A theoretical analysis of industrial 4.0 in the South African SMMEs

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Abstract
A number of challenges has been identified in the manufacturing sector in the past three decades. The industrialized uprising is currently known as the industry 4.0. Consequently, the concept of industry 4.0 has become the buzz word amongst scholars and industry practitioners. Despite the fact that the concept of industry 4.0 is attending high level of significance in the western and eastern countries i.e. America, Asia, etc., due to its ability of smoothing of business environment, in Africa, particularly in South Africa the integration and adoption of industry 4.0 concept is facing several challenges. To date, over the past decade many studies has been conducted to investigate the benefit of implementing industry 4.0 in manufacturing companies at global level. However very few studies have been conducted in the South African SMMEs manufacturing industry 4.0 perspective, thus, the overall goal of this paper is to fill these gaps by means of critically analyzing studies that were conducted or develop in the field of industry 4.0 over the past decade. This segment is too experiencing encounters that face unceasingly altering requirements of customer at an international level, pleasing into justification that they essential familiarize to the fluctuations to safeguard tenable. The manufacturing space is progressing at an effective means of production and the adoption of novel expertise.

Keywords
Industrial 4.0, South African Small Medium and Micro-Sized Enterprises (SMMEs)

1. Introduction

Around the globe, the traditional manufacturing has become tutus because of the technological or digital transformation that has continuously grow at a highest trajectory the world has ever seen. Smart technology has become a way of life, a way of doing things on a daily basis. Companies need to adopt to the rapid changes and exponential growth, others might be left behind by developed competitive countries. This applies to traditional industrial economics such as Germany and the United States of America, as well as emerging economies like Asia, Africa, and South America (Deloitte, 2016). The term industry 4.0 refers development stage in the organisation and management of the entire value chain process involved in manufacturing industries. Another term for this process is the "forth industrial revolution". Some commentators also use the term the "internet of things" or the "internet of everything or the "industry internet" (Deloitte, 2015). What all these terms and concept have in common is the characteristics of the traditional manufacturing and the production process are the throes of the digital or technological transformation. For some time now, most industrial process these days, have progressively embraced the modern information technology (IT). The industry or sector has been evolving on an ongoing basis since the olden times. The biggest shift of industrial revolution took place in the 18th century and was related to the transition from the economy based on agriculture, manufacturing and handmade production to mechanical large scale factory production, this does not entirely exclude service industries or sectors. The 19th century was the age of steam and electricity, referred to as the industry 2.0. The other years of intense development was the period after the 2nd World War which continues until nowadays, this was in regard of the continuous improvement philosophy, with scientific and technical growth taking

place. The most imperative elements of the Industry 3.0 include computerization/ technology, new energy sources, automation of work processes/ production, as well as enhancement of means of telecommunication. Industry 4.0 covers three possible archetypes See figure 2 below, which illustrate the evolution of industries since the 18th century. Industry 4.0 stanches from the concept of internet of things, smart factory, involving the electronic flow of production/ processes (Hermann *et al*, 2015). This means that centrally monitoring and controlling devices connect using the operating principle of social media (Radziwon *et al,* 2014).

Equipment and raw materials organize production on their own, beyond the borders of a company, or even countries, in order to ensure efficient and effectiveness of the operation. (Pfohl *et al*, 2015). The operations of such companies is centred on meeting customers order at high regard of quality, production is carried out in small batches. There is a very high variety of products, to help diversify the company's product offerings. The third archetype are these-called e-factories, focused both on individualization and remote operations. These companies operate on a small scale, producing limited amounts of products. The company's functional structures are integrated as per the mission of the company. They are oriented towards low investment expenditure in order to remain cost competitiveness. However Industry 4.0 does not only refer to changes in industrial unit but also in distribution and procurement as per the supply chain. General Electric emphasizes the role of the integration of complex physical equipment and digital devices with networked sensors and software, used to predict, control and plan for better business and societal outcomes (Drath, Horch 2014). According to Pfohl *et al* (2015), Industry 4.0 can be considered on the process, technology or management level in the whole supply chain and is defined as the sum of all disorderly innovations derived and implemented in a value chain to address the trends of digitalization, empowerment, transparency, mobility, modularization, network collaboration and socializing of products and processes. Industry 4.0 is a collective term for technologies/ digital and concepts of value chain organization (Herman *et al*, 2015). Based on the literature research, conducted by Herman *et al*, (2015), the most imperative are: Cyber-Physical Systems (CPS), Cloud Technology, Industry Internet, Internet of Things, Smart Factory and Internet Service. However, Industry 4.0 is something more, Pfohl *et al* (2015) distinguish more than 60 technologies related to this concept. All of them can be divided into the following four groups (Lee *et al*, 2014):(i) data and connection, (ii) analytics and artificial intelligence, (iii) human-machine interactions (Chen *et al*, 2012), (iv) automated machine park. The description of these groups is presented in Table 1.

