Proceedings of the First Australian International Conference on Industrial Engineering and Operations Management, Sydney, Australia, December 20-21, 2022

Dynamic Capability from Product Development Services in Incubated SMEs: A Technology Management Perspective

Phumuza E. Langa, Emmanuel I. Edoun and Anup Pradhan
Faculty of Engineering and Built Environment
Department of Quality and Operation Management
University of Johannesburg,
55 Beit St, Doornfontein, Johannesburg, 2028, South Africa
planga@uj.ac.za ; edounsen@hotmail.com; anupp@uj.ac.za

Abstract

The role that technology business incubators (TBIs) play in the development of new ventures is of utmost importance for innovative enterprises especially in preparing them to adapt during times of fast-changing business environments. Establishing the effects that incubation services have on these innovative ventures particularly small to medium enterprises (SMEs) can assist in understanding how they develop capabilities that can enable surviving in the market once they have graduated. The survival capabilities utilised by SMEs in changing business environments can be referred to as dynamic capabilities. This paper explored the dynamic capability developed by SMEs from product development services offered by TBIs. A qualitative research method approach was utilised where 16 technology business incubation managers were assessed to determine their perceptions of a dynamic capability developed from product development services. The results of the study reveal that Technology Management is a dynamic capability developed from Product Development services during the business incubation process. This study contributes to better understanding of the dynamic capabilities view (DCV) theory when looking at incubation services and their impact on innovative SMEs, particularly product development services. It practically explains the relationship between Product Development and Technology Management. This is important for incubation practitioners to understand when providing their services to SMEs. It is equally relevant for entrepreneurs in preparation for the inevitable change in business environment as it provides a perspective on how to adapt to this change by building technology management capacity from the product development services received during incubation. The study adopted a unique approach of combining two critical enterprise development instruments which are *business incubators and technology station*s into one component. These two entities were viewed with one lens and adopted an umbrella term that called these two entities combined as Technology Business Incubators.

Keywords

Business incubation, Dynamic capabilities, Technology Management, Product Development and operations Management

1. Introduction

The concept of the dynamic capabilities view (DCV) was originally defined by (Teece et al., 1997) as "The firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments". This has proven to be a very important concept for the field of strategic management theory since it talks directly to how firms survive and create competitive advantage in times of business environmental change, which is almost always inevitable in some point of a business cycle (Fatoki, 2021). Business incubation on the other hand is a concept which is mainly about provision of a variety of business development services to early-stage ventures that will allow them to graduate from the process and be able to survive in the real business environment Shih and Aaboen (2019). This study explored the role that product development services play in creating a dynamic capability for incubated SMEs. This was done in order to understand what is the capability that the enterprises get to build during their incubation period. A focus was made in particular to product development services within incubation. The type of incubators that can provide product development fall within the category of technology business incubators (TBIs) which are more focused on entities concerned with technology-based business and can be located within a variety facilities such as research parks, technology centres, business incubators and accelerators (Mian et al., 2016). For this particular study, TBI mechanisms examined entailed a combination of classical business incubators and the unique

Technology Stations program in South Africa. This approach of viewing business incubators and technology stations with one lens is not uncommon and was initially adopted by Ndabeni (2008) in the article entitled "The contribution of business incubators and technology stations to small enterprise development in South Africa" to drive the point that these TBI mechanisms are proving to play an important role in assisting technology-based enterprises (TBEs).

2. Literature Review

A good understanding of a concept is always best revealed by the definitional positions of various schools of thought. In keeping with this tradition, dynamic capabilities can be traced to several definitional permutations. These being by early authors such as (Teece et al., 1997), Eisenhardt and Martin (2000) who looked at it as resource reconfiguration activity during environmental changes to bring about a capability, for instance: Eisenhardt and Martin (2000): "Dynamic capabilities are 'The firm's processes that use resources – specifically the processes to integrate, reconfigure, gain and release resources – to match or even create market change. Dynamic capabilities thus are the organizational and strategic routines by which firms achieve new resources configurations as markets emerge, collide, split, evolve and die". Or as indicated by Bleady et al. (2018) that dynamic capabilities are processes that enable an organization to reconfigure its strategy and resources to achieve sustainable competitive advantages and superior performance in rapidly changing environments.

