" MACHINE AND DEEP LEARNING MODELING OF UNIVERSITY BUSINESS INCUBATORS(UBI) DYNAMIC CAPABILITIES WITH THEIR ENTREPRENEURIAL ACTIVITIES AND VALUE CREATION : A MIXED METHOD STUDY "

Research Paper

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Abstract

This study investigates how UniversityBusiness Incubators(UBIs) align their capabilities (substantive and dynamic) to their entrepreneurial activities in creating value within the ecosystem. The study is based on an aggregation of a doctoral research project and a research review article on UBIs capabilities.This study further develops a conceptual framework that integrates UBI based capabilities studies with their entrepreneurial activities and a statistical model with machine and deep learning in predicting how UBIs can align their innovation and market strategies with their capabilities in fostering startups and incubators survivability, sustainability and developing a high level of adaptation to challenges and crisis during the process of incubation. This study adopts a sequential exploratory mixed method approach based on exploratory and predictive research objective with a pragmatic paradigm or worldview.The study contributes to UBI study by developing an integrated framework that encapsulates UBIs dynamic capabilities, venture survivability and sustainability with UBIs socio-human structures and relationships with entrepreneurial activities studies which had been a major gap in literatures. This study further enhances the adoption of mixed method research design in UBI studies by combining the benefits of qualitative exploratory cases (studies) with statistical predictive modeling. Based on selected cases using purposive and nested sampling design and scheme, this research study would further apply the conceptual framework to UBIs in different regional contexts.

Keywords:University Business Incubation(Incubators),University Spin off, (Regional) Entrepreneurial Ecosystem, Regional Innovation System

1 Introduction

UBI studies have emerged in the past years from typical infrastructure and service provisioning based approach to a more strategic approach. However, the emergence and evolution of these UBI studies have also resulted in the transitioning and evolution of UBI forms and configurations. This has also exposed some gaps within the conceptual framework guide and a lack of theoretical grounding of how UBIs configurations or archetypes have emerged over the last three decades(Allen and McCluskey, 1991; Mian, 1997; Grimaldi and Grandi, 2005; Bruneel *et al.*, 2012; Taiwo, 2022).

Generally, Business incubators are composed of infrastructures and service management provisions and capabilities and a combination of these enable the UBI to provide support to startups and also

enhance entrepreneurial activities(Hughes, Ireland and Morgan, 2007; Lagos and Kutsikos, 2011). However how they combine these infrastructures and capabilities depends on internal mechanisms and a combinative capability of the UBI(Hughes, Ireland and Morgan, 2007). While the resource based view theory(RBV) initially asserted the combination of resources in providing beneficial value and sustainable competitive advantage for the firm, however criticism of the RBV has given rise to the emergence of higher order theories of dynamic capabilities as firms can also combine some resources even though they are VRIN without achieving sustainable competitive advantage(Teece, Pisano and Shuen, 1997; Zahra, Sapienza and Davidsson, 2006a; Inan and Bititci, 2015). In lieu of this, UBIs' ability to achieve sustainable competitive advantage would be based on their ability to develop higher order level of capabilities from their initial substantive capabilities which they possess at the inception of their business establishment(Zahra, Sapienza and Davidsson, 2006a; Wang and Ahmed, 2007; Heaton, Siegel and Teece, 2019; Heaton, Lewin and Teece, 2020). The theory of Dynamic Capabilities Framework(DCF) asserts the need for organization to continuously reconfigure, recombine, re-integrate their assets in achieving or creating business value and competitive advantage(Helfat and Martin, 2015; Inan and Bititci, 2015).

While the initial dynamic capabilities framework was applied to organization and firms(medium) and multi-national corporations(MNC), scholars have also initiated the application of the DCF to an academic environment using a leadership perspective(Heaton, Lewin and Teece, 2020). In lieu of this, the DCF is used as a stance in investigating and enumerating how UBIs (could)reconfigure, recombine and re-integrate their capabilities (substantive and dynamic) in creating business value and more importantly startups survival. It is worth noting that capabilities reconfiguration and recombination for value creation occurs overtime and in a dynamic manner. Also since UBIs are embedded within their regional ecosystem and there are attributes and elements within these ecosystems which are absorbed by the UBIs to further enhance their entrepreneurial activities in creating value, these ecosystems must be considered in the analysis of UBIs embedded capabilities in providing value(Brown and Mason, 2017). These regional ecosystems also undergo transformation due to adaptation of new technologies in adapting the regional infrastructure to global digitalization, these transformation causes renewal within the UBI ecosystem as a result the evolving regional ecosystem also affects the UBIs(Malecki, 2018). Therefore a cumulative overview of both the UBI and their regional ecosystem is essential(Taiwo, 2023).

