Framework for the Improving the Quality and Conformity of Carbon Steel AISI 1070

The chemical, mechanical and thermal properties of the carbon steel AISI 1070 is presented in Tables 1, 2 and 3 respectively.

**Table 1: The percentage chemical composition of carbon steel AISI 1070**

Fe	Mn	C	S	P
98	0.60-0.90	0.65-0.75	0.050	0.040

(Azom, Materials, 2017)

**Table 2: Mechanical properties of carbon steel AISI 1070**

Properties	Value
Ultimate tensile strength	585 MPa
Yield strength	370 MPa
Modulus of elasticity	210 GPa
Bulk modulus	140 GPa
Shear modulus	80 GPa
Poisson's ratio	0.27-0.30
Density	7700-8030 kg/m <sup>3</sup>

(Azom, Materials, 2017)

**Table 3: Thermal properties of AISI 1070 carbon steel**

Thermal Properties	Value
Thermal expansion co-efficient (20°C)	11.8 µm/m°C
Thermal conductivity	51.9 W/mK

(Azom, Materials, 2017)

## 2.1 Physical Experimentation

The Brinell's Hardness Test (BHT) was conducted by inserting the indenting ball into the ball loader and it was ensured that contact was made between the specimen surface and the ball by rotating the jack-adjusting wheel after which the load will be automatically applied gradually after 20 seconds. The degree of the indentation was observed through the microscope and the diameter of the indentation was measured via the micrometer fitted on the microscope. The procedure was repeated three times for the different thicknesses from room temperature to elevated temperature of 1200°C.

The degree of indentation impressed by the indenter can be expressed in terms of the Brinell's hardness number given by Equation 1.

$$HBN = \frac{2P}{\pi D (D - \sqrt{D^2 - d^2})} \quad (1)$$

Where;

*HBN is the Brinell's hardness number; P is the applied load, (3000 kg)*

*D is the diameter of steel ball indenter (10 mm); d is the diameter of indentation*

For the toughness, the Charpy's impact test was considered. The V-notched samples of different thicknesses (2 mm, 3 mm and 4 mm) was prepared and the temperature of test specimens was raised using the furnace from room to elevated temperature of 1200°C. This enabled the determination of the ductile-brittle transition temperature of the material.

## 2.2 Statistical Analysis

The test for the sample conformity in terms of hardness and impact after heat treatment is given by the chi-square expression, which is a function of the mean diameter of the sample (Equation 2).

$$X = \sqrt{\frac{(n-1)s^2}{X_{\frac{\alpha}{2},v}}} \leq \sigma \leq \sqrt{\frac{(n-1)s^2}{X_{\frac{\alpha}{2},v}}} \quad (2)$$

Where the mean diameter  $\sigma$  is expressed by Equation 3.

$$\sigma = \sqrt{\frac{\sum |d - \bar{d}|^2}{n-1}} \quad (3)$$

Also, the test for the sample quality in terms of its hardness after the heat treatment is given by the t-distribution expression which is a function of the standard deviation of the sample (Equation 4).

$$\bar{J} - \frac{s}{\sqrt{n}} t_{\frac{\alpha}{2}}; \nu \leq \mu \leq \bar{J} + \frac{s}{\sqrt{n}} t_{\frac{\alpha}{2}}; \nu \quad (4)$$

Where; n is the total of samples;  $\nu$  is the degree of freedom expressed as  $(n - 1)$ ;  $d$  is the sample diameter;  $s$  is the sample mean;  $\sigma$  is the average mean;  $\alpha$  is the confidence level;  $\mu$  is the average standard deviation while  $\bar{J}$  is the standard deviation of the hardness of the sample.

### 3. RESULTS AND DISCUSSION

At a temperature of 300°C (573K), for samples with 2 mm thickness, the mean diameter is presented in Table 1.

**Table 1: Mean diameter for 2mm thickness**

S/N	Diameter (mm)	$/d - \bar{d}/^2$
1	0.7	0
2	0.6	0.01
3	0.8	0.01

At 90% confidence level,

$$\frac{\alpha}{2} = 0.05 \left( \frac{0.1}{2} \right) = 0.05$$

$\alpha$  = maximum confidence level – Given confidence level

$$= \frac{100}{100} - \frac{90}{100}$$

$$= 1 - 0.9 = 0.1$$

Also, at 95% confidence level

$$\alpha = 1 - 0.95$$

$$= 0.05$$

$$\frac{\alpha}{2} = \frac{0.05}{2} = 0.025$$

$$\nu = n - 1 \quad (n = 3)$$

$$\nu = 3 - 1 = 2$$

$$X \text{ for } \frac{\alpha}{2} = 0.05 = 0.103, \frac{\alpha}{2}$$

$$X \text{ for } \frac{\alpha}{2} = 0.05 = 5.991, 1 - \frac{\alpha}{2}$$

$$= \sqrt{\frac{(3-1)^2}{0.103}} \leq 1 \leq \sqrt{\frac{(3-1)^2}{5.991}}$$

$$4.4065 \leq 1 \leq 0.5778$$

$$= \frac{4.4065 + 0.5778}{2} = 2.47 \text{ (at 90% confidence level)}$$

At 95% confidence level,

$$X \text{ for } \frac{\alpha}{2} = 0.051$$

$$X \text{ for } 1 - \frac{\alpha}{2} = 7.378$$

$$= \sqrt{\frac{(3-1)^2}{0.051}} \leq 1 \leq \sqrt{\frac{(3-1)^2}{7.378}}$$

$$= 6.3 \leq 1 \leq 0.521$$

$$= \frac{6.3 + 0.521}{2} = 3.41 \text{ (at 95% confidence level)}$$

At 90 and 95% confidence level, the mean thickness range which is a function of the degree of the material's conformity to standard for samples with 2 mm thickness at 300°C, was found to be the within the specified mean range, thus, confirming considerable conformity to specifications.

At a temperature of 300°C (573K), for sample with 3 mm thickness, the mean diameter is presented in Table 2.

**Table 2: Mean diameter for 3 mm thickness**

S/N	Diameter (mm)	$/d - \bar{d}/^2$
1	1	0.01
2	0.8	0.01
3	0.9	0

$$\bar{d} = \frac{1.1+1+0.9}{3} = 0.9$$

$$\sqrt{\frac{(n-1)s^2}{X \frac{\alpha}{2}, v}} \leq \sigma \leq \sqrt{\frac{(n-1)s^2}{X \frac{\alpha}{2}, v}}$$

$$\sigma = \sqrt{\frac{0.05}{2}} = 0.1578$$

At 90% confidence level,

$$\rightarrow \sqrt{\frac{(3-1)(0.1578)^2}{0.103}} \geq 0.1578 \geq \sqrt{\frac{(3-1)(0.1578)^2}{5.991}}$$

$$= 0.6953 \geq 0.1578 \geq 0.0912$$

$$\rightarrow \frac{0.06953 + 0.0912}{2} = 0.3933$$

At 95% confidence level,

$$= \sqrt{\frac{(3-1)(0.1578)^2}{0.051}} \geq 0.1578 \geq \sqrt{\frac{(3-1)(0.1578)^2}{7.378}}$$

$$= 0.9980 \geq 0.1578 \geq 0.0823$$

$$\rightarrow \frac{0.9980 + 0.0823}{2} = 0.5402$$

At 90 and 95% confidence level, the mean thickness range which is a function of the degree of products conformity to standard for samples with 3 mm thickness, at 300°C was found to be the within the specified mean range, thus, indicating significant conformity of the material to specifications.

At a temperature of 300°C (573K), for sample with 4 mm thickness, the mean diameter is presented in Table 3.

**Table 3: Mean diameter for 4 mm thickness**

S/N	Diameter (mm)	$/d - \bar{d}/^2$
1	1	0
2	1	0
3	1	0

$$\bar{d} = \frac{\Sigma}{n} = \frac{1+1+1}{3} = \frac{3}{3} = 1$$

$$\text{At } S_d = \sqrt{\frac{\Sigma |d-\bar{d}|^2}{3-1}} = \sqrt{\frac{0}{2}} = 0$$

At 90% confidence level

$$\alpha = 1 - 0.9$$

$$\alpha = 0.1$$

$$\text{Therefore, } \frac{\alpha}{2} = 0.05, 1 - \frac{\alpha}{2} = 1 - 0.05 = 0.95$$

At 95% confidence level

$$\alpha = 1 - 0.95 = 0.05$$

$$\frac{\alpha}{2} = 0.025,$$

$$1 - 0.025 = 0.975$$

$$\sqrt{\frac{(n-1)s^2}{X \frac{\alpha}{2}, v}} \leq \sigma \leq \sqrt{\frac{(n-1)s^2}{X \frac{\alpha}{2}, v}}$$

$$\sqrt{\frac{(3-1)0^2}{5.991}} \leq 1 \leq \sqrt{\frac{(3-1)0^2}{0.103}}$$

$$\sqrt{\frac{0}{5.991}} \leq \sigma \leq \sqrt{0}$$

$$0 \leq \sigma \leq 0$$

$\sigma = 0$  (at 90% confidence level)

At 95% confidence level

$$\sqrt{\frac{(3-1)0^2}{7.378}} \leq \sigma \leq \sqrt{\frac{(3-1)0^2}{0.0506}}$$

$$0 \leq \sigma \leq 0$$

$\sigma = 0$  (at 95% confidence level)

At 90 and 95% confidence level and a temperature of 300°C (573K), for sample with 4 mm thickness, there is no change in values of the mean diameter and this implies that the degree of conformity remains the same as confidence level increases, thus, indicating no varying degrees of deviations from the specifications.

At a temperature of 300°C (573 K), for sample with 2 mm thickness, the standard deviation of the hardness is presented in Table 4.

**Table 4: Standard deviation of the hardness for 2 mm thickness**

$S/N$	A $\Sigma$ (J)	$ \Sigma - \bar{\Sigma} ^2$
1	52	42.25
2	39	42.25
		$\Sigma = 84.5$

$$\text{Where } \bar{J} = \frac{\Sigma J}{n} = \frac{52+39}{2} = 45.5$$

$$\therefore S_{\Sigma} = \sqrt{\frac{\Sigma |J-\bar{J}|^2}{n-1}} = \sqrt{\frac{84.9}{1}} = 9.2$$

$$v = n - 1 \rightarrow 2 - 1 = 1$$

$$\therefore 90\% = \bar{J} - \frac{s}{\sqrt{n}} t \frac{\alpha}{2}; v \leq \mu \leq \bar{J} + \frac{s}{\sqrt{n}} t \frac{\alpha}{2} - 1; v$$

$$45.5 - \frac{9.2}{\sqrt{2}} 6.314 \leq \mu \leq 45.5 + \frac{9.2}{\sqrt{2}} 6.314$$

$$= 4.42 \leq \mu \leq 86.57$$

$$\text{At 95\%, } 45.5 - \frac{9.2}{\sqrt{2}} 12.71 \leq \mu \leq 45.5 + \frac{9.2}{\sqrt{2}} 12.71$$

$$= -37.2 \leq \mu \leq 128.18$$

Where  $\mu = 45.5$

At 90 and 95% confidence level, the mean hardness for samples with 2 mm thickness, at 300°C was found to be the within the specified mean range, thus, indicating the development of a material of high quality.

At a temperature of 300°C (573 K), for sample with 3 mm thickness, the standard deviation of the hardness is presented in Table 5.

**Table 5: Standard deviation of the hardness for 3 mm thickness**

$S/N$	At (J)	$ J - \bar{J} ^2$
1	57	2.25
2	54	2.25

Where  $\bar{J} = \frac{EJ}{n} = \frac{111}{2} = 55.5$

$$\therefore S_j = \sqrt{\frac{\sum |J - \bar{J}|^2}{n-1}} = \sqrt{\frac{4.5}{1}} = 2.12$$

At 90%,  $\bar{J} - \frac{s}{\sqrt{n}} t_{\frac{\alpha}{2}}; v \leq \mu \leq \bar{J} + \frac{s}{\sqrt{n}} t_{\frac{\alpha}{2}}; v$

$$\therefore 55.5 - \frac{2.12}{\sqrt{2}} 6.314 \leq \mu \leq 55.5 + \frac{2.12}{\sqrt{2}} 6.314$$

$$= 46.03 \leq \mu \leq 64.97$$

At 95%,

$$= 55.5 - \frac{2.12}{\sqrt{2}} 12.71 \leq \mu \leq 55.5 + \frac{2.12}{\sqrt{2}} 12.71$$

$$= 36.45 \leq \mu \leq 74.55$$

Where  $\mu = 55.5$

At 90 and 95% confidence level, the mean hardness range which is a function of the degree of the material's quality for samples with 3 mm thickness, at 200°C was found to be the within the specified mean range thus indicating the development of a material of high quality.

At a temperature of 300°C (573 K), for sample with 4 mm thickness, the standard deviation of the hardness is presented in Table 6.

**Table 6: Standard deviation of the hardness for 4 mm thickness**

$S/N$	A $\Sigma$ (J)	$ \Sigma - \bar{\Sigma} ^2$
1	66	1
2	64	1
		$\Sigma = 2$

Where  $\bar{J} = \frac{\Sigma J}{n} = \frac{52+39}{2} = 45.5$

$$\begin{aligned} \therefore S_j &= \sqrt{\frac{\sum |J - \bar{J}|^2}{n-1}} = \sqrt{\frac{2}{1}} = \sqrt{2} \\ v &= n - 1 \rightarrow 2 - 1 = 1 \\ \therefore 90\% &= \bar{J} - \frac{s}{\sqrt{n}} t_{\frac{\alpha}{2}}; v \leq \mu \leq \bar{J} + \frac{s}{\sqrt{n}} t_{\frac{\alpha}{2}} - 1; v \\ 65 - \frac{\sqrt{2}}{\sqrt{2}} 6.314 &\leq \mu \leq 65 + \frac{\sqrt{2}}{\sqrt{2}} 6.314 \\ &= 58.69 \leq \mu \leq 71.31 \\ \text{At 95\%, } 65 - \frac{\sqrt{2}}{\sqrt{2}} 12.71 &\leq \mu \leq 65 + \frac{\sqrt{2}}{\sqrt{2}} 12.71 \\ &= 52.29 \leq \mu \leq 77.71 \\ \text{Where } \mu &= 65 \end{aligned}$$

At 90 and 95% confidence level, the mean hardness for samples with 4 mm thickness, at 200°C was found to be the within the specified mean range, thus, indicating the development of a material of high quality.

The hardness variation over the ranges of temperature for different thickness samples of AISI 1070 is presented in Table 7.

**Table 7: Hardness variation over the range of temperatures**

S/N	Temperature (°C)	Brinell's Hardness no (2 mm)	Brinell's Hardness no (3 mm)	Brinell's Hardness no (4 mm)
1.	600	52.5	59.2	66.05
2.	700	52.5	59.2	66.05
3.	800	51	59.2	66.05
4.	900	48.02	59.17	66.00
5.	1000	37.43	40.20	58.20
6.	1100	30.56	32.17	45.38
7.	1200	21.02	23.3	39.04

Figure 2 shows the hardness variation over the ranges of temperature for different thickness samples. The service life of the material is partly a function of the working temperature it is subjected to. Hence, temperature is an important parameter to be considered in the investigation of the ability of AISI 1070 to meet the service requirements. From Figure 2, for the three samples of AISI 1070, the hardness was observed to be relatively stable at elevated temperatures ranging between 800-900 °C beyond which it decreases with increase in temperature. This point to the fact that the rate of plastic deformation increases with an increase in temperature.



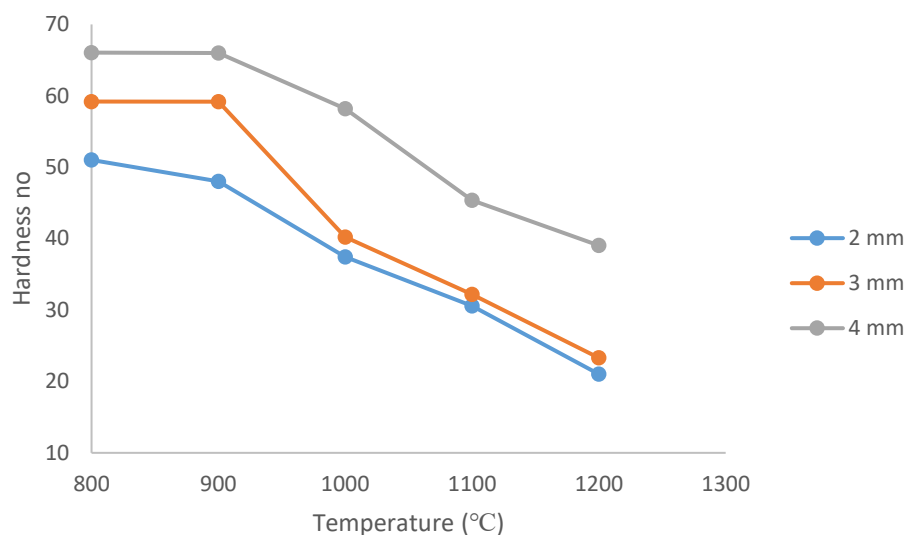


Figure 2: The hardness variation over the ranges of temperature for different thickness samples

#### 4 CONCLUSION

The results obtained indicated that the degree of the conformity and hardness of AISI 1070 decreases with increase in temperature thus indicating that its machinability, malleability and ductility increases with an increase in temperature. The successful completion of this work provides the design data for analysis of carbon steel AISI 1070 for the manufacturing process. The results obtained provides an insight for the improvement and quality control of carbon steel AISI 1070 compared to existing standards order to improve its service performance. This will reduce the chances of failure resulting from the deformation of the material under different operating or loading service conditions. In addition, the understanding of the behaviour of AISI 1070 under varying temperature will assist manufacturers in the determination of its design, functional and service requirements as well as its suitability for various applications in the rail industry. Hence, this will promote the reliability of products or components developed from the material thereby helping the industry gain a competitive edge and strong reputation.

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## **EARNED VALUE CHALLENGES IN PROJECTS WHERE THE PROJECT CURRENCY DIFFERS FROM THE FUNCTIONAL CURRENCY**

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### **ABSTRACT**

This paper investigates the challenges faced by businesses that perform projects in currencies different than those of their functional currencies.

Projects on the African continent are often performed in US Dollars. However, the businesses executing these projects typically do not operate in countries where the functional currency is US Dollars. In addition, these countries often have volatile currencies. This presents various challenges when performing earned value evaluations, which are typically not considered in traditional scenarios where the functional and project currencies are the same. As such, there is limited research available that is based on practical examples.

To investigate these challenges, this paper examines a case study project. The project was based in Kenya and was performed both in US Dollars and Kenya Shillings. The company that executed the project was based in South Africa and, as such, had a functional currency of South African Rand. The case study evaluates the effect that the exchange rates of the various currencies had on the earned value of the project.

This paper then proposes a practical solution to the challenges associated with volatile exchange rates by presenting a strategy that can be implemented to mitigate the effects on the earned value of such projects. By applying the proposed solution, more accurate earned value calculations can be made in the functional currency. This results in project reports that add value for both project and business management, and not only for project management.

### **1 INTRODUCTION**

In developing or third world countries, and especially in Africa, the project composition is not ideal for earned value systems due to the financially complex nature of the projects.

Projects are typically funded by international funders or investors outside of the project country. However, due to local government regulations, every capital investment project must have a local currency portion to encourage skills development in the project country (i.e., the developing/third world country). This results in projects being multicurrency in nature in that they comprise the following:

- Local portion: Those works and duties of the project that are performed in the country of the project country. This portion is accounted for in the local currency of the project country.
- Foreign portion: Typically, the larger portion of the project works is executed in the funder's currency or a mutually agreed upon prime currency. In some instances, this portion can even comprise multiple currencies that are not the project location's local currency.

Even though these types of projects are typically managed as a single unit from a project management perspective, contractual requirements often result in the project being managed as two (or more) separate projects from a project control point of view, since each project portion (e.g., foreign and local) has its own currency. Therefore, each portion has a different baseline budget, and may also have their own schedules that combine into one master schedule, where *baseline* is understood as “the general term to refer to the contractual baseline” (AACE International, Recommended Practice No. 10S-90) budget and schedule.

As such, at least one of the project currencies differ from the stakeholders’ (e.g. project owner or main contractor) functional currency. In addition, both project currencies usually differ from the main contractor’s functional currency, as very few developing countries have the technical skillsets to perform the work required on a large capital investment project.

Functional currency is defined as the currency used by a business for its financial accounting and is the same as the currency used by the country where that business is registered as a legal entity (Kenton, 2018). As an example, South Africa’s currency is South African Rand (ZAR) and any company registered as a legal entity within its borders will have ZAR as its functional currency. When a South African company performs a project in another country, that company will be a contractor on the project and its functional currency will be different to that of the project currency.

Even though the project currency provides the baseline budget, the stakeholders are exposed to the value of the project in their functional currency for administrative and risk purposes. As such, if there is a significant variance on currency fluctuation, the stakeholder that was previously exposed to a specific amount may find themselves exposed to a different value without the project scope increasing. Example: If the baselined project value is USD 10 000 and the exchange rate between ZAR and USD is 10:1, the functional currency exposure that the South African company is exposed to is R100 000. If the ZAR depreciates against the USD at any point in time after committing to the project, e.g., the exchange rate changes to 15:1, the company is exposed to R150 000, which is a 50% increase.

These factors can lead to significant administrative difficulties due to the inherent risks involved with these types of projects. As such, when administering the project from a project control perspective, attention must be given to the earned value based on the project currency for project management purposes, as well as to the earned value based on the functional currency for company business management purposes.

Few academic texts investigate the complexity of a dual- or multicurrency earned value systems. Furthermore, current available software does not have the capability and / or functionality to accommodate this issue.

Considering these identified project concerns, this paper evaluates the difficulties encountered with a multi-currency project and seeks to propose a solution to address the currency problems.

## **2 METHODOLOGY**

To evaluate the differences between the earned value for a project in its project currency versus the functional currency, and derive possible solutions thereto, this paper investigates a case study of a multicurrency project located in Africa that contains all the identified concerns.

The case study is investigated by comparing the earned value calculations as would typically be done on the project currency, with the earned value calculations performed on the functional currency at three different stages in the project. The earned value calculation results obtained for each currency is then compared at each stage. To investigate the Cost Performance Index (CPI) a

profile is created for each currency and compared to one another.

Following the case study and its analysis, the paper considers a possible solution to the identified problems, including the proposed solution's viability, based on the findings of the case study evaluation results.

### 3 EARNED VALUE SYSTEM

#### 3.1 Defining the Earned Value System

Sean T. Regan defines *Earned Value* (EV) as “a process for monitoring a project's performance against a baseline. Earned Value Management Systems (EVMS) are project progress control systems that integrate work scope, schedule, and resources to enable objective comparison of the earned value to the actual cost and the planned schedule of the project” (Regan, 2015).

Therefore, it can be said that an earned value system evaluates the relationships between the project's Planned Value (PV) or Budgeted Cost for Work Scheduled (BCWS), its Earned Value (EV) or Budgeted Cost for Work Performed (BCWP), and its Actual Cost (AC) or Actual Cost for Work Performed (ACWP). By analyzing the evaluated relationships in conjunction with the project's Budget at Completion (BAC) and the Estimated Actual Cost (EAC), a project controller can determine if the project's progress is favorable. Furthermore, the earned value system serves as an early warning system for project and business management, highlighting potential risks and / or deviations from the project's baseline plans.