Over the years this definition has taken different forms and shapes but has not deviated much beyond the **resource reconfiguration** element due to the environmental business change aspect. What is an interesting element to examine relates to what enables the firm to deploy its dynamic capabilities. For the purposes of this article, the Ambrosini and Altintas (2019) stance is adopted which indicates that dynamic capabilities are concerned with the role of managers in refreshing and transforming the resource base of the firm so that it can maintain and further develop its competitive advantage and performance. The assumption being made that incubated SMEs can utilise lessons learned from incubation services and then implement them in their business at a managerial level. A step further was to understand DCV from a development perspective in other words how are they developed (capacity formation). Teece (2007) looked at the microfoundations of dynamic capabilities in terms of how processes and procedures for instnace play a role in developeing dynamic capabilities. Whilst Sirmon et al. (2011) looked at capabilities developed as a result of managerial participation in this process. Recently Cyfert et al. (2021) has examined the process of developing dynamic capabilities by attempting to emperically link the activities in the process of developing dynamic capabilities and organizational effectiveness.

When looking at the link between business incubation and dynamic capabilities development, it is also then necessary to understand the business incubation conceptually. The concept of business incubation generally entails services provision to new/early-stage ventures with assistance in various enterprise support services such as business plan writing, fund raising, access to networks and mentoring in addition to various tangible resources such as office space and technical infrastructure (Ayyash et al., 2020). A particular focus for this study was made on product development services (closely linked to technical infrastructure support) and a close look at how product development services help SME managers develop dynamic capabilities or better put what is the dynamic capability they develop from this incubation exercise. Most TBI mechanisms would have this product development services due to their strong technical infrastructure because of their links to university research labs and science parks (Mian et al., 2016). One such TBI mechanism from a South African perspective is the Technology Station programme. Technology Stations are entities established the Department of Science and Innovation within South Africa through its implementing entity (Technology Innovation Agency) that have a main role to provide technical support to technology-based SMEs with the purpose of enabling universities to have a link with industry by transferring technical knowledge to SMEs (Tungande, 2012). Literature supports the review process of the relationship of dynamic capabilities and incubation (Gonthier and Chirita, 2019; Maus and Sammut, 2018). These identified relate to deliberate learning and business models respectively. However, the gap identified is that there is no specific link between services provided and the actual dynamic capability developed. This study fills the gap by examining that that link and provides suggestions for future research.

3. Methods

The method used in this study was qualitative in nature, it entailed a self-administered questionnaire with open ended questions. Data was gathered from technology business incubation experts to understand their perceptions on what they consider as a dynamic capability formed from product development services for technology-based SMEs.

Thematic analysis was the main analysis approach using Computer-Assisted Qualitative Data Analysis (CAQDA), a software named AtlasTi.

3.1 Target population

Selected managers within incubators and technology stations were approached to fill in the self-administered qualitative questionnaire. In South Africa there are approximately 101 incubators centres in the public sector and 18 technology stations. These experts had a total of about 136 years of experience when the number of years that they have worked in technology business incubation was combined.

4. Data Collection

The sampling approach used was a non-probability purposeful sampling approach. This type of sampling entails judgmental, selective, or subjective sampling, whereby the researchers rely on their own judgment when choosing members of the population to participate in their surveys (Berman, 2017). This technique was chosen as it assists with looking at current theoretical aspects or develop new ones. It played a critical role in unpacking theoretical insights since there was minor information on the formation of dynamics capabilities for incubated SMEs. In total sixteen (16) respondents participated of which eleven (11) were from incubators and five (5) were from Technology Stations.

