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An Evaluation of the Effectiveness of Innovation Ecosystems in Facilitating the Adoption of Sustainable Entrepreneurship

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An Evaluation of the Effectiveness of Innovation Ecosystems in Facilitating the Adoption of Sustainable Entrepreneurship

by

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ABSTRACT

Sustainable entrepreneurship has a substantial role of a steadily growing economy and advanced industrial economies. Several strategies have been formed and employed to support the adoption of innovation and technologies in the sustainable entrepreneurship sector. However, the successful outcome of these strategies in achieving their goals depends on how effective they are in satisfying their objectives and thus increasing innovation adoption. One measurement for effectiveness of ecosystem implements can be their support to the input of the process of innovation and technologies adoption and their impact on satisfying regional goals.

The objective of this research is evaluating the effectiveness of innovation ecosystem instruments on increasing the adoption of innovation in sustainable entrepreneurship by developing a comprehensive assessment decision model. Strategy targets used in this assessment depend on five perspectives that are perceived by decision makers as important for the adoption process. The decision model linked the perspectives to ecosystem targets and various innovation ecosystem instruments. These perspectives are economic, environmental, social, technical, and ethical. The research implemented the hierarchical decision model (HDM) to construct a generalized ecosystem assessment framework. The HDM model has the ability to be generalizable and can utilize in different regions. Also, in this research, the desirability curves methodology is implemented. This methodology will help the researcher in the future to consider any additional alternatives. As it is mentioned before, Desirability Curve describes how

desirable a certain assessment variable is for the decision-maker according to expert judgments.

Finally, two case studies were conducted to demonstrate the practicality of this assessment model. The model pointed to the weakness and strengths of Saudi Arabia's and China's Innovation Ecosystem in facilitating the adoption of sustainable entrepreneurship along with providing recommendations for areas of improvement based on desirability curves.

DEDICATION

To my Mom Latifah & my Dad Sami,
who taught me to believe in myself to achieve whatever I want in this life.

To my brother Ahmed and my sisters, Bodour, Ohoud, Sarah, Lujain, Asrar, Shouq and Shahad,
who always support me when mundane difficulties of life have heaved down on my shoulders.

To my future career,
which I always work for it hardly and never give up.

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CHAPTER 1: INTRODUCTION

Sustainable entrepreneurship has become a vital part of the ecosystem and it is getting more global spotlight. Sustainability entrepreneurship plays a significant role in solving social and environmental problems by recognizing and creating entrepreneurial opportunities. It provides integrated corporate social responsibility by considering economic growth, social equity, and environmental resilience through entrepreneurs entrepreneurial. According to a benchmarking survey of the ILO and the IFC (2009), "the average energy cost per ton of garments is USD 560, with a wide range from USD 30 to USD 1,737 per ton. Also, on average, approximately 100 to 150 liters of water are needed to process one kilogram of textiles. With an annual amount of approximately 28 million tons being dyed, the apparel industry has an annual water footprint of more than five trillion liters of water" (Maxwell, McAndrew & Ryan, 2015). The garment industry, as an example, has been considered as an issue of sustainability that needs to be identified as entrepreneurial drivers, challenges, and opportunities to pursue sustainable entrepreneurship and innovation.

Greening the industrial sector requires an effective national ecosystem to technologies that fulfill productivity enhancement and reduce social and environmental impacts. This will emphasize that full and sustainable economic advantages can be recognized. The meaningful aims to widen the adoption of sustainability entrepreneurship for the goals below (Gast, Gundolf & Cesinger, 2017):

- Enhance investment for resource efficiency improvements and adopting sustainable renewable energy sources.
- Create value that is beneficial for society through opportunity creation, and development in an uncertain environment.
- Recognize change through the improved scientific evidence about the effects of ecological disruption on population growth and the environment.
- Increase competitive advantage through proactive environmental stances

  Contribute to the economic and non-economic development of nations and regions.
- Create significant opportunities for employment.
- Decrease the creation and use of harmful substances and the production of waste and reduce environmental pollution.

Effective ecosystem interventions are needed to promote or incentivize the achievement of sustainable entrepreneurship. The literature review part of this document investigates, in-depth, the following sections: technology adoption and innovation for sustainable entrepreneurship, and the role of government and its ecosystem interventions to the development of sustainable entrepreneurship. The goal of this study is to evaluate the effectiveness of the innovation ecosystem on increasing the adoption of innovation in sustainable entrepreneurship by developing an assessment decision model.

