The Integration of the IoT in an Incubator Business Framework: A Conceptual Review

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Keywords

SMEs

IoT

Industry 4.0

Incubator

Incubator framework

Abstract

Business incubation is a crucial instrument for assuring the growth of small and medium-sized firms (SMEs), especially considering the rapidly evolving and noticeable trends in technology across the globe. The internet of things (IoT) is also gaining popularity in the commercial world on a global scale. However, evidence indicates that South African SMEs are trailing behind in the adoption of IoT technologies. To help SMEs expand, this conceptual paper aims to highlight the significance of incorporating IoT technology into incubators' business environment. Thus, the current status of the business incubator system is investigated. The opportunities and difficulties of IoT technology in incubators are also covered. The paper is based on interpretive research that gathers data through a literature review. Based on the literature presented and reviewed, it is apparent that the world is aggressively moving towards a seamless IoT-transaction-driven model. As the world of technology evolves, incubation programmes have to incorporate Industry 4.0 technologies to be able to compete in the global markets. Thus, this paper concludes that enterprises and government should embrace the use of technologies such as artificial intelligence (AI), big data analytics and IoT if they do not want to be left behind. The study sets a research agenda for the future on how IoT integration affects SMEs' development, expansion and economic growth.

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1. Introduction

In the past several years, the acknowledgment of small and medium-sized enterprises' (SMEs) role in economic growth in developing and developed countries has gained traction globally. The benefits of SMEs include job generation, innovation and creativity, economic growth and empowerment (Lose, Tengehg, Maziriri & Madinga, 2016). Due to the poor survival rate of SMEs, incubation has emerged as a means of business support. Incubators are established with the objective to create and develop enterprises by providing networking opportunities, shared administrative services, business advice and government support programmes, and by enabling access to finance, business and technical services, and access to new markets (Masutha & Rogerson, 2015). For this reason, incubators are perceived as providing the best support and a safe environment for SMEs. Additionally, as the Fourth Industrial Revolution, also known as Industry 4.0 or 4IR, progresses, there is an increasing demand for company incubation to ensure that SMEs are integrated with technology in order to enhance SMEs' survival rates.

Like all revolutions, Industry 4.0 is expected to cause disruption in society, business and government. Manda and Dhaou (2019) suggest that this revolution creates new opportunities that enterprises and government can embrace with the use of technologies such as artificial intelligence (AI), big data analytics and the internet of things (IoT). Businesses and the government risk falling behind if they reject the digitally driven Industry 4.0. The digital transformation of industry enabled by IoT permits new ways for enterprises to connect, collaborate, co-establish value and improve the incubator ecosystem (Munsamy & Telukdarie, 2018). As enterprises in the incubation phase strive for sustainability, the business industry is undergoing a revolution. IoT, as one of the technologies in Industry 4.0, is the connection of objects and things through embedded technologies, actuators and the internet (Dlodlo, 2012). IoT is expected to give rise to new opportunities for technology, including new applications and services that will leverage the opportunity it offers (Miorandi, Sicari, De Pellegrini & Chlamtac, 2012). It is also expected to offer solutions that will transform the operations and systems of enterprises. IoT will provide immense opportunities, effectiveness and efficiency, and financial returns (Palattella, Dohler, Grieco, Rizzo, Torsner, Engel & Ladid, 2016). However, Sommer (2015) argues that Industry 4.0 will bring potential distortion between the different enterprises in the ecosystem and the value chain of enterprise incubators. Therefore, incubators should not only integrate IoT technologies into their framework and ecosystem, but should also leverage the power of these technologies in their incubator frameworks to improve value chain and enterprise success.

1.1. Problem Statement

The growing number of incubators in South Africa demonstrates that incubators provide favourable business environments for SMEs, contributing to their success and the economy at large (Masutha & Rogerson, 2014b; Lose et al., 2016). However, if IoT technologies are not included in business frameworks and the incubator ecosystem by incubator managers, their absence could pose a danger to

the expansion of SMEs. Industry 4.0 technologies are transforming the business climate, and these developments necessitate a thorough examination of the prospects for and difficulties in integrating IoT technologies into South African incubators and corporate structures. That said, it is argued by some that SMEs in South Africa are lagging behind the rest of the world in adopting new technologies.