According to Recommended Practice 10S-90: Cost Engineering Terminology (AACE International, Recommended Practice No. 10S-90), the definitions for these concepts are:

- Planned Value (PV) / Budgeted Cost for Work Scheduled (BCWS) – the measure of the amount of money budgeted to complete the scheduled work as of the data date.
- Earned Value (EV) / Budgeted Cost for Work Performed (BCWP) – represents the budget value of work performed, rather than the actual cost of the work performed.
- Actual Cost (AC) / Actual Cost for Work Performed (ACWP) – a measure of the actual cost of the work performed as of a data date. (p8)
- Budget at Completion (BAC) – the summation of time phased costs at any work breakdown structure (WBS) level.
- Estimate at Completion (EAC) – an estimate of the total cost an activity or group of activities will accumulate upon final completion.

This paper uses the BCWP, ACWP and BCWS acronyms.

The following relationships between BCWP, BCWS, ACWP, BAC and EAC are evaluated:\_\_\_\_\_

**Table 1 – Earned Value System Indices**

Name	Acronym	Description	Formula
Schedule Variance	SV	The difference between what was earned and the scheduled value.	$BCWP - BCWS$
Cost Variance	CV	The difference between what was earned and what it cost to do it.	$BCWP - ACWP$
Schedule Performance Index	SPI	Ratio between EV and PV to reflect whether the project work is ahead of / on / behind schedule in relative terms.	$\frac{BCWP}{BCWS}$

Cost Performance Index	CPI	Ratio between EV and ACWP, to reflect whether to project work is under / on / over budget in relative terms.	$\frac{BCWP}{ACWP}$
Estimate at Completion	EAC <sub>stat</sub>	The estimated total amount of money needed to be put into the project based on the information available at that time.	$\frac{ACWP + (BAC - BCWP)}{CPI}$
To Complete Performance Index	TCPI	The cost efficiency required for the work remaining to achieve EAC.	$\frac{BAC - BCWP}{EAC - ACWP}$

Disclaimer: Where a concept has various (possible) formulas, this paper uses the formula reflected in Table 1 above.

### 3.2 The Earned Value System’s Purpose

The purpose of an earned value system is to provide information (analyzed data) to the project management team to enable them to finish the project within the baseline. As such, the result of the earned value system should be more than just a report provided to the client and funders of the project in the project currency – it should also provide information to the contractor’s management team in its functional currency, indicating where variances will have an impact, whether positive or negative, on the management of the contractor’s business.

## 4 CASE STUDY

### 4.1 Project Overview

The case study project evaluated as part of this paper was a greenfield project based in Kenya. Due to the high-profile nature of the project, as well as the necessity of the end product, the project delivery method was a design-build, with the contracting strategy that of independent prime contractors (two contracts were awarded) and a contract management agent appointed.

Figure 1 depicts the high-level project structure of the case study project, indicating the major parties to the contract, as well as the relationships between them and the currencies per contract.

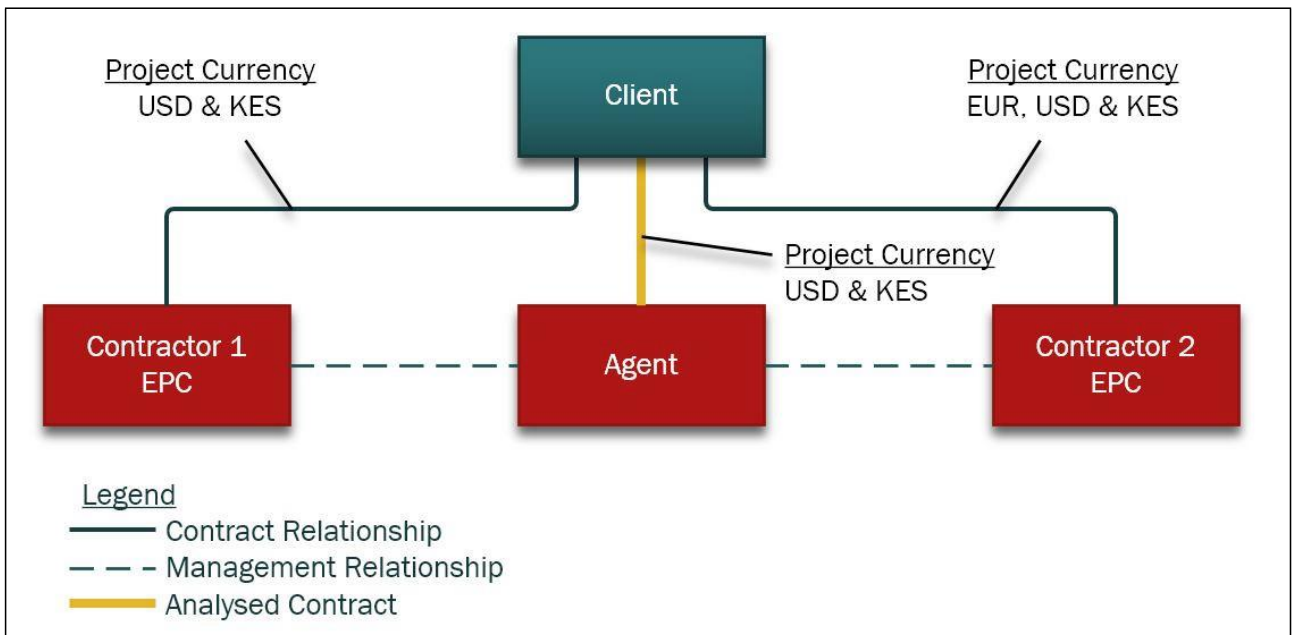


Figure 1 – High-Level Case Study Project Structure

The following two tables depict a high-level overview of the project’s characteristics to indicate its complexity from a project control point of view.

**Table 2 – Complete Project Statistics**

Characteristic	Value
Project Currencies	EUR; KES & USD
Project Location	Kenya
Nationalities (Contract parties)	4
Estimated Project Duration	24 Months
Actual Project Duration	63 Months
Total Project Value	\$108mil

**Table 3 – Agency Contract Statistics**

Characteristic	Value
Project Currencies	KES & USD
Cost Accrual Currencies	KES, USD & ZAR
Functional Currency	ZAR
Approved Variances	4

*Disclaimer: Due to the complexity of the project, only the USD portion of the contract (indicated in yellow in Figure 1) is analyzed in this paper.*

#### 4.2 The Currency Problem

Projects on the African continent are often performed in US Dollars due to funding requirements, while the main contractors that execute these projects are typically not based in countries where the functional currency is US Dollars (Deloitte Report, 2017). According to the Africa Construction Trends Report of 2017, only 3.3% of African projects was built by US firms in 2017, while 77.9% of the projects was built by firms that are based outside of the project country (Deloitte Report, 2017). For most of these contractors, either the contractor’s country or the project country often has a volatile currency, as they are based in developing countries.

For this case study, a South African company was awarded the agency contract of the project. The agency contract was divided into a USD (US Dollars) and a KES (Kenya Shillings) portion, i.e., the project currencies. The division was relatively equal, with the USD portion being 48% of the budget and the KES portion being 52% of the budget. Revenue on the project was accrued in USD and KES, while costs for both portions of the contract was accrued in three currencies, namely, USD, KES and ZAR (South African Rand). Although the functional currency of the project was ZAR (as the contractor was based in South Africa), all reports to the client and funders had to indicate the earned value achieved on the project currencies (USD and the KES), as per contract requirements. However, the contractor’s business management required that reports be in ZAR, as the functional currency was used to determine if the project was profitable or not for the business.

Over the course of the project (1 September 2012 to 30 November 2017), the ZAR exchange rate experienced a 108% variability to the USD, fluctuating from a minimum of R8.11 to a maximum of R16.89 to the USD (USD/ZAR – US Dollar South African Rand, 2019). The average exchange rate for the period was R12.02 to the USD. During the same period, the ZAR experienced a 71% variability to the KES, fluctuating from a minimum of KES6.07 to a maximum of KES10.38 to the ZAR. The average exchange rate for the period was KES8.03 to the ZAR (ZAR/KES - South African Rand Kenyan Shilling, 2019).

Figure 2 below indicates the change to the three currency groupings, i.e., USD to KES [7], USD to ZAR [5], and KES to ZAR [6], compared to the exchange rates at the onset of the project on 1 September 2012.



Figure 2 – Percentage Change in Currency Grouping, with 1 September 2012 as the Basis

**5 ANALYZING THE CASE STUDY**

The case study was analyzed at 15%, 65% and 100% of the project term in order to compare the differences in the various indexes (SPI, CPI and TCPI) between the ZAR value of the project at that point in time and the USD values of the project at that point in time.

**5.1 15% Project Duration**

The following figures and table indicate the project earned value of for the USD portion at month 10 of 63 of the project, i.e., 15% of the project duration for both the functional and project currencies.

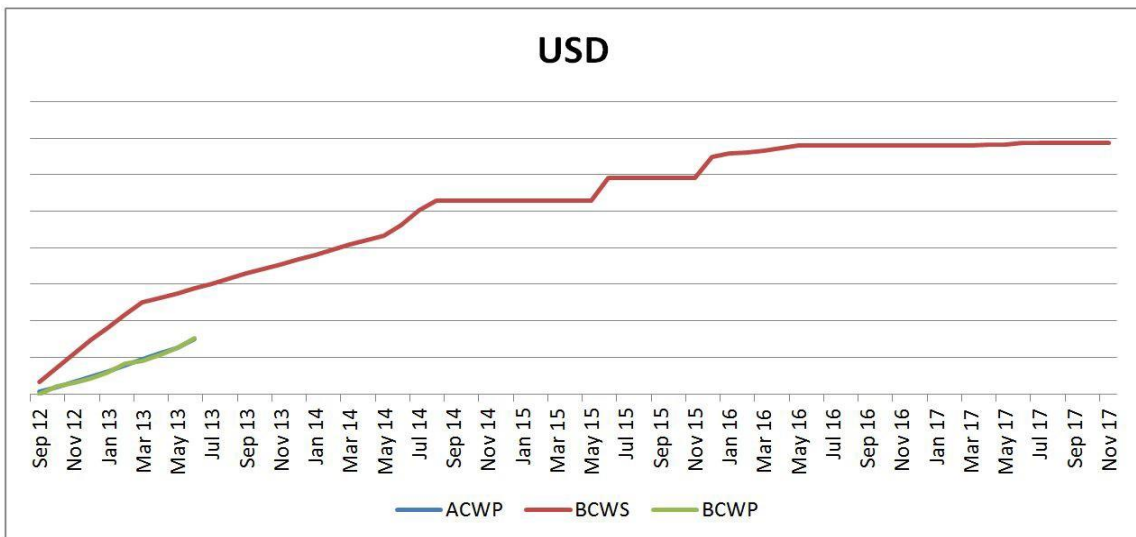
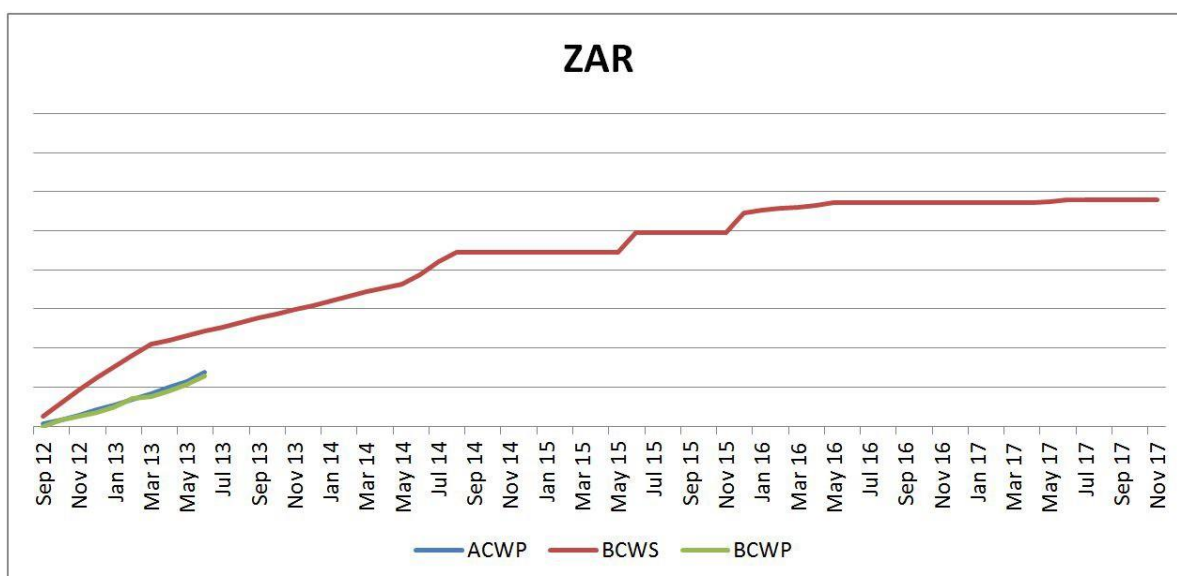


Figure 3 – Project Earned Value at 15% of the Total Contract Duration in the Project Currency





**Figure 4 – Project Earned Value at 15% of the Total Contract Duration in the Functional Currency**

*Disclaimer: The vertical axis is not shown on some of the case study figures in order to protect confidential information.*

**Table 4 – Comparison of Project Earned Value at 15% of the Total Contract Duration between Project and Functional Currencies**

Calculation	Project Currency	Functional Currency	Variance
SPI	0.53153	0.53153	0
CPI	1.01342	0.92988	8.35%
TCPI	1.01895	0.90204	11.69%
SPI	0.53153	0.53153	0

In month 10, the project was behind schedule due to client delays (SPI = 0.53), with no difference between the project and functional currency calculations, as expected, since the BCWS and BCWP in the functional currency is based on the exchange rate of 1 September 2012, which formed the baseline. However, the project was under budget in the project currency (CPI = 1.01) in month 10, while the functional currency indicated an overspend (CPI = 0.92). This was because the ZAR exchange rate depreciated in value against the USD, causing the cost of resources to be more expensive than originally planned. There was thus a variance of 8.35% between the USD CPI and the ZAR CPI at this point in time, while the TCPI for the project currency (1.02) and the functional currency (0.90) had an 11.69% difference.

During month 10, the variation between the USD and ZAR average exchange rate was 20.48% when compared to the initial exchange rate of 1 September 2012.

## 5.2 65% Project Duration

The following figures and table indicate the project earned value of the project for the USD portion at month 40 of 63 of the project, i.e., 65% of the project duration for both the functional and project currencies.

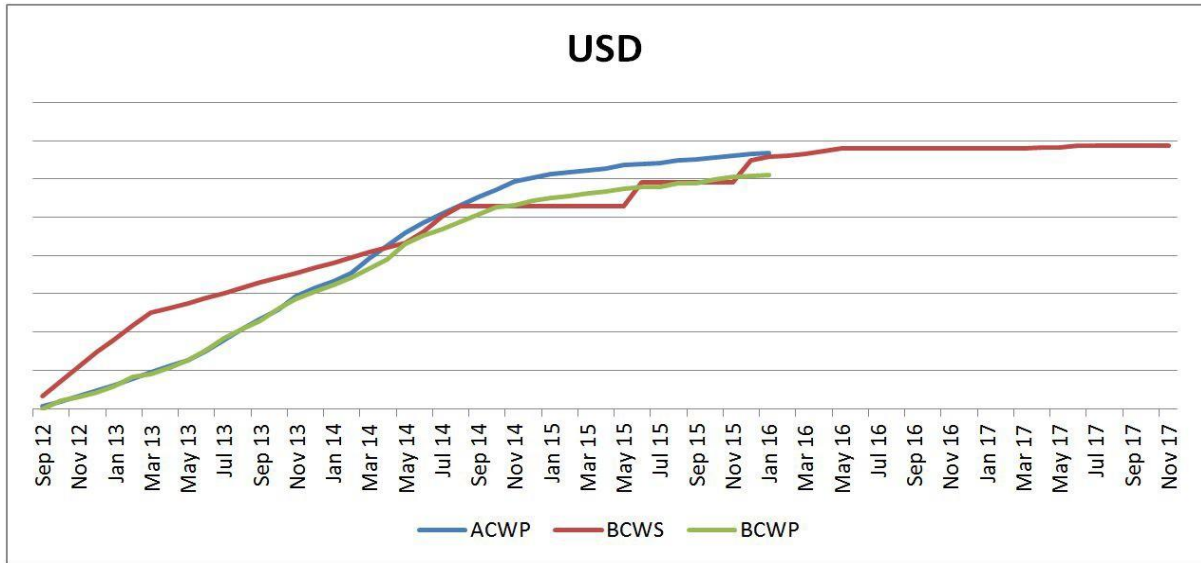


Figure 5 – Project Earned Value at 65% of the Total Contract Duration in the Project Currency

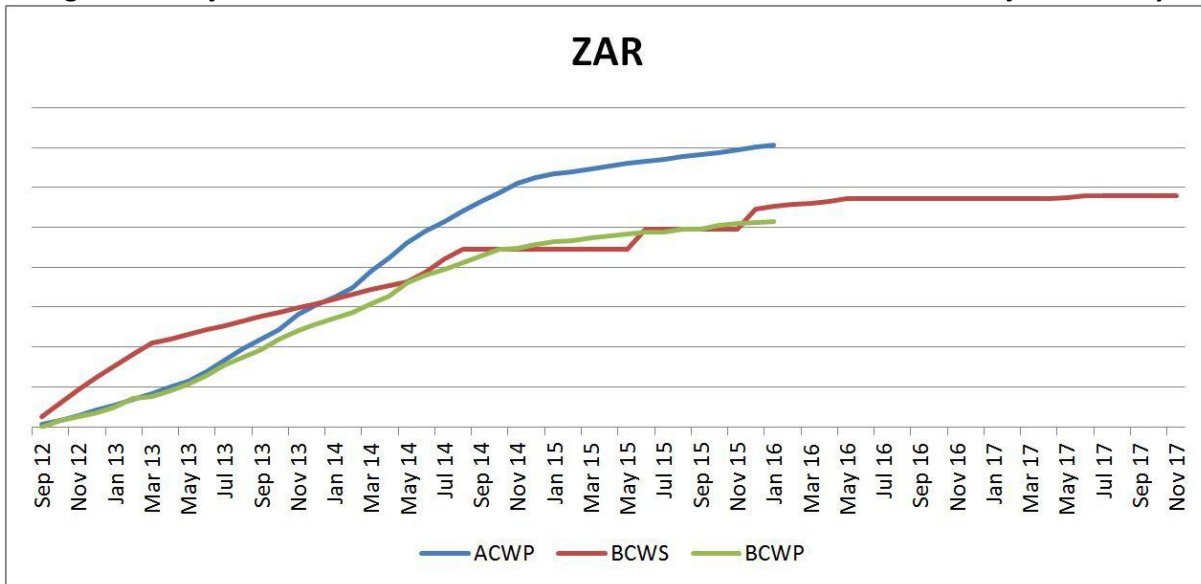


Figure 6 – Project Earned Value at 65% of the Total Contract Duration in the Functional Currency

Disclaimer: The vertical axis is indicated as a percentage of the Budget at Completion (BAC) on all relevant graphs to protect confidential information.

Table 5 – Comparison of Project Earned Value at 65% of the Total Contract Duration between Project and Functional Currencies

Calculation	Project Currency	Functional Currency	Variance
SPI	0.93023	0.93023	0
CPI	0.91445	0.72822	18.62%
TCPI	0.49467	0.16606	32.86%

In month 40, the project was still behind schedule (SPI = 0.93), with no difference between the project currency and functional currency calculations. At 65% of the project duration, the project was overbudget in the project currency (CPI = 0.91), while in the functional currency deteriorated to a larger overspend (CPI = 0.73). The variance therefore increased to 18.62% between the USD CPI and the ZAR CPI at this stage of the project, while the TCPI for the project currency (0.49) and the functional currency (0.17) had a 32.86% difference.

During month 40, the variation between the USD and ZAR average exchange rate was 96.55% compared to the initial exchange rate on 1 September 2012.

### 5.3 100% Project Duration

The following figures and table indicate the project earned value of the project for the USD portion at completion of the project, i.e., 100% of the project duration for both the functional and project currencies.

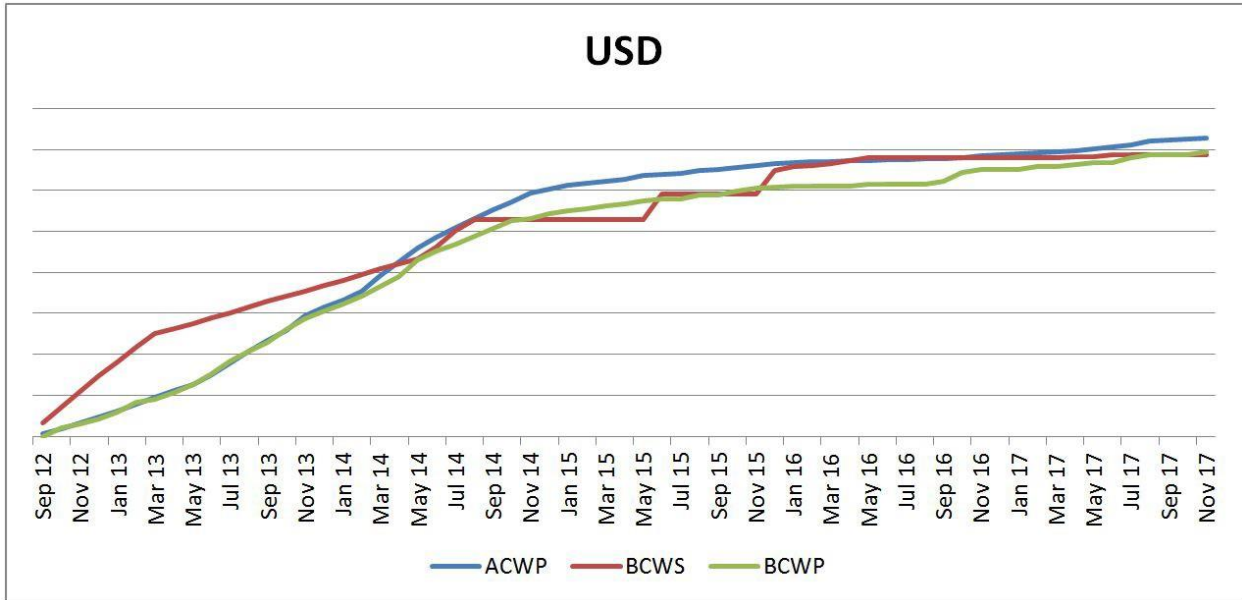


Figure 7 – Project Earned Value at 100% of the Total Contract Duration in the Project Currency

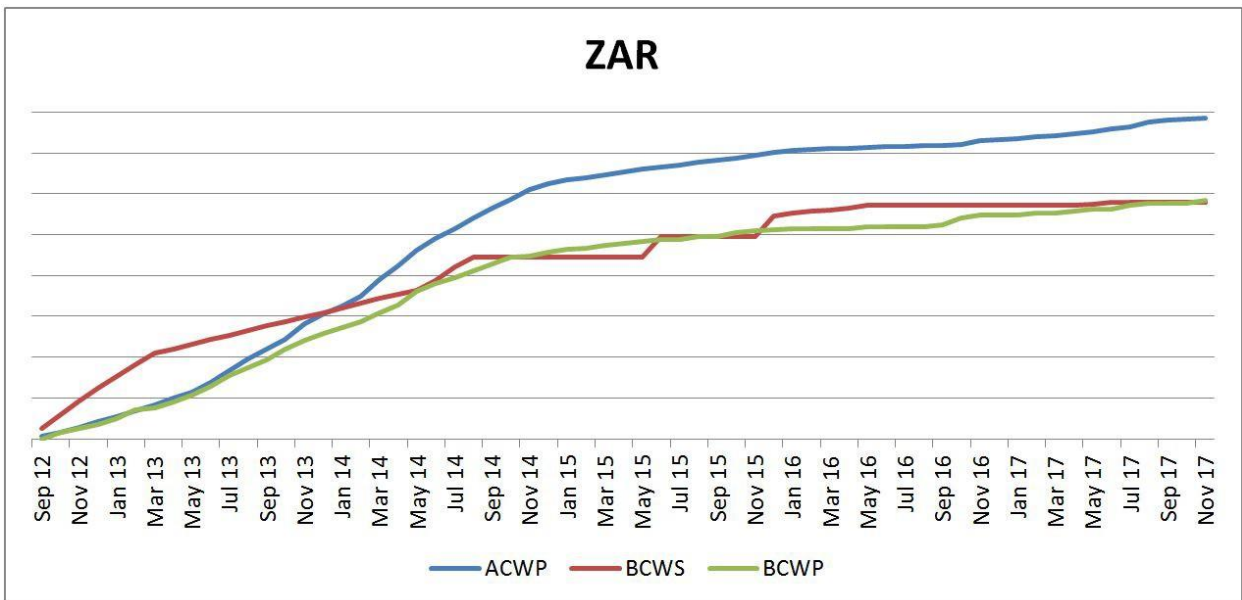


Figure 8 – Project Earned Value at 100% of the Total Contract Duration in the Functional Currency

Table 6 – Comparison of Project Earned Value at 100% of the Total Contract Duration between

**Project and Functional Currencies**

Calculation	Project Currency	Functional Currency	Variance
SPI	1.00	1.00	0
CPI	0.95307	0.74159	21.15%

At the conclusion of the project (SPI = 1.0), the project ended overbudget in the project currency (CPI = 0.95), while the functional currency indicated an overspend (CPI = 0.74). Thus, a variance of 21.15% was achieved between the USD CPI and the ZAR CPI, while the TCPI for the project currency (1.02) and the functional currency (0.90) had an 11.69% difference.