1.1 Innovation and Potential Entrepreneur

An entrepreneur is defined as an individual who takes advantage of the opportunity to create a new business, new product, or a new service (Drucker, 1985). New technologies always create an opportunity and platforms for new entrepreneurial ventures. Rogers (2010) states that before accepting and adopting a new product, consumers explore several phases. Usually, new technology or ideas are adopted by a small group of people. Then, relies on some factors, like awareness of the technology, the number of users can be estimated. However, there are many factors influencing the entrepreneurial adoption of new technology and starting a new business. These factors can be social and financial challenges, also pressure from policy reform in order to reach a range of social and environmental goals (Horlings, & Marsden, 2014).

Innovation is a remarkable word in entrepreneurship. As Drucker (1985) mentions, “Innovation is the specific tool of entrepreneurs, the means by which they exploit change as an opportunity for a different business or a different service.” He defines "Innovation" as an economic or social term more than technical. According to Rogers (2010), diffusion is "the process by which an innovation is communicated through certain channels over time among the members of a system." The key methodology for our research is the diffusion of innovation. Rogers (2010) describes diffusion as “the process by which an innovation is communicated through channels over time among members of a social system. It is a special type of communication, in that the messages are concerned with new ideas.” That means diffusion is always required for a novel idea or technology, the

human involved, and various communication channels in order to spread this innovation within the social system.

Sustainable entrepreneurs have a substantial role in a steadily growing economy and include poverty alleviation. Worldwide, policymakers recognize the value of entrepreneurship.

1.2 Innovation Ecosystems as a Context for Entrepreneurship

Innovation ecosystems are intended to enhance the deployment of sustainability in entrepreneurship. Innovation ecosystems are intended to enhance the deployment of sustainability in entrepreneurship. According to (Moore, 1993), " *an innovation ecosystem refers to a loosely interconnected network of companies and other entities that coevolve capabilities around a shared set of technologies, knowledge, or skills, and work cooperatively and competitively to develop new products and services*." (Granstrand & Holgersson, 2020) defined innovation ecosystems as the following definition: " *An innovation ecosystem is the evolving set of actors, activities, and artifacts, and the institutions and relations, including complementary and substitute relations, that are important for the innovative performance of an actor or a population of actors*." That means there is a need for integration of technology, suitable funding, skilled human capital, and policy in order to build an innovation and sustainable entrepreneurship ecosystem. Today, small/medium-sized enterprise (SME) startups have considerable innovation (Matricano, 2020). These start-ups need to exist in an environment that supports the creation and growth of innovation ecosystems. MIT Lab for Innovation

Science and Policy identifies as 'innovation-driven enterprises' (IDEs). That means the (SME) startups which have the potential for job creation and an object to develop solutions to significant issues (Murray, & Budden, 2017). For that, Evaluating the innovation ecosystem conditions to promote entrepreneurship for sustainable development is necessary need. The successful outcome of innovation policy instruments in reaching their goals depends on how effective they are in sustaining their objectives and thus increasing innovation adoption and entrepreneurship (Edler & Fagerberg, 2017). One measurement for the effectiveness of ecosystem implements can be their support to the input of the process of innovation and technology adoption and their impact on satisfying regional goals (See Figure 1). However, economic development, culture, technological development, and education are distinct factors that have influences on the emergence of sustainability entrepreneurship. Strong and consistent entrepreneurial growth is expected in countries where these factors are present and considered. It's important to realize how political changes could affect the world of entrepreneurship and startup companies. Government agencies can play a vital role in boosting enterprise and innovation. Governments can mobilize the changes required. They need to set guidelines and policies at the federal or state level and understand what innovation and entrepreneurial ecosystems are, how they shape, and the role and boundaries of public policy are well-placed to produce more effective outcomes (Considine, et al., 2009).