Technologies in Industry 4.0.	**Components and benefits**
Data and connection	Large databases (big data) - data storage, processing and calculations Internet of Things (IoT) and communication between machines (Machine to Machine) - connection and transfer of information / data Cloud technologies (cloud technology) - centralization of data storage and virtualization of storage
Analytics and artificial intelligence	Digitization and automation of work based on knowledge - use of artificial intelligence and machine learning Advanced analytics - improved algorithms and data availability, implementation of advanced data mining systems used mainly for predictions
Human Machine Interaction	Touch interfaces and new GUI interfaces - possibility of quick communication using portable devices Virtual reality - use of optics, including augmented reality glasses, in industry, e.g. in a warehouse
Automated machine park	New production opportunities, e.g. using 3D printers - extended range of materials, increased precision / quality, possibility to obtain spare parts or raw materials immediately Advanced robotics - use of artificial intelligence, full automation of production, use of M2M technology Energy storage - production and storage of energy by performing daily activities in companies

Table 1: Technologies used in Industry 4.0 (Szozda, 2017)

One of the fastest emerging technologies used in Industry 4.0 is Internet of Things (IoL).It is the indirect or direct ability of things and objects to store, process, and share or exchange data using network connections (Shimizu *et al*, 2016). In contrast with Industry 4.0., Internet of Things is not focused on factory, and its application is visible particularly in the distribution area or supply chain, logistic, mainly in customer service and use of objects. Business structure or models are created using IoT technology are completely different from the traditional ones. They demonstrate departure from conventional linear oriented value streams to creating values within a network of components. This means that when defining business structure/ models, the focus is on the entire bionetwork,

including a supply chain/ logistics, rather than one single company, so that all parties involved improve their processes in order to maximize benefits for the end customers. (Atzori *et al*, 2010).

1.2 Background of Small, Medium and Micro- sized enterprise (SMMEs

SMALL MEDIUM AND MICRO-SIZED ENTERPRISES (SMMEs) are acknowledged for their involvement to economic transformation and progression, creating jobs, novelty and riches formation (Bell et al., 2004). Nevertheless, SMMEs have a bigger influence on economic enactment in extremely industrialised markets where extraordinary levels of "education, low inflation rates and high levels of financial intermediary development are evident (Ayyagari et al., 2003)". The administration has recognised the SMMEs as one of the prospective contribution of producing an allowing environment by cultivating employment establishment prospects and riches disseminations provisions (Department Trade and Industry 1995).

The following table afford an indorsed meaning of each of the smaller business types as per the national small business Act, which reads as follows:

Table 2 Definitions of smaller business types

Category	Description
"Survivalist enterprise"	• Functions in the informal sector of the markets, • Largely assumed by a person without a job, • Revenue created below the poverty line, • Little investment invested and less resources, • Not much coaching and work sops, • Prospects for developing the enterprise is very limited.
"Micro enterprises"	• Amongst 1 to 5 workers, generally the proprietor or family, • Informal – less compliant, official private buildings labour legislature, • Yield underneath the VAT listing of 300k per year, • Basic industry skills and training, • Prospective to create the conversion to a feasible recognised small business
"Very small enterprise"	• Portion of the formal markets, use expertise • Less than 10 paid workforces • Comprise self-starting artisans (i.e. electricians, plumbers) and specialists
"Small enterprise"	• Fewer workforces • Supplementary recognised than "very small enterprises, formal and registered, fixed business premises", • Proprietor accomplished but further multifaceted administration arrangement,
"Medium enterprise"	• Employees up and about to 200 workforces • Primarily managed, but distributed administration arrangement with functional departments, • Functions from stable properties with all prescribed necessities
Note: women characterise roughly 56% of the "survivalist enterprises" grouping, 38 % of "micro enterprises" with no workers and 15% of "micro enterprises" with 1 to 4 workers	

SMMEs are the most diverse group of industries in SA, seemingly accountable for the uppermost amount of "employment, labour system, highest failure rate and the lowest skill and infrastructure (department of trade and industry, 2003 and 2004)".

