The Development of University Technology and Innovation Incubators to Respond to the Needs of the Modern Economy

Pfano Mashau[1,*] and Ziska Fields[2]

[1]*University of KwaZulu-Natal, Graduate School of Business and Leadership, Durban, South Africa*

[2]*University of KwaZulu-Natal, School of Management, Durban, South Africa*

Abstract: The growing demand for technology and innovation has created a pressing need for higher education institutions in South Africa to be involved in the development of the country. The National Development Plan 2030 challenges higher education institutions to actively participate in developing and sustaining the well-being of South Africa. The article emphasises that sustainable development can be achieved through university activities, in which university technology and innovation incubators play a role; hence the need for such incubators. Transition to a knowledge society entails the university and other knowledge institutions acting in partnership with industry and government, and even taking the lead in joint initiatives. Therefore, this article recommends that technology entrepreneurs and innovation should be developed through universities, both in South Africa and in Africa as a whole, as suggested by the triple helix theory.

Keywords: Economic development, technologist, technology entrepreneurship, technology innovation incubator, Triple Helix.

1. INTRODUCTION

Development is important for any country and once this has been achieved, it must start maintaining and building upon its developmental level (Rennkamp & Boyd 2015; Rogerson 2013). Universities are important for sustainable development (National Planning Commission n.d.). Universities encourage many activities that are complementary to the development of a country. These include innovation incubators and research to assist in increasing entrepreneurial success.

The influence of universities is prevalent in the external environment that pertains to the establishment of technology ventures and business success. In a study conducted by Dahlstrand (2007), it was found that a significant percentage of innovative businesses started as a result of the knowledge that the entrepreneur acquired through his or her university research. On the other hand, some entrepreneurs began a technology venture from an idea that emanated from a university and it is confirmed by Dahlstrand (2007:379) that "radically new ideas often have a university origin".

The South African government has realised the importance of technology incubators to support entrepreneurship and the Minister of Trade and Industry, Dr. Rob Davies, officially launched the latest university incubator, the Durban branch of the South African Chemical Technology Incubator, at the Westville Campus of the University of KwaZulu-Natal on 16 April 2014 (Seda 2014; UKZN 2014).

Many other universities around the country also offer innovation activities to support and grow innovative businesses. The Small Enterprise Development Agency (Seda), as part of its technology programme, has created 30 incubators across South Africa, ranging from information and communication technology small, medium and macro-sized enterprises to enterprises in the aluminium, platinum and bio-diesel industries (Seda 2014). However, the link to and role of universities are not fully utilised.

South African universities need to play a more prominent role as technology incubators to provide assistance to entrepreneurs and guide them in achieving growth and development. The start-up phase especially is very important, due to the lack of funding and strategic resources and the fact that 80% of start-ups fail in the first year of doing business (Seda 2014).

Providing support requires expertise and funding, and a long lag often exists between the discovery and commercialisation of new knowledge at the university level, which can weaken competitiveness (Pearce, Barbier & Markandya 2013; Peschl & Fundneider 2014; Rennkamp & Boyd 2015; Rogerson 2013). Due to the amount of revenue and profits made by universities, many of them seek better ways of effectively managing their ideas and selling their discoveries. This is also a reason why more and more universities around the

*Address correspondence to this author at the University of KwaZulu-Natal, Graduate School of Business and Leadership, Durban, South Africa;
E-mail: Mashaup@ukzn.ac.za

E-ISSN: 1929-4409/20

world are partaking in new venture 'nurseries', establishing incubators as a means to encourage new technology-based ventures and economic development (Alon & Godinho 2016: 242). More can be done, however, specifically in South Africa.

This article presents a theoretical discussion of how to develop university technology incubators in South Africa by (1) exploring the role and need for university incubators to develop technology entrepreneurship nationally, (2) identifying the challenges universities are facing in becoming incubators, (3) identifying possible benefits for a university to develop technology entrepreneurs in a technology incubator and (4) proposing recommendations that universities can use to develop technology entrepreneurship as incubators. The above points of discussion are important in increasing and maintaining development in the country (Etzkowitz 2008; Farinha & Ferreira 2013; Ranga & Etzkowitz 2013; Rennkamp & Boyd 2015).