4.1 Data analysis

The principles as described broadly by (Byrne, 2021) were utilised to conduct the data analysis for this study. This entailed:
Firstly: assessing the text from the responses and arranging the opinions section by section.
Secondly: Generating initial codes, which was done by using the raw data for assessment in a way that align with the dynamic capabilities' phenomenon. Thirdly: searching for themes in the codes by looking at relationships of these codes with potential themes at different levels and organizing them into categories. Lastly the themes were analysed and named. The approach was in the main guided by the approach as described by (Williams and Moser, 2019). Credibility of analysis was increased by getting an independent reviewer to verify if the codes were generated in a correct manner. The Atlas.ti software was used throughout the analysis.

5. Results and Discussion

Four codes were generated which assisted in creating two categories that were then combined to come-up with one Theme which entails Technology Management as seen on Figure 1 below.

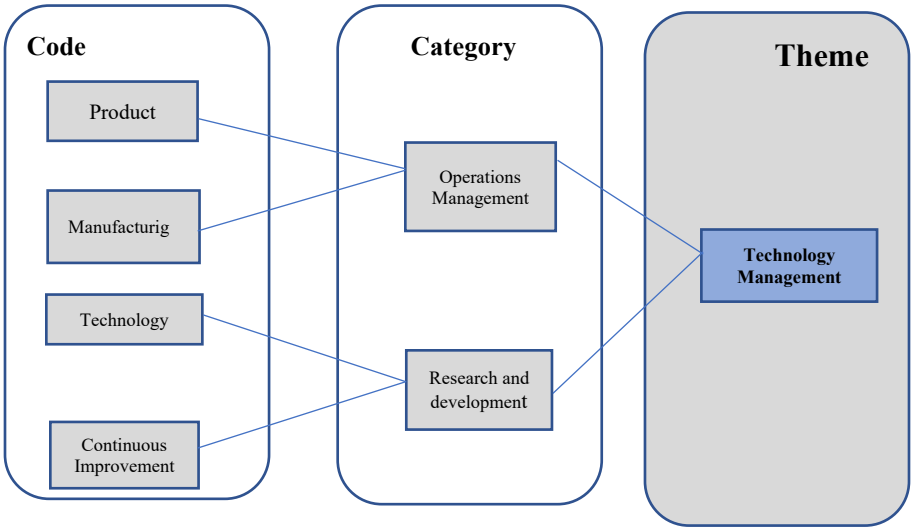

Figure 1. Technology Management (Sourced from Phd thesis, Langa,2022)

This was the theme of analysis when looking at the final dynamic capability arising from product development services for incubated SMEs.

This dynamic capability is organised along the codes (product, manufacturing, technology and continuous improvement) feeding in the categories (operations management and research and development) and is discussed below.

5.1 Code one: Product

A pattern of incubation assistance with managing products was reflected in responses. This entailed discussions as summarised below:

"The product development services allow the SMEs to have quality information from the technical advisors on a step-by-step development on the product. "This, together with the analytical results provides the SME with quality information and professional opinions to adapt things. Technical feasibility of the product. The ability to manufacture to specification and numbers as determined in the plan."

This reflects the importance of SMEs being exposed to how to utilise the skills set from incubation in product development, building a capability to handle any business environment change when it occurs.

Furthermore, this can assist the SMEs in being capable to make decisions around how product modifications can be handled when business changes occur.

"If the company is invested in knowing what goes into the product, it becomes easy to develop dynamic capabilities they know what can be modified in other to fit the certain market`s needs and maybe to cut costs while at it."

Overall, there is an emphasis of making certain that the process of product development is understood and helps SMEs to optimise their process when required. This then being a skill set transferred to the SMEs to further execute their business activities in the marketplace from a product management perspective.

5.2 Code two: Manufacturing

Manufacturing can be considered as a sequential step to take once the product to be made is well understood. It was reflected in the discussions with the business incubation experts that SMEs learn how to build manufacturing capability of the products in their portfolio.