The South African economy has put much importance on the attributes of SMMEs to produce jobs, thus subsidising to "poverty alleviation". "The research emphases on the role of SMMEs in local economic development, entrepreneurship, growth prospects and constraints". The significance of invention in small industry improvement is also underlined. Wolf (2006) specifies that the capability to revolutionise, accept novel technologies and apply them to local surroundings is critical to intensify the productivity and competitiveness of SMMEs. Rogerson (2001) suggests that pioneering private enterprise is one of the key accomplishment influences for the development of SMMEs. Luiz (2002) disputes that SMMEs be responsible for a nursery and showing ground for novelty. "The dynamics of innovation, entrepreneurship and small enterprises have, however, only received a little research attention in South Africa". At present, macroeconomic tactics in South Africa emphasis on transmuting the markets to an information based economy (Department of Science and Technology (DST), 2008). The National Research and Development Strategy (NRDS) centres not only on attractive South Africa's national competitiveness within a world-wide environment, but also targets to eradicate social ills (South Africa, 2002). At policy level, the role of small business expansion are acknowledged as significant for job formation, poverty eradication, trade and industry improvement (O'Neill and Viljoen, 2001). The National Small Business Act 102 of 1996 recognises small business expansion and the authorisation of businesspersons as the utmost significant possibilities for commercial development in South Africa (South Africa, 1996). Rohan (2006:24) indicates the analysis of how SMMEs, can be used to progress the sustainability in South African markets. He illustrate the economic growth, which explains why nations or countries have diverse "standards of living" (Mulongo & Kholopane, 2018a; 2018b, 2018c, 2018d, 2018e).

research directs that in Africa, SMMEs have acknowledged rising attention for the reason that their workforce absorptive capability in times of both a withdrawal public sector and private economy, and collective numbers of novel workforce participants. With the move of industrial policy away from import-substitution and of industry policy just before liberalisation, SMMEs are anticipated to react compliantly and thus endure international competition (Hirst and Zeitlin, 1992; Bambara, 1995; Kaplinsky, 1997; Schmitz, 1997).

In 2006 South Africa's Department of Trade and Industry (DTI) propelled its novel cohesive small enterprise tactic that affords a platform for small enterprise improvement for the future developments (DTI, 2006). The tactic document is the produce of an extensive progression of assessment, discussion and exploration which pursues to advance from the accomplishments (Rogerson, 2004). Amongst the essential aims of the approach is to improve the contribution of SMMEs to development of the nationwide economy, to construct sustainable employments in the small business sector, and to "create an enabling environment for small enterprises with a level playing field between big businesses and small enterprises, that reduces the disparities between urban and rural enterprises and is conducive to entrepreneurship (DTI, 2006: 15)". Supplementary, the tactic intentions is to "ensure equitable access and participation in terms of race, gender, disability, age, geographical location and sector (DTI, 2006: 15)".The essential directions of the provincial policy remained affiliated diligently with those of the "1995 National White Paper on Small Business Development (South Africa, 1995)". The essential targets of the regional SMMEs tactic were specified as of generating more jobs, contributing to the changing aspects of the markets, vesting formerly underprivileged sectors of society; and, given that an intricate social net for the jobless, deprived and impoverished. The SMMEs economy is regarded as "a vital part of the provincial economy" (Mpumalanga Province, 2005) and a crucial foundation for local economic improvement in the jurisdiction (Meyer-Stamer, 2002; Fiedeldei, 2004; Mpumalanga Province, 2004; Gunter, 2005).