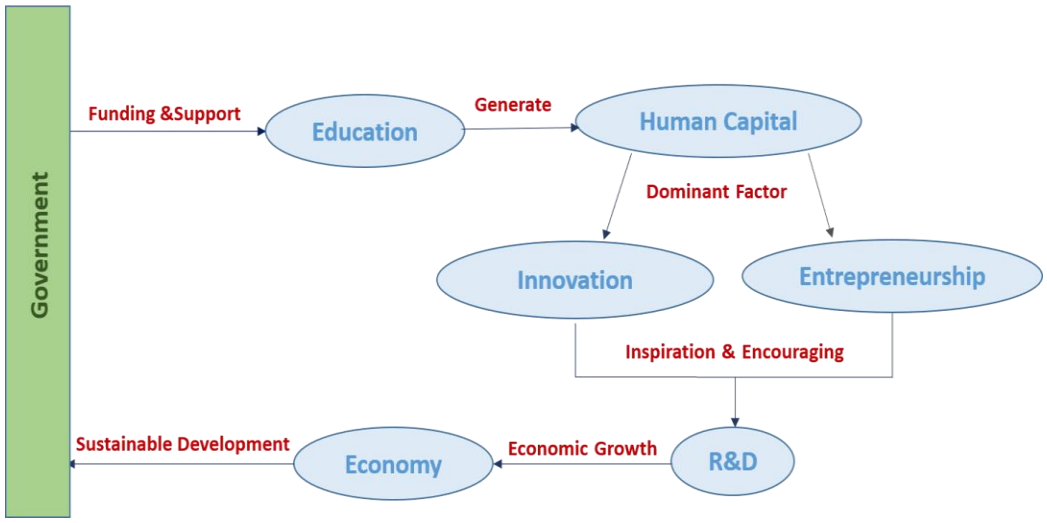


Figure 1: Innovation Ecosystem Model

1.3 Research Motivation

Sustainable entrepreneurs start and operate a business with considerable initiative and risk in order to pursue self-interest aligned with collective interests by addressing unmet social and environmental needs. However, sustainable business is not merely market transformation or imposition business strategies. It requires new conceptions of corporate purpose, notions of consumption, and models and metrics of business success. In this case, we need government intervention via regulation in social conduct. Adopting innovation and sustainability in entrepreneurship will ensure that full and sustainable economic benefits can be realized. Also, it will create value and material and non-material wealth for all stakeholders through actions that are ethical and able to achieve social justice. The following shows examples of the need of sustainable business:

- Innovation is the most reliable approach for entrepreneurs (Devece, Peris-Ortiz, & Rueda-Armengot, 2016)
- According to the OECD (2009) report, the worldwide greenhouse gas emissions are most probably increasing by 70% by 2050.
- In various of the Asian countries, SMEs employ about 60–70% of the total labor force in the manufacturing sector (Khurana, Khan & Mannan, 2012).
- It is important to understand some areas of strengths of the country's economic dynamics to foster them and build strategies to achieve sustainable entrepreneurship and green business.
- There is a lowering in the rates of medium or high technological innovation in Gulf Cooperation Council (GCC) countries from 3% (2006) to 2.3% (2011), they account for less than 3% of new enterprises (Callen et al., 2014)
- A study states that the challenges that have the highest impact in the Middle East and North Africa (MENA) region are lack of individual skills, deterioration in the economy, government support, and social culture (Dababet al., 2020)
- Having a comprehensive multi criteria decision making model helps to promote the balance between fair trade and operations management, training and qualification of people, and optimization of logistics systems.

The research investigates the innovation ecosystem as it is believed to increase the adoption of innovation for sustainable entrepreneurship. Chapter two discusses in detail the strategies that can affect the adoption of innovation.

1.4 Problem Statement

Sustainable entrepreneurship has become a vital part of the ecosystem and it is getting more global spotlight. Sustainability entrepreneurship plays a significant role in solving social and environmental problems by recognizing and creating entrepreneurial opportunities. It provides integrated corporate social responsibility by considering economic development, social equity, and environmental resilience through entrepreneurs entrepreneurial (Szirmai, Naudé, & Goedhuys, 2011). Effective ecosystem interventions and healthy institutional ecosystem settings are needed to promote or incentivize the achievement of sustainable entrepreneurship (Lafuente et al., 2016). For that, most governments have started to change and develop their government policies (African Economic Outlook, 2017) to a more comprehensive look in which institutional restructuring is required to foster economic development (Herrington, & Coduras, 2019). According to the Organisation for Economic Co-operation and Development (OECD), measuring entrepreneurship locally, regionally, nationally, or internationally has been a challenge for many years (OECD, 2009). For that, there are some efforts that have been trying to systematize an entrepreneurial economy model (Arruda, Nogueira, & Costa, 2013).