There is a dearth of UBI based studies that elucidate on overview of UBI evolution using capabilities and with their evolving ecosystem overtime. Absent is also predictive statistical modeling that uses the power of machine learning and deep learning(Zahra, Sapienza and Davidsson, 2006b; Wang and Ahmed, 2007). This study intends to fill this gap by combining the power of an in-depth exploratory case study to understand and apply the DCF to UBI studies with quantitative techniques in backcasting, forecasting and predicting the application of UBI capabilities and ecosystem attributes in enhancing entrepreneurial activities and value creation using machine and deep learning. Using a multi-level units of analysis (individual, firm and networks-REE, trans regional networks(Baraldi and Havenvid, 2016), this study investigates and enumerates how UBIs develop different capabilities across their incubation process and industry value chain, the social interactions effects that facilitate the development of these capabilities and how they adapt to different external impact, disruptions and challenges. It is relevant to understand the initial socio-human structures that exist within UBIs and how these structures are transformed by the capabilities renewal and recombination with their social structures and the response of the various actors within these UBI structures to environmental impact and arising tensions and disruptions. An earlier study initiated the application of the strong structuration theory to UBI studies to facilitate the internal and external structures within a system and the responses of the actors to external conditions based on their disposable characters and normative expressions(Jack and Kholeif, 2007a; Stones, 2017a; Taiwo, 2022). This study further developed on this concept using the combinative benefits of a mixed method research design and based on exploratory and predictive research objectives. Overall this study aims to understand the UBI capabilities that enhance entrepreneurial activities within their regional ecosystem, their evolution and transformation overtime, the socio human structure and external conditions and how these UBIs adjust

to these external conditions using internally developed capabilities and disposable skills. This study also intends to understand the evolving social networks dynamism that occur during these transformations. The study is guided by the following research questions:

(i) What are the capabilities identified in UBI studies and how do they differ from proprietary UBIs in different regional ecosystem contexts that aids entrepreneurial activities and value creation?

(ii) What are the different UBI socio human structures and how do they evolve overtime based on the influence of external conditions and pressures?

(iii) How do UBIs attain sustainability and survivability using these capabilities?

The next sections develop a conceptual study and framework for UBI capabilities based studies and accompany concepts and theoretical stances, description of the categorized patterns and themes and cases.

2 UBI Capabilities and their Dynamic Structural Networks in Creating Entrepreneurial Activities within their Region

Entrepreneurs are at the core of entrepreneurial activities within the UBI ecosystem. In achieving their entrepreneurial goals such as product development or venture formation, individual and team capabilities, competencies are needed. Scholars have emphasized the need for competencies such as opportunity identification and recognition, i.e. the ability of an entrepreneur or a firm to understand its entrepreneurial ecosystem, scan and exploit its environment for entrepreneurial opportunities. Furthermore, a level of innovation and risk taking are also important for successful venture formation. Scholars have earlier discussed some of these capabilities and competencies of venture formation and individual self-efficacy and motivation that aids academic entrepreneurship and ensure sustainable business advantage(Walter, Auer and Ritter, 2006; Rasmussen and Borch, 2010; Rasmussen, Mosey and Wright, 2011).

In lieu of this, this study advances the earlier integrative review(Taiwo, 2022) then develops a conceptual framework to enumerate and align how UBIs develop capabilities with their assets and reconfigure, recombine and re-integrate them to create business value. This study also considers the linkage, interactions and ties that facilitate these capabilities,the actors or active agents within the UBIs structures that tend to align and respond to the various changes during the recombination and reconfiguration of these capabilities.

To facilitate these understanding, this study builds upon an earlier review and application of the structuration to UBI(Taiwo, 2022)by aggregating and enunciating further on related capabilities(substantive and dynamic), dynamic social networks and socio human structures studies based on a multi-level analysis (i.e. individual, firm or organization(UBI) and their networks). Qualitative thematic coding was applied to identify themes, patterns and categories which are further discussed in this study. Categories and sub-categories that ensued during the analysis include the following: UBI Entrepreneurial Activities and Regional Ecosystem with sub categories (UBI Entrepreneurial Activities, Value creation Entrepreneurial Ecosystem and Regional Innovation System), UBI Social Networks (with categories such as UBI Actors and Stakeholders, UBI Ties and Relationships, UBI Networks (Performance Measurement). Other categories include UBI Structures and Dynamic Capabilities, UBIs Dynamic Capabilities,Survivability and Sustainability and Knowledge and Innovation in UBIs.

