# 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 gaining popularity in the commercial world on a global scale. Evidence, however, indicates that SMEs are trailing behind in the adoption of IoT technologies. To help SMEs expand, this conceptual paper aimed to highlight the significance of incorporating IoT technology into the incubator's business environment. Thus, status of the business incubator system is investigated in the paper. 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 evolved, the incubation programme has 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, IoT, etc. 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 years, the acknowledgment of SMEs' role to the growth of economies in developing and developed countries has gained traction globally. The benefits of SMEs include the generation of jobs, innovation and creativity, economic growth, and empowerment (Lose, Tengehg, Maziriri & Madinga, 2016). Due to the poor survival rate of SMEs, incubation as a means of business support emerged. Incubators were established with the objective to create and develop enterprises by providing networking opportunities, shared administrative services, business advice, government support programmes, 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. However, as the fourth industrial revolution approaches, there is an increasing demand for company incubation to make sure that the SMEs are connected with technology, so that they enhance survival rates.

Like all revolutions, the Fourth Industrial Revolution, also known as 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 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). Because of businesses in incubation that are striving for sustainability, the business industry is undergoing its fourth revolution. IoT, as one of the technologies in Industry 4.0, is the connection of objects, things through embedded technologies, actuators and the internet (Dlodlo, 2012).

The IoT is expected to give rise to new opportunities for technology; giving birth to 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 in enterprises. Nonetheless, Jere and Ngidi (2020:2) contend that South African SMEs continue to lag behind in terms of technology. To this end, the IoT will provide immense opportunities, effectiveness and efficiency, and financial returns (Palattella, Dohler, Grieco, Rizzo, Torsner, Engel & Ladid, 2016). Yet, 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, the incubators should not only integrate IoT technologies into the framework and ecosystem, but 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 translates to the acknowledgment that incubators provide favourable business environments for SMEs, which contributes to their success and the economy at large (Masutha & Rogerson, 2014; L ose et al., 2016). IoT, for example, could pose a danger to the expansion of SMEs if incubator managers do not include these IoT technologies into their business frameworks and incubator ecosystem. Industry 4.0 technologies are, however, transforming the business climate. These developments necessitate a thorough examination of the prospects for and difficulties in integrating IoT technologies into South African incubators and corporate structures.

Previous studies in South Africa focused on the impact and performance, challenges and opportunities, as well as incubator services and sustainability of the enterprise incubators (Buys & Mbewana, 2007; Sukhur & Bakar, 2018). Limited research has been conducted on the use of IoT technologies in enterprise incubators. Therefore, it is more important to carry out additional research aimed at improving our comprehension of Industry 4.0 technologies like Big Data Analytics, AI, IoT and Virtual Reality among other emerging ones.

The remaining sections of the paper are structured as follows: we begin by present the objective of the paper then review the literature on the role of business incubators, incubator framework, prospects, difficulties and IoT technology. After outlining the research methodology, we go on to the results and suggestions, before setting the agenda for future research.

### 1.2. Research objective

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

## 2. Literature Review

### 2.1 Overview of small enterprises

Different definitions of SMEs have emerged in the past years, resulting in not one that is agreed upon. There are inconsistencies in how SMEs are defined globally. The definitions range between survivalists, 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). Micro-enterprises in the different sectors, varying from the manufacturing to the retail sectors, are defined as businesses with five or fewer employees and a turnover of up to R100,000. In South Africa, a ‘small business’ is defined in Section 1 of the National Small Business Act of 1996 as amended by the National Small Business Amendment Acts of 2003 and 2004 (NSB Act), 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 the growth of the economy (Khosa, 2020); they drive growth in the economy, create jobs and provide innovation. The 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 et al., 2020; Chimucheka & Mandipaka, 2015). While the significance of SMEs in economic growth is acknowledged and agreed upon, most of them fail to survive for a variety of reasons, such as the entrepreneur's lack of business management experience, lack of technical skills, lack of managerial skills, lack of financial skills, lack of planning skills and lack of market research skills (Lose et al., 2016; Masuthu & Rogerson, 2014).