"*The understanding of components that goes into making the product and cost of those components. Insight in the development of the product,* ***manufacturing*** *feasibility, machinery required, involved costs."* These incubated SMEs learn various ways of handling manufacturing and how to prioritise the products in the production line. This is reflected for instance by the comment below:

"*They slowly acquire their own knowledge, regarding* ***manufacturing*** *processes, cost factors and materials by working closely with the Technology Station in the development process."*

Overall, the SMEs build competencies that mirror the ones that the incubators (technology stations) have at a technical infrastructure level. They learn ways to improve their manufacturing process and production facilities by applying standard procedures and methods.

5.3 Code three: Technology

This Technology utilisation skills emerged in the discussion with the incubation experts. In line with Krawczyk-Dembicka (2017) who indicates technology to be about the understanding and implementation of scientific knowledge acquired in past. Or about the different methods and techniques. This is in line with the respondents on the concept as discussed below:

"The integration of new strategic assets, including capability, ***technology*** *and customer feedback. Production and technical capabilities as scaling up is often a challenge. From the interaction with both the production team as well as the end user."* They point out that SMEs use technological resources to adapt their product offerings with the dynamic market environment. This occurs when they gain access to equipment and associated technical expertise which are at their disposal and the technology stations and business incubators that have these technical facilities.

5.4 Code four: Continuous improvement

This is followed by having the ability to continuously improve the processes that they have put in place to manage their production lines. *"****Continuous improvement*** *of the products or the technologies assist in forming partnership with academics who can assist in this regard."* Ultimately these companies learn to implement more efficient mechanisms to continuously improve their business. They learn root cause analysis that will guide them in how to come up with creative solutions leading to an alternative perspective in solving problems in the manufacturing process when they arise. "By *learning from and re-creating processes followed during product development services, they can apply these to future projects/challenges/opportunities."*

Eventually they find themselves in a position where they better understand ways to "future proof" products during development. This is achieved by them being able to continuously develop products and use technology in different ways.

5.5 Category one: Operations Management

The codes from the product and manufacturing were categorised to a term "Operations Management" as reflected on the Figure 2 below. Emphasising that the skill transferred relate to how SMEs build capabilities that assist with effectively managing operations.

Figure 2. Operations Management category: Own compilation as assisted by Atlas Ti (Sourced from Phd thesis, Langa,2022)

This element assists the SMEs with designing the product to suite changing consumer times and how to adapt their production line in manufacturing to align with the new product being developed. (Kavadias and Ulrich, 2020) makes a point that these schools of thought (new product development through innovation and operations management) can be aligned and have been forming communities of practice over the years, recently. This puts into perspective operations management as a dynamic capability in its own right and has been identified through the responses received.

5.6 Category two: Research and Development

The codes of Technology and Continuous Improvement were combined to have a category pertaining to Researchand Development (RandD). For instance, Breznik (2015) studied RandD from a dynamic capability viewpoint. Emphasizing that it can be used to sensing, seizing and reconfiguring in changing business environments. Furthermore, RandD and technological capabilities are the abilities of the firm to exploit the recognized knowledge (Figure 3).

Figure 3. Research and Development (RandD) category: Own compilation as assisted by Atlas Ti (Sourced from Phd thesis, Langa,2022)

Theme: Technology Management (Dynamic Capability)

The categories from the sections above were then combined to consolidate into the *Theme* in the form of **Technology Management.** This theme has been well examined initially by Cetindamar, Phaal and Probert (2009) as a dynamic capability in their seminal paper, emphasizing the development and exploitation of technological capabilities that are changing on a constant basis. This is also reflected in a model that that provides a better understanding of technology management by drawing boundaries and relationships between the concept and other management disciplines particularly with innovation. In the responses received from the respondents above, there seems to be a pattern in an integration of other management practices such as manufacturing and continuous improvement. This integration approach is consistent with the argument made by Krawczyk-Dembicka (2017) who look at technology management as involving the steps of identification, selection and acquisition. Finally the study reflects that it is possible for the managers of incubated innovative SMES to transform their resource base in the enterprise to develop dynamic capabilties as consistent with (Ambrosini and Altintas, 2019).