3 Methodology

Based on an earlier study on dynamic capabilities in UBI and related themes(Taiwo, 2022), this research study further develops a conceptual framework based on the initial integrative review on extant UBI literatures spanning the concepts of dynamic capabilities,knowledge flow,incubation support,social networks and capital(Rothaermel and Thursby, 2005; Newey and Zahra, 2009; Rasmussen and Borch, 2010; Cooper, Hamel and Connaughton, 2012a; Heaton, Siegel and Teece,

2019; Redondo and Camarero, 2019; Heaton, Lewin and Teece, 2020). This study continues in that direction by developing a conceptual and study framework using mixed method approach with qualitative thematic analysis and statistical quantitative modelling with machine and deep learning.

3.1 Category A: UBI Entrepreneurial Activities and Regional Ecosystem

Several themes and concepts identified that aligns with Entrepreneurial activities include Entrepreneurial Orientation, behavior, autonomy, patterns and Network capabilities. Entrepreneurial orientation(EO) is required by individuals and firms for innovation and risk taking during venture formation. Although based on studies, EO does not directly affect organization' or firm performance, however it has effect on an organization achieving sustainable competitive advantage. EO with Network capabilities together affect the performance of a venture firm as well as Network Capabilities' components like relational development with other actors within the entrepreneurial ecosystem, partner communication and collaboration, marketing relationships and co-ordination (Walter, Auer and Ritter, 2006). It is also pertinent to note that EO has an effect on the survivability and sustainability of business ventures as it is required for customer attraction. It is also relevant to understand that capabilities differ from firms even if they have the same strategies and mechanisms as the regional contexts in which they are embedded differs and should be taken into consideration. This gave rise to the sub categories of entrepreneurial ecosystem and regional innovation system.

Since UBIs are embedded within their regional ecosystem and innovation structures to not only generate and diffuse knowledge, but also facilitate both the commercialization of ideas and startups formation within their ecosystem(Etzkowitz, 2004; Lee and Osteryoung, 2004; Bathula, Karia and Abbott, 2011; Mian, 2011; Al-Mubaraki and Busler, 2012). To achieve this, Universities establish innovative platforms such as UBIs, Technology Centers or Science Parks together with the regional actors. Elements, dimensions and attributes (such as infrastructural support, capital, social, economic, legal, cultural and technological platforms(MacKinnon, Cumbers and Chapman, 2002; Spigel, 2017; Malecki, 2018)available within the regional ecosystem are absorbed together with the UBIs' capabilities in transforming their assets and creating business value. The dynamic evolution of the UBI capabilities with their regional ecosystem overtime is essential as these elements undergo recycling and transformation which are vital for the ecosystem development(Zahra, Sapienza and Davidsson, 2006a; Heaton, Lewin and Teece, 2020) and there is a dearth of understudying UBIs dynamic capabilities transformation with its embedded ecosystem and dynamic social networks overtime within different regional innovation system type(Heaton, Siegel and Teece, 2019; Taiwo, 2023). This study bridges this gap by taking into cognizance the dynamic evolution of UBI capabilities, their ecosystem and networks overtime.

Within typical entrepreneurial ecosystem are sets of informational, legitimate and resource exchange based networks that enhance the flow of resources and information within an entrepreneurial ecosystem. These network types and actors develop norms, rules and policies required for the ecosystem transformation(Inan and Bititci, 2015; Brown and Mason, 2017; Spigel, 2017). Formal, informal, personal, academic, inter-firm and self-organized networks have been identified as the forms of networks formed by actors within these regional ecosystems(McAdam *et al.*, 2006). An important factor is also the actors available within these ecosystems as they determine the degree of collaboration, partnerships, ties (strong and weak) and frequency of communications and interactions. In developing these collaborations and partnerships among organizations, network, relational and alliance capabilities are required which aids the linkages formation, density and fluidity within the network and mutual interests(Cooper, Hamel and Connaughton, 2012b). The concepts of IOR (Inter-Organizational Relationships) gives insight into inter-firm collaborations and relationships development by actors whose roles include brokers, mediators, boundary spanners, mentors, multi-stakeholders, inventors, developers, entrepreneurs and Unicorn startups creators (those with $1bn valued startups). Studies have also highlighted the impact of regional stakeholders on UBIs incubation processes i.e. their power exertion, salience and normative dispositions and expressions in the process of incubation(Baraldi and Havenvid, 2016; McAdam, Miller and McAdam, 2016; Spigel, 2017).