## 2.2 Incubator

According to Buys and Mbewana (2007:356), an organisation that aids small business owners and entrepreneurs, in some way, in the development of their business ideas is referred to as an incubator. Business incubators were developed to aid small businesses by providing support with the difficulties they experience, as part of a bigger company growth strategy (Mutambi et al., 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, as well as inside the incubator.

SMEs are known to have dismal survival rates in South Africa. By offering operating SMEs support during their early phases of business development, incubators are thought to help improve these survival rates (Chimucheka & Mandipaka, 2015). Since their inception, there has been different definitions and interpretations of incubation globally. In contrast, academics have 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). South Africa had to adopt business incubation as part of national and local creativity to help the small business economy, in order to follow trends from other developing and developed nations. Nonetheless, there is a growing need to equip incubators with the technology necessary to operate efficiently in the Industry 4.0.

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 like offices, phones, fax machines, company management assistance, counselling and networking services. In the 1990s, the second generation expanded the available assistance to include consulting and business advice.

Incubators throughout this age 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. The fourth-generation incubator offered assistance with market analysis, counselling on global market strategy, partner and international sales development, and opening offices in nations where there is a market. 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 the incubator's 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

On a worldwide scale, the following attributes are some of the key characteristics of incubators: the provision of an extensive and well-rounded business support service in collaborative spaces. This is providing 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. In all incubators, incubatees go through a rigorous selection process before they are admitted into the incubator programme. Incubators provide a conducive business environment at a cost subsidised by the government for public sector incubators. Incubatees are selected on the ability of self-sustaining and potential growth. 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, according to Van der Spuy (2019:6), the Northern Cape Province of South Africa contains only a few incubators, each with 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* - these incubators are non-profit development agencies sponsored by government and mandated to allocate funds. 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* - these 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.

*University incubators* - these incubators are supported by the universities, offering them access to research facilities such as research labs, equipment and computers, libraries, assistance on the use of those facilities. Their primary objective is to promote a commercial university research in a financially viable way. They are normally non-profit incubators. All South African public incubators are accountable to the Department of Trade and Industry (DTI), while all private incubators are accountable to their parent firms (Ravjee, 2013). Noticeable differences can be identified in how public and private sector incubators recruit incubatees to their incubators' programmes. While private 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 and 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 (2014) study found that private incubators performed significantly better than public incubators overall. They had an ability to create more jobs and graduate more incubatees than that of 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 the 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, Gilbert & Huq, 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 the 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, in April 2006, the Small Enterprise Development Agency (SEDA) Technology Programme (STP) was created 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 SEDA Technology Programme 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 of the SEDA

Technology Programme's establishment and the programme's mandate 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, 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 the 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 stage is a panel of seasoned business owners and industry professionals analysing the possible 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.