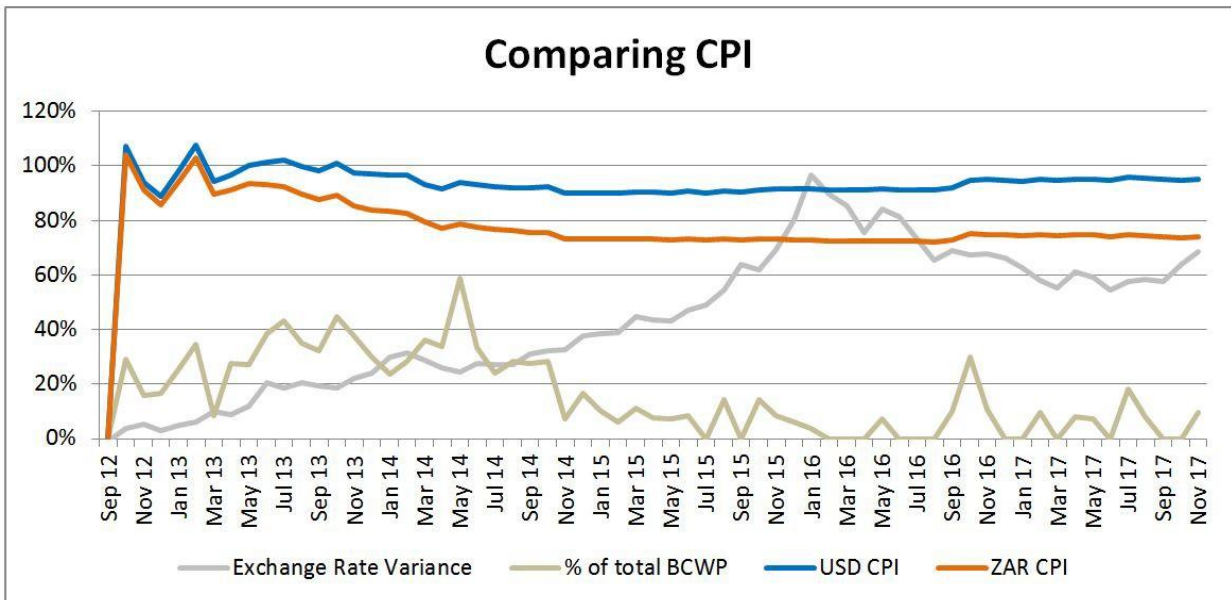
In the final month of the project, the variation between the USD and ZAR average exchange rate was 68.66% when compared to the initial exchange rate of 1 September 2012.

**6 EVALUATION SUMMARY**

BAC, BCWS and the rates used for BCWP is based on the baseline (schedule and budget), and as such should only be changed if there is a contractual change to the project, e.g., an approved scope change. Where the functional currency and the project currency is not the same, though, this basic rule cannot be applied, as the ACWP will vary based on the exchange rate at the time at which the cost is incurred. Therefore, not adjusting the BAC, BCWS and BCWP to reflect the exchange rate differences, but leaving them at the original exchange rate may provide misleading information.

When comparing Figure 7 and Figure 8, it is noted that the project finished with a budget over run of 4.7% in the Project Currency, while the Functional Currency calculations indicated a 25.84% overrun.

The following figure indicate the difference between the CPI achieved by doing the calculations in the project currency of USD (Blue line) compared to the CPI achieved by doing the calculations in the functional currency of ZAR (Orange line). The variance in the Exchange rate (Grey) line as well as an indication of in which months project expenses were incurred (yellow line) is added as reference.



**Figure 9 – Comparison of CPI in the Project and the Functional Currencies**

*Disclaimer: The percentage of total BCWS curve is on a different vertical axis scale the other curves – it was increased for clarity purposes.*

In Figure 9, the CPI for the project and functional currencies has the same curve, with the variance

increasing the farther the project progresses. Although the CPI variance increases as the exchange rate variance increases, it must be noted that the CPI variance is not directly related to the variance in the exchange rate. This is because the majority of the project's work was executed during the first 30% of the project, while the exchange rate variance was in the region of 30% for the same period. Although the highest exchange rate variance is noted during the December 2015 to January 2016 period, minimal project work was performed during this time. Therefore, the exchange rate did not have a significant influence on the CPI variance during this period.

This clearly demonstrates that when a possible solution is evaluated to overcome the problem of multi-currency project reporting, one should not only consider the volatility of the exchange rate, but also when the work was or will be done during the lifetime of the project.

## **7 PROPOSED SOLUTION**

As can be seen from the case study and its evaluation, any possible proposed solution needs to include not only the effect that exchange rates have on a project during the course of its lifetime, but should also consider when the work was planned to be executed, and the variance between the planned execution and actual execution.

Since ACWP is based on the actual cost incurred by the contractor, there is no need to adjust the value. However, in order to calculate an accurate CPI in the functional currency, BCWS, BCWP and BAC need to be adjusted periodically due to the changes in the exchange rate. The proposed solution suggests formulas to make the necessary adjustments, as such, BCWS and BCWP is calculated in the functional currency using these formulas, as opposed to converting them with the project start exchange rate.

The proposed solution will be performed at the end of each evaluation period and, as such, an average exchange rate will be available for each period. The solution involves adjusting the BCWP and BCWS and obtaining a new BAC from the adjusted BCWS.

### **7.1 Adjusting the BCWP**

The BCWP value for work performed in each evaluation period need to be adjusted based on the average exchange rate of that period, using the following formula:

$$BCWP_{adjusted} = (BCWP_n \times E_n)$$

Where:

*BCWP*: The BCWP for the current evaluated period in the project currency.

*E*: Average exchange rate for the current evaluated period.

*n*: The current evaluated period.

#### **Example 1 – Test Project**

After six periods had lapsed on the test project, work had been performed to the BCWP amount of 70 000. To generate the project currency report at the end of Period 6, the accumulated BCWP information will be used.

As per the proposed solution, each period's average exchange rate will be used to calculate the *BCWP<sub>adjusted</sub>* for the functional currency report, as opposed to converting the BCWP at the project start exchange rate of 9.8.

Table 7 –BCWP Conversion on Example 1’s Test Project

Period	Project Currency		Average Exchange Rate for Period	Functional Currency	
	Work Performed (Periodically)	BCWP (Cumulative)		Work Performed (Periodically)	BCWP (Cumulative)
<i>n</i>	<i>BCWP</i>		<i>E</i>	<i>BCWP<sub>adjusted</sub></i>	
1	10 000	10 000	10	100 000	100 000
2	15 000	25 000	10.2	153 000	253 000
3	9 000	34 000	10.6	95 400	348 400
4	10 000	44 000	10.4	104 000	452 400
5	15 000	59 000	10.5	157 500	609 900
6	11 000	70 000	10.3	113 300	723 200

7.1.2 Case Study Application

By using the average exchange rate for each period of the case study, the BCWP is adjusted to more closely the expected cost, as can be seen in Figure 10.

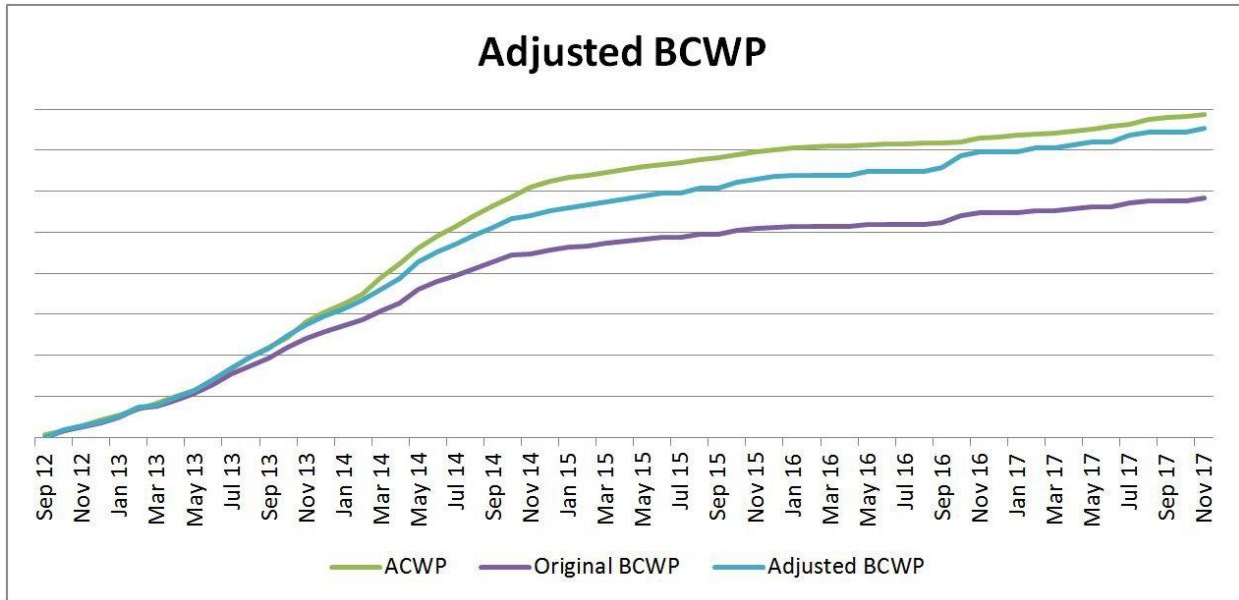


Figure 10 – Comparison of ZAR BCWP when Using the Initial Exchange Rate of the Project Versus the Period Averages

By using the period averages for the BCWP calculation (blue line in Figure 10), the curve more closely resembles the project currency graph and results in a comparable CPI calculation, as shown in Figure 11.



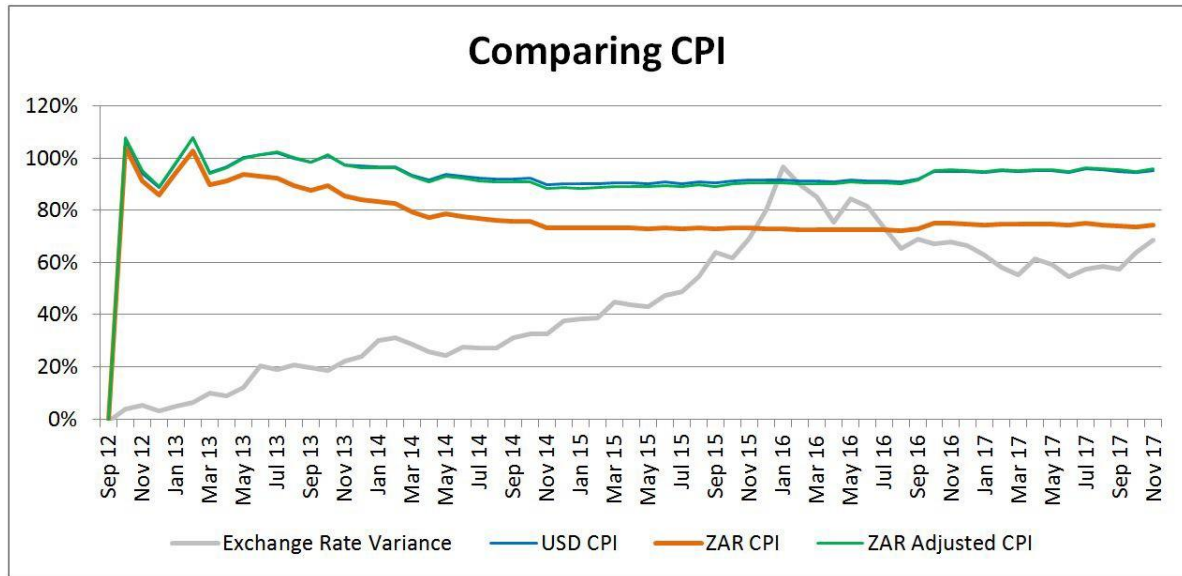


Figure 11 – Comparison CPI between the Project and Functional Currencies Before and After Adjustment

Consequently, the ZAR adjusted CPI closely resembles the USD CPI for the entire project duration. As can be expected, slight differences between the curves remain, due to the average exchange rate used for the specific period’s BCWP calculations, while the ACWP is based on the actual exchange rate at the date of expense. However, this difference is small enough to be negligible.

## 7.2 Adjusting the BCWS and BAC

In contrast to the BCWP, which is calculated on a periodic basis based on the work completed for that period, the BCWS is created at the start of the project and provides the baseline for scheduling and cashflow planning. The BCWS is calculated using two formulas – the first is used for periods on the project that have been concluded, while the second is used for future periods.

### 7.2.1 BCWS Formula 1

The formula proposed to calculate the BCWS for the current evaluated period and the periods that have already concluded are as follows:

$$BCWS_{adjusted} = ((CumBCWS_{n-1} - CumBCWP_{n-1}) \times (E_n - E_{n-1})) + (BCWS_n \times E_n)$$

Where:

*CumBCWS*: The cumulative BCWS up to and including the stated period in the project currency.

*CumBCWP*: The cumulative BCWP up to and including the stated period in the project currency.

*BCWS*: The work planned for the current evaluated period in the project currency.

*E*: Average exchange rate for the stated period.

*n*: The current evaluated period.

*n-1*: The stated period.

*Disclaimer: The formula has been developed by the author of this paper as part of the proposed solution.*

The two sections of the formula each address a portion of the factors that influence the difference between the BCWS in the project currency and the BCWS in the functional currency.

$$(CumBCWS_{n-1} - CumBCWP_{n-1})$$

The first portion of the formula calculates the cumulative work that was planned (BCWS) but not yet performed (BCWP) at the end of the previous  $(E_n - E_{n-1})$  evaluated period. This value is multiplied by the difference between the average exchange rate for the current evaluated period and the previous evaluated period. By doing this, the formula accommodates the exchange rate difference between the work that was planned but not yet executed, if the project's performance is not as per the baseline schedule.

The second portion of the formula  $(BCWS_n \times E_n)$  multiplies the planned work for the current evaluated period by the average exchange rate for that period.

### 7.2.2 BCWS Formula 2

The formula proposed to calculate the BCWS for future periods is as follows:

$$BCWS_{adjusted} = (BCWS_n \times E_l)$$

Where:

*BCWS*: The work planned for the period in the project currency.

*E<sub>l</sub>*: Average exchange rate for the last evaluated period.

*n*: The planned period.

The formula  $(BCWS_n \times E_l)$  multiplies the planned work for the future periods by the average exchange rate for the last evaluated period, as that average exchange rate is the most accurate at the evaluated period. By using the evaluated information, the exchange rate used for future periods will be adjusted after each evaluation.

### 7.2.3 Determining BAC

The adjusted BAC can be determined by cumulating the adjusted period amounts. This adjusted BAC can then be used for TCPI and  $EAC_{STAT}$  calculations.

#### Example 2 – Test Project

For the project, a BAC of 70 000 was baselined, as per the amounts indicated in the BCWS periodic column of Table 8. The project start exchange rate was 9.8. After three periods, the BCWS for the remainder of the project can be calculated as shown in Table 8.

**Table 8 – BCWS Conversion on Example 2's Test Project**

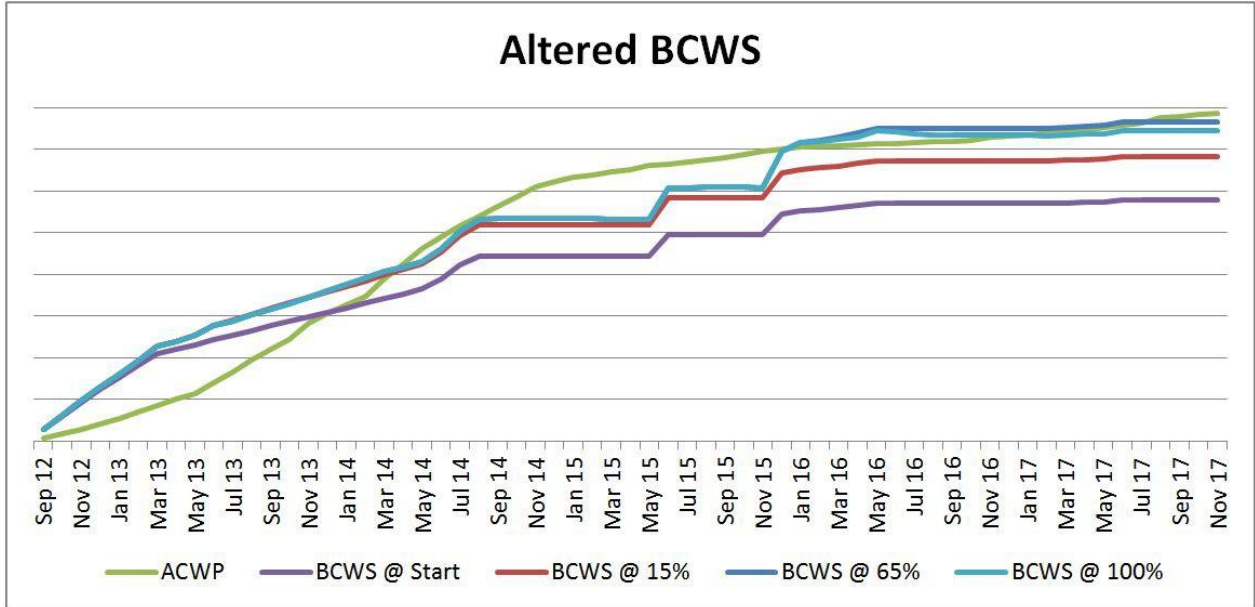
Period	Project Currency			Average Exchange Rate for Period	Functional Currency	
	Work Planned (Periodically)	BCWS (Cumulative)	BCWP (Cumulative)		Work Planned (Periodically)	BCWS (Cumulative)
<i>n / l</i>	<i>BCWS</i>	<i>CumBCWS</i>	<i>CumBCWP</i>	<i>E</i>	<i>BCWSadjusted</i>	
1	10 000	10 000	9 000	10	100 000	100 000
2	15 000	25 000	23 000	10.2	153 200	253 200
3	9 000	34 000	34 000	10.6	96 200	349 400
4	10 000	44 000			106 000	455 400
5	15 000	59 000			159 000	614 400
6	11 000	70 000			116 600	731 000

In Example 2, the original BAC in the functional currency was 686 000 (70 000 x 9.8), but after the adjustments were applied, the calculated BAC was 731 000.



### 7.2.4 Case Study Application

By applying the formulas to each period, an adjusted BCWS graph can be created, as shown in Figure 12. In the figure, the BCWS profile (purple) is compared with the altered profile at month 10 of the project (15% of project duration), at month 44 of the project (65% of project duration) and at the completion of the project.



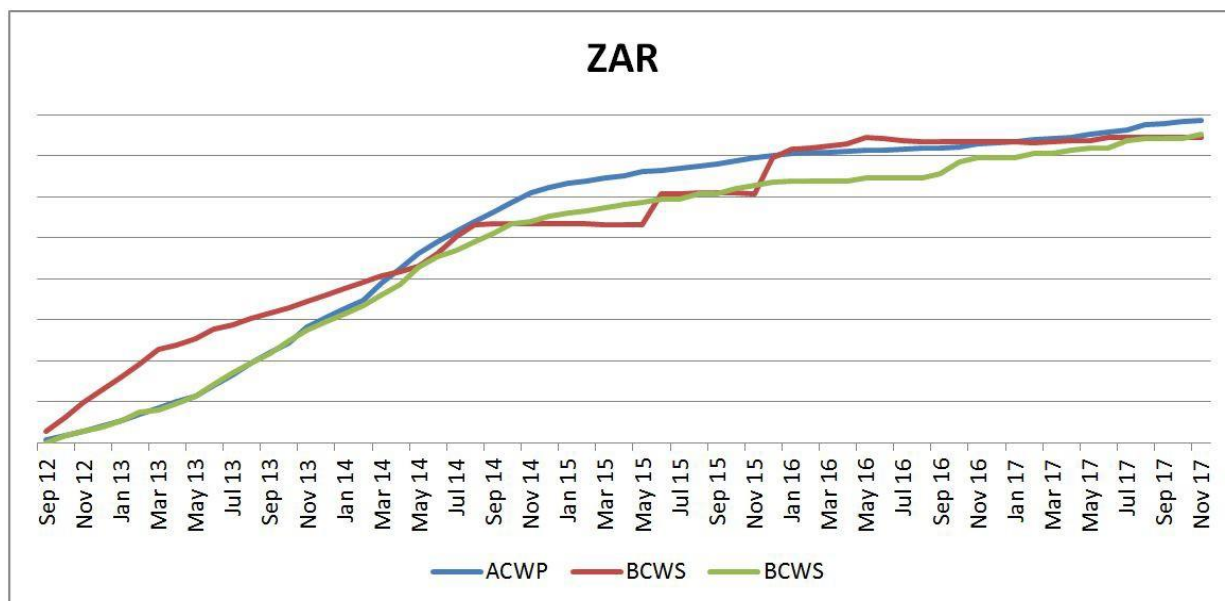
**Figure 12 – Comparison of BCWS at the Start (0%), 15% and 65% Duration of the Project, and at Project Completion (100%) after Implementation of the Solution**

Note that although the curves of Figure 12 are similar, the BAC value increases or decreases based on the average exchange rate for the evaluated period where the calculation was performed.