Previous studies in South Africa focused on the impact, performance, challenges and opportunities of incubators, as well as on incubator services and the sustainability of enterprise incubators (Buys & Mbewana, 2007; Sukhur & Bakar, 2018). Limited research has thus far been conducted on the use of IoT technologies in enterprise incubators. Therefore, it is important to carry out additional research aimed at improving our comprehension of Industry 4.0 technologies such as big data analytics, AI, IoT and virtual reality, among other emerging ones, and their adoption by South African SMEs.

1.2. Research objective

The purpose of this conceptual paper is to evaluate the existing literature and investigate the advantages and potential of incorporating IoT technologies within incubator frameworks in South African SMEs.

2. Literature Review

2.1 Overview of small enterprises

Different definitions of SMEs have emerged in the past years, and there is no universally agreed-upon definition. There are inconsistencies in how SMEs are defined globally. Many definitions include survivalist, micro, very small, small, and medium-sized enterprises (Masarira & Msweli, 2013). Some academics categorise SMEs based on their size, resources and revenue generated by each business or area (Rwigema & Karungu, 1999). In South Africa, a "small business" is defined in Section 1 of the National Small Business Act of 1996, and amended by the National Small Business Amendment Acts of 2003 and 2004 (South Africa, 1996), as a business entity that is managed by one or more people, which is predominately carried out in any sector or sub-sector of the economy (Van Scheers, 2018).

SMEs in South Africa play a vital role in economic growth (Khosa, 2020); they drive economic growth, create jobs and provide innovation. The South African government acknowledges the importance of SMEs, so much so that a Ministry of Small Business Development was established in early 2014. SMEs are recognised worldwide as the engines for economic growth and innovation (Gherghina, Botezatu, Hosszu & Simionescu, 2020; Chimucheka & Mandipaka, 2015). While the significance of SMEs in economic growth is generally acknowledged and agreed upon, most SMEs fail to survive for a variety of reasons, such as the entrepreneur's lack of business management experience and lack of technical, managerial, financial, planning and market research skills (Lose et al., 2016; Masutha & Rogerson, 2014b). SMEs in South Africa are known to have dismal survival rates (Leboea, 2017). By offering operating SMEs support during the early phases of business development, incubators are thought to help improve these low survival rates (Chimucheka & Mandipaka, 2015). South Africa had to adopt

business incubation as a creative development strategy, both at the national and local levels, in order to help the small-business economy and to follow trends from other developing and developed nations. There is thus a growing need to equip incubators with the technology necessary to operate efficiently in the Industry 4.0.

2.2 Definition of incubator

Since its inception, there have been different definitions and interpretations of incubation globally. However, academics have generally agreed on what enterprise incubators are. Therefore, for the purpose of this research, an enterprise incubator is seen as an organisation that supports incubatees by offering technical, business, managerial, operational and financial support (Lalkaka, 2003; Hackett & Dilts, 2004). According to Buys and Mbewana (2007:356), an incubator can be defined as an organisation that aids small-business owners and entrepreneurs in some way in the development of their business ideas. Business incubators are developed to aid small businesses by providing support with the difficulties they experience, as part of a bigger company growth strategy (Mutambi, Byaruhanga, Trofer & Buhwezi, 2010). According to the National Business Incubation Association (Mian, 2014), business incubation is a business assistance procedure that offers incubatees a variety of instruments and services in order to quicken the successful development of start-ups. The management of the business incubator typically arranges for these services and makes them accessible through its contacts.

Since incubation was originally introduced in the 1980s, four generations have been recognised on a global scale (Lalkaka, 2001). In the first generation, the incubators offered incubatees office space at a reasonable cost to aid in the development of the business. Incubatees were, additionally, helped by shared resources such as offices, phones, fax machines, company management assistance, counselling and networking services.