2. METHODOLOGY

An exploratory research design was used, using a variety of databases, journals, and governmental reports. Exploratory research is an investigation into a problem or situation that provides insights to the researcher (Bryman 2012). The research design and data-collection methods were suitable for meeting the objective of the study, as they aimed to find facts, identify trends, and make recommendations regarding university technology incubators. The study used data from old and recent journals to conduct a literature review to validate the views of other researchers. The data collection adopted a non-systematic review of the available evidence, and consisted of the following steps:

Step 1: Identification of different sources of secondary data

Step 2: Critically reviewing the content of each of the secondary data sources

Step 3: Making conclusions and recommendations based on comparisons of the findings.

3. MAINTAINING DEVELOPMENT

Development is important for livelihood and the economy, which is why it has to happen and be maintained (Ciegis, Ramanauskiene & Martinkus 2015). Sustainable development means being able to maintain or add on the current level. Development (Silva, Oliviera & Moraes 2016) embraces wider concerns regarding the quality of life (Pearce *et al*. 2013). Sustainability suggests required effort aimed at making development achievements last long and well into the future (Pearce *et al*. 2013). Sustainable development, therefore, means a situation in which development does not decrease over time (Pearce *et al*. 2013).

Moran, Wackernagel, Kitzes, Goldfinger, and Boutaud (2008) assert that sustainable development represents the advancement of human well-being. Technology has become an essential element of human life and therefore the development of new technology is also vital (Etzkowitz 2008). With a move towards a globalised technological environment, firms are competing for new technologies and securing intellectual property rights to assist in technological competitiveness (Kim, Park & Yoon 2016).

Developing a technology incubator is one of how to sustain development and get firms and host institutions involved in endeavours to advance the well-being of the people. Small and medium-sized technology-based companies are recognised as essential for the economy and business activity (Silva *et al*. 2016). Technology and innovation help sustain development, which also depends upon the type of economic activity that is developed by the company and the interactions it has with the internal and external environment (Silva *et al*. 2016). The development of technology will lead to faster incremental development. Technology incubators are therefore needed to keep development happening.

Innovation activities conducted by universities, including innovation incubators, touch various facets of human life. Engaging universities in the development of entrepreneurs will result in increased business success for the country. University innovation activities are also needed, as they are efforts aimed at developing and sustaining the quality of life.

4. THE ROLE OF UNIVERSITY TECHNOLOGY AND INNOVATION INCUBATORS

A study by Hess and Siegwart (2013) mentions that academia has established several technology transfer channels to support the progress of technology transformation in various countries. Universities are not expected to directly access the market, therefore they establish partnerships to become involved and establish new enterprises (Etzkowitz 2008). Through their activities, universities work with communities,

businesses, and governments. University incubator activities, therefore, are aimed at making technology transfer more effective. Research findings assert that technology associations between academic spin-offs (or any other entrepreneurial activity) and industry are a natural way of developing technologies efficiently (Hess & Siegwart 2013). This is because technology incubation at university is based on new venture formation, venture development, new product development, and business assistance, rather than on the incubator facility. All of these form the basis for development.

University institutions around the world are increasing their impact on society and this is evidenced by the number of patent disclosures made on behalf of these institutions. According to Dabic, González-Loureiro, and Daim (2015), the transformation has provided significant pressure on the interaction between government, university, society, and the private sector. These changes have led to universities developing new roles in the economy because research, development, and transfer of knowledge are becoming more essential in these learning institutions(Etzkowitz 2008; Farinha & Ferreira 2013; Farinha, Ferreira & Gouveia 2014; Leydesdorff 2012; 2013). The knowledge economy has led to businesses embedding university research findings in their processes to encourage innovation.

Özdemir and Şehitoğlu (2013) concur that entrepreneurship and innovation are widely accepted as sources of business success, high value-added job creation, and national economic development. University spin-off firms arise as a result of the institution supporting innovative entrepreneurship. Further, university business incubation is acknowledged as an effective support system for small and medium enterprises and technology entrepreneurship in many countries (Dabic *et al*. 2015; Özdemir & Şehitoğlu 2013).

Research done in the 1990s shows that a university adds value to technology-based firms through its technology business incubators (Mian 1996). These provide a nurturing environment for businesses. According to Mian (1996), laboratories and equipment, and students and employees in universities add major value to the client firms, making the incubators a viable strategy for nurturing businesses.