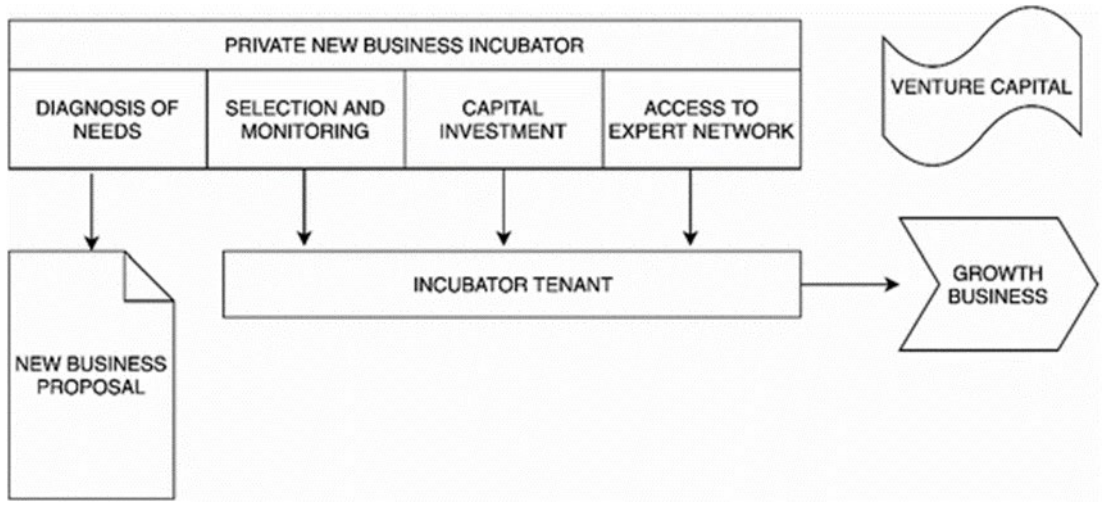


**Figure 1: Incubation model**
**Source: Campbell at al., (1985)**

The framework is devoid of specific selection criteria; it solely considers internal sources of value addition and it 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 et al., 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. The features that Bergek and Norrman (2008) identified explain the procedure of incubation into an external and internal variable as selection, business support and mediation, which are all equally important. *Selection*: focused on the idea of the incubate's technical abilities and feasibility study of the business, thus, only the business ideas that have potential get to be 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 managerial areas of support, judicial matters, marketing and assistance related to finance. These strategies depend on the level of the required intervention as per incubatee needs. *Mediation*: business incubator 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 Industry 4.0. In reference to Industry 4.0, Schwab (2015:1) bemoaned how the technology revolution would fundamentally alter how people lived, worked and interacted with one another. Industry 4.0 refers to a global revolution in the use of mobile internet, low-cost robust sensors, artificial intelligence and machine learning (Dlodlo, 2012). Since the beginning of industrialisation in the 18th century, we are currently in the fourth great industrial period. Industry 4.0 is revolutionising quickly and will have a significant impact on systems and society as a whole. It also introduces changes that will affect production and management systems. It introduces digitisation and technologies that diffuse the lines between the physical, digital spheres of global production (Kearney, 2017; Xu et al., 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". Industry 4.0 system 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. 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 the Industry 4.0

*Cloud Computing Technology* is a computing technology that 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 a large amount 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, along with the external environment (Kebande et al., 2018).

*Internet of Things (IoT)* was presented by Kevin Ashton in 1999, but it has only recently begun to gain popularity (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. 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. The increase is only possible when

consumers and the public sector are included. IoT has the ability to benefit society. IoT is fundamentally about using previously connected gadgets to measure, and remotely control 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, USA, Yokohama (Japan) and Singapore (Singh et al., 2022; Strielkowski et al., 2020; Musakwa & Mokoena, 2017). The 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 the IoT as one of the Industry 4.0 technologies that can benefit enterprises in incubation. The IoT will bring fundamental changes in the management of incubator dispersed value chains and increase the relations in the incubator networks. Presently, 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 et al., 2015). Real-time capturing of data, customer 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 in order to improve products (Raconteur, 2016). The IoT future opportunities will enable tailormade solutions for a very specific business need. This will result in reduction of the bargaining power of the buyers significantly, as the cost of customised products will rise. 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

The Industry 4.0 revolution has a variety of challenges that Manda and Dhaou (2019) recognised, 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, to extract insights and 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 32,7% according to the national accounts data (Statistics South Africa, 2022). On the other hand, the World Economic Forum (2016) suggests that industry revolution will bring a momentous impact on jobs, ranging from momentous creation of jobs to job displacement widening the skills gap and increasing the skills challenges. These challenges will greatly affect SMEs in addition to the economic challenges. Some of the enterprise challenges include a high probability of new industry entrants. Products will have embedded software that will require a new type of skills to enable enterprises to compete on a global stage (Porter & Heppelmann, 2014). Spencer et al. (2014) asserts 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 the internet of things (Manda & Dhou, 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 softwares, suppliers that 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, such as software and analytics.