In the 1990s, the second generation of incubation expanded the available assistance to include consulting and business advice. Incubators throughout this period were designed to advance and expand the information and communication technology (ICT) sector.

The third generation of incubators concentrated their efforts on assisting technology labs in the establishment of prospective high-tech and ICT start-ups. For the growth of knowledge-based businesses, this generation provided a comprehensive array of support services (Masutha & Rogerson, 2014a; Lalkaka, 2001).

The fourth generation of incubators offers assistance with market analysis, counselling on global market strategy, partner and international sales development, and opening offices in nations where there is market potential. International business incubator accreditation is granted to incubators of this generation (Khalid, Gilbert & Huq, 2014). According to Van der Spuy (2019:4), the majority of South Africa's incubators are third-generation facilities; as a result, there is a need to upgrade incubators'

structure and incorporate cutting-edge technology that will enable incubatees to successfully compete on the global market.

2.3 Incubator characteristics and types of incubators

In this section, some of the key characteristics of incubators worldwide will be discussed. Firstly, incubators provide an extensive and well-rounded business support service in collaborative spaces. This provides access to mentorship programmes, a team of experts who support new start-ups in their early stages and a network of professionals who can address early-stage dangers to incubatees (Lose, 2016; Lalkaka & Bishop, 1996). In all incubators, incubatees go through a rigorous selection process before they are admitted into the incubator programme. Public-sector incubators provide a conducive business environment at a cost subsidised by the government. Incubatees are selected on the ability of self-sustaining and potential growth, and incubators set a time period by which an incubatee must graduate. The incubators also provide post-incubation support for recent graduates, to help integrate and run operations independently (Lalkaka & Bishop, 1996; Ravjee, 2013).

South Africa has three different types of incubators: those that are located in the public, private and academic sectors. However, some regions have far fewer incubators than others. For example, Van der Spuy (2019:6) found that the Northern Cape Province has only a handful of incubators, each of which only has a single manager. Additionally, there is a growing trend in many nations to choose virtual incubators over actual incubators, which will not be covered in this study.

Public-sector incubators are non-profit development agencies sponsored by the government and mandated to allocate funds to enterprises. Their main objective is to support enterprise growth and to create employment to rejuvenate the economy. Statistics South Africa (2022) reported an unemployment rate of 33,9% in the second quarter of 2022. Therefore, any country with a high unemployment rate must prioritise employment generation. Additionally, incubators in the public sector work with a variety of organisations, including academic and research institutes.

Private-sector incubators are profit-driven incubators and are not financially supported by the government. They are capable of working successfully with their own financial resources. They offer useful services to incubatees such as shared resources, equipment and other business services.

Academic incubators are supported by universities, offering them access to research facilities such as research labs, equipment, computers and libraries, as well as assistance on the use of those facilities. Their primary objective is to promote commercial academic research in a financially viable way. They are normally non-profit incubators.

All public incubators in South Africa are accountable to the Department of Trade and Industry (DTI), while all private incubators are accountable to their parent firms (Ravjee, 2013). Noticeable differences between the types of incubators include how public and private incubators recruit incubatees to their

incubators' programmes. While private-sector incubators are recognised for having more stringent and inflexible selection criteria, public-sector incubators are known for having relatively flexible selection criteria. In the private sector, the main considerations are a business plan, profitability, development potential and an entrepreneur with a strong track record. Consequently, private incubators focus on selecting enterprises that have the potential to grow into assets of value (Masutha & Rogerson, 2015).

Masutha and Rogerson's (2014b) study found that private incubators overall performed significantly better than public incubators. They had the ability to create more jobs and graduate more incubatees than the public-sector incubators. However, they face similar challenges in their programmes. Despite the interventions by the public and private sectors in South Africa, incubators still face a high dropout rate. There are several reasons for these high dropout rates, including lack of effort or commitment from incubators, a drop in sales due to a lack of demand for local goods, financial mismanagement, a dearth of entrepreneurs who are also employed, and non-compliance with procurement requirements (Khalid et al., 2014).