Friedman and Silberman (2003) show that if a university stands behind its technology transfer activities, the institution gains a great reward. The location of a university within a region that has a concentration of high-technology firms will result in a clear university mission to support technology transfer. University technology transfer activities are becoming increasingly important as a source of regional economic development and revenue for the university.

Current research by Etzkowitz and Dzisah (2015) shows that universities are undergoing a cultural transformation, in that they are now playing a significant role in a knowledge-based society. The research university combines the production of knowledge with teaching creativity and this has proven to be more productive than separating these activities within the university. The Massachusetts Institute of Technology (MIT) managed to build and grow many high-technology firms and are responsible for their varied successes (Jansen, Van de Zande, Brinkkemper, Stam & Varma 2015). The entrepreneurial university encompasses teaching, research, and service to society. A modernised university role extends beyond its traditional role to incorporate the development of technology and innovative businesses. Therefore, these are needed concerning developing a country.

5. THE NEED FOR UNIVERSITY INCUBATORS

Universities have different missions (Etzkowitz & Dzisah 2015). Entrepreneurship is now part of these missions and forms a part of those sectors that advance and encourage development in a country. A university is an institution that is intended to be durable and enduring because it is a unique global institution for knowledge. Multiple sources show that universities are neutral conveners, assemblers of talent and unmatched ideas factories where the passion, creativity, and idealism of great minds, young and old alike, can be applied to problem-solving and advancing societal and economic well-being (Guerrero, Cunningham & Urbano 2015; Maietta 2015; Soetanto & Van Geenhuizen 2015). Universities are a catalyst for change.

Universities must adapt and innovate to fulfil their mission. The development of a technologically entrepreneurial culture encourages universities to look at their research results for their commercial as well as their intellectual potential (Alessandrini, Klose & Pepper 2013; Etzkowitz 2008). This means that contemporary universities have a responsibility to transcend traditional disciplinary limitations in pursuit of

intellectual fusion and develop a culture of academic enterprise and knowledge entrepreneurship. Etzkowitz (2008) further states that universities are extending their teaching capabilities to include not just the education of individuals, but also the shaping of organisations in entrepreneurial education and incubation programmes. These activities provide new ideas to existing firms and utilise research and teaching capabilities in advanced areas to form new firms.

Universities are regional innovation organisers (Etzkowitz 2008). They take the lead in recruiting partners and managing their interaction among a group of firms in a region. Universities must embrace their cultural, socio-economic, and physical setting, which makes them a source of agglomeration economics. Several studies show that universities must be socially embedded and thereby foster development through direct engagement (Britto, Dos-Santos, Kruss & Albuquerque 2015; Chang, Guo, Shieh & Wang 2015; Dabic *et al*. 2015; Denning 2014; Etzkowitz 2008; Ferreira, Fernandes, Alves & Raposo 2015; Mian 1996; Reveiu & Dardala 2013; Soetanto & Van Geenhuizen 2015; Vaquero-García, Del Río & Álvarez-García 2016).

A recent study asserts that universities are agents for change, shaping a new era of international affairs, and bringing new challenges to institutional integrity (Heitor 2015). Universities must become effective partners for global development. According to Heitor (2015:281), a well-organised and structured international academic institution sets up and maintains a dense network of contacts with universities and research institutions, supports national/regional entrepreneurs, strengthens the emergence of different nations and/or regions, supports the internationalisation efforts of national institutions worldwide, strengthens the development of scientific and technological exchange and facilitates the access of national companies to emerging markets worldwide.

Britto *et al*. (2015) state that potential interaction with universities and public research institutes in a region or country is a key factor influencing innovation strategies, concerning both the education and training of a pool of highly skilled knowledge and to meeting research and development needs through university and firm linkages. Britto *et al*. (2015:164) found that "firms build external knowledge networks to overcome the constraints of immature innovation systems, using the resulting global knowledge flows to strengthen local capabilities". Therefore, university research is very important for innovation success and is an enabler of innovation. Britto *et al*. (2015) further state that global innovation networks (GINs) contributed to changes in the innovation activities of multinational corporations. Interactions between universities and firms are seen as an important factor for the emergence of GINs and their success.