Using the proposed solution, a variance between the project currency BAC and the functional currency BAC calculated will still occur due to the exchange rate averages used. However, the resulting BAC will be more accurate than the initial BAC calculated using the project start exchange rate.

### 7.3 Results of Proposed Solution

The following figure shows the earned value curves of the functional currency after the adjustments have been made using the proposed solution. Table 9 shows the variance between the adjusted curves of Figure 13 and Figure 7, i.e., the difference between the earned value results for the project and the functional currencies after implementation of the proposed solution.



**Figure 13 – Project Earned Value at 100% of the Contract Duration in the Functional Currency after Implementation of the Proposed Solution**

**Table 9 – Comparison of the Project Earned Value at 100% of the Contract Duration between the Project and Functional Currencies after Implementation of the Proposed Solution**

Calculation	Project Currency	Functional Currency	Variance
CPI	0.95307	0.95834	0.53%

Therefore, the proposed solution provides a workable method to more accurately evaluate the project’s earned value in the functional currency in addition to that of the project currency.

## 8 CONCLUSION

The difficulties encountered by multi-currency projects because of volatile exchange rates complicate an EVMS in that the report showing the project currency may assist with project management, but it provides inaccurate data from a business management perspective. In projects where one of the currencies (project or functional) have a volatile exchange rate, the risk of the contractor may increase if the effect of the exchange risks on the project is not monitored closely.

By applying the proposed solution, more accurate earned value calculations can be made in the functional currency. This results in reports that add value for both project management and contractor business management.

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## **A PLANNING STRATEGY TO IMPROVE ECONOMIC DEVELOPMENT OF SOUTH AFRICA: MDG1**

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### **ABSTRACT**

In 1987, the World Commission on Environment and Development published a Brundtland Report entitled "Our Common Future". They defined sustainable development as 'development that meets the needs of the present generation without compromising the ability for future generation to meet their needs (HSRC 2000).

Development planning at international level has focused on the Millennium Development Goals, which are called Sustainable Development Goals, with 17 Sustainable development goals. In this paper we will focus on goal number 1, to eradicate extreme hunger and poverty in South Africa.

**Key words:** Sustainability, MDG, South Africa.

### **1 INTRODUCTION**

The Millennium Development Goals focus mostly on addressing extreme poverty, hunger, gender equality, education and so on. They mark a historic and effective global mobilization effort to achieve a set of common societal priorities, by packaging these priorities into an easy to understand set of different goals, and by establishing measurable, time-bound objectives. The Millennium Development Goals promote global awareness, political accountability, improved monitoring, and mobilization of epistemic communities, civic participation, and public pressure.

2014 did not only commemorate 20 years of democracy, it also marked the year that the South African government had set for itself to meet and surpass most of the Millennium Development Goals. South Africa had also set specific goals of its own in 2004, some of which overlapped with the Millennium Development Goals that were to be achieved by 2014. These include reducing poverty and unemployment by half, providing the skills required by the economy and reducing cases of tuberculosis, diabetes, malnutrition and maternal deaths, turning the tide against HIV/AIDS, and reducing preventable causes of death.

#### **1.1 Theoretical Background of poverty**

Definition of Poverty: Poverty is a multidimensional phenomenon and complex issue to be defined. The World Bank (1990,26) defines poverty as the inability to attain a minimum standard of living and produced a universal poverty line of \$1 or \$2 a day to identify the poverty by reference to the overall standard of living. Ringen (1998) argues that poverty is a standard of consumption which is below what is considered minimum.

According to Bradshaw (2006), recent literature on poverty acknowledges different theories of poverty, but the literature has classified these theories in multiple ways (for example, compare Blank, 2003; Goldsmith and Blakely, 1992; Jennings and Kushnick, 1999; Rodgers, 2000; Schiller, 1989; Shaw, 1996). Virtually all authors distinguish between theories that root the cause of poverty in individual deficiencies (conservative) and theories that lay the cause on broader social phenomena (liberal or progressive). Ryan (1976), cited in Bradshaw (2006), addresses this dichotomy in terms of “blaming the victim”. Goldsmith and Blakely (1992), for example, distinguish “Poverty as pathology” from poverty as incident or accident” and “poverty as structure”.

Schiller (1989:2-3) on the other hand, explains it in terms of “flawed characters, restricted opportunity, and Big Brother” while Jennings (1999) reviews a number of variants on these individual and society conceptions, giving emphasis to racial and political dynamics (Bradshaw, 2006). Rank (2004:50). is adamant that “the focus on individual attributes as the cause of poverty is misplaced and misdirected”, and contends that structural failings of the economic, political, and social system are caused instead. The various theories are divergent and each result in a different type of community development intervention strategy.

Of the five explicit theories of poverty discussed by Bradshaw (2006), this paper will focus on the third one: Poverty caused by Economic, Political, and Social Distortions or Discrimination. The theories are listed below:

Poverty Caused by individual Deficiencies

Poverty Caused by Cultural Belief Systems that Support Sub-Cultures of Poverty

Poverty Caused by Economic, Political, and Social Distortions or Discrimination

Poverty Caused by Geographical Disparities

Poverty Caused by Cumulative and Cyclical Independencies

Since the abolition of apartheid, one of the key objectives of the South African government has been to reduce the level of poverty and improve the quality of life for all South Africans.

Nearly 25 years into democracy, South Africa is still battling with issues of poverty, inequality, unemployment and hunger. Thus, the overarching policy of government to address Millennium Development Goal 1 (MDG 1) is through the provision of a “social wage” package intended to reduce the cost of living of the poor. Social wages in South Africa are packaged in different targeted forms. In the list of these are the following: free primary care, no-fee paying schools, social grants (such as old age pensions, and child support grants), RDP housing, provision of basic and free basic services in the form of reticulated water, electricity, sanitation and sewerage as well as solid waste management to households, particular those categorized as indigent. Since 2001 the indigent household are entitled to a monthly free six kiloliters of water, fifty kWh of electricity and R50 worth of sanitation, sewerage and refuse removal.

## **1.2. Methodology**

Literature study, different types of sources such internet sources, books, theses, dissertations and journals were used to serve as a theoretical and literature basis of this paper. All sources used in this paper are clearly specified and acknowledged. This was desk top research.

## **2 HISTORICAL OVERVIEW**

At the United Nations’ Millennium Summit in September 2000, world leaders endorsed a set of time-bound and measurable goals and targets to combat poverty, hunger, diseases, illiteracy, environmental degradation and gender inequality and create a global partnership for development.

189 Heads of State came together at the United Nations Millennium Summit in New York and signed the Millennium Declaration, thereby strongly affirming the commitment and will of their nations and the international community to the achievement of the Millennium Development Goals by 2015 (Cimadamore, 2013).

According to Cimadamore (2013), this global agreement, now known as the Millennium Development Goals, was endorsed by all members of the United Nations. In developing countries, the Millennium Development Goals are proving their potential to bring together a wide range of opinion and decision-makers in support of a common development agenda (Cimadamore, 2013).

According to Pogge (2013), in the year 2000, the rousing Millennium Declaration and its timid operationalization, the Millennium Development Goal, conveyed the message that concrete and stepped-up action was needed. The economic and social systems were reproducing poverty and exclusions at levels that were not compatible with democratic ideals and the notion of dignity and a decent life for all. These had been promised by the United Nations and the multilateral system since 1945. The Millennium Declaration signed by leaders of 189 states resulted in one of the most visible and unified global campaigns to address poverty in the history of multilateral development cooperation, viz. the Millennium Development Goals (Pogge, 2013). Below the list of the MDG goals:

1. To eradicate extreme poverty and hunger
2. To promote universal primary education
3. To promote gender equality and empower women
4. To reduce child mortality
5. To improve maternal health
6. To combat HIV/AIDS, malaria and other diseases
7. To ensure environmental sustainability
8. To develop a global partnership for the development.

A critical review of the Millennium Development Goals needs to acknowledge their merits, even if the text of the eight Millennium Development Goals considerably weakened and watered down the core tenets of the Millennium Declaration (Pogge, 2013). According to Cimadamore (2013), chapter III of the Millennium Declaration on development and poverty eradication, for example, had clearly spelt out the commitment of the leaders of the world to spare no effort to free our fellow men, women and children from the abject and dehumanizing conditions of extreme poverty and to making the right to development a reality for everyone and to freeing the entire human race from want. The road out of poverty was more vaguely defined as the aspiration to create an environment at national and global levels alike, conducive to development and to the elimination of poverty (Cimadamore, 2013).

### **2.1 Millennium Development Goal 1: Eradicate Extreme Hunger and Poverty**

According to Koehler (2015) the Millennium Development Goal 1 is to eradicate extreme poverty and hunger and the first target is, between 1990 and 2015, to halve the proportion of people whose income is less than one dollar a day. Globally, we are well on track towards this target. On present trends, by 2015 the proportion of people living in extreme poverty should have passed below the 14 percent target. This achievement owes much to progress in East Asia and the Pacific. South Asia is also on track, as is Latin America and the Caribbean. But sub-Saharan Africa is proceeding at a much slower pace: by 2004 the region had only reduced the proportion living in extreme poverty from 47 percent to 41 percent (Koehler, 2015).

The target of 24 percent by 2015 seems increasingly out of reach. As a result, by then close to half of the world's poorest people would have been concentrated in sub-Saharan Africa. The poverty goal included targets on nutrition aiming to have halved the prevalence of underweight children under five

by 2015. Globally, this target is likely to be missed (Koehler, 2015). According to Alkire and Foster (2011), continuing the fight against poverty will require sustained investment in human development ensuring that families have the standards of education, nutrition and health that allow them to develop their capacities, as well as creating employment and other opportunities that allow them to use those capacities (Alkire & Foster, 2011).

It is important to note that during the Millennium Development Goals implementation phase, improvements in business and macroeconomic environments coupled with high commodity prices accounted for most of the growth and poverty reduction of the past decade. However, even with such strong growth, reducing the high rates of poverty prevalent on the continent has been hampered by overreliance on a few sectors for growth, high unemployment rates particularly for youth and women and a lack of industries to absorb the continent's existing large labour supply. Koehler (2015) further argues that, while, broadly speaking economic growth has played a significant role in poverty reduction, the reduction has not been sufficient to meet the Millennium Development Goal 1 target of halving poverty by 2015, nor to meet the human development challenges that remain enormous on the continent.

Africa, excluding North Africa, remains the most difficult region for human development although worldwide human development indicators have shown positive and strong progress. Poverty in Africa, excluding North Africa, went down from 56.9 percent in 1990 to 42.8 percent in 2012, while North Africa achieved a 60 percent reduction in poverty rates over the same period. Despite the 14.2 percent drop in the poverty rate, Africa's rapid population growth means that there are still many more poor people on the continent today than there were in 1990, with 389 million people in Africa, excluding North Africa, living in poverty in 2012, compared to 280 million in 1990.

## **2.2 Progress**

According to Langford, Bartram and Roaf (2013) between 1990 and 2005, the proportion of people living below the poverty line fell from 42 per cent to 25 per cent, and based on this trend the developing world as a whole is on track to meet this Goal 1 target. But, the pattern of growth has not been even across the globe and some regions remain off track (Langford, Bartram & Roaf, 2013). The effect of the global economic crisis on developing countries has yet to be fully quantified, but it could push a further 90 million people into poverty. Monitoring how the crisis is affecting the poor and putting in place mitigating and supporting initiatives will be crucial to keeping this number down.

According to Chowdhury (2011) higher food prices have triggered an increase in hunger worldwide making the task of reaching this target more difficult. In September 2008, the United Nations Food and Agriculture Organization announced that high global food prices had pushed 75 million more people into hunger the number of people suffering from hunger is now 923 million. However, there has been a reduction in hunger in Eastern and South East Asia. These regions, along with Latin America and the Caribbean, are expected to meet the target. In Sub-Saharan Africa, Southern Asia, and Western Asia, the absolute number of undernourished has increased, but the percentage of undernourished has decreased (Chowdhury, 2011).

According to the latest information provided by the World Bank on data and analysis for Goal 1, the number of people living on less than US\$ 1.25 a day, declined globally from 1.922 billion in 1990 to 1.011 billion in 2011 (Chowdhury, 2011). The proportion of extreme poor as a percentage of the population of the developing countries decreased from 43.35 percent in 1990 to 16.99 percent in 2011. It is quite clear that, according to this measurement, extreme poverty can be reported as reduced. Poverty rates have been halved and about 700 million fewer people lived in conditions of extreme poverty in 2010 than in 1990. Such quick facts show that the Millennium Development Goals campaign is moving in the right direction (Chowdhury, 2011)



### **2.3 Challenges**

According to Kanbur (2005) the world grows enough food to feed its population. To eradicate hunger, ordinary people need to be able to access food either by growing it or by buying it. Poverty is the primary cause of hunger, and poverty reduction is the principal means of tackling it. But climate change, poor farm productivity, weak governance, and armed conflict are also contributing factors. Drought and other natural disasters often increase the number of people facing acute hunger. Hunger reduces the ability of the poor to work and make a living (Kanbur, 2005).

According to Karnani (2011) government policies and actions are critical for creating an environment in which people can obtain enough food. These include encouraging efficient markets and trade; enhancing productivity, especially farm productivity, and economic growth; tackling risk and vulnerability and putting in place measures to assist the poor directly. International support is needed to meet the immediate needs of vulnerable populations by improving access to food and nutrition support and increasing food availability.

This includes humanitarian actions as well as actions to boost smallholder farmer-led food production, trade, and tax measures. It is also critical to establish better global information and monitoring systems. Countries need sustained economic growth if they are to lift a significant number of people out of poverty, and it is the countries with the strongest growth rates that have seen the greatest progress in income poverty reduction (Karnani, 2011).

According to Karnani (2011), food and fuel price rises have changed the outlook for growth and limited developing country governments' ability to provide public services and protect the poor. Policies to stimulate investment are affected by conditions beyond their control, for example, gaining access to international markets for developing countries is likely to be more difficult. There needs to be continuing support to countries to lay the foundation for future economic growth by strengthening the environment for investment and job creation. It will also include action to protect the poor and ensure they have access to hospitals and schools and can feed their families (Karnani, 2011).

### **3 DISCUSSION OF THE CHOSEN MILLENNIUM DEVELOPMENT GOAL IN THE SOUTH AFRICAN CONTEXT**

The Millennium Development Goals were adopted in September 2000 through the Millennium Declaration at the 55th session of the United Nations General Assembly, convened as the 'Millennium Assembly'. South Africa had also set specific goals of its own in 2004, some of which overlapped with the Millennium Development Goals that were to be achieved by 2014. These include Goal 1: Eradicating Extreme Poverty and Hunger. The 2013 South African Millennium Development Goals report outlined that the government integrated the Millennium Development Goals into the Medium-Term Strategic Framework, the National Development Plan (NDP) and other policy planning and implementation instruments (Gumede, 2014).

According to Bhorat et al (2010,14), the challenge of poverty in South Africa is multidimensional, as it is in most parts of the developing world. In the main, though, poverty in South Africa is structural it is the structure of the economy that perpetuates poverty through its capital intensity, mineral-energy-complex character, and high-skill demand in the labour market. Gumede (2014) further argues that poverty remains very high in South Africa at least 40 percent of South Africans still live below the poverty line. It might also be that income poverty is increasing in South Africa due to the deteriorating domestic economy, increase in unemployment rate and poor state of the global economy (Gumede, 2014).

According to Frye, Farred and Nojekwa (2011: 260), there is general consensus in South Africa that inequality, particularly economic inequality and poverty, specifically income poverty, have remained

unacceptably high. Poverty and inequality in South Africa have a very clear racial bias as a result of the colonial and apartheid policies of racial discrimination and deliberate impoverishment. Also, in the South African context, the strong inequality between the various racial groups has always been a significant driver of aggregate inequality and poverty (Bhorat et al., 2010:14). Inequality is largely a function of an under-transformed labour market and a skewed structure of the economy in South Africa, the entrenched legacy of apartheid colonialism has ensured that economic inequality has increased and remains very high (Frye et al., 2011:260).

### **3.1 Progress Made in South Africa**

According to Gumede (2014), South Africa has made significant progress in reducing the depth of poverty and quality of life of those continuing to live below determined poverty lines where it managed to reduce the depth of poverty across several defined poverty gaps. South Africa's fiscal and social policies are widely acknowledged as being pro-poor and contributes to reduced poverty headcounts. South Africa's leveraging of its taxation system in the fight against poverty and inequality has enabled expansion of the social assistance system, increasing access to healthcare and education and extending free basic services to large numbers of indigent households (Gumede, 2014).

According to Thwala (2011), South Africa attained three of the nine Millennium Development Goals indicators marking progress towards achieving reductions in poverty and hunger. The results show that progress has been made towards eradicating extreme poverty and hunger as defined by the international Millennium Development Goal poverty lines. Income inequality remains a challenge, however between 2001 and 2011 the proportion of households which are multi-dimensionally poor fell from 17.9 percent to 8.0 percent (Thwala, 2011).

According to Gumede (2014), the coverage of social grants increased from just over 2.5 million in 1997 to approximately 16.6 million beneficiaries by February 2015. The share of the poorest quintiles in national consumption which is defined as the income versus consumption that accrues to the poorest fifth of the population has decreased from 2.9 percent in 2000 to 2.7 percent in 2011 which is still below the Millennium Development Goal target of 5.8 percent. The employment-to-population ratio which measures the economy's ability to create enough jobs for those willing to work has reached 42.8 percent in 2014, thus falling far short of the 50 percent to 70 percent target. The unemployment rate remained high, in 2013; it stood at 24.7 percent according to the official definition. (Gumede, 2014).

### **3.2 Challenges Facing South Africa**

According to Aharonovitz (2011), during the past two decades, South Africa has grappled with the triple challenges of poverty, unemployment and inequality. South Africa's unemployment problem is the biggest threat to achieving universal poverty reduction. The situation has not improved sufficiently between 1990 and 2015 to meet the Millennium Development Goal targets and provide a foundation for sound national social and economic development. Van der Berg (2007) further argues that the major thrust of South Africa's challenges has to do with apartheid colonialism and its profound and lingering legacy. It is in this context that the government should have been more serious about meeting Millennium Development Goals and addressing other pressing developmental challenges.

According to Sachs (2005), apartheid colonialism employed various strategies and policies to sustain white control over the economy and to guarantee superior living conditions at the expense of South Africa's other population groups. One way of examining the severity of the ramifications of apartheid colonialism is to analyse the post-apartheid development dilemmas that constrain South Africa's socio-economic progress. The main ones are race relations, economic inequality and poverty (Sachs, 2005).

According to Van der Berg (2007) in discourses related to the latter two, the government frequently talks of the “triple challenge” of unemployment, poverty and inequality. Linked to the three main development dilemmas is unemployment, because of a poorly performing economy, and weak human development, because of poor education and health. Aharonovitz (2011) state that sound social policies should form the foundation of Africa’s developmental progress, including socio-economic development in South Africa.

### **3.3 Experience of South Africa**

South Africa has started the fight against poverty in 1994 and this is reflected in the types of policies adopted. The government has always shown concerns on poverty and has since aimed at addressing poverty and ensuring a better life for all. Despite the government efforts in poverty reduction, there are certain groups of people experiencing poverty. Recently Anti-poverty initiatives have been successfully mainstreamed into the planning and implementation of government programmers and in the budgeting process in order to wage a fight against poverty.

Poverty has been declining in South Africa. As per poverty threshold of \$1 to \$2.50 the proportion of the population living in poverty and poverty gap has been reduced. Based on Millennium Development Goal (MDG) of halving poverty proportions by 2015, South Africa has successfully achieved this goal by reducing poverty from 11.3 percent in 2000 to 5 percent in 2006 using the poverty line if \$1 per day. Despite the decline in poverty levels, the proportion of females living in poverty is still as high as 12 percent and 5.3 percent in the year 2000 and 2006 respectively as compared to the proportion of males living in poverty running at 10 percent in 2000 and 4.8 percent in 2006. Despite the excellent performance of poverty reduction, South Africa is unlikely to reach the MDG target at \$2.50 per day of halving the population below poverty line

## **4 PLANNING STRATEGY TO IMPROVE ECONOMIC DEVELOPMENT OF SOUTH AFRICA**

### **4.1 The Distribution of Income Strategy**

According to Chenery and Kretschmer (1956), changes in the distribution of income are the most political part of the development process; provoke the most envy and the most unrest. Sensible policymaking is impossible without understanding why these changes occur, and what function they serve.

#### **4.1.1 Growth versus Distribution**

According to Chenery and Kretschmer (1956), normally, in the early stages of development, when the rate of economic growth is accelerating, the distribution of income becomes more uneven; in the later stages distribution stabilizes, then tends to be less uneven. Distribution becomes less even in the early stages, because acceleration of the rate of growth creates acute shortages of those factors of production which play the greatest part in bringing about growth.

According to Chenery and Kretschmer (1956), entrepreneurs are scarce, and in a private enterprise system will remain scarce if profits are low. If growth is accelerating profits are high and since the modern sector is growing faster than the traditional the relative share of profits in national income must increase even if the relative share of profits in the modern sector is constant. Chenery and Kretschmer (1956) further argued that there is acceleration in the demand for technicians, engineers, administrators, accountants and other educated persons, so middle class incomes rise. Incomes of skilled workers rise relatively to those of the unskilled for the same reason.

According to Lewis (1966), a change in distribution occurs because demand and supply are out of equilibrium; the supply of some resource is either too small or too large. A rising price signals that supply is growing too slowly, but the movement is self-reversing. For the price increase encourages people to increase supply to check the rise in price and if it has been excessive to bring the price down

again, faced with a change in distribution, the policy maker may react in one of two conflicting ways. The easier and more popular is to control the price; the more difficult is to effect an increase in supply. The two conflict because the incentive to increase supply is reduced when the price is not allowed to rise (Lewis, 1966).

The planner's contribution is to put major emphasis on increasing the supply of those resources whose scarcity is responsible for the uneven distribution of income. The conflict between distribution and growth arises only out of shortage of supply; if shortage can be eliminated, growth is possible without uneven distribution. However, shortage cannot be eliminated without incentives; so, the planner has also to plead for that minimum of change in distribution without which supply cannot be adequately increased (Lewis, 1966).

#### **4.1.2 Farm Incomes**

According to Hapgood and Millikan (1965), development may raise or lower the farmers' incomes. Since farmers are more than half the population an increase in their real incomes is much to be desired, the main purpose of development is to raise the real incomes of most of the people. Farmers' incomes fall if world prices move against them, or, in commodities insulated from world prices, if supply increases faster than demand. The former case is liable to damage the whole economy; the latter calls for more rapid development outside agriculture, which would increase the demand, and at the same time through migration, reduce the supply (Hapgood & Millikan, 1965).

According to Lewis (1966), the kind of increase in farm incomes which is required is not that which is due to food prices rising relatively to other domestic prices: this makes the farmers richer, but only at the expense of the rest of the population; and it may bring development to a stop by raising wages relatively to profits. The kind of increase in farm income which is required is that which is due to an increase in productivity or to an increase in exports or the prices of exports (Lewis, 1966).