2.4 The role of incubators

The basic aim of a business incubator is to create successful SMEs that will graduate from the programme as flourishing, independent businesses. Through the provision of complete support ranging from office space, tools and technical support, business incubation therefore aims to systematise the process of developing successful new enterprises. By offering SMEs business development and training support services, as well as networking opportunities and key infrastructure support services, a business incubator aims to provide SMEs with the fundamental skills needed to create viable businesses (Lose, 2021:8; Scaramuzzi, 2002; Mutambi et al., 2010; Virtanen & Kiuru, 2013).

In response to the increasing number of failing SMEs in South Africa, the Small Enterprise Development Agency (SEDA) Technology Programme (STP) was created in April 2006 through the "combination of the activities of the Godisa Trust, the National Technology Transfer Centre (NTTC) of the Department of Science and Technology, and the Technology Advisory Centre (TAC) of the Department of Trade and Industry" (SEDA, 2006). The creation of the STP stemmed from the South African government's strategic decision to merge and assimilate the activities of SME support interventions across the different government agencies. The main goal and mandate of the STP's establishment was to turn the eight out of ten small-business failures into eight out of ten successes, by increasing small businesses' competitiveness, performance, and productivity; boosting their profitability and growth; expanding the availability and usefulness of technologies; and facilitating the acquisition, development, and transfer of technology to small businesses (SEDA, 2006).

2.5 Incubator business framework

An incubation framework is broadly defined as a guide for easing the process of starting and growing enterprises, and providing expertise and networks for the success of incubatees (Bhaskar & Phani, 2018).

In the early phases of the concept's development, Campbell, Kendrick and Samuelson (1987) provided a foundation for the business process (Figure 1). They discussed the many tools and strategies an incubator uses to turn business ideas into profitable enterprises (Bhaskar & Phani, 2018). They then envisioned the incubation process that adds value to the incubatee and provided four stages for incubation. The initial step is a panel of seasoned business owners and industry professionals who analyse the potential new incubatee's business needs as a whole. Next, they choose incubatees who meet the requirements and who can receive services at a reasonable cost. For the purpose of boosting competitiveness and reducing failure risks, the incubator oversees, plans and effectively delivers the services that the incubatee has identified as necessary. The incubator administers the funding required for product development and other outside services in the third step. The incubator offers access to its ecosystem, network of experts and client base to the incubatees in the fourth step, to ensure the flow of knowledge and information.

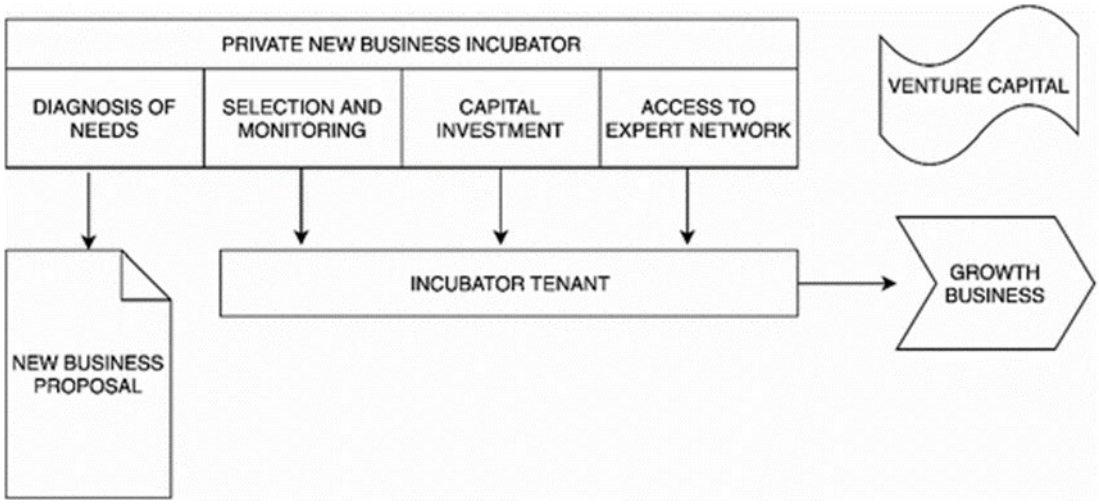

Figure 1: Incubation model
Source: Campbell et al. (1985)