In 2006, OECD's EIP – Entrepreneurship Indicators Programme was created, this program joined forces with Eurostat in 2007 (Arruda, Nogueira, & Costa, 2013). EIP is a system that helps to develop definitions and concepts that would become the base for the construction of a universal database on the entrepreneurship phenomenon by collecting statistics from a European country (Ahmad, & Hoffmann, 2008). This database is comparable to show the actuality of different countries as indicators reflecting the determinant elements of entrepreneurship (Arruda, Nogueira, & Costa, 2013). OECD identifies three stages to evaluate and formulate entrepreneurship policies: determinants, entrepreneurial performance, and impact. "The first stage of the model comprises various determinants which policy can affect and which in turn influence entrepreneurial performance or the amount and type of entrepreneurship that take place. The final stage is the impact of entrepreneurship on higher-level goals such as economic growth, job creation or poverty reduction" (Hoffman and Ahmad, 2007). Then, the OECD-Eurostat Entrepreneurship Indicators Programme has come up (Ahmad, & Hoffmann, 2008). This framework is adopted by the programme that is based on the economic and innovative value of entrepreneurial activity (Marcotte, 2013). There are six themes (access to capital, access to R&D & technology, capabilities, market conditions, regulatory framework, and culture) that represent the determinants impacting entrepreneurial performance (Hoffman and Ahmad, 2007). However, The OECD-Eurostat programme is still not a fully developed phase and new countries and indicators are added annually (Marcotte, 2013).

Global Entrepreneurship Monitor (GEM) provides Entrepreneurial Framework Conditions (EFCs) (Bosma, 2013). It is considered as a comprehensive national and regional framework that represents the political, economic, social and cultural perspectives (Orobia et al., 2020). These perspectives are identified in twelve conditions include, Entrepreneurial Finance, Government Support and Relevance, Taxes and Bureaucracy, Government Entrepreneurship Programs, Entrepreneurial Education at School Stage (the education and training system at primary and secondary levels), Entrepreneurial Education at Post School Stage (the education and training system in higher education), R&D Transfer, Commercial and Legal Infrastructure, Internal Market Dynamics, Internal Market Burdens or Entry Regulation, Physical Infrastructure, and Cultural and Social (GEM Global Report, 2019). However, EFCs has a lack of nationally harmonized measures such as the environmental perspective. For that, GEM has The National Experts Survey (NES) as part of the standard GEM methodology and it assesses various EFCs as well as some other topics related to entrepreneurship such as environmental perspective (Bosma, 2013). The aim of NES is to obtain the views of additional experts and recommendations that can be useful for policymakers to make policy decisions that are important for stimulating entrepreneurial activity (Herrington, & Coduras, 2019). GEM has the Adult Population Survey (APS) and the National Expert Survey (NES) as complementary tools to power its research.

Sitaridis & Kitsios (2019) use the twelve GEM's NES criteria for the competitiveness analysis of the entrepreneurial ecosystems of nine countries, Argentina, Bulgaria, Croatia, Cyprus, Greece, Ireland, FYROM, Portugal, and Turkey by using the

application of a Non-Weighted Method (Sitaridis & Kitsios, 2019). The limitation of their study is the small number of alternatives and criteria used, and there is still a need for applying the pairwise comparison weighted method to support the robustness and reliability of the method (Huang & Moh, 2017).

A comprehensive assessment decision model is still needed to measure the effectiveness of the innovation ecosystem on increasing the adoption of innovation in sustainable entrepreneurship by examining the performance of every ecosystem from all perspectives. According to Vogel (2013), “if we do not measure the effectiveness of the various components in an ecosystem as well as the ecosystem as a whole, we will not be able to improve existing programmes and put in place new and complementary sources (Vogel, 2013).”

CHAPTER 2: LITERATURE REVIEW

The focus of this chapter is to understand the role of government in achieving high policy performance standards. Next, it navigates to highlighting the links between universities and economic development, and the requirement for transforming into entrepreneurial societies. Finally, the literature review investigates the ways in which the adoption of innovation for sustainable entrepreneurship is limited by certain perspectives and challenges, as well as how it supports increasing degrees of entrepreneurial development.