2. Gap identification in previous studies

The purpose for this section is to analyses the past study and criticize the gaps or evaluate the work done by the author. The analysis will be looking at the core study of the research, the year published, location of the study, the sample size, methodology, and the findings of the study in order to increase the reader's understanding of the research. To begin with the critical assessment, the ISI web of science data base was used on the industrial 4.0 as key words. A critical analysis is subjective to a number of categorized objectives, are as follows:

- Publication year (1997 to 2017),
- Language selection (English),
- Pear reviewed article source title,
- Country/ region,

The search resulted had 257 document, that were critical assessed by means of tittle and abstract with the purpose, of developing boundaries (screening phase). Through the groups of inclusion, segregation of standards established and against which every journal was assessed. Article are those are precise, which focused in the adoption of industry 4.0 in the SMMEs. It pointed out that the studies which did not meet the requirements were taken out. At this stage generated 87 focusing in industry 4.0 in manufacturing and information and communication technology. These studies were labeled on the basis of the set of standards, i.e. the studies were assessed were selected based on the citation.

The below table is the list of all critical assessed studies, we have selected 15 most critical analyzed studies over the past 3 decades. Below after the table is the details of the critical assessed and the gaps identified.

2.1 **Critical analysis table**

Author	**Location**	**Sector**	
		Manufacturing	Information and communication Technology
Liu et al. (2016)	Not specified		X
Lin et al. (2016)	Not specified		X
Kong et al. (2016)	Not specified		X
Leitao et al. (2016)	Europe		X
Kolberg et al. (2015)	Germany	X	X
Stock et al. (2016)	Germany	X	
Zhang et al. (2016)	Not specified		X
Kanaris et al. (2016)	Not specified		X
iadziwon et al. (2014)	Not specified	X	
Wang et al. (2016)	Not specified	X	
iathore et al.(2016)	Korea		X
Chun- Wei Tsai (2016)	Taiwan		X
Yue et al. (2015)	China	X	
Chen et al. (2006)	UK		
ioy (2016)	Not specified		X

Liu et al. (2016) argued that with the increasing scarcity of energy supply around the universe, energy proficiency is one of the utmost significant regarding for a data centre. He proposed that "green data centre air conditioning system assisted by cloud techniques, which consists of two subsystems: a data centre air conditioning system and a cloud management platform The data centre air conditioning system comprises environment monitoring, air conditioning, ventilation and temperature control, whereas the cloud platform provides data storage and analysis to support upper-layer applications". Furthermore, he presented a comprehensive "design and implementation are obtainable, comprising the dispatch algorithm for the temperature control, topological structure of the sensor network, and framework for the environment monitoring node". A feasibility evaluation is used to confirm that the planned system can meaningfully lessen the data centre energy ingesting deprived of dilapidation in the refrigerating performance. Though he failed to collect data using quantitative and qualitative methodology and also failed to disclose the size of the enterprise and the location where the study was conducted and doesn't argues the relevance of the industry 4.0 technology in his study. Therefore my research will be looking at the impact and competitiveness of the adoption of industry 4.0 in the South African SMMEs.

Lin et al. (2016) argued that localization services, particularly for human localization, are an essential element of most technologies and presentations related to the "Industrial Internet of Things (IIoT)". Nonetheless, he indicated the intricacy of an industrialised surroundings and the movement of the matters, efforts to grow an exact localization resolution facade assured challenges. He proposed a new method that influences the inertial sensors entrenched in "smartphones and uses Wi-Fi thumbprints founded on the Angle of Arrival (AoA)" to support in localization; this method is referred to as ISWF for short. He points out that by means of data from "inertial sensors in smartphones and with the additional combination of thumbprint localization, his tactic was overcome" the challenges impersonated by multifaceted peoples actions and magnetic interfering in an industrialised surroundings. From the study it shows that the author used a qualitative methodology to gather data. Though he failed to collect data using quantitative methodology and also failed to disclose the size of the enterprise and the location where the study was conducted and doesn't argues the relevance of the industry 4.0 technology in his study. Therefore my research will be looking at the impact and competitiveness of the adoption of industry 4.0 in the South African SMMEs.