The framework is devoid of specific selection criteria; it solely considers internal sources of value addition and operates under the presumption that firms with potential would succeed. The approach solely examines private incubators and presumes that every incubatee will succeed (Bhaskar & Phani 2018, Gozali, Masrom, Haron, Teuku & Zagloel, 2015).

Through the use of an outside viewpoint, Smilor (1987) expanded Campbell's framework. Internal incubation procedures were left out of the framework. Following several modifications to the initial framework over the course of a decade, Bergek and Norrman (2008) developed a framework with three stages, namely: selection, business assistance and mediation. They considered both sources of value addition, i.e., internal and external, as opposed to the first incubator framework by Campbell and his team. Bergek and Norrman (2008) define the procedure of incubation by distinguishing between external and internal variables and including the three stages of selection, business support and mediation, which are all equally important.

Selection focuses on the incubatee's technical abilities and the feasibility study of the business; thus, only the business ideas that have potential are selected. The incubator manager must have expertise in judging the entrepreneurs' or teams' behavioural and personal traits and business-related capabilities.

Business support includes training, business advice, administrative support, various business and managerial areas of support, judicial matters, marketing support and finance-related assistance. These strategies depend on the level of the required intervention as per incubatee needs.

Mediation is the third feature of the incubation framework. Business incubators must provide a network and ecosystem for mediating or to ensure the free flow of resources, such as knowledge and technology, finance and human capital between incubatee and innovation systems. This may help to create a more supportive environment for the growth of early-stage businesses and increase the chances of their success.

Figure 2: Incubation framework
Source: Bergek and Norrman (2008)

2.6 Industry 4.0

Klaus Schwab, the founder and executive chairman of the World Economic Forum, coined the term Fourth Industrial Revolution or Industry 4.0. In reference to Industry 4.0, Schwab (2015:1) has stated that the technological revolution would fundamentally alter how people live, work and interact with one another. Industry 4.0 refers to a global revolution in the use of mobile internet, low-cost robust sensors, AI and machine learning (Dlodlo, 2012). Industry 4.0 is progressing rapidly and has a significant impact on systems and society as a whole, as well as introducing changes that will affect production and management systems. Industry 4.0 has introduced digitisation and technologies that diffuse the lines between the physical and digital spheres of global production (Kearney, 2017; Xu, David & Kim, 2018).

According to Lu (2017), the concept of Industry 4.0 can be summarised as "an integrated, adapted, optimised, service-oriented, big data, as well as the creation of digital value chains to enable communication between products, their user environment, and business partners" (2017). Industry 4.0 involves digital technology, network communication technology, computer technology, automation technology and many other areas. In addition, the foundation of its application is built on digital design and simulation, extremely automated methods, manufacturing method management, translating the

whole method to access of knowledge and the laws of management and decision-making. This includes IoT technologies (Javaid, Haleem, Singh, Suman & Gonzalez, 2022; Lu, 2017). The IoT technologies that serve as the foundation of this study will be highlighted in the next section, together with cloud computing, big data and advanced analytical approaches.

2.7 Technologies in Industry 4.0

Cloud computing technology is established from a search engine platform to offer high performance at reduced cost. The platform provides numerous internet services such as software, hardware and other information technology infrastructure resources. The end user simply uses resources depending on application needs, relying on on-demand access to computers and storage systems (Kebande, Malapane, Karie, Venter & Wario, 2018).

Artificial intelligence (AI) is the study of diversity of intelligent behaviour, to understand human intelligence and to produce machines that are useful to humankind (Garnham, 2017). AI includes the study of perception, memory, emotion, judgment, reasoning, proof, recognition, understanding, communication, design, thinking, learning, creating and so on, which can be realised artificially by machine, system or network (Li & Du, 2017).