Although universities have been important to the development of technology entrepreneurs and business innovation, some universities in developing countries are still unable to extend their roles to the level where they can become a source of spin-off companies. Universities in these countries are subject to change to stay relevant and, as a result, they face many challenges.

6. THE CHALLENGES UNIVERSITIES ARE FACING IN BECOMING INCUBATORS

This article acknowledges that universities do not exist in isolation and that the most important stakeholders are industry, government, and civil society. The industry is the primary consumer of talent and technological innovation and the government provides a regulative environment (Etzkowitz & Dzisah 2007; Etzkowitz & Leydesdorff 2000; Farinha *et al*. 2014; Peschl & Fundneider 2014; Ranga & Etzkowitz 2013; Villarreal & Calvo 2015). On top of being a regulator, the government also ensures that industry and academia function within an enabling environment. The government creates this environment by making funds available and preparing society for change. The relationship of government, industry, and business is explained by the triple helix theory.

The balanced configuration of the triple helix theory is specific to the transition to a knowledge society, where the university and other knowledge institutions act in partnership with industry and government, and even take the lead in joint initiatives (Etzkowitz & Leydesdorff 2000). This configuration allows for the development of a public-private partnership, which is the key to unlocking opportunities for more informed and relevant research by the university. This configuration makes the university a holder of critical information that is needed to be innovative. The balanced configuration seems to fit very well with modern economic ideology and explains why actors have mutual roles. The university role has extended beyond its primary mission and has brought many challenges. A few of these are discussed below.

6.1. Academic Talent and Workforce Structure

If universities are to adopt new roles within their more traditional ones, in response to the needs of the knowledge economy, academic staff members must be ready to face new challenges. However, if they are not able to do so, universities may fail to stay relevant. According to Britto *et al*. (2015), an incubator has to attract new talent to replace the old staff and at the same time build a new workforce structure that can support new business models, deliver increased productivity and accommodate non-traditional operating models. This may not be the case in many universities, but change begins within an institution. If a university does not have the talent and structures to enable change, it may end up losing relevance.

6.2. University Commercial Skills

As universities take action to develop a 'third mission' by fostering links with knowledge users and facilitating technology transfer, they task technology transfer offices to develop spin-off companies that are, in the main, innovative technology firms (Perkmann *et al*. 2013). Higher education markets are competitive and consumer-driven, which is why public universities are deepening their commercial skills and capabilities in technology entrepreneurship and the administrative and academic workforce (Perkmann *et al*. 2013). University technology, innovation, and research have to be commercialised and this can prove to be a good revenue stream for the institution (Etzkowitz 2008; Etzkowitz & Leydesdorff 2000). If universities do not have commercial skills, it becomes a challenge for them to compete.

6.3. Change Management

The knowledge economy needs new university models and these require significant change within educational institutions, as they must engage in tasks that are not traditional to a university (Laurillard 2013). In general, universities have been resistant to change and new business models, with academics citing the need for academic independence and maintaining the purity of their mission. However, in response to the needs of the knowledge economy, universities find ways to stay true to their mission and maintain academic integrity and independence, while changing their business and operating models (Laurillard 2013). The critical component of this change is market relevance. New activities to support the requirement of an entrepreneurial university need to be established, as universities are becoming increasingly competitive, both domestically and internationally. They need to be first in the market with new teaching and research programmes and innovative student experiences (Christensen 2013; Etzkowitz 1998; Laurillard 2013; Perkmann *et al*. 2013; Trauth, Diraimo, Hoover & Hallacher 2015).

6.4. Relationship with Government

The government is an important component and enabler of a country's transformation to the knowledge economy. The relationship with government is important, as it is a driver for change and funding (Muscio, Quaglione & Vallanti 2013). Government buy-in is important concerning a university obtaining funds for technology transfer activities. Governments and universities are teaming up to develop technology programmes, because knowledge economy technologies add real value to the economy. Muscio *et al*. (2013) state, however, that growing political pressure is being applied to universities to intensify their interaction with industry and enlarge their research funding options, in a context that is being characterised by increasing constraint on public spending. This factor adds to the challenges faced by universities.