However, there is need to understudy the effect of an ego, actor or relationship on a network overtime within UBIs EE and evolving capabilities. In other words, ascertaining the effect and the affect or the probability of a tie, ego and relationship on a network overtime. This study intends to evaluate and investigate important ties within UBI' network and their evolving effect and patterns on the changing UBIs dynamic capabilities and structures.

Based on the themes and concepts within this category and sub-categories, a proposition is made:

I. Capabilities required by UBIs to facilitate entrepreneurial activities and value creation are developed internally and externally via interactions and competencies and they evolve overtime with their Entrepreneurial ecosystem attributes.

3.2 Category B: UBI Social Networks

The concept of Social Networks and Social Capital within UBI studies have shown the importance and relevance of ties and relationships in networks in facilitating social capital development which is important in the UBI' goals of enhancing and stimulating entrepreneurship within its organization, regional ecosystem and trans-regional ecosystem. On a multi-level analysis, social capital dimensions include relational, structural and cognitive social capital as these aid mutual interest formation, developing the required entrepreneurial culture and language with the mindset required for venture formation. This is required from the incubatees or student entrepreneurs in developing social culture and relations that stimulates co-working and opportunity exploitation within the ecosystem. The incubatee bonding social capital is important in enhancing cordial and mutual relationships within an incubator and ecosystem. While the incubator bridging social capital facilitate UBI bonding with the incubatees and external networks(McAdam and McAdam, 2006; McAdam *et al.*, 2006; Redondo and Camarero, 2019; Pellegrini and Johnson-Sheehan, 2021). Alliance and relationships formation within UBIs are also aided by the alliance, network and relational capabilities as these aids partnerships, collaborations,understanding,communications and partnership co-ordination. Co-ordination is required to understand the continual changing dimensions within the dynamic relationships and alliances. An important factor within the UBIs study of social networks and its measurements is also the dynamism involved in social networks analysis. Social networks are not static but evolving and the dynamism or evolution overtime must be considered with the effect of external impact and conditions on their structures(Scott, 2012; Onwuegbuzie, 2019; Froehlich, Rehm and Rienties, 2020; Taiwo, 2023).

3.3 Category C: UBI Socio Human Structures and Dynamic Capabilities

The theme within this category identify UBI capabilities required within their incubation model process and networks interactions, it also describes how these capabilities are formed and change overtime based on the reconfiguration and reintegration of their assets. This category also highlights themes and related concepts in the UBI socio-human structures based on their internal structures, the actors or active agents within their networks.

The SST aids the analysis of socio human structures (which are based on recursive relationships between actors or active agents within a structure or system and the external conditions). External conditions include the surrounding immediate or external environment of the UBI. These external conditions impact on the UBI structures and processes. How they align to these changes is based on their internal structures as defined by the SST which is based on the Habitus and Conjectures i.e. disposable skills, views perspectives, culture and normative expressions or norms, rules, regulations, policies legitimation, domination and significance(Jack and Kholeif, 2007b; Greenhalgh and Stones, 2010; Stones, 2017b).

Based on the thematic analysis and coding, UBIs' external condition and structures, Internal structures and possible active agents are identified and based on the SST' Quadripartite framework(QNS) consisting of external and internal structures, active agents and outcomes, the QNS is also applied to

the UBI studies. Figure I illustrates the SST' QNS application to these UBI study and socio human structures.

External Structures and conditions identified in this category include: Government roles and Regional Stakeholders influence on UBI incubation processes, Government' Power exertion due to fund changes and budgeting for UBIs(Soetanto and Jack, 2016a).

Capabilities identified in this categories include Absorptive Capabilities (PCAP-potential absorptive capabilities and Realized Absorptive Capabilities),Innovative capabilities, reliance, alliance, relational, network, support, internal and external capabilities.

The concept of ACAP enumerate the amount of external knowledge acquired and assimilated by a firm in providing business value and the level to which it can exploit this knowledge in transforming its organization processes. ACAP is further divided into two dimensions which are potential absorptive capabilities(PACAP) and Realized absorptive capabilities (RACAP)(Zahra and George, 2002; Rothaermel and Thursby, 2005; Rothaermel and Hess, 2007; Novino, 2022).

The potential absorptive capability(PACAP) is further divided into acquisition and assimilation. With respect to external knowledge acquisition commences in a firm based on the need to further develop their entrepreneurial processes and adjust their strategy to customer demands or the changing business dynamics. However the type of knowledge which could be tacit or codified(Cooke, 2003; Asheim and Coenen, 2005; Trippl and Tödtling, 2007) must be assimilated and put to effective usage by the firm. This absorptive capacity is then exploited in combination with tools and operational efforts and then added to business process to aid organizational transformation(Zahra and George, 2002; Asheim and Coenen, 2005; Wang and Ahmed, 2007; Asheim, Valentin and Zeller, 2009; Inan and Bititci, 2015) giving rise to the Realized Absorptive Capabilities(RACAP). Organizational antecedents such as External Openness(EO), Tolerance to Failure(TF) are also important to align with the firm's ACAP and the firm's innovative outcome(Novino, 2022). ACAP dimensions such as patents, backward citations and licensing have also been identified in studies as crucial to knowledge flows and exchange within UBIs(Walter, Auer and Ritter, 2006).