Kong et al. (2016) argued that "wireless sensor network (WSN) is one of the mainstay technologies in Internet of Things". He indicated that the WSNs, grouping is to establish sprinkled "sensor nodes into a cluster topology network for communications". He mentions that in prevailing determinations on grouping intensively emphasis on the energy competence matter. Though, he noticed that in "mission critical applications, a fast clustering scheme, which can not only gather sensory data immediately after deployment but also reduce the energy consumption, is more desired. In this paper, we study the clustering problem considering both time and energy efficiency". He proposed a new "instantaneous clustering protocol (ICP)" that bunches sensor nodes into sole hop groups in an equivalent manner. He indicates that the ICP can immediately thorough the grouping owing to binary significant designs: "First, to determine the cluster heads locally. Existing methods require a long duration on cluster head voting. To waive the voting consumption, a cluster head in ICP is locally determined by the pre-assigned probability and its present status. Second, to minimize the amount of transmissions". He indicates the performance outcomes validate that ICP meaningfully outpaces prevailing grouping approaches by decreasing to 55% period ingesting and 89% volume of conductions for energy saving. From the study it shows that the author used a qualitative methodology to gather data. Though he failed to collect data using quantitative methodology and also failed to disclose the size of the enterprise and the location where the study was conducted and doesn't argues the relevance of the industry 4.0 technology in his study. Therefore my research will be looking at the impact and competitiveness of the adoption of industry 4.0 in the South African SMMEs.

Leitao et al. (2016) argued that "Cyber-Physical Systems (CPS)" is an up-and-coming method that emphases on the addition of computational presentations with corporal devices, these are produced as a system of interrelating "cyber and physical elements". He indicates that CPS governor and observer real world physical structures and thus is preliminary consuming a high influence in industrialised mechanisation. He derive an impression of key characteristics of industrialised CPS, their knowledge and developing instructions, as well as encounters for their application is obtainable. His findings were grounded on the practical involvements gather round from four "European innovation projects over the last decade (i.e. SOCRADES, IMC-AESOP, GRACE and ARUM), a key challenges have been identified and a prioritization and timeline are pointed out with the aim to increase Technology Readiness Levels and lead to their usage in industrial automation environments". From the study it shows that the author used a qualitative methodology to gather data. The study was conducted in Europe.Though he failed to collect data using

quantitative methodology and also failed to disclose the size of the enterprise and the location where the study was conducted and he argues the relevance of the industry 4.0 technology in his study, but in the context of Cyber Physical System. Therefore my research will be looking at the impact and competitiveness of the adoption of industry 4.0 in the South African SMMEs.

Kolberg et al. (2015) argued that lean manufacturing paradigm has develop the main method to generate extremely effective procedures in business since the primary 1990's. He mentions the declined of "Computer Integrated Manufacturing (CIM) era", which lastly was fated to fail unpaid to its untrustworthy difficulty of the obligatory mechanisation equipment, the Lean methodology was fruitful for the reason that its extraordinary usefulness by decreasing difficulty and evading non worth add progression steps. He indicates that "today, the term Industry 4.0 defines a vision of prospect production". Though he found that many individuals are at least doubtful towards this novel method. He indicate a synopsis over prevailing groupings of "Lean Production and automation technology, also called Lean Automation". Additionally, he discussed major "Industry 4.0" contribution and linkage to the unshakable Lean methodology. He identified instances of conjoining both are smart watches for seconding the "Andon principle or Cyber Physical Systems (CPS) for a flexible Kanban production scheduling". The study was conducted in Germany. Though he failed to collect data using quantitative methodology. He argues the relevance of the industry 4.0 technology in his study, but in the context of Andon principles or Cyber Physical System. Therefore my research will be looking at the impact and competitiveness of the adoption of industry 4.0 in the South African SMMEs.

Stock et al. (2016) argued that the present globalization is confronted by the encounter to meet the constantly developing international demand for investment and customer goods by instantaneously confirming a maintainable "evolvement of human existence in its social, environmental and economic dimensions". He indicated that most important thing in eliminating waste, is to create value creation must be headed for sustainability. He mentions that the presently, the industrialised value creation in the primary industrial developed republics is formed by the improvement towards the 4th stage of industrialization, the so-called Industry 4.0. He indicates that such improvement affords enormous prospects for the understanding of sustainable manufacturing. The author examination of Industry 4.0 based on latest expansions in research and practice. The study was conducted in Germany. The author used a critical review methodology to collect data. Though he failed to collect data using both qualitative and quantitative methodology. He argues the relevance of the industry 4.0 technology. Therefore my research will be looking at the impact and competitiveness of the adoption of industry 4.0 in the South African SMMEs.