An increase in farm income, due to the right causes, helps not only the farmers but also the rest of the economy. In countries where development policies mainly make the rich richer, the market for local manufactures is limited, since the rich spend much of their surplus on luxury imports and foreign travel (Lewis: 1966). By contrast, an increase in farm income widens the market for manufactures, and so stimulates industrialization; even the difference between a good harvest and a bad harvest can be observed in industrial output, once the limits of import substitution have been reached (Lewis, 1966). According to Lewis (1966), an increase in farm income also increases the resources available for development. Farmers save and invest more; borrow less from other sectors; or invest more in other sectors. They can also be taxed more heavily, the proceeds being used either to finance public services, or to finance increased capital formation. Hapgood and Millikan (1965) further argues that if the farmers save more, the economy is not so dependent on the savings of capitalists and need not therefore be so tender towards profits. Thus, a sound agricultural policy is a necessary basis for policy towards all other incomes, including wages and profits; for rising farm productivity provides leeway which does not exist when agriculture is stagnant.

#### **4.1.3 Differentials for Skills**

According to Anderson and Bowman (1965), the range of wages and salaries is much greater in poor than in rich countries because of the relatively greater shortage of skills. This handicaps development since it makes relatively expensive all services and industries which depend on skill and these tend to be the sectors that should grow fastest in a developing economy (Anderson & Bowman, 1965).

According to Lewis (1966), the situation is currently worst in Africa, which has been importing not only university graduates, and high school graduates, but also skilled artisans, and which has inconsequence had to establish for these grades salaries higher than could be earned in Europe,

whence personnel has been recruited. The ratio between the earnings of high school graduates and of unskilled workers is therefore fantastic, when compared with differentials in other continents (Lewis, 1966).

According to Lewis (1966), this situation will reverse itself dramatically as the proportion of young people passing through secondary schools climbs to 10 percent, and the university proportion to 1 per cent and more. The higher incomes may not fall in terms of money, but they must fall relatively, as unskilled wages rise faster than middle class salaries, and real income may even fall absolutely, as the opportunity of hiring servants cheaply diminishes. This will not happen without heartache. For those few Africans who currently enjoy higher than European standards will deeply resent their loss of status, if not also their loss of servants, and will make political trouble (Lewis, 1966).

#### **4.1.4 Wages**

According to Reynolds (1965), politically the most difficult problem in new states is wages policy, since the trade unions have usually more power than either the middle classes or the farmers. Both the general level of wages and the differentials between prosperous and less prosperous industries cause trouble.

From the point of view of trade unions, the obvious policy to pursue is to raise wages highest in the industries which can pay most, and trust to the high wages there to pull up the low wages elsewhere. We have already seen the disastrous consequences this can have for employment. One industry can pay higher wages than another, whether because it can more easily pass wages on to the consumer or the taxpayer in higher prices (or taxes), or because it is using natural resources which it has obtained too cheaply or because the opportunities for mechanization are specially good (Reynolds, 1965).

According to Lewis (1966), raising wages in such an industry may have little effect on investment there, but it pulls down investment in the rest of the economy, as wages are driven up there, or pulls down employment by turning investment in the labour-saving direction. Lewis (1966) further states that if a country wants to achieve a high level of investment it is clearly undesirable that the general level of wages be determined by what the most prosperous industry can afford to pay. The appropriate way to treat industries with excess profits is not to raise their wages but to levy taxes on them if they are producing for an export market, or to control their prices if they are producing for the home market under monopolistic conditions (Lewis, 1966).

In the absence of Trade Union or Government Pressure, the general level of wages would be determined by the level of agricultural incomes, since by paying something more than the average agricultural income, the towns could get all the labour they wanted (Lewis, 1966). Urban wages will always exceed farm incomes, partly because the cost of living in towns is higher, partly because a more rapidly growing sector has to offer higher real earnings in order to attract labour, partly because working eight hours a day for five or six days a week throughout the year requires a greater input of food than working the farmer's year, and partly because working eight hours every day for wages in towns is less pleasant than working on one's farm, and therefore demands higher compensations (Lewis, 1966).

#### **4.1.5 Profit**

According to Abramovitz (1959), profit generates enterprise and saving. An economy can dispense with private enterprise if it possesses a capable and enterprising public service, but it cannot in any case dispense with profit, since profit is the major source of saving in a developing economy, whether in private or public enterprise (Abramovitz, 1959).

According to Abramovitz (1959), small farmers do a fair amount of saving in kind, using their own labour for physical improvement of their farms and houses; but they tend to look outside agriculture for funds to finance those agricultural investments which require a good deal of money, whether on the farms or off the farms. So, the modern sector has sometimes to finance not only itself but some part of agriculture as well, unless the farmers are properly taxed.

According to Lewis (1966), the working classes save very little, and what the salaried classes save goes mainly into housing and education. Profits provide most of the saving for new investment in commerce and industry. They are also a major source of taxation. An economy will grow rapidly if profits are high and will stagnate if profits are low (Lewis, 1966).

According to Lewis (1966), in an economy depending mainly on public enterprise, the government has no difficulty in seeing the close connection between the share of profits and the rate of growth, and in the early stages of its development programme, always throws its weight on the side of keeping down real wages. In a private enterprise economy dominated politically by capitalists, the same philosophy is effective. In a private enterprise economy whose government is hostile to capitalists, the conflict between growth and distribution comes to a head. (Lewis, 1966).

#### **4.2 Income Policy**

According to Chenery and Kretschmer (1956) if it were feasible to regard the level of profits as a matter mainly between the government and the employers, in the sense that the government will set tax rates or control prices at whatever gives the appropriate level of profits, then the desirable wages policy would be clear. Chenery and Kretschmer (1956) further stated that there is no ethical or economic reason why unskilled labour should outdistance the farmers, at the cost of increased unemployment and reduced saving and investment. The main elements of an incomes policy would then be clear:

- Raise agricultural productivity as quickly as possible
- Keep unskilled wages about 50 percent above average agricultural incomes
- Accelerate the output from secondary schools, training schools and universities, so as to diminish the gap between middle class and working-class earnings in a private enterprise economy
- Tax profits as heavily as they can bear without reducing gross private investment below 15 percent of national income.

According to Reynolds (1965) this is not a wage freeze policy since, if agricultural productivity is rising, workers' and farmers' incomes will both rise in step. It is only a policy for the early stages of growth. If private investment exceeds 15 percent, the modern sector must sooner or later absorb all the surplus farm labour and the gap between wages and farm incomes will have to widen if the labour force of the modern sector is to continue its relative expansion. Reynolds (1965) further argued that by that time wage earners will be so large in numbers relatively to farmers that their incomes will determine the farmers', rather than the other way around.

According to Reynolds (1965) this formula is only one possible solution; it assumes that in a private enterprise economy profits are recognized as necessary to growth; that growth is given equal priority with distribution, and that as far as possible the fruits of growth should be enjoyed generally, rather than be concentrated on workers in some industries, or on special grades of skill. Reynolds (1965) further argued that these assumptions are acceptable to most governments, and even to some trade union leaders, but are difficult to sell to the rank and file. Based on mutual confidence between political and trade union leaders, is one of the more important features of development strategy (Reynolds, 1965).

According to Lewis (1966) government should spend liberally on social services, especially education, health and welfare services, and take aggressive steps to improve working class housing; adequate opportunities for secondary education are especially valued because they give working class families the sense of an opening future. Lewis (1966) further argued that the employment aspects of the Plan should also receive special consideration; prestige expenditures should be cut, and the money used instead to create resources which will provide employment; capital-intensive schemes should give place to more productive labour-intensive enterprises; and useful relief projects should be started for all who are genuinely seeking work (Lewis, 1966).

## **5 CONCLUSION**

The Millennium Development Goals which were adopted in 2000 to focus on developing countries only ended up in 2015. Since their adoption the millennium Development goals have played a role in lifting more than one billion people from extreme poverty, reducing the number of people suffering chronic hunger, preventable death and illness, and enabling more girls and boys to attend school than ever before. People today, in all regions are on average healthier, better educated and more prosperous than ever before.

The Declaration, adopted by Member States of the United Nations General Assembly in the year 2000, articulated the world's collective responsibility to uphold the principles of human dignity, equality and equity at the global level" and to eradicate the world's most extreme and deplorable conditions, including poverty and destitution. South Africa has done relatively well in some Millennium Development Goals. Although there are improvements and major challenges remain with Millennium Development Goal 1. The post-2015 development agenda for South Africa should prioritise socio-economic challenges that relate to income inequality, job creation, poverty reduction and social cohesion.

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## **COMPARISON OF A CLOSED-CIRCUIT TELEVISION (CCTV) VIDEO SURVEILLANCE WITH A CAMERA TRIPOD TRADITIONAL METHOD OF CAPTURING VIDEO FOOTAGE IN A PRODUCTION FACILITY WHEN CONDUCTING MOTION & TIME STUDY**

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### **ABSTRACT**

Conducting workstudy, method study and motion study is a key in productivity improvement. Workstudy involves analyzing all the factors that affect the operation's efficiency and economy. Using CCTV saves time, reduces human errors, and improves workers effectiveness because it does not interrupt production. Traditional method of using a tripod camera to capture a video footage in a production line is time consuming, subjected to a lot of human errors and it can sometimes interrupt production. To address and understand the problem; experimental observation, benchmarks and some literature analysis were used to compare the tripod camera method of capturing production footage with mounted installed CCTV in the production shop floor. This paper highlights the benefits of mounting CCTV in the production shop floor compared to using a camera placed on a floor-standing tripod when conducting motion analysis and time study. Observational experiment results show that using CCTV surveillance camera is 60 - 80% effective and subjected to less human error.

**Keywords:** Productivity, CCTV, method study, time study, workstudy

### **1 INTRODUCTION**

This paper compares the benefits and doubts of using a closed-circuit television and a tripod traditional method of capturing video footage in a production shop floor as one conducts motion analysis and time study. Using closed circuit television at work is subjected to data protection and human rights law and could also breach the duties of one's employees (McClatchie, 2009). Traditional method of capturing video footage in a production shop floor by using a camera placed on a floor-standing tripod is also another method of motion, workstudy and method study detection. Legitimate reasons why employers monitor employees using CCTV are to keep employees safe, secure by preventing violence or theft, monitor labor productivity, measure performance, ensure and record that health and safety procedures are being followed. One main legitimate reason for writing this paper is that CCTV monitors and improve productivity in the production shop floor (Susan, 2011). Experimental, benchmarks, observational and literature analysis were used to find benefits and disadvantages of the two methods. Traditional methods of capturing footage in a production shop floor improves productivity. The objective of this project is to assist private abattoirs to improve its productivity, work methods, safety, ergonomics, and operational efficiency.

### 1.1 Background

A camera is an optical instrument or device that records or capture images that can be stored for future use, locally or be transmitted to another location (Wikipedia, 2018). The author further stated that the functioning of the camera is very similar to the functions of the human eye, i.e. it senses subjects without any contact. Camera works with the light of a visible spectrum or with other elements of the electromagnetic spectrum. Below in Figure 1 shows an example of a camera with its labelled components. For a camera to work, a light enters an encircled box through a convex or converging lens and an image is recorded on a light- sensitive medium. A shutter component controls the length of the time that light can enter the camera. There are various types of cameras which include plate camera, folding camera, box camera, rangefinder camera, instant picture camera, single- lens reflex, twin-lens reflex, large-format camera, medium-format camera, sub miniature camera, movie camera, camcorders, professional video camera, digital camera, panoramic camera, VR camera, and this cameras vary according to their lenses, focus length, exposure control, and rendering (Steven & Edward, 2007). The lens of a camera captures the light from the subject and carries it to a focus on the sensor (Peter & Robert, 2003). Peter & Robert (2003) stated that the design and the manufacture of the lens is very important and critical because it determines the quality of the photograph being taken. Moreover, the author explained that camera lenses are made in a wide range of focal lengths which ranges from extreme wide angle, standard and medium telephoto. Robert (2000) stated that each lens is best suited for a certain type of photography in a way that the extreme wide angel lens is most suitable for architecture because it has the capacity to capture a wide view of a building, a normal lens is most often used for street and documentary photography because it has a wide aperture while the telephoto lens is useful for sports and wildlife. A tripod camera traditional method of capturing production video and a mounted closed-circuit television as methods of capturing motion study and video in a production shop floor. Using CCTV is subjected to data protection and human rights law and could also breach the duties to employees. There are many important business reasons why business directors monitor employees using CCTV. Reasons for using CCTV in a production shop floor is to keep employees safe and secure by preventing violence and theft, to ensure and record that health and safety procedures are being followed, to monitor and improve productivity, to improve human factors, industrial ergonomics and to comply with regulatory requirements.



Figure 1: Camera with its components retrieved from (Parks, 2016)

The process of obtaining a producible and usable exposure involves the use of a few controls to ensure the video and photograph is clear, distinctive and well illuminated. These few controls were explained by Todd (2009) in Table 1 below:

Table 1: Camera control components and its description

Control	Description
---------	-------------

Focus	The position of a viewed object or the adjustment of an optical device necessary to produce a clear image: in focus and out of focus
Aperture	Adjustment of the lens opening measures as f-number, which controls the amount of light passing through the lens. Aperture also influences depth of field and diffraction; the higher the f-number, the smaller the opening, the less light, and the greater the depth of field, and the more the diffraction blur. The focal length divided by the f-number gives the effective aperture number
Filters	It is placed between the subject and the light recording material to balance the exposure of a bright sky with a darker foreground, to cut down on reflections and boost saturation and contrast.
Shutter speed	Modification of the speed (it is often expressed either as fractions of seconds or as an angle with mechanical shutters) of the shutter to control the amount of time during which the imaging medium is exposed to light for each exposure. Shutter speed may be used to control the amount of light striking the image plane. Faster shutter speeds (that is, those of shorter duration) decrease both the amount of light and the amount of image blurring from motion of the subject or camera. The slower shutter speeds allow for long exposure shots that are done used to photograph images in very low light including the images of the night sky.
White balance	On digital cameras, electronic compensation for the color temperature linked with a given set of lighting conditions, ensuring that white light is registered as such on the imaging chip and therefore that the colors in the frame will appear natural. On mechanical, film-based cameras, this function is served by the operator's choice of film stock or with color correction filters. In addition to using white balance to register natural coloration of the image, photographers may employ white balance to aesthetic end, for example, white balancing to a blue object to obtain a warm color temperature
Metering	Measurement of exposure so that highlights and shadows are exposed according to the photographer's wishes. Many modern cameras meter and set exposure automatically. Before automatic exposure, correct exposure was accomplished with the use of a separate light metering device or by the photographer's knowledge and experience of gauging correct

	settings. To translate the amount of light into a usable aperture and shutter speed, the meter needs to adjust for the sensitivity of the film or sensor to light. This is done by setting the film speed or ISO sensitivity into the meter.
Film speed	Film speed are employed on modern digital cameras as an indication of the system's gain from light to numerical output and to control the automatic exposure system. Film speed is usually measured via the ISO system. The higher the film speed number the greater the film sensitivity to light, whereas with a lower number, the film is less sensitive to light. A correct combination of film speed, aperture, and shutter speed leads to an image that is neither too dark nor too light leading to correct exposure, indicated by a centered meter.
Autofocus point	On some cameras, the selection of a point in the imaging frame upon which the auto-focus system will attempt to focus. Many Single-lens reflex cameras (SLR) feature multiple auto-focus points in the viewfinder.

### 1.1.1 Capturing of motion and time study video footage in a production shop floor using CCTV

When using CCTV three key areas of law must be observed. The first law is the protection law that states that employers must not act in a way which is likely to damage or destroy the mutual trust and confidence between an employer and employee. The second law is the data protection law which regulates how an employer can collect and process personal data about employees (include video footage that is recorded using CCTV cameras). The last law state that employers should respect their employees' rights to privacy under human rights law by making sure that CCTV monitoring is proportionate and not too intrusive. CCTV systems uses an analogue video signal, but there was an important update that was devised in 2015 whereby a new technology called analogue high definition abbreviated as AHD CCTV (Haldas, 2015). The image and video recording quality of a CCTV is determined by its resolution. There are various types of resolutions that are used in CCTV and these includes; high definition (HD), 1080p, 720p, D1, CIF and QCIF. High definition resolution supports 720p and 1080p (Haldas, 2015). Furthermore, the author further stated that CCTV resolution is measured in vertical and horizontal pixel dimensions and typically limited by the capabilities of both the camera and the recorder that is used for the CCTV surveillance installation. Even though CCTV has more advantages, it has some limitations too, that needs awareness of both operatives, management and board of directors. These limitations include regular compliance with data protection, change management initiatives, change management campaigns to aware affect members, thorough consultations with involved parties. Challenges that arise from capturing production footage in a production shop floor are expensive costs of installing and mounting CCTV in a production shop floor, employees resisting change of installation of CCTV, expensive training of the personnel who will be responsible for monitoring and analyzing the footage whenever there is an incident that needs to be reported (Hartley & Zizzerman, 2003). Below in Figure 2 is a CCTV installation and its communication process channel.

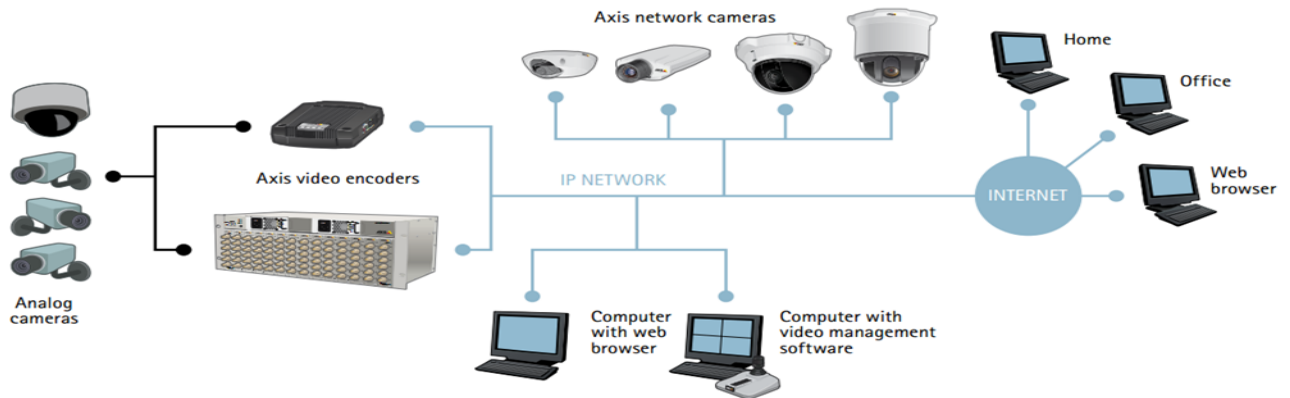


Figure 2: CCTV connections retrieved from (Administrator, 2006)

Below is a further explanation of CCTV resolutions that are used by CCTV system;

- **1080p CCTV Resolution**- It has 1920 x 1080 pixels and its image are very clear compared to 720p CCTV resolutions
- **720p CCTV Resolution** – It 1280 x 720 pixels and its image are clear
- **D1 CCTV Resolutions** – It has 704 x 480 pixels and is the highest resolution the CCTV system can record. High end digital video recorders offer this resolution at thirty frames per second recording.
- **CIF CCTV Resolutions**- It has 352 x 240 pixels in size and is quarter the resolution of D1. It is mostly used by mid-level stand-alone DVR recorders when recording real time video and by higher end systems for remote internet viewing (Haldas, 2015).
- **QCIF CCTV Resolutions**- It has 176 x 120 pixels in size and is one quarter the size of CIF resolution (Haldas, 2015). Furthermore, this resolution is typically used for remote reviewing from a mobile device (cellphone). Figure 3 is an example of CCTV cameras that were used for comparisons.



Figure 3: Pan tilted zoom and a fixed CCTV camera retrieved from (Admin, 2014)

### 1.1.2 Traditional method of capturing production footage using a tripod stand for supporting a camera in a production facility

A traditional method of capturing a video footage involves using a digital camera supported by a tripod stand to capture the video. According to Wikipedia (2018) a tripod provides a method of holding a camera at exactly the right angle and keeping it absolute still so that images and videos are pin-sharp

and full of detail. Furthermore Parks (2016), stated that a tripod is helpful since it enables a slower shutter speed to be used. Below in Figure 4 shows a tripod stand being used to capture a video footage. Convectional camera is used mostly because it is affordable and most industries use it for entertainment purposes and leisure (Christopher, 2011).



**Figure 4: A photographer using a tripod to capture a video footage retrieved from (Wikipedia, 2018) and a camera tripod retrieved from (Parks, 2016)**

### **1.1.3 Workstudy used as a benchmark method**

Workstudy can be used as method that can be used as a tool to company company's performance in terms of efficiency and productivity (Laguna & Marklund, 2005). Furthermore, benchmarks of workstudy in industries play important role in job simplification, job design, job enrichment, value analysis/engineering, method analysis, operational analysis. Haldas (2015) added that method study and work measurement techniques that can be benchmarked on how company use them to understand human work potential in terms of time spend on completing a task, ways to make the task simpler and easy, to increase productivity and efficiency.

## **2 METHODOLOGY**

### **2.1 Introduction**

This section explains methods that were used to collect information. Three data collection methods were used to find comparison of using a tripod camera traditional method and a mounted CCTV video surveillance method of capturing a video footage in a production shop floor. These methods were selected based on the available tools, methods, capacity and time.

### **2.2 Experimental study**

Several experiments were done to compare image quality of a mounted CCTV compared to a tripod traditional method of capturing a production video footage in a production facility. Textile and beef abattoir production industry were the industries that were selected for investigation. A Sony digital camera using a tripod stand and a mounted MPEG-4 CCTV surveillance were used during the study. Video quality was compared as the videos were analyzed. Distance between the camera's placement were varied for tripod camera while for a CCTV camera was fixed and about 500 meters. Parameters that were considered are image quality, video quality, visibility, energy consumed, operator interruptions to engaged working employees, employees' reactions, employees measurable errors noticed, flexibility, video resolution, remote video access, remote monitoring, efficiency and effectiveness.

### **2.3 Observational study**

Observation were made as the cameras were in place to capture production footage in a production shop floor. Observations were done to see how the employees react when there are being monitored by a CCTV surveillance and a tripod camera. Factors that were considered are employees' reaction,

effectiveness, performance errors. Employees were informed before motion and time study was conducted. Observation was the method that the author experienced while there was a benchmark session attended at two different companies that were carrying workstudy as a way of productivity improvement (i.e. CCTV for a textile industry and a tripod camera method for a beef abattoir). Direct observation was done at both the production lines and in the production shop floors. At first a detailed analysis of the operation was broken down so that non – productive activities are separated from a productive one. Behavioral factors were considered during direct observation method especially in a beef abattoir whereby a convectional camera supported by a tripod stand was used. After the activities were broken down, a CCTV was observed capturing motion analysis in a textile industry. Activities in a beef abattoir were also broken down and a convectional camera was taken under study to observe how it captures motion analysis. Both captured video footage was saved for later analysis.

#### **2.4 Literature review sources**

Secondary sources were used to support the two comparisons. There was limited secondary sources when writing this paper. It was relied mostly from a limited range of books and CCTV installation books.

#### **2.5 Data analysis procedure**

Analyzing information involves examining it in ways that reveal the relationships, patterns, trends, etc. that can be found within it (Kombo & Tromp, 2006). That may mean subjecting it to statistical operations that can tell you not only what kinds of relationships seem to exist among variables, but also to what level you can trust the answers one is getting from the results. Qualitative and quantitative data analysis were used to analyze the data using frequency tables, charts and graphs (Kombo & Tromp, 2006).