6.5. Adding Real Value

It is implied that effective university incubation programmes provide business counselling and management assistance to their client firms (Muscio *et al*. 2013). The value-added business services differentiate a university from an office suite, as they are keepers and creators of knowledge (Muscio *et al*. 2013). Therefore, technology transfer activities in university institutions will assist in situations where an entrepreneur is a technologist lacking business skills and hence the technology transfer office and incubator must assist the entrepreneur in finding managers that have the necessary skills to manage a successful entity and take it to the next level.

The above aspects are challenges faced by universities in remaining relevant. If a university can embrace these challenges, it will be able to create an innovation incubator that benefits society.

7. BENEFITS FOR A UNIVERSITY IN BECOMING AN INCUBATOR

Technology and innovation are important for economic development and therefore add to university

activities whose benefits extend beyond a company. A study by Thomson, Kilgore, and Lionnàin (2015) showed that innovation is important and is a process that requires both internal and external stakeholder input, thereby making incubation for technology a source of knowledge. University involvement in the development of technology entrepreneurship smooths the way for an open innovation process by bringing to it a wealth of knowledge. Open innovation has purposive inflows and outflows of knowledge to accelerate internal innovation and expand markets for external use (Thomson *et al*. 2015). It was stated earlier that a university is a key driver of innovation; knowing its role as an academic institution, it manages and creates inflows and outflows of knowledge. Partnerships and collaborations help in acquiring information that is foreign and important for the development of technology. As a result of growing complexity in the innovation process, Thomson *et al*. (2015) further discovered that such complexity has led to companies and firms searching for new knowledge outside of their organisations.

The reason that firms contact universities is that the latter assist with increased research capacity. Sawyerr (2004) asserts that the skills needed to build and construct the knowledge economy depends on research work. Research capacity includes the quality of the research environment, funding, adequate infrastructure, research incentives, time available to the researcher, and collaboration (Sawyerr 2004). Etzkowitz and Leydesdorff (2000) state that an incubator is a university activity used to bridge the gap between academic research and actual practice. Therefore, incubation allowing for firms' inputs is used for the development of innovation and technology development. It also allows for the testing of academic models and student research on real firms.

This has not been the case in most African countries and South Africa (Sawyerr 2004), with conditions for research severely compromised, as manifested by general poor remuneration, heavy teaching loads, inability to mentor young faculties and inadequate infrastructure. While the adequacy of public funding is a crucial condition, several concrete programmatic initiatives could be undertaken by higher education and research institutions (Sawyerr 2004). The importance of current universities' capacity is that it can host many activities, obstacles such as funding and collaboration with businesses were stopping these institutions from becoming entrepreneurial.

Etzkowitz (1998) states that literature was largely based on explaining the emergence of the entrepreneurial university that integrated economic development as an additional function of the institution. Further studies assert that universities are now expected to knowledge hubs and a significant player in economic development activities (Etzkowitz 2008; Etzkowitz & Dzisah 2015). In this way, the development of entrepreneurs was a role that the university allowed itself to play in the development of the economy. Studies have shown that incubators result in many spin-off companies that in turn result in a spill-over of knowledge and know-how (Bramwell & Wolfe 2008; Deligianni, Voudouris & Lioukas 2014; Naldi & Davidsson 2014; Smith, Chapman, Wood, Barnes & Romeo 2014; Soetanto & Van Geenhuizen 2015; Villarreal & Calvo 2015). The development of new businesses and innovation brings a positive contribution to the economy.

Developing countries such as South Africa are using university incubators and science parks to fast-track the development of technology and science. The research of Chan, Kirsop, and Arunachalam (2005) showed that the outlook for building science capacity in developing countries had improved significantly between the years 2000 and 2010 (Naldi & Davidsson 2014; Soetanto & Van Geenhuizen 2015). Incubation results in the development of entrepreneurship and university success. A rapidly growing in higher education activities opens opportunities for a truly global knowledge exchange in developing countries, to respond to the needs of the knowledge economy.

8. THE TRIPLE HELIX COLLABORATION

As shown earlier, the triple helix model reflects the relationship between government, industry, and academia. Study of collaborations describe triple helix models as in the Figure **1** below:

The figure shows the interaction between the three actors. Etzkowitz and Leydesdorff's 2000 study showed that even more than a decade ago the three actors had interactions. However, in recent years there has been a greater need for knowledge. Universities, being creators of knowledge, have become key players in this relationship. The quest for knowledge has not only resulted in firms starting research units but also in firms and governments associating themselves more with universities. The complexity of the knowledge economy has led to a greater need for academia to address economic and business problems.