Innovative Capabilities are essential in fostering innovation and product development within the firm. However this entails the understanding of the market and the application of the right strategy (market or technology or a combination of the two- ambidextrous market strategies) with the required support mechanisms such as entrepreneurship and networking support(Soetanto and Jack, 2016b).

It is important to understand that developing dynamic capabilities takes time and involves co-creation within the firm and external networks with the UBI manager(s) playing vital role in the development of both the internal and external capabilities required to facilitate entrepreneurship activities and value creation.

The Dynamic Capabilities Framework(DCF) highlight the order in the formation and development of dynamic capabilities. New venture formed or startups within UBIs possess substantive capabilities at the inception of the venture formation which are essential to aid in initial opportunity identification, recognition and in solving their initial venture or business problems. These initial capabilities are classified as scanning, seizing and transformation capabilities as they are required for exploring and exploiting opportunities within the UBIs environment and transforming them to business values(Heaton, Siegel and Teece, 2019; Heaton, Lewin and Teece, 2020).These substantive capabilities could be from the entrepreneurs' personal experience in business development, a background of family business venture creators or a highly motivated individual and venture risk taking individual who has a sound exposure in radical innovation and startup formation. These initial capabilities (substantive) are required during inception of the venture business and are continuously integrated, re-combined and reconfigured until these capabilities evolve into dynamic capabilities based on the firm' ability to develop operational processes and strategic alignment of their assets (including resources and their initial capabilities). The DCF framework is based on order level from resources being the zero order, followed by the firm operations which include lean management, project management processes, incubation models, Just-In-Time(JIT) as first order and Strategic Management as second order. Dynamic capabilities sit as a higher order in the DCF framework(Zahra,

Sapienza and Davidsson, 2006a; Wang and Ahmed, 2007; Inan and Bititci, 2015; Heaton, Siegel and Teece, 2019).

An important dimension in the study of dynamic capabilities is the evolution of capabilities overtime based on these reconfiguration, reintegration and recombination activities within a firm. Dynamic Capabilities development undergoes a cycle of transformation with the firm activities and processes. The Capability Life Cycle(CLC) explains the transformation of these capabilities as they navigate through the firms' processes with time. The capabilities undergo evolution from the development, growth, maturity and decline states through which they undergo transformation via recombination, re-integration, reconfiguration and retirement as some capabilities can become obsolete(Wang and Ahmed, 2007; Teece, 2017). A combination of the Capability Life Cycle, the Dynamic Capability Framework and the Socio Human structures will aid both socio-structural and capabilities transformation within UBIs.

Based on the themes and concepts identified in categories B and C, a proposition is made:

II. UBIs capabilities (substantive and dynamic) and outcomes are impacted by external conditions and change overtime with the UBI' socio human structures and UBIs adapt and respond to these changes using their internal capabilities within their embedded ecosystem.

To understand the changing dynamics of UBIs capabilities with their structures, the DCF and the SST will be considered together in this study. Due to the time variation and evolution involved, SST's methodological bracketing and temporality will be used to understand the changing effect of UBI's socio human structure overtime to ensure survivability during the transformation. (Jack and Kholeif, 2007b; Makrygiannakis and Jack, 2018).

3.4 Category D: UBI Survivability, Sustainability and Dynamic Capabilities

Business Survivability and Sustainability are critical factors that must be considered for both startups and UBI as an organization. The journey of survivability with a venture firm or startup commences with the ability of the entrepreneur to venture into business via idea generation and team formation which involves risk taking and a level of innovation which is garnered via developing a degree of EO (entrepreneurial orientation). The firm's ability to create opportunities within her ecosystem and also explore and exploit these opportunities for the startups or venture firm survivability depends on both EO and NC (network capabilities). These together enhance firm performance, the ability to manage partners, attract customers and maintain their external network collaborations(Walter, Auer and Ritter, 2006). For a successful incubation process and model outcomes, the venture firms and UBI internal capabilities of mutual trust, commitment, entrepreneurial mindset (behavioral patterns) and culture are important to enhance entrepreneurial activities and value creation for successful performance. However, stakeholder's influence on the incubation models and funding of the UBI has an impact on its business survivability and sustainability(Soetanto and Jack, 2016a) and the level of power exertion of the UBI' incubation model determines the degree of autonomy.