#### **2.6 Random sample**

Population of these production shop floors in Botswana was too big because there are approximately 35 production companies that has installed CCTV and about 30 production companies that has not installed CCTV surveillance camera in their production shop floor (Kibuka, Mordi, Bell, & Oumi, 1997). Sending out a questionnaire and conducting interviews at each of these companies would prove to be a very tedious and resource-intensive exercise. For this reason, it was more economically viable to sample the populations by means of a stratified sample. The Yamane (1967) formula for calculating sample sizes was used to calculate the sample size at 95% confidence level and P = 0.5.

$$n = \frac{N}{1 + Ne^2}$$

Where n is sample, N is the population, e is the error or level of precision. Using the above formula, the sample for selecting each company were calculated and tabulated in table 2 below.

**Table 2: Determination of sample size**

<b>Status of the company</b>	<b>Population size</b>	<b>Sample</b>
Company has installed CCTV surveillance camera	35	1
Company has not installed CCTV surveillance camera	30	1

#### **2.7 Benchmarking practice**

Laguna & Marklund (2005) defined benchmarking as a method that that compares the firms activities and performance with what others are doing. Moreover, the author further stated that benchmarks helps to assess the firms performance relative to the competition as a way to identify performance goals and gaps and also to stimulate creativity and inspire innovative ideas on how the process

performance. Christopher (2011) explained that benchmarking creates a competitive advantage through gaining information required within competitors and their internal systems and processes. The author adds that benchmark increase both quality and productivity through collaboration especially in industries that are non- competing. Benchmark was used to compare CCTV motion analysis in a textile industry and a a convectional method in a beef aabattoir.

### **3 RESULTS AND FINDINGS**

This section illustrates the results that were obtained from the data collection methods used, mainly benchmark, direct observation and one experiment conducted. Table 3 below shows a comparison results of a camera tripod traditional method and a mounted CCTV as method(s) of capturing a production video in a production shop floor that was found through the use literature sources, documents reviewed. More camera parameters were explored to extend the comparison of a camera tripod and a mounted CCTV surveillance camera and results analysis are shown in Table 4 below:

**Table 3: Comparison findings**

<b>Factor(s)</b>	<b>Camera tripod traditional method of capturing a production video footage in a production shop floor for time and motion study results</b>	<b>Mounting a CCTV surveillance camera in a production shop floor to capture a video production footage for motion and time study</b>
Employee’s effectiveness	It is affected	Not affected
Privacy	Exposed	Protected
Image quality	It is affected by the camera holder’s movement and experience when capturing video footage that day	It is not affected since it is mounted in a fixed position
Productivity	It can affect productivity and leads to less productivity	It does not affect productivity and leads to improved productivity in terms of better human factors, ergonomics and employee safety
Performance	Lowers performance especially when an employee is not confident enough or is an amateur	Does not affect performance because the employee works freely without camera disruption
Production disruption	Affects production when a photographer takes employees motion video	It does not disrupt production
Coverage	It may not cover the whole building	It can do large coverages when mounted in a suitable position
Specialist experience	Require less specialist’s experience	Requires specialized personnel for installation
Maintenance cost	Less cost	It is highly expensive to maintain it
Data loss	It is subjected to high data loss	It is subjected to less data loss
User’s morale	Affects the image and video quality for that day	It is not affected by nobody’s morale

Benchmark was one of the methodologies that was used to compare two tools that are used to capture motion analysis in a production shop floor. Results from benchmark were taken from a textile industry that had installed CCTV in their production line and a beef abattoir which was using



convectional Sony camera to capture motion analysis. Below in Table 4 parameters that were considered for comparisons.

**Table 4: Comparison findings**

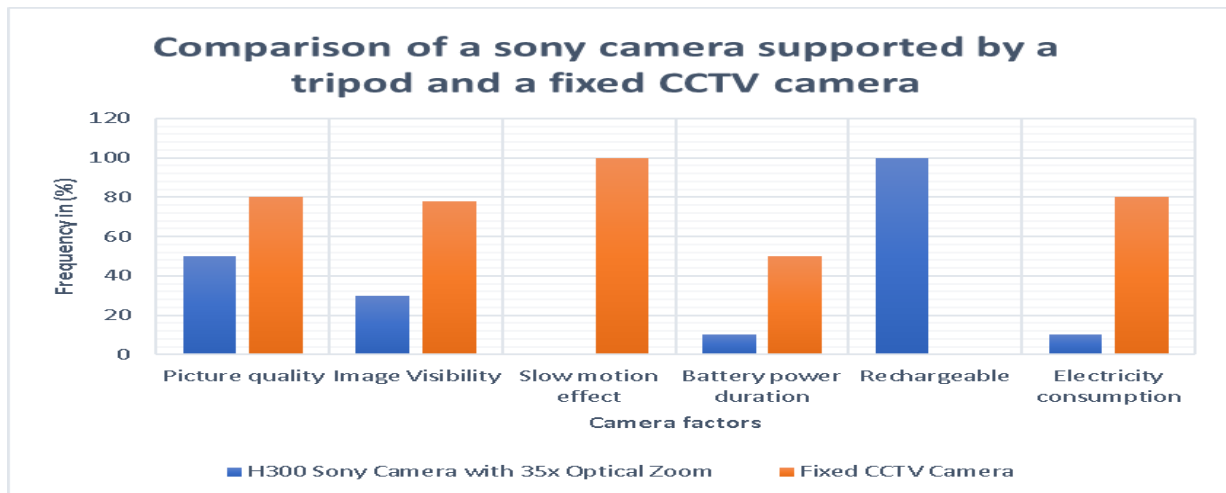
Parameters	Camera tripod traditional method of capturing a production video footage in a production shop floor for time and motion study results	Mounting a CCTV surveillance camera in a production shop floor to capture a video production footage for motion and time study
Focal length of the lens	Affected by the camera holder	No camera holder
The size of the pixel	Camera quality and orientation of the camera holder, hence affecting image quality	Fixed
The position of the principal point	Affected by the camera holder's orientation and body positioning	It is not affected since it is fixed
The position and orientation of the camera	It is affected by the camera holder	Fixed and is set once
Translation vector between the relative positions of the origins of the two reference frames.	Not fixed because relies on the camera holders' position	Fixed
Rotation matrix that brings the corresponding axes of the two frames into alignment (i.e., onto each other)	Fluctuates	Fixed
Camera settings	Fluctuates	Fixed

Further analysis was done in terms of image qualities, visibility, slow motion effect observed with the two methods of video capturing devices. These factors were quantified in percentages as shown in Table 5. Picture quality in a convectional Sony camera is fifty-percent clear due to the fact that the camera is hold by a person and it is not fixed, and due to some movements and distortion that might occur while a human being takes some motion analysis. As of fixed CCTV camera, image quality is the best which a percentage of eighty percent. For a convectional camera, the image is not visibility hence making the image to be poor. As of CCTV the images are more visible. Sony Camera is not able to capture slow motion effect while as of CCTV, slow motion effect is visible with hundred percent. Figure 5 and 6 shows comparison graphs quantified in percentages.

**Table 5: Factors considered for comparison**

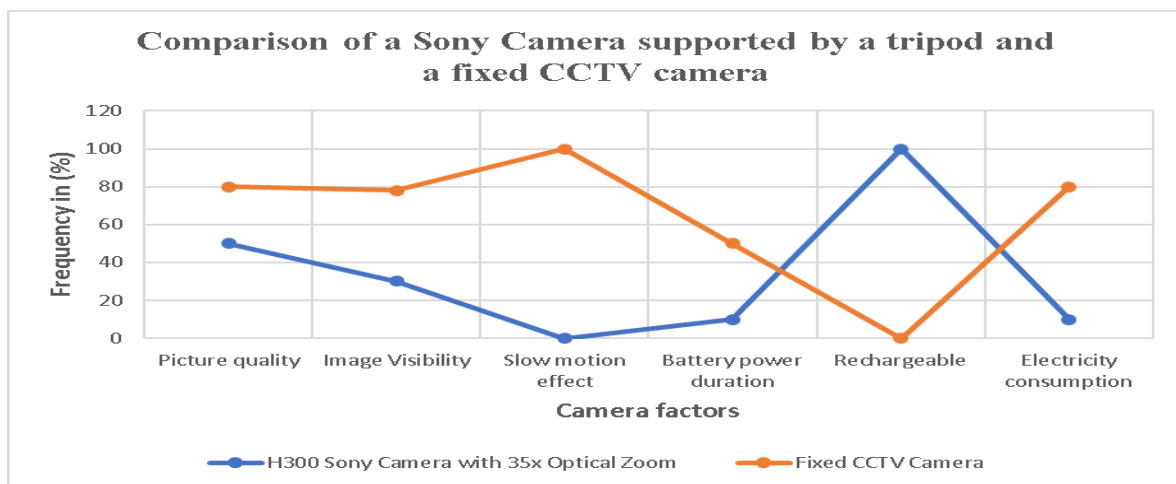
Factors	H300 Sony Camera with 35x Optical Zoom (%)	Fixed CCTV Camera (%)
Picture quality	50	80
Image Visibility	30	78
Slow motion effect	0	100
Battery power duration	10	50
Rechargeable	100	0
Electricity consumption	10	80

Figure 5 shows the effect of convectional Sony camera and a mounted CCTV in terms of electricity consumption, battery power duration and rechargeability. Convectional Sony camera supported by a tripod stand, does not consume electricity because it is either it is rechargeable for future use, while of CCTV camera it consumes a lot of electricity. Sony convectional camera are more rechargeable compared to the CCTV mounted camera.



**Figure 5: Comparison of cameras used**

Figure 6 shows a trend of line graph showing comparing of the two methods; CCTV camera and convectional Sony camera. According to the graph CCTV is more effective when it comes to monitoring performance in terms of labor productivity because images are visible, picture quality are clear in such a way that you can see who is in a motion. For that it allows for easy analyzing of motion and other metrics such as value adding time.



**Figure 6: Comparison of comparison used**

In Figure 5 and 6, analysis shows that fixed CCTV camera is more effective than Sony digital camera. Only one factor that showed a slack is rechargeability because fixed CCTV camera consumes more energy. Justification of motion study by a researcher when conducting motion study at a textile industry using CCTV versus when a researcher conducted work-study using a convectional method.

#### 4 DISCUSSION, CONCLUSION AND FUTURE DIRECTIONS

##### 4.1 Discussion

During benchmark sessions, human error was observed while the camera was positioned to capture video footage in a production shop floor. Errors were inevitable in manners that the camera holder was not placing stand lone camera in the best position to capture the footage clearly thereby producing low quality picture, faded images and low-quality audio video. There was also instrumental error that was occurring which interfered with the motion analysis results and picture quality. There is a much difference in terms of the orientation of the cameras and image qualities. In a convectional camera supported by a tripod stand; the orientation is determined by the camera holder's body

position and its surface samples. Recommendations were made to the company that does not have a CCTV surveillance camera; to consider it in future as it saves time, reduces human errors, and improves workers effectiveness because it does not interrupt production.

#### **4.2 Conclusion**

Workstudy is more effective when a CCTV camera is used compared to when a convectional camera is placed on a tripod stand. Reasons why CCTV camera are more effective is that during benchmark session attended, the one in a textile industry (which was using a CCTV) and the beef abattoir (which was using a convectional camera) it had shown that CCTV does not interrupt production and it easily monitors human performance during working in a private manner. The convectional camera which is placed in a tripod stand it had shown that it is ineffective because it interrupts with the production, and it acts as a kind of intimidation to some employees. images taken by a mounted CCTV surveillance camera are clear, with high image quality and subjected to more data protection and better camera video analyzing

#### **4.3 Future directions**

Based on the results from experimental, literature review and observational study; conducting motion analysis and time study motion is very challenging in most production shop floor facilities. These challenges factors are due to the camera settings, image quality and the sizes of the pixel. Mounting a CCTV in a production shop floor have demonstrated potential improvements such as working methods and safety awareness in terms of efficiency. Further work is planned to understand the economic cost saving analysis on doubts of mounting CCTV and tripod camera when conducting motion analysis and time study.

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## **IMPLEMENTING 5S IN A BEEF ABATTOIR**

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### **ABSTRACT**

Good workplace organization and easy information retrieval in a workplace helps in achieving optimum productivity through maximum utilization of the resources available, steering to least possible industrial and time wastages thus resulting in low production cost. The aim of this paper is to study the implementation of 5S (Japanese tool for workplace organization) in a beef abattoir. The purpose of carrying out this study is because there is a less literature on implementation of 5S system in a meat processing industries and abattoirs. This study started with conducting site visits, touring the plant, doing 5S pre-audits and understanding the existing workplace organization. At the same time observation at the production line were made to identify problems and areas of improvements in terms of 5S standard system. The following were identified during site visits and plant tour; unneeded items lying around, torn sign displays, labels and shelves not partitioned, bins not clearly stored in demarcated areas and storage tools not clearly shown with sign panels and labels. Due to budget constraints and the abattoir not ready to adopt the 5S system; not all the 5S implementation phases were done. 5S was not fully implemented since the beef abattoir was not ready for this change process, therefore suggestions and recommendations were made on how 5S system can be implemented in the future. Projected suggestion and recommendations emphasized on how 5S can efficiently save the workplace organization, lost time in retrieving information, good housekeeping to mitigate non-value adding activities and space utilization, thereby resulting in improved productivity in a beef abattoir.

**Keywords:** 5S, beef abattoir, workplace organization, lean, roadmap

### **1 INTRODUCTION**

Literature sources and papers on lean implementation in abattoirs are very limited, therefore that is one of the reasons that motivated the author to conduct and write a paper on implementing 5S in a beef abattoir. Objective of this paper is to illustrate 5S implementation in a beef abattoir and to increase 5S literature papers on lean implementation. The abattoir sector has been abandoned in most national livestock development level for most developing countries (Nwakaire & Keirstead,

2015). Beef abattoirs are meant to recover the edible portions of slaughtered animals and make them available for human consumption and this makes a beef abattoir to be a key sector in the food industry. Botswana has a livestock population of 3.36 million ruminants (cattle, sheep and goats). Out of which fifteen Percent (%) falls under a well-developed commercial farming system comprising cattle ranching and feedlots coincide with a large number (85%) of ruminants under the traditional or communal grazing system (unfenced ranges) including small farms. Agriculture remains the critical source of livelihood for most people in Botswana (Boy, 2016). Agriculture contributed to 2.3% GDP in 2003/2004, out of which 70 to 80% was attributable to cattle production (BEDIA, 2007). Good housekeeping in an abattoir is very key since it maintains good standard in food safety and awareness. This research studies and highlights the implementation of 5S lean system to improve productivity and workplace improvement in a beef abattoir. Benefits of 5S are that the workplace becomes cleaner and better organized, shop floor and office operation become safer, and enhances generation of more and better ideas through visible results. This research was conducted in a case study company X, which is a private beef abattoir in Botswana.

## **2 LITERATURE REVIEW**

5S is a management tool from Japan, that focuses a quality environment in the organization, ensuring adherence to standards and in the process, fosters the spirit of continual improvement (Rahman, 2005). Bamber, Sharp, & Hides (2000) defined 5S as a tool that is based on the Japanese acronyms of seiro (organisation), seiton (neatness), seiso (cleaning), seiketsu (standardisation) and shitsuke (discipline) to develop a platform of an intergrated management system. Moreover, Becker (2001) stated that a common name in the Western side of the world is housekeeping. Rahman (2005) explained that 5S management technique has contributed a lot to recuperate internal inefficiencies, operational effectiveness and nurture on time delivery system to the delight of customers. The practice of 5S intend to imbed the values of organisation, neatness, cleaning, standardization, and discipline in the workplace Mapfaira, Monageng, Kommula, Gandure and Sethunyane (2016). Futhermore Rahman (2005), explained that for 5S to be succesfully, it needs commitmentparticipation and involvement of everyone and strong visible support from top management. (Kodama, 1959) stated that 5S is an endeavour journey should be intergrated with other Japanese life wisdom called kaizen ( continous improvement & change for better) and visual methods. (Rahman, 2005), devised a 5S roadmap implementation which is shown in Figure 1 below. The author explained that phase 1 and 2 are enablers (i.e Plan and Do phases). Ashta, Stokes and Hughes (2010) emphasized that activities that are inclusive in phase 1 and 2 are; providing training and education, forming 5S council, set up 5S zones, determining 5S objectives, plan 5S action plan and lauch 5S. Phase 3 and 4 are the actual results (i.e Check and Act). Activities involved are cleaning standards, better visual control system, establishing rules and Standard Operating Procedures (SOP), using techniques and strategies to sustain activities, review 5S newsletter to share the progress of 5S activities and reviewing 5S achievements (Prieto, Lopez, Zijlstra, Uttaro, & Aalhus, 2014).

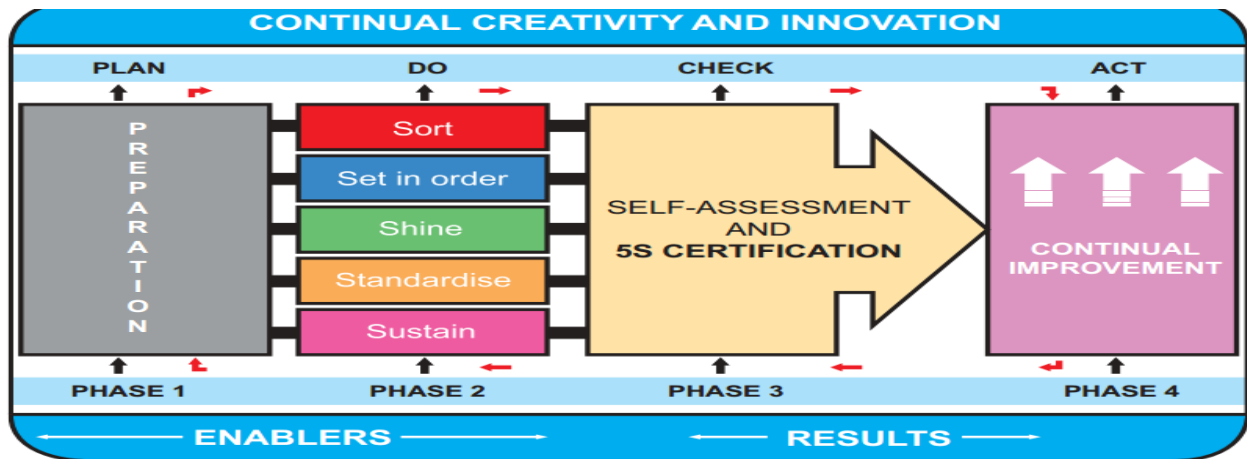


Figure 1: 5S roadmap implementation plan retrieved from (Rahman, 2005)

GBMP (2019), stated that stability and visual standardization provided by 5S is an important aspect to lean practice and is visually attractive to management. The author further stated that challenges affecting 5S implementation are back sliding and lack of participation. 5S methodology has expanded from manufacturing and is now being applied to a wide variety of industries including health care, education, and government (Gapp, Fisher, & Kobayashi, 2000). 5S and visual management can be beneficial in an abattoir (Kufigwa, Gwangwava, Tenkorang, & Ude, 2018). Chron (2019), explained that without efforts of 5S especially the Sustain phase, good habits of 5S implementation it can be difficult to maintain. Moreover, it is important to focus on ways that will enable the process to be a habit. Pradeep Mahalik (2019) stated that 5S activities should be integrated into business function so as to achieve organisational excellence culture.

Navajas, et al. (2010) explained that 5S is easy for everyone to understand because it does not require the understanding of difficult technologies, it is simple, driven by logic and it is within the reach of all type and size of industry or organisation. Furthermore, Jackson (2017) stated that 5S management technique considers 5S standards which are Sort, Set in Order, Shine, Standardize and Sustain. Bayo – Moriones, Bello – Pintado, & De - Cerio (2010) defined these concepts as follows:

- **Sort** – means sorting and systematically items that are not needed in the workplace
- **Set in Order** – means arranging necessary items in a neat and systematic manner so that they can be easily retrieved for use and to return after use.
- **Shine** – means cleaning and inspecting the workplace thoroughly so that there is no dirt on the floor, machines and equipment.
- **Standardize** – always means maintaining a high standard of workplace organization by keeping everything clean and orderly.

Khanna (2009) emphasized that for 5S system to be successful, the most important factor is the commitment, participation and involvement of everyone and strong visibility support from the top management. Moreover, the author stated that there are activities that help to systematically carry out 5S activities and these are:

- Visit 5S model companies for continual improvement
- Train everyone adequately on 5S Practices
- Promote 5S campaign

- Plan systematic approach following the Plan-Do-Check-Act (P-D-C-A)
- Practice Performance Measurement and Reward System

This section outlined sources, materials, publications, case study reports, documents and books that reveals successful implementation 5S system, gaps that exist in implementation of 5S in abattoirs and meat processing industries and explains on how to close those gaps by emphasizing them through writing.

### **3 METHODS AND MATERIALS**

Methodology of this research study relied on secondary research( such as reviewing available literature and data), informal qualitative approaches (such as discussions, consultative meetings) and formal qualitative research( such as face to face interviews, direct observation, case studies, audits and plant tours).It explores application of lean manufacturing tools in a meat processing industries (an abattoir). Lean has been introduced in abattoirs in different worlds and this is supported by its application at the UK Red Meat. Lean tools were first introduced at the research company through campaigns, management buy in, proposals to company’s management, trainings and awareness.

#### **3.1 Data collection methods**

Information on 5S implementation was collected by direct observation, photograph, audits, plant tours and discussion with workers. 5S scoring sheet and PDCA (Plan, Do, Check and Act) framework were also followed and used as methodical approaches to 5S implementation. These methods are explained further below.

##### **i. 5S Score sheet**

As company audits were being done, there was a need for the author to find a tool that would help to successful conduct audits without biasness. 5S scoring sheet was used as part of methodology and to help understand improper workplace organization, some bottlenecks that the company experiences in its 5S workplace organization and workplace safety issues. 5S audit was done using 5S scoring sheet as the tool for assessment and it is shown in Figure 2 below. See Appendix A, an audit checklist used for 5S. The purpose of 5S audit is identifying issues of 5S which require attention and to be able to track the changes and measure the benefits brought about through the implementation of 5S. Scoring criteria was the only way that the author could investigate on how the company is performing in terms of its workplace arrangement and space utilization as they are key to productivity improvement and enhances good working environment, safety and morale boosts. Assessment for 5S audit results performance is in Table 1. In Figure 2 is score sheet used to grade each area at the beef abattoir.

Score	Condition Observed	Score (check box)				
		0	1	2	3	4
4	Very Good (perfect condition)					<input checked="" type="checkbox"/>
3	Good (1-2 problems)				<input checked="" type="checkbox"/>	
2	OK (3-4 problems)			<input checked="" type="checkbox"/>		
1	Bad (5-6 problems)		<input checked="" type="checkbox"/>			
0	Very Bad (above 7 problems), or non existent	<input checked="" type="checkbox"/>				

**Figure 2: 5S Score sheet used**



Other methods of data collection were used and are explained in roman figures below:

**ii. Audits**

Audits were done to understand the root causes, some problem areas, and some bottlenecks that the company experiences in its business process, system and operation. See Appendix A, an audit checklist used for 5S. 5S scoring sheet was used during audits to score the current 5S that is existing in the abattoir.