Big data refers to large numbers of data sets that include mixed methods of structured and unstructured data. Due to its complexity, big data requires the most powerful technologies and algorithms (Oussousa, Benjellouna, Lahcena & Belfkih, 2018). Big-data technology employs cutting-edge processing techniques to quickly obtain valuable information from a variety of data kinds to produce in-depth comprehension, insight and findings to support precise decision-making. Enterprises must manage a wide range of data, including enormous amounts of both structured and unstructured data, as well as data on products, operations, value chains and the external environment (Kebande et al., 2018).

Internet of things (IoT) was conceptualised by Kevin Ashton in 1999, but it has only recently begun to gain popularity as a concept (Dlodlo, Gcaba & Smith, 2016). IoT refers to a system of interconnected things or objects that can speak to one another or with other devices over the internet. Embedded technologies within devices such as radio frequency identification, sensors and microchips allow these devices to be interconnected, thereby becoming “smart devices”. The internet is the source of these smart devices as they cannot connect outside the internet (Kebande et al., 2018). IoT is the largest enabler of responsible digital transformation. The World Economic Forum (2018:3) has estimated that IoT will bring about $14 trillion of economic value to the global economy by 2030. IoT has the ability to benefit society as it is fundamentally about using connected gadgets and remotely reaching people and objects that technology previously could not reach.

However, the good news is that significant progress is already being made in South Africa, where IoT projects are ongoing and the creation of smart cities is a top priority (Mavimbela & Dube, 2016). Cape Town and Johannesburg are considered the leaders in the race to become smart cities such as Dubai,

San Francisco, Yokohama and Singapore (Singh, Solanki, Sharma, Nayyar & Paul, 2022; Strielkowski, Veinbender, Tvaronavičienė & Lace,2020; Musakwa & Mokoena, 2017). IoT is critical to the realisation of a smart city, as it facilitates the traverse between the physical world and the digital one (Mavimbela & Dube, 2016). This study focuses on IoT as one of the Industry 4.0 technologies that can benefit enterprises in incubation. IoT will bring fundamental changes in the management of incubator-dispersed value chains and will increase the relations in the incubator networks. At present, enterprises monitor the flow of products and services, and also maintain separate flows of information. However, with the use of IoT, products will be tracked using their assigned unique identities. The information regarding their origin and destination will be linked and stored. IoT will reduce the need of manually coordinating and synchronising information on the flow of products and services.

2.8 Opportunities and benefits

With the help of IoT, enterprises will be afforded the opportunity to create new value propositions to grow their businesses. IoT will enable expansion when it comes to product differentiation, as the software will allow enterprises to customise their products. Enterprises will customise their new smart products to fit their customers' needs, which has the potential to increase demand (Schmidt, Möhring, Härting, Reichstein, Neumaier & Jozinović, 2015). Real-time data capturing, including of customers' historical data and product data, will enable enterprises to form stronger relationships with their customers (Porter & Heppelmann, 2014). The analysed data will be used to gain a competitive advantage by understanding customer, market and industry patterns. The data can also be used to improve products (Wason, 2016). IoT will create future opportunities that will enable tailormade solutions for very specific business needs. IoT will increase value-added services to customers as well as offering superior performance, customisation and differentiation (Mabotja, 2018), which can drive customer loyalty and retention.

2.9 Challenges

Industry 4.0 also comes with a variety of challenges, as recognised by Manda and Dhaou (2019), including job loss, infrastructure issues, security and privacy issues. IoT generates a massive amount of data, which can be challenging to manage and analyse effectively. Enterprises must have the right infrastructure and tools in place to store, process and analyse this data, so they can extract insights to inform business decisions. The use of Industry 4.0 technologies, such as IoT, presents a massive threat of job losses globally. In South Africa, the government is struggling to curb the high unemployment rate of 33.9% according to the national accounts data (Statistics South Africa, 2022). However, the World Economic Forum (2018) suggests that Industry 4.0 will have a momentous but varied impact on jobs, ranging from momentous job creation to job displacement, and widening the skills gap and decreasing the skills challenges. These challenges will greatly affect SMEs, in addition to their broader economic effects.