The potential for innovation and economic development in a knowledge society lies in a more prominent role for the university (Ranga & Etzkowitz 2013). The collaboration of university, industry, and government results in the generation of new institutional and social formats for the production, application, and transfer of knowledge (Carayannis, Barth & Campbell 2012; Ranga & Etzkowitz 2013). This has led to the triple helix being used as an operational strategy for regional development and to further a knowledge-based economy (Leydesdorff 2012). The phenomenon has become popular all over the world and resulted in considerably good results. In Brazil, the triple helix became a 'movement' for generating incubators in the university context; it was an interventionist activity that led to universities, together with industry and government, joining forces to address economic challenges (Leydesdorff 2012).

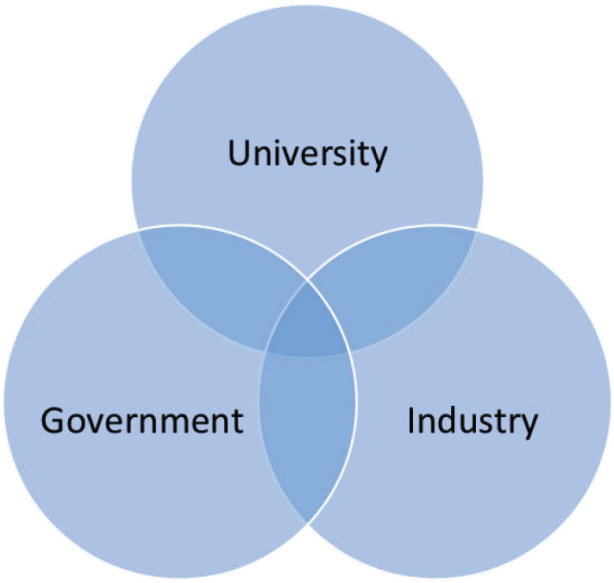

Figure 1: Triple helix model.

Source: Adapted from Etzkowitz and Leydesdorff (2000).

Among the leading theories in the development of university activities, the triple helix model (of academic, industry and government collaborations) explains the emergence of the entrepreneurial paradigm, whereby universities play an enhanced role in technological innovation (Etzkowitz 2002a; 2002b; 2003). It shows that governments encourage this academic transition as an economic development strategy that also reflects changes in the relationship between knowledge producers and users. This makes the entrepreneurial university a global phenomenon with a strategic developmental path, despite different starting points and modes of expression (Etzkowitz, Webster, Gebhardt & Terra 2000). Therefore, this development has resulted in many universities starting science parks, incubators, and innovation hubs to inculcate recent developments concerning their role in increasingly knowledge-based societies. Incubation is a good strategy to address high business failure and low innovation levels.

The incubation of technology entrepreneurs and/or firms will not only attract funds to the university but will also result in the institution having technology businesses associated with its name and the possible creation of a cluster of firms that are associated with it (Özdemir & Şehitoğlu 2013; Trauth *et al*. 2015). This, in turn, improves the stance of the university in terms of its image and reputation as an entrepreneur. The benefit of such a role for the university is that it draws experts from the field and helps create its experts. Incubators mean that the university will have a pool of innovative and creative professionals, linked with successful technology businesses, who are enablers of innovation. This may address the challenge presented by the academic talent and workforce structure in universities. The university incubators and technology transfer in universities are part of an international strategy to enable clustering for knowledge (Rothaermel & Thursby 2005; Smith *et al.* 2014).

The collaborative relationships of university and industry, about knowledge and technology transfer, are still very important and part of a university's function (Dell'Anno & Del Giudice 2015). According to Vaquero-García *et al.* (2016), universities are currently experiencing significant changes in their mission, which have gone from carrying out traditional activities (such as teaching and research) to promoting creative, innovative and enterprising capabilities that enable them to generate economic and social value through the transfer of knowledge. Minguillo, Tijssen and Thelwall (2015) and Miller, McAdam, Moffett, Alexander, and Puthusserry (2016) mention that there is a better understanding of knowledge transfer in modern economies, and that this goes beyond university activity to the regional environment. This new development has led to the commercialisation of much intellectual property. The study of Miller *et al.* (2016) identified five factors that mediate both the ability of stakeholders to engage in knowledge transfer and the effectiveness of knowledge transfer, namely human-centric, organisational factors, knowledge characteristics, power relationships, and network characteristics. The factors are an important element of university development, especially in building university

relations. Therefore, the benefit of innovation activities lies in research implications for policymakers and practitioners. These identify the need to implement interventions to overcome barriers to knowledge transfer in order to make the open innovation process fully functional.