**iii. Plant tour**

Plant tour was done to see where the company stands in terms of workplace organization, safety and housekeeping. Illustration of a picture captured during the plant tour is shown in Figure 2. This was done to show the existing 5S standard in terms of workplace organization and safety compliance.

**iv. Observation**

Figure 3 shows 5S observations and some of the areas that needs improvement in terms of signage, floor markings, visuals and labellings. These pictures were taken before 5S implementation to illustrate areas that are still lacking behind in terms of 5S. As audits were being done, and pictures being taken in the plant in areas that are lacking in terms of good workplace organization, it was found that visual labels are not displays in some equipment and tools. It can be seen in the Figure 3 below that there is sign of a fire extinguisher, but the actual product is not there. There was also a reel without being indicated by labelling, according to the Safety regulations. A scoring was done, and it was found that safety regulation in terms of labelling and providing signs for tools was at a rating of 2.5 out of 4.



**Figure 3: No labelling and floor markings**

**4 LEAN IMPLEMENTATION IN A BEEF ABATTOIR AND RESULTS**

**4.1 Introduction**

The purpose of this study is to implement 5S in a private abattoir. The literature was already fused on the concept of 5S standard in abattoirs, but the actual implementation, verification, validation and development of framework for 5S system remains questionable. To establish how well the literature matches the real-life issues; framework for 5S was developed with the help of the PDCA problem solving approach. This section presents the results of the findings, roadmap to lean implementation, suggestions and improvements that can be done to status quo. The section is structured on the logic and phases of lean implementation based on the PDCA approach.

## 4.2 5S Implementation

This section is about implementation of 5S which is a lean technique that uses the 5S (Sort, set in order, Shine, Standardize and Sustain) to organize and maintain a neat and clean facility. Below in Figure 4 shows the roadmap to 5S implementation.

The meaning of 5S:

**Sort-** Means separating what is needed and what is not needed and keep only those things that are need in the workplace. Discard unnecessary items

**Set –in order-** Neatly place and identify needed work items. Designate a place for everything so that anyone can find it. Always put things back in their designated spots

**Shine-** clean up. Always maintain a clean and shine workplace. Identify why are things are getting dirty.

**Standardize-** Become a role model for adhering to the standards of the first three S’s and encourage others to follow them. Make rules and procedures to promote a good working environment until the first three S’s become everybody’s second nature.

**Sustain-** Maintain and practice the first four S’s. Be thorough in straightening up, putting things in order and cleaning.



Figure 4: Roadmap to 5S implementation retrieved from (Pradeep Mahalik, 2019)

### 4.2.1 5S Objectives and goals

Setting 5S objectives is important in the implementation of 5S as they guide the successful implementation of 5S. The main objective of implementing 5S is to create a clean, orderly environment; an environment where there is a place for everything is in its place. Target goals of the implementation are to; reduce non-value adding activity, reduce search navigating the facility and allocating tools, parts and supplies, improve floor space utilization, improve employee safety and moral, and extent equipment life through more frequent cleaning and inspection.

Table 1 below shows the performance of company X after a 5S audit was performed using the stated criteria. The director, the production manager and the researcher(i.e three individuals) independently

audited the facility using the 5S audit checklist, see *Appendix A*. The findings of the three individuals were averaged out to combat bias.

Radial charts in Figure 5 below were used to analyse how each element of the assessment area is performing in each phase. Doing so enabled to pinpoint performance of elements in each phase. This analysis helped the researcher in developing future roadmap for 5S implementation in a beef abattoir. The performance of 5S in the abattoir is seriously lacking in all aspects of 5S. This implies a call for an all round improvement with regard to all areas assessed. Implementation effort should especially be put in structures that will boost the Standardisation and Sustain phases of 5S because performance in these areas were very unsatisfactorily. Note should also be taken in the fact that performance in other phases is lacking. Figure 5(a) shows the performance of Sort and Straighten phases. From the audit, there are no sign panels, and safety posters in the building.

**Table 1: Audit performance ( refer to Appendix A for assessment form)**

Criteria (AREA)	Sort(/4)	STRAIGHTEN (/4)	SHINE(/4)	STANDARDIZE(/4)	SUSTAIN(/4)	TOTAL(/20)
1 Healthy and Safety	3	2.5	3	2.5	4	13
2 Environment	1.5	1	1	0.5	0	4
3 Facilities	1.5	2	0.5	0.5		4
4 Floors and gangways	1.5	0	1.5	0	0.5	3.5
5 Duty technician	0	0	0	0	0	0
6 SHE officer	0	0	0	0	0	0
7 Tooling, fixtures and jigs	3.5	1.5	2.5	0	0.5	8
8 Wire, Cabling & hoses	2.5	2	1	1	1	7.5
9 Work benches & surfaces	3	3	3	3	3	12
10 Visual tracking boards	0	0	0	0	0	0
11 Production boards	0	0	0	0	0	0
12 Red tag	0	0	0	0	0	0
13 Mobile equipment	3.5	1.5	1	1	1	8
14 Cleaning standards	3.5	1.5	1.5	0.5	1	5.5
15 Intergrated tracking device of a carcass	0	0	0	0	0	0
Total	22	13	14.5	8.5	11	69
Overall	60	60	60	60	60	300

Figure 5(b) shows the audit results of Shine and Standardize phase, where there are no cleaning schedules and standard that tracks the frequency of cleaning in the building. Figure 5(c) illustrates the performance of Sustain phase. Sustain phase scored lower marks because the 5S standard is not yet Standardize in the beef abattoir X.

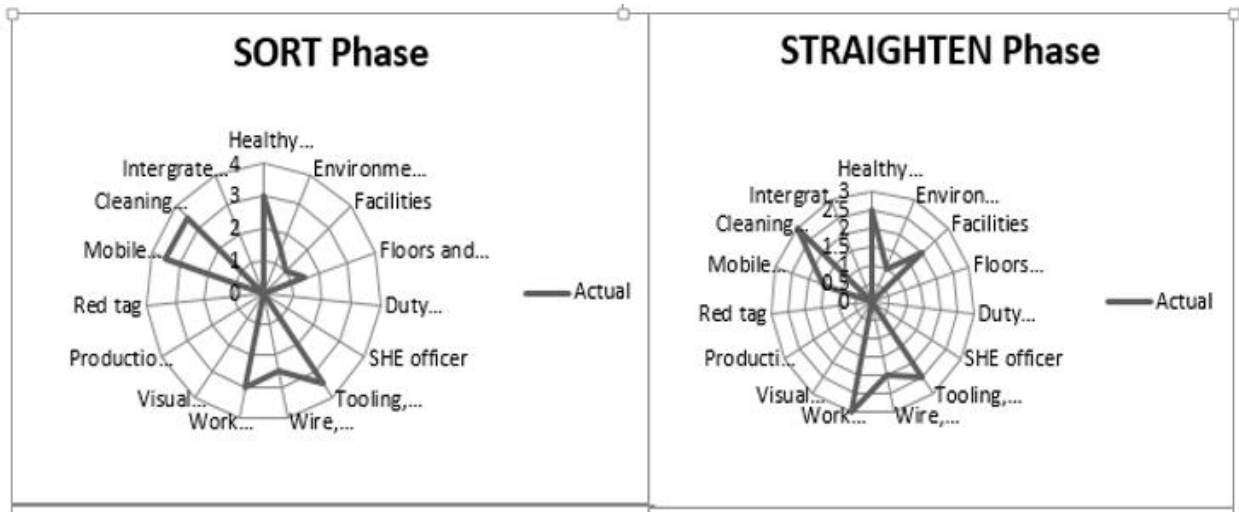


Figure 5 (a): Audits resultss of Sort and Straighten phases

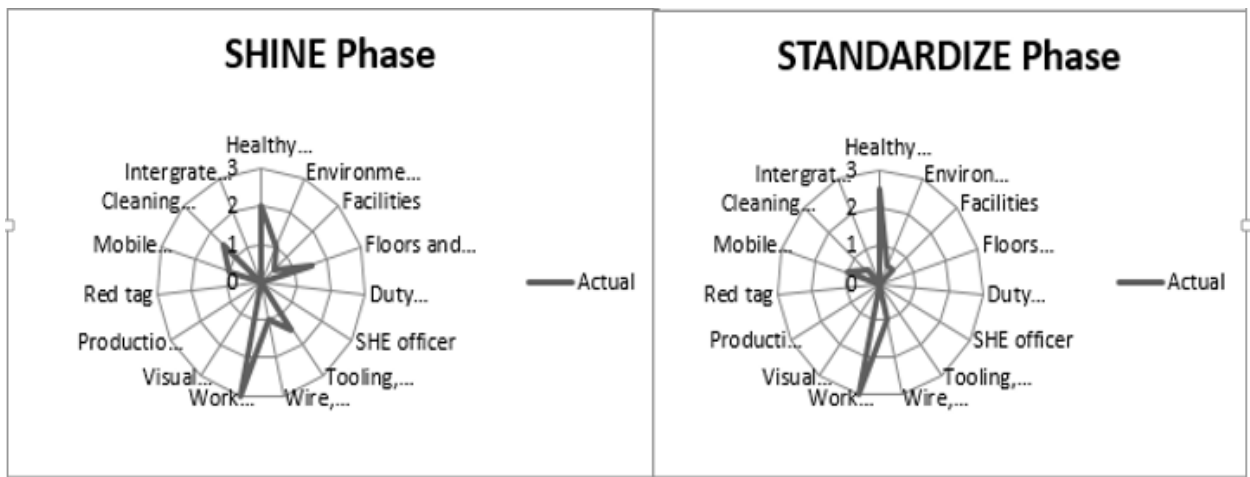


Figure 5 (b): Audits results of Shine and Standardize Phase



Figure 5 (c): Audit results of Sustain Phase

#### 4.2.2 5S Council

In order for the 5S system to be successful commitment, participation and involvement of everyone is vital and most importantly a strong visible support from the top management. The 5S council is formed to enhance the total participation at all levels of employees, to develop continuous improvement culture and best performance spirit in the teams. 5S implementation responsibilities were distributed across the organization to staff. Steering committee is responsible for selecting,

assisting in conducting trainings, sharing information and assisting in developing 5S plan. Before the 5S council, a proposal letter was issued to the company requesting the 5S council to consist of two three individual that is two beef abattoir staff ( production manager and the director) and the researcher.

#### 4.2.3 Conducting 5S Training

The most common mistake organisations make when implementing the 5S is the failure to adequately train employees from the onset. Training is important to ensure that workers understand and are fully involved in the 5S exercise. Thorough understanding and involvement will improve the likelihood of sustainable high standards in 5S. For workers to develop a culture and accept 5S it is important that management is also fully involved. The 5S training is set up with an objective to disseminate 5S methodology and prepare the workforce for meaningful participation in 5S activities. This training programme is the starting point of 5S. After the training is completed, all workers would have enough knowledge on 5S and be responsible for action in progress.

#### 4.3. Results

5S was partially implemented, due to the abattoir not being ready to adopt and implement all the 5S phases. Mostly, 3 phases that is Sort, set in order and Shine were almost 70% implemented, then the last two phases that is Standardize and Sustain were not implemented with almost 10% work done. Below in Figure 6 and Table 2 shows 5S achievements quantified in terms of implementation phases and percentages:

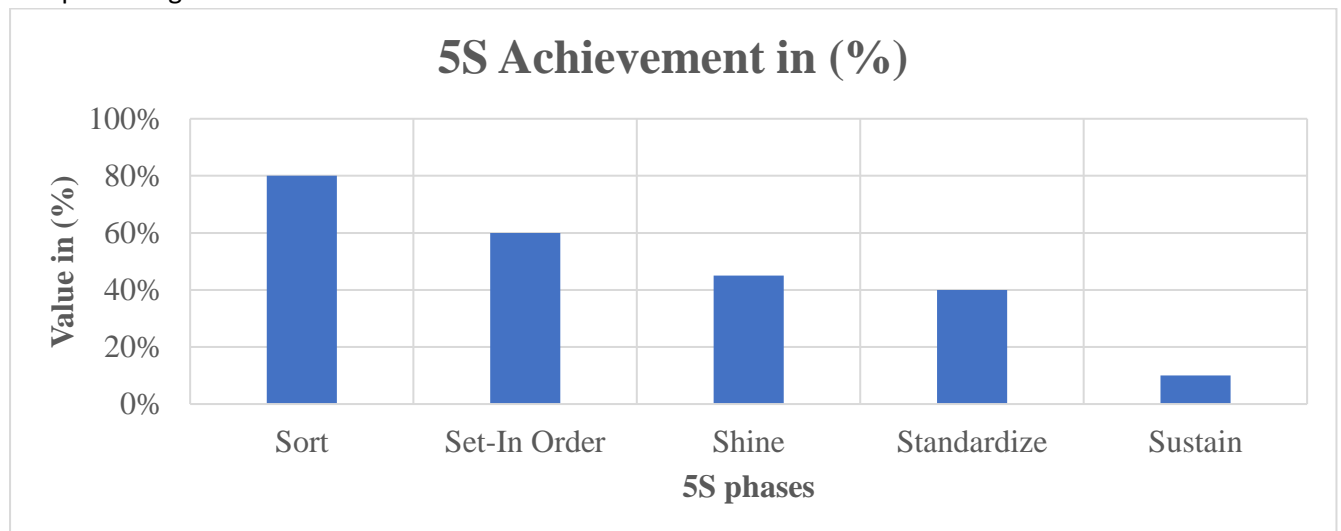


Figure 6: 5S achievement

Table 2: 5S achievement quantified in terms of implemented phases and their percentages

5S Implementation phase	Activities achieved	Completion %
Sort	-Red tag was done -Unnecessary items were identified -Discarded items were red tagged -Items which are used weekly/hourly/ everyday were identified	80%
Set in Order	-Materials that needs signage, labels and of stock were identified	60%

	-Standard color coding, display cautions, messages were not done rather it was recommended for 5S future implementation -5S document manual was prepared and developed	
Shine	-Cleaning schedule was done -Inspection has been put in place -Area of cleaning storage and cleaning aids was done	45%
Standardize	-A 5S checklist was done for each area section -5S training was done -Periodic evaluation was not done but rather it was recommended for 5S future implementation	40%
Sustain	-5S council team was formed -5S was not fully implemented -There is no 5S good habits and discipline rather it was emphasized in future 5S implementation.	10%

Findings show that 5S can be applicable in a beef abattoir, more especially when the company is committed to address safety and improve productivity in a beef abattoir. Employees buy in and engagement with employees is very key to change management.

## 5 DISCUSSION AND RECOMMENDATIONS

### 5.1 Introduction

This section discusses the results and recommendations based on the 5S implementation. The objective of this study was to implement 5S system in a beef abattoir, and not all the 5S phases were implemented. Two last phases (i.e. Sustain and Standardize) were not done because the abattoir was not ready to implement all the 5S phases. Discussion and recommendations were made based on what was achieved in terms of 5S implementation. Implications were made as to what might be done for future researchers in 5S implementation in a beef abattoir.

### 5.2 Recommendations

Recommendations were made to the study company since it was not ready to implement all the 5S abattoir in their company. Suggestions and recommendations were made in the following subheadings.

- **Conduct a red tag and cleaning event**

It is recommended that the abattoir should conduct a red tag event and be named “The Red Tag Strategy event”, to identify potentially unneeded items in the work cell, evaluating their usefulness, and dealing with them appropriately. The area should be cleaned with purpose and always maintained clean and shiny. Get rid of all the garbage and dust in the workplace. The machines and equipment should thoroughly be polished every day to discover even small abnormalities. Correct any issues uncovered during cleaning by pin pointing the root cause of dirt and cutting it off from the source. Shine is also a total equipment maintenance practice that will increase the total life of machine

### 5.3 Summary

Below in Table 3 is a summary of the present situation on 5S implementation and proposed methods as the company agreed to continue with 5S implementation in future. Reason for partially implementation of 5S was due to budget constraints, unavailability of resources and time. As lean is continuous improvement tool, the company will always thrive to abide to the set proposed methods for workplace improvements, safety and workspace utilization.

**Table 3: Proposed methods and suggestions as to the present situation of 5S standard system**

<b>Present situation</b>	<b>Proposed methods</b>
No clear gangways and floor markings	It was recommended for the company to mark floors in future or use a simple white tape for markings
Improper cabling of electric wires	Recommendations were made as to manage cables properly for worker's safety or to use wire cable trays to support cables
No safety rules displayed and safety awareness posters	It was recommended for the company to have 5S, safety awareness posters displayed in the production plant
No production charts	It was recommended for the company to have atleast one production reporting boards within the production plant
No red tag station	It was recommended that the company should have a red tag station where red taggings are placed and easily accessible
Lacking waste management practises	It was recommended for the company to have waste containers and well labelled according to Waste Management Act 89 of 2008.
Mobile equipment not properly displayed	Recommendations were made for the company to have demarcated floor area where mobile equipment will be placed.

## 6 CONCLUSION

In concluding, 5S implementation in an abattoir is very difficult because many aspects are involved which are top management's buy in, commitment from the top management, employees response to change and resource investment for 5S implementation change. For abattoir industries to survive in this competitive world, they need to improve productivity, food and safety standard, workplace organisation so that beef abattoirs can work more efficient and in a safe manner. Concept of implementing 5S in a beef abattoir are ultimately important because it ensures quality environment in the organization by ensuring adherence to standards and fosters the spirit of continual improvement. Future work need to consider investigating the readiness of beef abattoirs in implementing 5S management technique due to the fact that all 5S phase were implementing. Only recommendations and suggestions on the remaining two phases were made for consideration when the beef abattoir X is ready for continuing the 5S fully implementation.

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**Appendix A: 5S Audit form**

# 5S Audit Form

NAME: \_\_\_\_\_ DATE: \_\_\_\_\_ TEAM: \_\_\_\_\_

For each statement, check the score that best represents the 5S level for each item in each category.

**Total score for each category and then add category totals.**

<b><u>SORT</u></b> Sort out necessary & unnecessary items. The items deemed unnecessary and not being used should be removed from the area (incl. General area, workstations, personal storage areas, desk drawers, filing cabinets, PC electronic files, safe)	Unacceptable <i>No evidence shown</i>	Poor <i>Only evident here and there</i>	Good <i>Applied and evident in most areas</i>	Excellent <i>Thoroughly evident and applied to all areas</i>	World Class <i>Continuously looking for ways to make even more improvements</i>
1. Items/supplies on surfaces have been sorted, separating needed (used frequently) from unneeded (used infrequently or not at all).	1	2	3	4*	5
Details:					
2. Items/supplies in bookcases or on shelves have been sorted, separating needed from unneeded (available electronically or not needed at location).	1	2	3*	4	5
Details:					
3. Items in cupboards or drawers, including desk and file drawers, have been sorted, separating needed from unneeded (available electronically or not needed at location).	1	2	3*	4	5
Details:					
4. Items on floors have been sorted, separating needed from unneeded eliminating floor piles and all cords are safely contained.	1	2	3*	4	5
Details:					
5. Needed items (in cupboards, drawers, bookshelves, on surfaces, or floors) have been placed at the closest location to where they are used the most to minimize the waste of motion.	1	2	3*	4	5
Details:					
6. Unneeded items have been removed from the work area.	1	2	3	4*	5
Details:					
7. Work agreements for the above are documented and all staff know where to find the agreements.	1	2	3	4*	5
Details:					
<b>Total Score</b>					24

<b><u>SET IN ORDER</u></b> A place for everything and everything in its place so it should be easy to find	Unacceptable	Poor	Good	Excellent	World Class
8. Locations of needed items are labeled and items are in correct locations.	1	2	3	4*	5
Details:					
9. Required quantities for needed items are determined (par levels), including items in desk drawers and in bookshelves.	1	2	3	4*	5
Details:					
10. Locations for movable items are labeled, and items are placed in correct locations (white board/laminated card/label on wall can be used).	1	2	3	4*	5
Details:					
11. Visual controls and indicators are established including: Posted map of area, including individual room maps.	1	2	3*	4	5
Details:					
12. There are Kanbans for re-order (if used by group agreement).	1	2	3	4*	5
Details:					
13. There is Labeling indicating contents of drawers and cupboards (a new person should be able to locate without assistance).	1	2	3	4*	5
Details:					
<b>Total Score</b>					23

## **TECHNOLOGY SYSTEMS FOR LAND ADMINISTRATION: A CASE STUDY OF SOUTH AFRICA**

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### **Abstract**

Both private and public sector businesses are aware of the need to deploy information and communications technologies to improve their internal processes as well as to optimise external linkages. For public sector organisations, there is even the greater need to promptly capture, store, transmit, and retrieve information in the electronic domain, particularly because of the large volumes of vagarious data that legislatively must be recorded. This article describes an empirical study on e-conveyancing, that is, business processes legally required to transfer landed property from one owner to another. The survey of respondents focused on the identification of types of data and information sourced from the various private firms and public sector agencies involved in conveyancing processes. The paper surmises that conveyancing is tantamount to data and information supply chain linkages between stakeholders. The study explores issues and challenges for automation of information and communication systems for land administration.

**Keywords:** e-Conveyancing · Cadastre automation · Data integration

### **1 INTRODUCTION**

Globalisation, economic growth and sustainable development imperatives, socio-political reforms, urbanisation challenges, and technological innovations are changing policies and models for land administration (Williamson & Ting, 2001). The processes for determining, recording and disseminating information about the tenure, value and rights to the use of land (UNECE, 1996) culminate in the registry and cadastre (Williamson, 2001). The cadastre Divithure, H. and Tang, C. (2013) contains systematic (Velencoso & Luz, 2013) and up-to-date data and information on landed property such as spatial extents and restrictions (Williamson, 2001). The registry contains data and information regarding deeds, titles rights (Silva & Stubkjær, 2002) and responsibilities (Enemark, 2004). The combination of the cadastre, registry with data and information generated during conveyancing transactions (McDougall, Bennett & Van der Molen, 2013) constitutes a land administration system.

The cadastre focuses on data regarding spatial extents and restrictions on landed property, and may be confined within a municipality, region, country or national boundary. Similarly, the registration of deeds and titles to landed property are bound within legal jurisdictions. This means that there are no internationally connected land administration systems to guarantee the identity of all transacting parties and the land in question, or to ensure authoritative and valid global transactions (Pienaar, 2009). The significance of a land administration system is not on its legal or technical sophistication, rather it is important that the information and communications systems provide the means to

readily administer land rights in a secure, efficient and effective manner, at minimum costs (Mitchell, Clarke & Baxter, 2008).

Cadastrals, deeds and titles are continuously updated with data and information arising from ongoing landed property transfer transactions. The automation of data and information exchange between the components of land administration systems also need to keep pace with rapidly changing technologies, especially information and communications technologies (ICT). Land administration systems need to incorporate provisions of new legislation, albeit that legislation does not necessarily change in a rapid manner. The inherent recursive loops connecting the components imply that the land administration processes, and the linkages between the processes, also change continuously, and the ramifications extend to many stakeholders. For example, advances in digital imaging technology may be deployed to significantly upgrade cadastral maps. Such upgrades may affect information flows between the conveyancing processes linking buyers and sellers of land. Furthermore, there will be ramifications on information flows between professional services providers like estate agents, notaries and surveyors, private and public agencies and institutions like banks and municipal governments.

In many jurisdictions, complex land reform legislation often demands active involvement and participation of many stakeholders. It is difficult to imagine how the effort, time and costs involved in linking all the stakeholders can be managed without automation of the cadastre, conveyancing, and registration systems. There is also the attendant problem of ongoing education (Williamson, 2001) and knowledge exchange between the stakeholders involved in land administration processes. There is also the consequential training of administrators to ensure that land administration processes keep pace with, and track changes in technologies and legislation (Ramwell, Brink & West, 2008). How could technology be employed to improve the property process in South Africa?