6. Conclusion

Given that **Technology Management** is the dynamic capability identified as being developed from product management services of business incubation. The Technology Management capability reflected from the respondents above gives an indication that products can be modified by the incubated SMEs based on adjusting their manufacturing process to adapt to changing business environment when they arise. This can be attributed to assistance received in the form of RandD and operations management which leads to better management of the technology by the incubated SMEs who have acquired product development services from technology business incubators and Technology Stations in particular (or from the global phenomenon, TBI). Central to the DCV perspective is the aspect of resource reconfiguration (Cyfert et al., 2021). From a reconfiguration perspective, in this study this aspect has been displayed, for instance the resources identified were products and technology as enabled by manufacturing and continuous improvement capabilities of the SMEs in the dynamic capabilities' development process.

The main question that the study asked was: *What is the dynamic capability developed from product management services of technology business incubation?* The results found that **Technology Management** is a dynamic capability developed from Product Development services during the business incubation process.

This is important for the incubation process in three levels. Firstly, at a services level. Secondly at a dynamic capabilities level. Thirdly at a managerial level for SMEs in terms of how they make their decisions in assisting their enterprises thrive during business environmental changes which is at the essence of DCV.

Acknowledgements

Phumuza E. Langa conducted the overall research study whilst being a Phd student at the University of Johannesburg. Emmanuel I. Edoun supervised the findings of this work. Authors discussed the results and contributed to the final manuscript of this Article.

References

Ambrosini, V., and Altintas, G., Dynamic Managerial Capabilities. In *Oxford Research Encyclopedia of Business and Management*. Oxford University Press. 2019.

Ayyash, S. al, McAdam, M., and OGorman, C., Towards a New Perspective on the Heterogeneity of Business Incubator-Incubation Definitions. *IEEE Transactions on Engineering Management*, 1–15, 2020.

Berman, E., An Exploratory Sequential Mixed Methods Approach to Understanding Researchers' Data Management Practices at UVM: Integrated Findings to Develop Research Data Services. *Journal of EScience Librarianship*, *6*(1), e1104, 2017.

Breznik, L., Exploiting Knowledge Through RandD and Technological Capability: A Dynamic Capabilities Perspective. *Dynamic Relationships Management Journal*, 19–33, 2015.

Byrne, D., A worked example of Braun and Clarke's approach to reflexive thematic analysis. *Quality and Quantity*. 2021.

Cetindamar, D., Phaal, R., and Probert, D., Understanding technology management as a dynamic capability: A framework for technology management activities.*Technovation*,*29*(4),237–246, 2009.

Cyfert, S., Chwiłkowska-Kubala, A., Szumowski, W., and Miśkiewicz, R. (2021). The process of developing dynamic capabilities: The conceptualization attempt and the results of empirical studies. *PLoS ONE*, *16*(4 April).

Eisenhardt, K. M., and Martin, J. A., DYNAMIC CAPABILITIES: WHAT ARE THEY? In *Strategic Management Journal Strat. Mgmt. J*, vol. 21, 2000.

FATOKI, O., Dynamic capabilities and performance of hospitality firms in south africa: The mediating effect of innovation. *Geojournal of Tourism and Geosites*, *36*, 616–623, 2021.

Gonthier, J., and Chirita, G. M., The role of corporate incubators as invigorators of innovation capabilities in parent companies. *Journal of Innovation and Entrepreneurship*, *8*(1), 1–21, 2019.