The sustainability of entrepreneurial ecosystem in which the UBI and startups are also embedded is also important. In this vein, sustainability and survivability of the UBI must be assessed overtime and collectively with that of the entrepreneurs' or startups and its embedded ecosystem or cluster. Capabilities required for business survivability and sustainability at the venture formation stage, incubation processes, collaborations and partnerships, managerial processes, knowledge and innovation management, strategies (market and technology) must be integrated together to determine the effective overall performance based on a long-term sustainability level of the firm and business.

3.5 Category E: UBI Knowledge and Innovation flows and networks with Dynamic Capabilities

Knowledge and Innovation flow within UBIs networks are based on relationships and trust development which are developed and enhanced via social capital development. The relational aspect

of social capital is fostered by the relational and alliance capabilities which are required in creating mutual trusts and benefits that enhance easy exchange of knowledge and information(Rothaermel and Thursby, 2005; Wachira, Ngugi and Otieno, 2016; Redondo and Camarero, 2019). Some of the knowledge sources from the University includes intellectual Property, patents and backward citations based on research and spinoff product and services. Knowledge flow and diffusion to the University and UBI's immediate environment include via survey, academic journals, regional conferences and joint project collaborations facilitated by the University. In diffusing knowledge, a relational level of social capital and Inter-organizational relationship(IOR)(Cooper, Hamel and Connaughton, 2012b; Redondo and Camarero, 2019) is required. Capabilities required for these knowledge exchanges and IOR are relational, alliance and network capabilities. While for successful knowledge flow and diffusion the UBI' and venture firm' ACAP (PACAP and RACAP) is essential. Within typical networks and IOR, there are knowledge bases which are source(s) of information and resources. The extent of the centrality and linkages the knowledge bases have determine the level of information flow within and outside the UBI. It is also important to note that knowledge flow is facilitated by the level of development of both bonding and bridging social capital.

Manager's incubator' bridging Social Capital(SCAP) could aid in facilitating information exchange within the UBI and among entrepreneurs. The logic and competencies of the manager is also an important attribute as a manager with a more business logic than academic logic will facilitate entrepreneurial activities and value creation better compared to a manager with an academic logic. On a multi-level analysis at the incubatees or entrepreneurs' level, incubatee bonding SCAP is required to build mutual trust and collaboration. On the incubator (organizational level) the managerial proactiveness and incubator' bridging capital is essential for success with incubatees, the incubator and external networks and in creating business value via innovative product development(Rasmussen, Mosey and Wright, 2011, 2015; Redondo and Camarero, 2017).

Innovation within the UBI is essential both for the regional ecosystem and economic growth. However, in creating innovative products and services, incubatees require innovativeness which is an element of Entrepreneurial Orientation(EO) a level of innovation capabilities required by incubatees. While the UBI via its open innovation process require both innovative and network capabilities in coordinating with partners and the market or industry. The Network capabilities concept dimensions include market knowledge, communications(internal), partner knowledge and co-ordination. The IOR, relational and alliance capabilities are also required alongside the network capabilities for open innovation collaboration and partnerships(McAdam *et al.*, 2006; Walter, Auer and Ritter, 2006). However these capabilities interlinked with the innovation strategies employed by the UBI and entrepreneurs which could be technology and market exploitation and exploration strategies or a combination of the two (ambidextrous innovation strategy),requires a lot of resources and high order capabilities for small venture firms or startups as the transaction costs needs to be considered(Somsuk, Punnakitikashem and Laosirihongthong, 2010; Pazos *et al.*, 2012; Somsuk and Laosirihongthong, 2014; Soetanto and Jack, 2016b). Based on the themes and patterns identified in this categories, a proposition is thus made:

III. Specific capabilities (substantive and dynamic) that are essential for startups and UBIs survivability and sustainability occur throughout the UBI and startups' lifecycles i.e. during venture formation by entrepreneurs and through the incubation process, knowledge generation and open innovation and these capabilities ensure the venture or startups, the UBI and the ecosystem survivability and sustainability and should be determined collectively with other UBI performance metrics.

Based on the three propositions, qualitative interviews and survey are prepared (as shown in Table III) and further quantitative techniques are applied. The next section discusses the quantitative modeling, findings and further research questions.