For instance, in China, Mok and Yue (2015) showed that higher education had experienced significant transformation to cope with the growing challenges of the knowledge-based economy. This showed that university activities were important for the development of the economy. Their findings were supported by Trauth *et al*. (2015:1), who states that the transition to the new economy defined by innovation, knowledge, and continuous learning entails three views:

- University research supports industrial competitiveness in the region. This includes both technology transfer and assisting firms to develop a greater capacity for competitiveness in the new economy.
- University research promotes innovation and entrepreneurship. A university's new role is to embed the development of technology.
- A university's education mission is to develop and retain a new economy workforce.

The views above show that a university goes beyond educating its youth and/or its community, as it creates linkages between the educated workforce and the needs of companies (Trauth *et al*. 2015).

9. THE USE OF THE TRIPLE HELIX FOR THE DEVELOPMENT OF AN INNOVATIVE SOCIETY

It has been stated in this article that South Africa has high business failure and organisations have been working on strategies to address the problem. As in other countries, South Africa's higher education institutions are changing with the needs of the economy. Its universities are incubating businesses and engaging in technology transfer activities to address national issues. Such commitment from universities has resulted in the formation of innovation incubators in higher education institutions.

The triple helix collaboration is very important for the development of both the country and its businesses. It suggests bringing in expertise from different actors (government, industry, and businesses) to sustain and build upon the current level of development. It can be seen that, with the use of university innovation incubators, higher education institutions certainly have a major role to play in a country's development and business success. Universities have a wealth of knowledge and need incubators to spread this out among businesses and communities.

Higher education institutions must address the same challenges faced by universities when they take on additional roles, such as the development of entrepreneurs. Add to this South African development challenges that include social challenges faced by universities and those concerning unemployment and education that are addressed by the national government. Universities' incubator success has the potential to address South African social challenges.

Literature has revealed that universities across the world, such as MIT, have established research/science parks and incubators to foster new venture creation that is based on university-owned (or licenced) technology and that a gap exists about the involvement of South African universities. The precise nature of the business models of these university research/science parks and incubators, as well as their managerial practices, is not easy to determine and can often be complex (Smith *et al*. 2014). However, there are a few benchmarks to ensure the successful implementation and measurement of success.

Universities must work creatively and be willing to take risks to become even greater forces of societal transformation. Student entrepreneurship, encouraged by incubator facilities, is supported as an economic development strategy.

10. CONCLUSION

The article recommends that more incubators be formed by universities to transfer their intellectual property, employ their graduates, and contribute to economic growth in South Africa. As a way of sustaining its developmental level, South Africa has to embrace the importance of university activities, such as innovation incubators, as a strategy for sustainable development. This article has given a theoretical discussion concerning the development of university technology incubators in South Africa, explored the role and need for university incubators to develop technology entrepreneurship nationally, and identified both the challenges universities are facing in becoming

incubators and the possible benefits for such institutions in developing entrepreneurs in technology incubators.

Universities need to evolve and embed the development of technology entrepreneurship and make this their primary mission. They are innovators because they have spin-off companies and are involved in research to develop futuristic products. This study shows that universities are regional development organisers and are important drivers of development in a knowledge economy, where innovation and research are centres of development. They are further agents of change and should connect businesses.

The benefit of university involvement in the development of technology entrepreneurs is that they can use accumulated technological and organisational knowledge to stimulate innovation and wealth creation. University technology transfer activities still face challenges in funding the development of entrepreneurs, the innovation of ideas, and the emergence of new products that are to be commercialised.

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Received on 20-06-2020 Accepted on 22-08-2020 Published on 21-09-2020

DOI: https://doi.org/10.6000/1929-4409.2020.09.46