Kavadias, S., and Ulrich, K. T., Innovation and new product development: Reflections and insights from the research published in the first 20 years of manufacturing and service operations management. *Manufacturing and Service Operations Management*, *22*(1), 84–92, 2020.

Krawczyk-Dembicka, E., Analysis of Technology Management Using the Example of the Production Enterprise from the SME Sector. *Procedia Engineering*, *182*, 359–365, 2017.

Maus, A., and Sammut, S. (2018). Business model innovation in incubators: the role played by dynamic capabilities theory. *Academy of Management Proceedings*, *2018*(1), 12441.

Mian, S., Lamine, W., and Fayolle, A. (2016). Technology Business Incubation: An overview of the state of knowledge. *Technovation*, *50–51*, 1–12.

Ndabeni, L. L., The contribution of business incubators and technology stations to small enterprise development in South Africa. *Development Southern Africa*, *25*(3), 259–268, 2008.

Shih, T., and Aaboen, L., The network mediation of an incubator: How does it enable or constrain the development of incubator firms' business networks? *Industrial Marketing Management*, *80*, 126–138, 2019.

Teece, D. J., Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal*, *28*(13), 1319–1350, 2007.

Teece, D. J., Pisano, G., and Shuen, A., DYNAMIC CAPABILITIES AND STRATEGIC MANAGEMENT. In *Strategic Management Journal*, vol. 18, 1997.

Tungande, D. H. R., *THE DEVELOPMENT OF A FRAMEWORK FOR ACCELERATING TRANSFER OF INNOVATION AND TECHNOLOGY TO TECHNOLOGY-BASED SMALL AND MEDIUM ENTERPRISES IN SOUTH AFRICA*.2012.

Williams, M., and Moser, T., The Art of Coding and Thematic Exploration in Qualitative Research. In *International Management Review*,vol. 15, Issue 1, 2019.

Biographies

Phumuza E. Langa is currently a PhD candidate in operations management at the University of Johannesburg (UJ). He has over a decade of experience within the field of technology transfer where he has played various roles in intellectual property (IP) commercialisation in several publicly financed research and development (RandD) institutions in South Africa. These include being previously employed as the RandD Outcomes Manager at the Council for Scientific and Industrial Research (CSIR), responsible for IP commercialisation matters within the Materials Science Manufacturing unit and as a Manager at the University of Pretoria where he was responsible for a wide range of commercialisation aspects such as IP licensing, seed fund management and business plan development. His research interests are within the field of Strategic Management of Technology and Innovation, with a particular focus on IP commercialisation and technology transfer at large.

Edoun E.I is an academic, he holds a PhD from the University of Witwatersrand in Johannesburg South Africa. He has travelled widely between different countries in Africa while interacting with academic institutions, policy makers, policy implementers and community members. He is industrious and has good conceptual and organizational skills. He has consulted and spearheaded projects at the African Union, NEPAD, the Pan African Parliament ; AFRODAD. I have been involved as an academic at various University is South Africa and abroad. He has supervised more than 20 PhD Students, 30 full master's and 100 MBAs students. He has attended many conferences, locally and abroad, and has published many articles in the International accredited Journals.

Anup Pradhan is an Associate Professor in the Department of Quality and Operations Management at the University of Johannesburg, South Africa. He received BSc in Agricultural Engineering from Bangladesh Agricultural University, Bangladesh, ME in Agricultural Engineering and Systems from Asian Institute of Technology, Thailand, and PhD in Biological and Agricultural Engineering from University of Idaho, USA. His research interests include life cycle assessment, renewable energy, farm mechanization, smart factory, smart grid management, applied research and optimization, organizational productivity, knowledge management. He has published several journal and conference papers. He is a NRF rated researcher in South Africa and a registered engineer with Nepal Engineering Council (NEC). He is a member of American Society of Agricultural and Biological Engineers (ASABE), Engineering

Council of South Africa (ECSA), Nepal Engineer's Association (NEA), Gamma Sigma Delta, Golden Key International Honor Society.