3.6 Description of the Cases

Based on identical and purposive sampling scheme and design, several number of cases are selected for interviews and the survey shown in Table III will be sent to the participating UBIs. The cases are selected from different regional contexts. With a multi-level unit of analysis,the survey engages the entrepreneurs,the UBI as an organization or institution and their networks of collaborations. The design of the survey was based on the patterns and classification of themes that occurred during the thematic analysis as discussed above.

3.7 Statistical Modeling with Machine and Deep Learning

The quantitative design commences from the inputs from the survey shown in Table III. The sets of capabilities will be modeled based on machine learning. The entrepreneurial behavioural patterns will be modeled using deep learning.

4 Discussions and Future Research Agenda

From UBI literatures and on a multi-level analysis perspective, specific capabilities are needed at specific stages of the business incubation process and this differs based on individual(entrepreneur) competencies and self-efficacies, the UBI innovation and market strategies and cognizance of its embedded entrepreneurial ecosystem and regional innovation system(RIS). It has also been ascertained that these capabilities are developed overtime but differs under the prevailing ecosystem', need, attractiveness and level of knowledge flow in the RIS and the degree of developmental, generative and transformative roles of the Universities' and UBI. The variation in these roles and embedded elements and dimensions of the ecosystem have given rise to different forms and combinations of the capabilities and management value provisions such as support and infrastructure. This also aligns with the Potter's Diamond Model for Regional Innovation System(Cooke, 2003) development based on the availability of the infrastructure, rivalry and competition in the ecosystem, presence of a thriving research and academic institutions and firms. In lieu of this, UBI's specific capabilities should be investigated on specific contexts with the regional ecosystem impact.

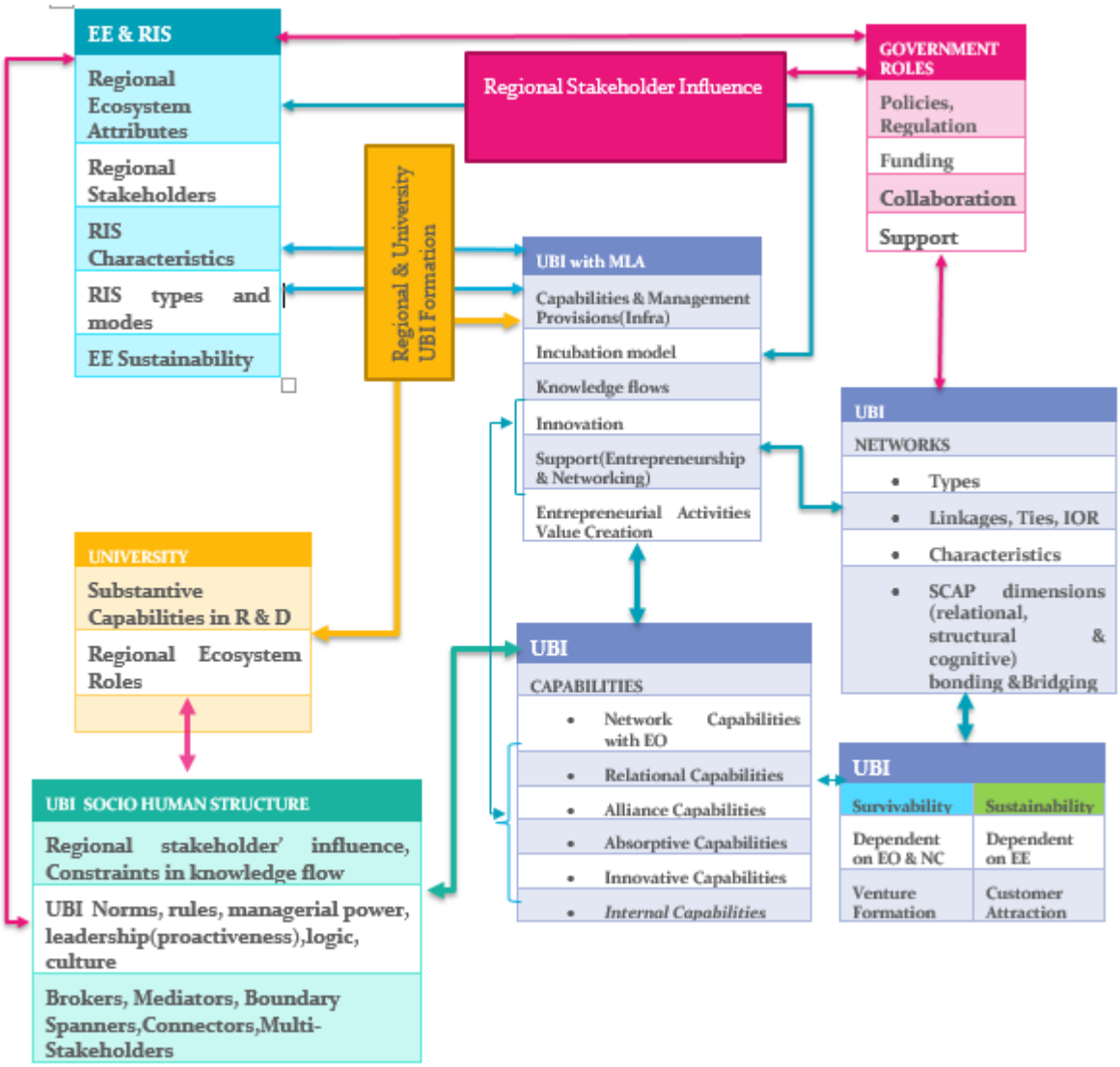
This study based on the intial review from an earlier study by the author and the conceptual framework designed in this review have highlighted some capabilities(both substantive and dynamic) in UBIs, however this would be futher clarified based on qualitative indepth interviews and quantitative techniques to justify or diverge from the earlier conceptual framework.