Some of the challenges to enterprises include a high probability of new industry entrants. Products will have embedded software that will require new types of skills to enable enterprises to compete on a global stage (Porter & Heppelmann, 2014). Spencer, Ruiz-Sandoval and Kurata (2014) assert that there will be a need for complex algorithms that will be used to monitor and control the devices that will be providing the core capabilities of the enterprise. The software will need to be standardised in order to improve and achieve full compatibility between the technologies in IoT (Manda & Dhaou, 2019). There is a potential hike in the cost of these smart devices and software, which will lead to a decline in profit margins. IoT devices and systems can be expensive to develop, deploy and maintain. Enterprises must carefully weigh the costs and benefits of IoT solutions to ensure that they are cost-effective and provide a positive return on investment.

Another challenge is that, due to IoT software, suppliers that previously provided physical components in the incubator value chain and network will cease to exist, as new suppliers will emerge with a more aggressive approach for growth. Therefore, the new suppliers will provide new value to the market through areas such as software and analytics.

3. Research Methodology

The conceptual approach used in this study lends itself to a content analysis supported by the literature review. In this study, the researchers adopted an interpretivist approach in order to understand and describe the meaning of the study. Interpretative philosophy is receptive to individual meanings and interpretations. Therefore, the interpretative paradigm allows researchers to assess many characteristics, such as behavioural features, based on participant experiences (Alharahsheh & Pius, 2020:42). This research cannot be generalised because of the ever-evolving status of the business environment. Therefore, this makes an interpretative framework ideal. An interpretivist paradigm argues that each business circumstance is unique and distinct from others (Al-Ababneh, 2020:80). Since the study was descriptive in nature, a qualitative approach was employed to investigate the possibilities for integrating IoT technology in incubators, as well as IoT's obstacles and prospects. Qualitative research was chosen as it affords researchers with theoretical lenses that offer direction to the research (Cohen, Manion & Morrison, 2011).

The literature review followed a typical format (Creswell, 2009). The databases searched included ProQuest and EBSCOhost which enabled searches in different journals. The search keywords used included "business incubators", "business incubator framework", "IoT strategies and frameworks", "SMEs in Industry 4.0". Google Scholar was also used to search for IoT challenges and opportunities, as well as Industry 4.0 technologies. Data analysis was completed using content analysis, which is commonly used with text-based data, either written transcripts of verbal interactions or documents created in written form, as the goal was to develop an understanding of the meaning of the data set (Vears & Gillam, 2022:112). The data processing, including coding, utilised Microsoft Word software.

Topics included the role of incubators, the challenges and opportunities that will be presented by IoT to incubators, incubator business framework and Industry 4.0 technologies.

4. Findings

This conceptual paper reviewed existing literature on the state of incubators in South Africa with regards to Industry 4.0. It is evident that incubators in South Africa are generally still performing as per the third generation. They are still lagging behind in terms of the technology support. As stated by Sommer (2015), these Industry 4.0 technologies will bring distortion to enterprises that have not yet integrated technology into their value chain and network. Incubators are and have been a good instrument to develop and grow economies, both in developed and developing countries. Literature revealed that even though incubators have been in existence for a number of years, they still face a high dropout rate due to challenges that incubators are not designed to mitigate. However, it is the researchers' view that, although incubators are still in the third generation and struggling to report on success, incubators in South Africa have the potential to change the situation. In order to do so, incubators need to be equipped with a framework that will integrate IoT technologies into their ecosystem and network, to help SMEs grow and become sustainable. A competitive advantage in the local and global market will only be achieved through the reduced costs associated with international distribution and trade.