## 3. Research Methodology

The conceptual approach used in this study lends itself to a content analysis that is 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 more receptive to individual meanings and interpretations. Therefore, interpretative paradigm allows researchers to assess many characteristics such as behavioural features based on participant experiences (Alharahsheh & Pius, 2020:42). This research could not be generalised because of the ever-evolving status of the business environment. Therefore, this makes interpretative ideal. The Interpretivism ideology 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 the IoT's obstacles and prospects. Qualitative research was chosen on the ground that it affords researchers with theoretical lenses that offer direction to the research (Cohen, Manion & Morrison, 2011).

The literature search followed the typical format of a literature review in research (Creswell, 2009). Therefore, databases that were searched included ProQuest, EBSCOhost and Mendeley; which enabled searches in different journals. The search keywords used included "business incubators", "business incubator framework", "IoT strategies and frameworks", "SMEs in the Industry 4.0". Google Scholar was also used to search for IoT challenges and opportunities, as well as Fourth Industrial Revolution

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/s of the data set content (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 the Industry 4.0. It is evident that incubators are still performing on the third-generation era. They are still lagging behind in terms of the technology support. As Sommer (2015) alluded, these Industry 4.0 technologies will bring distortion to enterprises that have not yet integrated technology in their value chain and network. Incubators are and have been a good instrument to develop and grow economies in both developed and developing countries. Literature revealed that even though incubators have been in existence for a number of years, they still face a high rate of dropouts 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 a potential to change the situation around. 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. Competitive advantage in the local and global market will only be achieved by the reduced costs associated with international distribution and trade.

After reviewing the literature on the current incubator structure, it became clear that the framework has to be revised. Additionally, there is little study on the main issues incubators confront and the solutions they need to implement, to improve the success rate of their incubated companies. When IoT is implemented, literature has demonstrated that it will provide a variety of opportunities and economic advantages, but it is mute regarding the incubators' readiness to help incubatees transition to Industry 4.0. Additionally, the government of South Africa 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

The incubation programme must embrace Industry 4.0 technologies due to technological advancements. This paper underscores the necessity for both governments and businesses to adopt technologies such as artificial intelligence (AI), big data analytics, IoT, and others if they do not want to fall behind.

## 6. Conclusions, Limitations and Future Research

SMEs can expand and survive in the current challenging business environment with the help of incubators. This paper looked at the incubation concept and business frameworks that exist, based on literature. Types and characteristics, and the role of incubators in South Africa were discussed. This study together with its literature, addresses the research objective by demonstrating that there are benefits in implementing IoT technology inside incubator structures. 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 evolved, the incubation programme has 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 Internet of Things (IoT), if they do not want to be left behind. The focus of this paper is Industry 4.0 which prioritises interconnected technologies and smart (machine-to-machine) devices that provide value. Nonetheless, the world is evolving with the introduction of Industry 5.0 that focuses on the integration of humans and machines (Noble et al., 2022:203). Globally, technical advances in Industry 5.0, such as AI, are pushing 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 service that they offer. As a result, future researchers can concentrate on ethical and humanitarian applications of technology.

Lastly, it is crucial to consider these issues for future research: what measures will improve the success rate of incubatees? A look at the difficulties incubators are having in Industry 4.0. What qualifications do they have and how do these incubators get hired? Can they integrate IoT into their corporate structure? A technical education is also required for them. They want to train incubators on IoT, but will they be able to do that? Developed countries such as Japan and Korea have already begun the sixth industrial revolution, which promotes technological research and application to replace humans in hard tasks (Park, 2020:824). Researchers can look into ways to integrate the fourth, fifth, and sixth industrial revolutions into South African SMEs. A framework that will incorporate IoT and other technologies into the incubator ecosystem and network must also be created.

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