Stock et al. (2016) argued that the mobile crowdsourcing systems are significant foundations of info for the Internet of Things (IoT) such as assembly locality related detecting data for numerous requests by employing normal populations to contribute in data gathering. He indicates that in demand to progress the Quality of Information (QoI) of the collected data, the system server requirements to organise applicants with different data collection abilities and numerous inducement requirements. Though, he reiterate that prevailing applicant synchronisation approaches involve the applicants to disclose their trajectories to the system server which effects discretion leakage. He proposed an applicant synchronisation framework, which permits the system server to offer optimum QoI for detecting responsibilities without meaningful the trajectories of applicants. He states that an accommodating data combination, an inducement dissemination technique, and a sentence appliance are further projected to both defend applicant discretion and certify the QoI of the collected data. The author used a Coordination methodology to collect data. Though he failed to collect data using both qualitative and quantitative methodology and he failed to specify the location where the study was done. He argues the relevance of the industry 4.0 technology. Therefore my research will be looking at the impact and competitiveness of the adoption of industry 4.0 in the South African SMMEs.

Kanaris et al. (2016) argued that the endowment of precise location info is a significant task in the "Internet of Things (IoT)" requests and situations. He suggested that the need has improved the investigation and expansion of thumbprint established, "indoor localization systems, since GPS information is not available in indoor environments". He indicates that performance appraisal of such schemes and their connected "localization algorithms", is commonly established on selection assortment in pre-set test surroundings. The author used a "sample size purpose and sampling methodology, in other words it's called a quantitative methodology". His methodology helps to calculate the "minimum sample size of positioning data requisite for impartial performance appraisal of fingerprint centred localization schemes". He proposed a "Sample Size Determination Algorithm (SSDA)" takings into deliberation the anticipated sureness equal, "the resulting standard deviation of a small size preliminary sample as well as the error approximation with respect to the actual error of the system and proposes the final sample size for the evaluation and/or calibration and/or training of the utilized radio-maps". Furthermore, he indicated that the SSDA, accepts

accidental sample distribution in the area of interest in directive to evade prejudiced outcomes. Though he failed to collect data using qualitative methodology and he failed to specify the location where the study was done. He argues the relevance of the industry 4.0 technology. Therefore my research will be looking at the impact and competitiveness of the adoption of industry 4.0 in the South African SMMEs.

Radziwon et al. (2014) argued that in modern society, which an era ago would only be labelled in the science fiction literature. He indicates that additional effects become smart and both "scientists and engineers" go all-out for emerging not only novel and inventive devices, but also homes, factories, or even cities. His findings shows that the continuous expansion are still at a conceptual stage, which are just being great ideas, which still suggest a need of a lot of exertion to become true. He reviewed the practice of adjective "smartin" detail to technology and with a distinct importance on the smart factory concept assignment among modern research. His emphasis are that most lack an understanding of this term. He underlined that conceptualization will not only mention to numerous smart factory visions stated in the literature, but similarly link the critical appearances of this developing manufacturing notion to typical manufacturing practice. Successively, the authors deliberate the encounters of the prospective smart factory uses in SMEs, and also suggest an upcoming investigation viewpoint in order to supplementary expand the smart factory conception. Though he failed to collect data using quantitative methodology and he failed to specify the location where the study was done. He argues the relevance of the industry 4.0 technology. Therefore my research will be looking at the impact and competitiveness of the adoption of industry 4.0 in the South African SMMEs.

Wang et al. (2016) argued that the "proliferation of cyber-physical systems" presents the 4th industrial revolution, usually called as Industry 4.0. He indicates that the perpendicular integration of numerous workings inside a workshop to instrument a "flexible and reconfigurable manufacturing system, i.e., smart factory". He presented a "smart factory" context that integrates industrialised "network, cloud, and supervisory control terminals with smart shop-floor objects such as machines, conveyers, and products". He further states that the independent resolution and dispersed collaboration between representatives lead to great flexibility. Furthermore, He indicates that a self-organised scheme influences the reaction and organisation by the central planner in directive to attain extraordinary competence. All these supports are done by the big data base feedback and coordination. He proposed that an intelligent co-operation instrument for agents to cooperate with each other and he also demonstrates that corresponding approaches can be considered to inhibit impasses by cultivating the managers' result creating and the planner's performance. The author used qualitative methodology, however he failed to collect data using quantitative methodology. He argues the relevance of the industry 4.0 technology. Therefore my research will be looking at the impact and competitiveness of the adoption of industry 4.0 in the South African SMMEs.