After reviewing the literature on the current incubator structure, it became clear that the existing incubator framework has to be revised. Additionally, little research has been done on the main issues confronted by incubators and the solutions they need to implement in order to improve the success rate of incubated companies. Literature has demonstrated that, when IoT is implemented, it will provide a variety of opportunities and economic advantages, but there is almost no research regarding incubators' readiness to help incubatees transition to Industry 4.0 technologies. Additionally, the South African government must update its plan for promoting SMEs. Innovative approaches to tackling socio-economic difficulties, including probable job losses and the skills gap, should be considered in the redesigned strategies.

5. Managerial Implications

Due to recent technological advancements, effective incubation programmes must embrace Industry 4.0 technologies. This paper underscores the necessity for both governments and businesses to adopt technologies such as AI, big data analytics, IoT and others if they do not want to fall behind.

Incubator managers should engage in strategic planning to update their framework and clearly envision how these technologies can benefit their incubated companies and contribute to economic growth. Managers and staff must acquire expertise in Industry 4.0 technologies to effectively support start-ups and SMEs, which may involve hiring experts or forming partnerships with technology-focused organisations. Collaboration with research institutions, technology companies and other stakeholders can provide access to resources, knowledge and funding for implementing IoT and related technologies

within the incubator ecosystem. Additionally, incubators should develop monitoring and evaluation systems to track the progress of incubated companies and identify challenges early on while being adaptable and flexible in updating their strategies to stay relevant. Managers should advocate for government support and policies promoting Industry 4.0 integration in SMEs and actively create networking opportunities for start-ups to foster collaboration and support. Lastly, they should help start-ups with risk mitigation, provide training and business support, and establish key performance indicators to measure the impact and success of Industry 4.0 integration, making data-driven decisions to demonstrate the effectiveness of their incubator programme.

6. Conclusions, Limitations and Future Research

With the help of incubators, SMEs can expand and survive in the current challenging business environment. By making use of a literature review, this paper explored existing concepts of incubation and business frameworks. The types, characteristics and role of incubators in South Africa were discussed. The study and research of literature in this paper addresses the research objective by demonstrating that there are benefits to implementing IoT technology inside incubator structures. Based on the literature presented and reviewed, it is apparent that the world is steadily moving towards an IoT-transaction-driven model. As the world of technology evolves, incubation programmes have to incorporate Industry 4.0 technologies to be able to compete in global markets. This paper thus concludes that enterprises and government alike should embrace the use of technologies such as AI, big data analytics and IoT if they do not want to be left behind. The focus of this paper is Industry 4.0 technologies that prioritise interconnected technologies and smart (machine-to-machine) devices that provide value. However, the world is evolving even further with the introduction of Industry 5.0, which focuses on the integration of humans and machines (Noble, Mende, Grewal & Parasuraman, 2022:203). Globally, technical advances in Industry 5.0, such as AI, are pushing the technologies further, with the danger of crossing important ethical boundaries. According to Lose (2021:9), business incubators, like their incubatees, are evolving and will continue to evolve, changing the services that they provide. Therefore, future researchers can focus on the ethical and humanitarian aspects of technology usage.

The study employs a conceptual approach supported by a literature review, suitable for exploring theoretical perspectives. However, the study's literature review may need to be expanded in scope, depth and breadth. The study focuses on incubators in South Africa and their potential to embrace Industry 4.0 technologies. As a result, the findings and recommendations may not be generalised to incubators in other regions or countries with different economic, cultural and technological contexts.

Lastly, it is crucial to consider these issues for future research: what measures will improve the success rate of incubatees? A look at the obstacles faced by incubators in Industry 4.0 would be useful. What qualifications do they have and how are these incubators hired? Can they integrate IoT into their corporate structure? These incubators also require technical education. Incubators are aiming to be

trained in IoT, but do they have the capacity, expertise and skills to do so? Developed countries such as Japan and Korea have already began the sixth era of industrialisation, which is to promote technological research and application to replace humans doing laborious tasks with technology (Park, 2020:824). Researchers can look at ways of integrating the fourth, fifth and sixth industrial revolutions to SMEs in South Africa. A framework that will incorporate IoT and other technologies into the incubator ecosystem and network in South Africa must also be created.

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