Dynamic capabilities are developed overtime and this requires a multi-dimensional modeling for investigation and assessment with time intervals and temporality onsiderations.(Zahra, Sapienza and Davidsson, 2006a).

The overall contribution of this study include a bridge in the gap of UBI studies lack of a generalized conceptual framework(Mian, 2011),a multi-dimensional approach to capabilities study and modeling in UBI(Wang and Ahmed, 2007; Heaton, Siegel and Teece, 2019; Heaton, Lewin and Teece, 2020; Taiwo, 2022) and further enhancing the use of mixed methodology in UBI studies and business management research via data integration and meta-inferencing applications(Azorín and Cameron, 2010; Molina-Azorin, 2016; Taiwo, 2023)

4.1 Figure

Figure 1. Pre-Conceptual and Integrated Study Framework.



4.2 Table

Dynamic Capabilities(DC) Order	
Dynamic Capabilities (Higher Order)	Higher Order
Strategy	Second Order
Organizational Operations (e.g. Lean, Just-In-Time(JIT), Agile Project Management)	First Order
Organizational Resources(e.g. Financial, Technological, Human, Social)	Zero Order

Table 1. Dynamic Capabilities(DC) Order.

Quadripartite Strong Structuration Framework for UBIs	
EXTERNAL STRUCTURE and CONDITIONS	
Government Policies and regulations on funding, Stakeholder's influence on incubation models, Constraints in knowledge, information flow and Innovation.	
INTERNAL STRUCTURE	
Conjectures: norms, policies and rules within the UBI,UBI stakeholder's power exertion and salience	Habitus: (mutual) interests, entrepreneurial behavioral patterns, mindset and orientation, UBI' entrepreneurial culture
ACTIVE AGENTS	
Brokers, Mediators, multi-stakeholders, boundary spanners, Connectors, Unicorn owners, Regional Stakeholders, Firm Networks, Inter-firm Networks	
OUTCOMES	
Entrepreneurial Activities &Value Creation effects, Regional Economic growth, Spin-off Performance, Customer Attraction, Competitive Advantage, Business Survivability and Sustainability, Regional Sustainability	

Table 2. UBI Quadripartitie Framework based on Strong Structuration Study.

Our Entrepreneurs and UBI have developed these capabilities to enhance entrepreneurial activities and value creation:	Level of Agreement
Entrepreneurs Initiation & Intention Capabilities: Innovativeness Entrepreneurial mindset Incubation process Motivation Commitment	Strongly Disagree Disagree Neutral Agree Strongly Agree
Knowledge Flow Capabilities: Acquisition and assimilation of external knowledge Exploration and Transformation of Knowledge Continuous Knowledge flow among entrepreneurs	Strongly Disagree Disagree Neutral Agree Strongly Agree
Our UBI have developed these capabilities to enhance entrepreneurial activities and value creation	
Innovation Development: Successful innovation strategy for market entry Successful product development strategy Thriving open Innovation processes Absorption of attributes (economic from regional Ecosystem)	Strongly Disagree Disagree Neutral Agree Strongly Agree
Operational and Resource Development Continual adaption of incubation processes Re-configuration resources (human, financial resources etc.) Managerial proactiveness for Entrepreneurs & partners bonding	Strongly Disagree Disagree Neutral Agree Strongly Agree
Dynamic Social Networks Partner and Alliances Formation Entrepreneurs bonding and Trust Building Regional Ecosystem Collaboration	Strongly Disagree Disagree Neutral Agree Strongly Agree

Table 3. UBI Capabilities Survey Extract based on Thematic Analysis.

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