Rathore et al. (2016) argued that the fast growing population concentration in metropolitan towns demands that amenities and an organisation structures be delivered to encounter the requirements of urban occupants. He mentions that there has been an upsurge in the demand for entrenched devices, "such as sensors, actuators, and smartphones, leading to considerable business potential for the new era of the Internet of Things (IoT), in which all devices are capable of interconnecting and communicating with each other over the Internet". He indicates that technology has been at a centre stage of providing an integrated communication medium. In the paper he propose that a combination of IoT centred system for smart town's enlargement and metropolitan development using big data analytics. He further suggest a comprehensive system containing of numerous forms of "sensor deployment, including smart home sensors, vehicular networking, weather and water sensors, smart parking sensors, and surveillance objects". He proposed four tier design that includes "1) Bottom tier-1, which is responsible for IoT sources and data generation and collection, 2) Inter- mediate tier-1, which is responsible for all types of communication between, for instance, sensors, relays, base stations, and the Internet, 3) Intermediate tier 2, which is responsible for data management and processing using a Hadoop framework, and 4) Top tier, which is responsible for application and usage of the data analysis and the results generated. The system implementation consists of various steps that begin with data generation and move to collection, aggregation, filtration, classification, pre-processing, computing and decision making". His support system initiation is applied using "Hadoop with Spark, voltDB, Storm or S4 for real time processing of the IoT data to generate results to establish the smart city" and the justification on urban preparation, integrates the disconnected historic data which was examined with Hadoop using Map Reduce programming. His results shows that IoT datasets produced "by smart homes, smart parking weather, pollution, and vehicle data sets are used for analysis and evaluation". He points out that the type of programming is not fully operational and does not currently exist. His conclusion shows that the outcomes prove that the future system is more ascendable and effectual than current systems. The author used analytical methodology, however he failed to collect data using qualitative and quantitative methodology. He also failed to specify the type of a business in terms of size. He argues the relevance of the industry 4.0 technology and the

competitiveness of maintenance. Therefore my research will be looking at the impact and competitiveness of the adoption of industry 4.0 in the South African SMMEs.

Chun- Wei Tsai (2016) argued that the expansion of an influential search instrument to find a virtuous resolution is the present investigation course of studies on meta-heuristic algorithms; though, he mentions that utmost of the industrialised instruments will pursuit and check the potential resolutions without understanding of the inclusive background of the resolution space through the meeting method. He indicates that it's important that each exploration during the convergence method is as operational as possible. He presented a novel meta- heuristic algorithm known as "search economics (SE)" to resolve the disposition challenges of wire-less sensor networks. He maintains that the "main distinguishing features of the SE are twofold: the first is its capability to depict the solution space based on the solutions that have been checked by the search algorithm, and second is its capability to use the knowledge thus obtained, i.e., the landscape of the solution space, during the search process". He indicates that the foundation of the system is more meaningful and less informal to descent into a local optimal during primary adoption. His conclusion shows that the suggested algorithm can afford an outcome to disposition challenges that are meaningfully restored than those providing by the contemporary meta-heuristic algorithms assessed in the research in terms of the quality. The author used a qualitative methodology, however he failed to collect data using quantitative methodology. He also failed to specify the type of a business in terms of size. He argues the relevance of the industry 4.0 technology and the high competitiveness search optimisation and system thinking. Therefore my research will be looking at the impact and competitiveness of the adoption of industry 4.0 in the South African SMMEs.