There has not been much research conducted regarding the property processes from a South African perspective. This paper incorporates quantitative questionnaires and qualitative interviews conducted with role players involved conveyancing processes. South Africa was used as a case study and the role players that are currently involved in the property process formed part of the study. Purposive sampling was used to identify participants that adhered to the specified requirements. The sample included the Banking Association of South Africa, the Law Society of South Africa, the deeds office, South Africa's Central Securities Depository (Strate Ltd), Tshwane Municipal Council, buyers, sellers and the Reserve Bank of South Africa. The qualitative interviews were analysed by means of content analysis and statistical analyses have been used to analyse the survey data collected.

The goal of this paper is to illustrate the types of quantitative data and qualitative information that are implicit in the transfer of landed property between deeds and title holders. The paper also highlights some of the issues and challenges that affect the automation of information flows between the components of land administration systems. The paper further aims to show that a technological system that connects the various role players in the property market should link individual entities and enhance the systems approach of the property supply chain in South Africa. The findings are embedded across the length of the paper.

## **2 LAND ADMINISTRATION SYSTEMS**

Land administration encompasses the deeds registry and the cadastre, albeit that, in some jurisdictions, the registry and cadastre may be regarded as the same. There are subsystems that facilitate how data and information are accessed, captured, retrieved, stored, and transmitted, as well as support the processes of conveyancing.

Registration involves the official recording of rights in immovable property through *deeds* or *title* (Divithure & Tang, 2013; Velencoso & Luz, 2013) and in general, there are two types of registrations (Silva & Stubkjær, 2002):

- i. Deeds – that is, a register of owners focusing on 'who owns what'.
- ii. Titles – that is, a register of properties that reflects 'what is owned by whom'.

The distinguishing aspect is whether the transaction is only recorded, or the transaction is recorded and secured. Incomplete data regarding a parcel of land, or false information regarding the transactions and declarations of the parties involved in landed property transfer may respectively render the deed invalid and the title insecure. Whereas deeds are formal and legally valid documents, however, it is conventional that data and information contained may not be examined *a priori* to establish, for example, the authenticity of the holder (who), and as such, there is no guarantee as to the validity of the information contained in the documents. Deeds registered without guarantees are regarded as negative, in the sense that the authenticity of associated data and information may be suspect. Consequently, it is quite common to obtain 'title insurance' to indemnify deeds.

For titles, it is conventional to apply the principles of exactness and priority so that data and information contained in the registry is presumed to be a true reflection of the legal situation. The registration of a title typically requires that a conveyancer and a public official conduct prior examination of the legality of the rights to be inscribed. Although this increases the cost of the registration process, however, the increased cost may be offset by the authenticity of data and information, improved security of title, plus the overarching perception of reduced uncertainty or risk. The benefits-to-cost trade-off is apparent, it may cost more to obtain a *title* than a *deed* but, the *title* is legally more secure in terms of the risk of losing property rights. This means that titles are guaranteed upfront, and such registration is regarded as positivistic. The guarantee aspect implies that registration of land rights in a positivistic setting tends to be slower than deeds registration.

Land administration is typically the responsibility of government, and pressure arising from globalisation and economic growth, socio-political reforms, sustainable development, technological innovations, and urbanisation means that the responsible public sector agencies have a greater need to promptly capture, store, transmit, and retrieve information in the electronic domain, particularly because of the large volumes of vagarious data that legislatively have to be recorded. The benefit-to-cost trade-off between registering a *deed* and a *title* becomes pertinent when new technologies are deployed to automate land administration systems. It is important to note that technology refers to knowledge of material, processes, methods, techniques and capital goods, and do not only refer to ICT systems (Balakrishnan, 2018). It is conceivable that, from a technological perspective, automation may extend from conveyancing processes through to the cadastre and the registry, linking all data, information and the associated transactions. This proposition assumes that this is what the stakeholders want, despite technicalities involved in linking disparate sources of data and information.

Although the ubiquitous ICT can provide the necessary functionalities, however, the historically heritage nature of land administration means that some types of data and information are not available or provided in electronic format, thus rendering automation of the linkages between the various components of the land administration systems a significant challenge in some jurisdictions. Stand alone or isolated and manual approaches to land administration and cadastral systems, as well as traditional structures that supported economic and taxation imperatives in the past, where data and processes such as valuations and land titling were maintained separately are not sustainable and should become more integrated to take a broader view (Williamson, 2001; Mooney & Grant, 1997).

Land information and land administration systems need to be reengineered to better cope with the increasing complexity of the ‘humankind-land relationships’, which are influenced by factors such as water, indigenous land use and pollution (Williamson, 2001). These challenges often overwhelm land administrators, exacerbate conveyancing processes, causing bottlenecks and sometimes resulting in cumbersome and tedious transactions between the various stakeholders (Amadi-Echendu, 2013).

### 3 CONVEYANCING PROCESSES

Conveyancing processes include all transactions that result in the transfer of a landed property from one owner to another culminating in the registration of deeds, or titles, and necessary updates of relevant data and information in the cadastre. Each component of the land administration systems comprises specific forms of data and information, therefore, it is obligatory that authentic and valid data is collected and captured at source. The sources of data and information are the variety of role players within the conveyancing processes:

- i. Buyers – wishing to acquire deeds or titles to landed property;
- ii. Sellers – wishing to exchange or relinquish deeds or titles to landed property;
- iii. Professional services providers in the conveyancing value chain e.g., estate agents, attorneys/notaries, surveyors;
- iv. Financial agents and institutions like banks and mortgage lenders;
- v. Government establishments

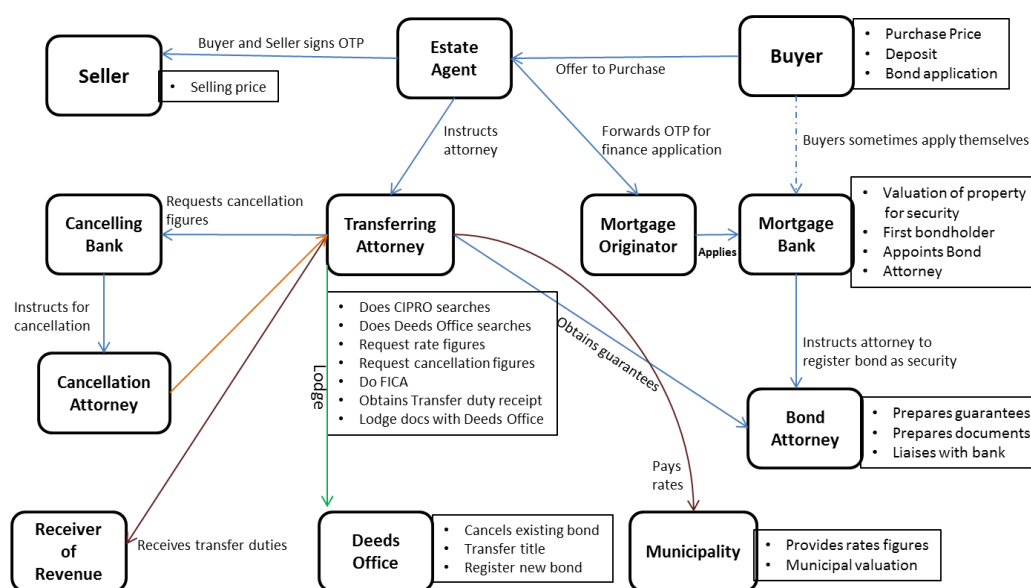


Figure 1: A mapping of conveyancing processes [cf:2]

Figure 1 aimed to showcase the various stakeholders involved in property processes as well as how they may interact. Their interaction currently is very manual with limited technological interlinks. Each type of stakeholder that is involved in the conveyancing processes may capture and store its own set of data. The particular kinds of data and information may exist in different databases across the end-to-end conveyancing value chain illustrated in Figure 1. The linkages between the role players within the conveyancing processes cut across private and public entities, and this manifests as reasonably sophisticated and complex data and information supply chain.

Table 1 summarises some of the questions included in a survey of respondents involved across the conveyancing value chain in South Africa. Data arising from the survey and its analysis are described

in detail in (Amadi-Echendu, 2013) but, the table depicts the mixed mode nature of data and information in conveyancing.

**Table 1: Sample questions used in a study of conveyancing processes**

Question	Respondent type	Data type		Information type	
		quantitative	qualitative	word/phrase	narrative
What type of property did you buy?	buyer		‡	‡	
What was the value of the property you bought/sold?	buyer/seller	‡			
How was the property financed?	buyer				‡
How long does it take to obtain relevant information from the cadastre/registry?	Service provider/financial institution	‡			
List the delays you experience during your involvement in conveyancing	all			‡	‡
Frequency of exchange between you and other role players in conveyancing	all	‡	‡		‡

#### 4 ISSUES AND CHALLENGES FOR AUTOMATION OF CADASTRE

From a systems approach, although it is a costly exercise, it is imperative for all role players to integrate information and systems across the supply chain in order to achieve effective supply chain integration (Sukati, Hamid, Rohaizatand, & Rosman, 2012; Ye & Wang, 2013). The resultant benefits apply to synchronisation and coordination of complex supply chain activities among supply chain partners (Premkumar, Ramamurthy & Crum, 1997; Thun, 2010), reduced communication and transaction cost (Muller & Seuring, 2007), improved efficiency in coordination (Sanders, 2005), improved customer service and reduction in operational cost (Premkumar, et al., 1997; Ye & Wang, 2013), easy retrieval of past stored information to support current business, thus leading to improved customer responsiveness (Ye & Wang, 2013). Coordination amongst trading partners requires the sharing of knowledge and information across a trusted network (Yu, Jacobs, Salisbury & Enns, 2013; Lotfi, Mukhtar, Sahran & Zadeh, 2013) that may include workflow automation systems, electronic data interchange systems and transaction processing systems for monitoring day-to-day activities (Qrunfleh & Tarafdar, 2014) across the supply chain. Supply chain disruptions and delays do not just impact the organisation’s ability to satisfy their customers, but also affects brand reputation, working capital requirements and cash cycles, as well as threaten the economic wellbeing of other participants in the entire supply chain (Badea, Prostean, Goncalves & Allaoui, 2014). Contracts are used to regulate relationships and the level of cooperation among role players (Ha & Tong, 2008).

As previously mentioned, property rights are linked to aspects of validity and authentic which affects the underlying security of *title* or *deeds*. Linkages between partners and customers have created new inter-organisational risks (Sutton, Smedley & Arnold, 2008) that comprise strategic and operational aspects over the long and short-term (Badea et al., 2014). In addition, payment systems create security vulnerabilities that are perpetuated fraudulent activities that include false

identification, counterfeiting and unauthorised alterations of documents (Smith, 1999). The most prevalent method of fraud penetration is firstly forgery of the victim's signature on the mortgage or transfer instrument followed by impersonation of the victim or identity fraud and lastly misleading the victim into signing relevant documentation (Barkataki & Zeineddine, 2013). Restricting access could reduce opportunities for fraudulent alterations but may not have any effect on identity fraud (Low, 2010). The additional responsibilities of adopting safe electronic practices and processes also raise regulatory and compliance issues (Low, 2010). Risks are often interconnected (Badea, et al., 2014). In addition to the correctness of information, it is therefore imperative to also ensure that technological linkages, automation and linkages are secure and tamperproof.

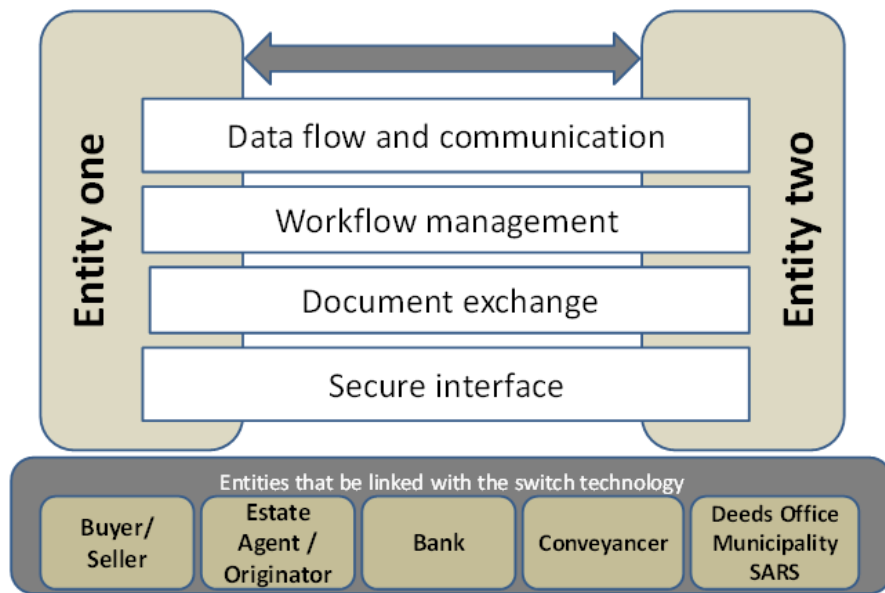
Access control typically ensures that only authorised users can access specific information (Zeng, Wang, Deng, Cao & Khundker, 2012) and is traditionally controlled through models that are based on digital certificates and Public Key Infrastructure (Zeng, et al., 2012) to control confidentiality, anonymity, privacy, verifiability and non-repudiation in transactions among several role-players (Barkataki & Zeineddine, 2013). Public key cryptography administered via a public key infrastructure (PKI) system may also be used to digitally sign electronic documents (Low, 2010). According to reference (Low, 2010) authentication techniques are classified into token-based, for example a smartcard; knowledge-based, for example a pin or password; and biometrics, for example a facial image, fingerprint or retinal scan. Using multifactor authentication by using a combination of token and knowledge-based authentication methods will provide greater security (Low, 2010). This means that an outsider would need to gain access to a token and guess the correct password before gaining access to the system. In addition, each user's identity is independently verified (Low, 2010). Fraud prevention requires that the instructions given by customers, merchants and financial institutions are not able to be tampered with (Smith, 1999).

Improvements in information technology are apparent in many countries. In New Zealand, British Columbia and Ontario, paper certificates are no longer used (Low, 2010). In Australia, The National e-Conveyancing Development Limited (NECDL) was formed to deliver a national electronic conveyancing solution by removing manual processes and paperwork associated with the exchange of landed property (Sheeran, 2013). Property Exchange Australia (PEXA) will enable the settlement of electronic conveyancing transactions through a pay as you go system that will not charge subscription fees (Sheeran, 2013), subject to regulatory oversight by the Reserve Bank. An electronic certificate of title will exist as there will no longer be hard copy certificates of title in existence in certain circumstances. The fundamental principles of the Torrens system will remain.

South African legislation provides for paper documents to be handed in at the Deeds Office by a conveyancer, even though land title instruments are prepared electronically. The Electronic Deeds Registration Bill that has been updated to allow for electronic signatures and other electronic legal instruments is yet to promulgated. The Deeds Registry staff manually checks documents that have been lodged for registration before the register is manually updated. Any alterations to paper documents may leave a physical mark but would still need to be detected by the examining officer (Low, 2010). Registered title deeds have been converted to microfiche since 2005 for better storage and retrieval. Despite the digitised recordkeeping, manual paper-based systems prevail.

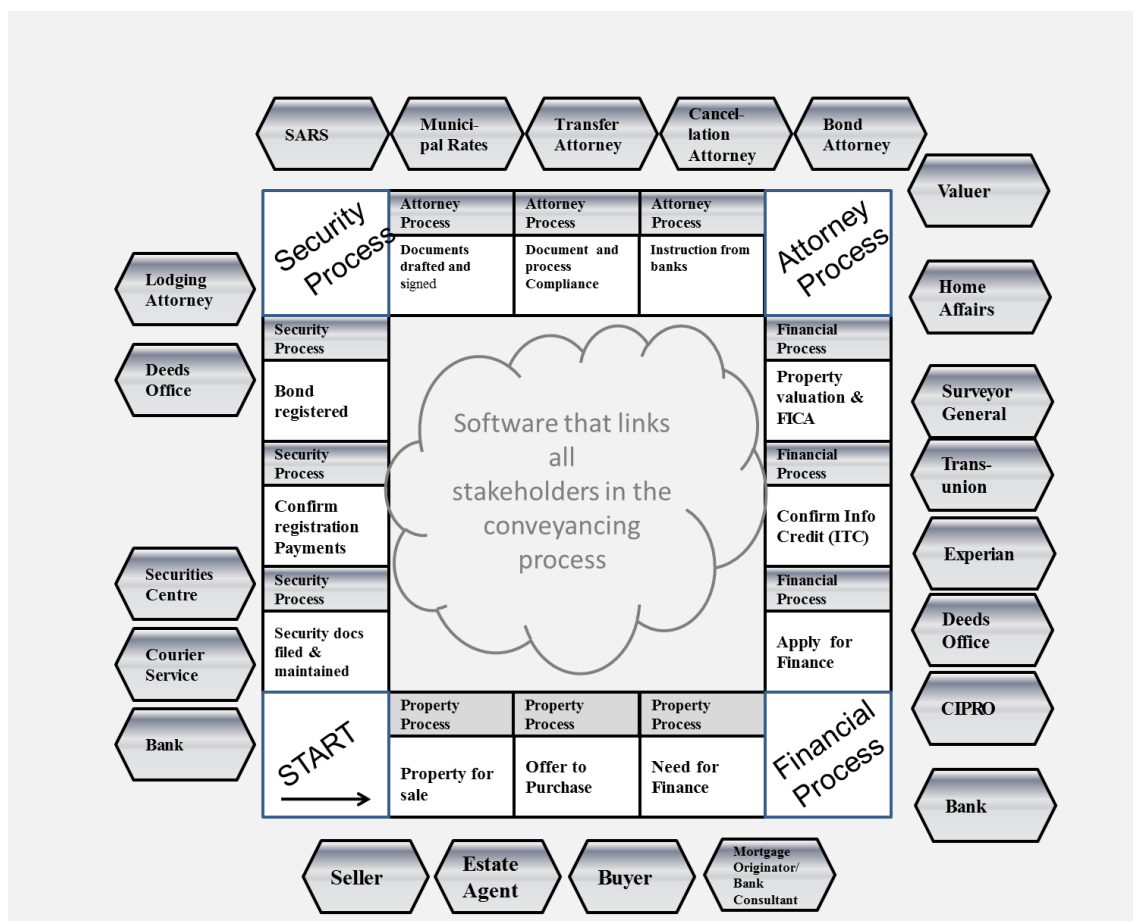
A single national deeds office and not provincial designations are preferred as future technology developments could better be enabled without having to go to Parliament for approval of further developments (Whittle, 2014). Electronic registration submissions would reduce registration time, as uploads can be done from other provinces without using corresponding attorneys. Furthermore, a system that could link all parties involved in a single transaction, would allow for increased security and transparency as illustrated in Figure 2:





**Figure 2: Software switch**  
**Source: Amadi-Echendu, 2013**

Entities one and two in Figure 2 refer to any two of buyer, seller, estate agent, mortgage originator, bank, conveyancer, Deeds Office, Municipality or SARS. Data and documents could be securely communicated between the entities via an encrypted switch. A document workflow could structure the sequence and type of communication that need to take place at predetermined intervals. There are many benefits that can be derived from a secure communication link between the entities in the conveyancing value chain. This links to a finding of the study that there is a need for a centralised information sharing capability whereby non-competitive information that are collected from the onset of the transaction can be verified and made available across the supply chain. Using a software switch among all the stakeholders in the value chain would enable for all stakeholders in the supply chain to be inter-connected as per the illustration in figure 3.



**Figure 3: The immovable property supply chain**  
**Source: Amadi-Echendu, 2013**

The introduction of an electronic registration system should enhance the service delivery to customers as the total time from completing the offer to purchase to registration can be reduced. Due to the electronic storing capabilities of an electronic conveyancing system, as well as the ability to send documents and images via an electronic system, the use of paper may be reduced or even eliminated. Banks and conveyancers could reduce the costs associated with the storage of paper documents in storage facilities, as well as associated staff and fireproofing costs, and the replacement of misplaced and lost title deeds within their storage facilities. Banks could bank interest income sooner due to earlier registrations. Improved quality of the applications due to the introduction of an electronic system (less finger errors) could lead to a reduction in the number of rejections at the Deeds Offices. e-Conveyancing would enhance searching options and the availability of information to the general public. It would produce better tools for the registration process (Whitman, 1999). The system may reduce fraud by raising an alarm at source when tampering occurs. Electronic communication will increase transparency for all parties that are linked to a particular transaction. An e-conveyancing system may enable electronic payments of taxes and other payments related to the property transfer. Electronic notifications will inform relevant parties of any changes that have occurred in the process as they happen.

The various entities involved in the property market tend to operate in silos. As a result, vendors have built their businesses around connecting the individual entities and charging a premium for each of these connections. These amounts are outsourced to the end user being the buyers and sellers of properties. As a result, property costs have soared and have become unaffordable to a large percentage of the SA population. If the deeds office, as custodian of the property title register, could introduce a technological system that connects the various role players in the property

market, it should eliminate the need for individual entities to build interfaces in order to connect to each other, which in turn should reduce the cost of transferring properties in South Africa. Integration enables a supply chain to operate as a single unit motivated by customer requests (Palma-Mendoza, Neailey, & Roy, 2014). In addition to the cost saving, a supply chain perspective would also assist to make the entire end-to-end process more transparent, therefore reducing uncertainty and fraud in the process. A supply chain perspective may also reduce duplications that are taking place currently. One such duplication may be FICA identification.

## **5 CONCLUSION**

The principle function of a system of land registration is to create and ensure *title* or *deed* security. In South Africa, title security flows from the deeds registration system in the Deeds Office. The deeds registration system comprises private and public entities. As confirmed with the data collected, the current property process in South Africa is manual and paper based. The role players are not linked, and data and information are not centralised but stored in various databases or individual entities. Private organisations have automated pockets of information for profit which increases the costs associated with property transfers. Another finding of the study was that integration efforts should be reviewed, and a new industry model would need to be developed for the transfer of landed property.

The property market has grown in complexity and it has become necessary to incorporate more sophisticated and electronic governance structures and technologies into the deeds registration system to enable a quicker and more effective collection, storing and dissemination of information, as well as to have better control over the respective processes, while ensuring safety of title. The main theoretical contribution of the study is that supply chain integration and centralisation of technologies, records management and security relates to the systems theory (Halldorsson, Kotzab, Mikkola, & Skjøtt-Larsen, 2007:291). The supply chain should be viewed as a system that uses different processes and entities to convert input into output; integrates information, finance and systems; and achieves cross-functional effectiveness and efficiency. It is recommended for an integrated model to be incorporated into property processes in South Africa.

Although the benefits far outweigh the cost, uptake on integrated systems are still low. Land administration systems may need to be re-engineered and evolve to face the increasing complexity of property rights and land transactions, so that they take a broader and more integrated view. As such, a supply chain approach is recommended. The aforementioned clearly indicates the working of systems theory and provide explanations to illuminate our understanding of real-world systems we encounter. Industry specialists can benefit by applying systems theory as a lens to view multidisciplinary systems and their associated difficulties. Academics can benefit by researching multidisciplinary systems with their associated difficulties and making recommendations for ways to overcome such difficulties.

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