Yue et al. (2015) argued that the expansion of economic growth and "information communication technology (ICT)" has intensely transformed our way of living. He indicates that in specific, with the developing philosophy of ''Industry 4.0", the addition of "cloud technologies and industrial cyber-physical systems (ICPS)" come to be progressively significant, as this will significantly advance the industrialised chain and organisational services. He first define the improvement and appeal of ICPS, that the system will certainly produce a significant part in manufacturing, sales, and logistics. He further indicates that with the livelihood of the cloud, ICPS expansion will influence "value creation, business models, downstream services, and work organization". He further state that the "support of the cloud, infrastructure platform and service application, ICPS will promote the manufacturing efficiency, increase quality of production, enable a sustainable industrial system and more environmentally friendly businesses". He alludes that the key enablers will have a bigger impact on the smart factories. He highlights the importance of these significant qualifying technologies will also assist businesses to recognise "high quality, high output, and low cost". The author used a qualitative methodology, however he failed to collect data using quantitative methodology. He also failed to specify the type of a business in terms of size. He argues the relevance of the industry 4.0 technology and the high competitiveness on system thinking. The study only focused on ICT systems, not the production or manufacturing of products. Therefore my research will be looking at the impact and competitiveness of the adoption of industry 4.0 in the South African SMMEs

Chen et al. (2006) argued that the research reviews the "clinical effectiveness and cost-effectiveness of adalimumab, etanercept and infliximab, agents that inhibit tumour necrosis factor- (TNF-), when used in the treatment of rheumatoid arthritis (RA) in adults". He indicates that the data source used were acquired from electronic databases which were examined up to February 2005. His methodology used was "systematic reviews of the collected works on effectiveness and cost-effectiveness was undertaken and industry suggestions to the National Institute for Health and Clinical Excellence (NICE) were reviewed", as well as the "Meta-analyses of effectiveness data" was also examined from each agent. He attained the "Birmingham Rheumatoid Arthritis Model (BRAM), a simulation model", was additional industrialised and used to yield an incremental cost-effectiveness examination. His stated the findings that 29 "randomised controlled trials (RCTs)", utmost of extraordinary excellence, were encompassed. He indicates that the only intimate appraisals were in contrast to methotrexate. The study was conducted in the United Kingdom. He failed to collect data using both qualitative and quantitative methodology. He also failed to specify the type of a business in terms of size. He also failed to argue the relevance of the industry 4.0 technology and though he indicates high competitiveness on clinical effectiveness and cost-effectiveness. The study only focused only in clinical management, not the production or manufacturing of products. Therefore my research will be looking at the impact and competitiveness of the adoption of industry 4.0 in the South African SMMEs

Roy (2016) argued that extraordinary worth and extensive life produces entail continuous preservation through-out their life cycle to attain essential performance with optimal "through-life cost". He presented a base and technology compulsory to propose the maintenance service. He mentions that the "component and system level degradation

science, assessment and modelling along with life cycle 'big data' analytics are the two most important knowledge and skill base required for the continuous maintenance". He advises that a progress "computing and visualisation technologies" will progress competence of the maintenance and lessen "through-life cost" of the product. He further indicates the projection of "continuous maintenance within the Industry 4.0 framework also recognises the role of Interne of Things (IoT), standards and cyber security are important". The author used analytical methodology, however he failed to collect data using qualitative and quantitative methodology. He also failed to specify the type of a business in terms of size. He argues the relevance of the industry 4.0 technology and the competitiveness of maintenance. Therefore my research will be looking at the impact and competitiveness of the adoption of industry 4.0 in the South African SMMEs

CONCLUSION

The theoretical analysis frame work has shown strong confrontational in the Information and Communication Technology (ICT) sector, though a couple of studies done in the manufacturing space, most in the large enterprises. Very little was done in the small medium and macro-sized enterprises (SMMEs), the analysis showed that the multi-nationals in the world have shown interest of the so called industry 4.0. Though the interest is there from a South African government point of view, but very little or close to non-existence implementation done in most SMME's. But again the challenges of implementing an integrated value proposition of the industry 4.0 has shown to be an expensive exercise thus far. Most the South African SMMEs have shown to living from hand to month. A doubt has been identified from the little interaction with the business owners and the unavailability of infrastructure as shown to be the biggest hurdles. The industry 4.0 has taken great attention to most business owners and individuals, it's said that the impact of such a revolution will take industry by surprise especially in the optimisation of the business supply chain and skills enhancement. Such an initiative will create more jobs in the South African economy.

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