2.1 Government and Political Performance

From history, we find that governments have a big role in raising their societies up or going through a downfall in their life. A government is an umbrella that protects citizens from outside interference and striving to provide well-being and happiness for them. However, there is a need of measuring national capacities of governments in order to analyze the role of political performance in achieving their goals (Weaver & Rockman, 2010). Knowing the national capacities of states assists the government to implement welfare programs (Abdollahian, Arbetman-Rabinowitz, & Kang, 2009). There are a few researchers who attempt to find precise definitions of political performance. (Arbetman-Rabinowitz et al., 2012) define political performance as “the ability of governments to reach their population, to extract economic resources from that population, and to allocate those resources to secure the long-term survival of the political structure”. They explain the process of political performance inputs and outputs. The components of political

performance from their point of view are political extraction, political reach, as inputs, and political allocation, as outputs. The results show that these three variables are affected by the development and stability of society (Arbetman-Rabinowitz et al., 2012). (Kugler & Tammen, 2012) believe that movement toward democracy regime and the provision of freedoms is not the necessarily way to extract, reach, and allocate resources more efficiently. They provide the United States and China as examples. On the other hand, most previous studies illustrate assessments of political metrics measuring the national capacities of states show that there is a need for going towards democracy (Bueno de Mesquita et al. 2003). According to (Olson, 1993), autocratic regimes will often have a bad economic performance at least over the long run. He states that "the conditions necessary for a lasting democracy are the same necessary for the security of property and contract rights that generate economic growth." Furthermore, according to (Huntington, 2016), democracy regime has many factors that have a positive impact on society such as "higher levels of economic well-being; the absence of extreme inequalities in wealth and income; greater social pluralism, including particularly a strong and autonomous bourgeoisie; a more market-oriented economy; greater influence vis-a-vis the society of existing democratic states; and a culture that is less monistic and more tolerant of diversity and compromise (Huntington, 2016)." Also, (Acemoglu, & Robinson, 2006) state that "democratization creates a credible commitment to future redistribution by transferring political power to the majority in society". They develop a framework to analyze democratic and nondemocratic politics and the transitions between those regimes (Acemoglu, & Robinson, 2006). Acemoglu, & Robinson find that the

extent of political equality is the essential distinction between democracy and nondemocratic regimes (Acemoglu, & Robinson, 2006). (Dariah, Salleh, & Shafiai, 2016) propose a comprehensive conceptual framework for sustainable development goals, including economic, social, educational, and governmental mechanisms to support institutional and political structures. They seek to implement this approach in Muslim countries. However, Dariah, Salleh, & Shafiai have not provided an effective tool to evaluate these mechanisms yet.

After going through metrics measuring the national capacities of states from a different point of view, we find that regime type does not matter to ensure policy performance and achieving policy goals. For example, the regimes in Nazi Germany (Gellately, 2002), Stalin's Russia (Tucker, 1992), North Vietnam (Gurr, 1988), or pre–World War II Japan (Tsurumi, 2015) was coercive and did not support a democratic regime. However, these governments achieved high policy performance standards because political performance is associated with success in accomplishing government-defined policy results (Kugler & Tammen, 2012). The capacity degree of government is important for achieving policy goals. For example, when the government has powerful strategies for building the population trusts, the involvement of the government will reduce the cost of participating in economic development and provide social service organizations that exceed cost together with taxation (Arbetman-Rabinowitz, & Johnson, 2007). Furthermore, it is important for those with political power to make commitments, not just promises. Promises may sometimes be unattainable especially in nondemocratic regimes, and this may be one of the key causes of a revolution to happen (Acemoglu, &

Robinson, 2000). Moving to Saudi Arabia as an example of an Islamic country in the Middle East. This country is known as a rich country because of oil as well as it is controlled by the state, which is an absolute monarchy (Al-Atawneh, 2009). Over the years, Saudi Arabia has been overly dependent on its oil wealth (Mahmood, 2018). However, today Saudi Arabia government has started building and working on a longer-term economic plan, known as Vision 2030, to diversify its economy away from oil and develop public service sectors such as health, education, infrastructure, recreation (National Planning Commission, 2013). The Saudi government is working to overcome the political challenges to the effective implementation of the National Transformation Plan, such as changing state and regime structures to give the ruling monarchy yet-more centralized control over Saudi Arabia's affairs (Moshashai, Leber, & Savage,2020). All this happened after Mohammed Bin Salman, the Crown Prince of Saudi Arabia, was having upended the traditional balance of power. He has been working on increasing the loyalty of the Saudi citizens and gaining their trust through several issues such as granting women the right to drive, then, the launching of a sweeping anti-corruption drive. Thus, Mohammed bin Salman has been able to involve the Saudi citizens in implementing and achieving this vision.

Achieving policy goals needs the power and the capacity, not domination, of the government to create new forms of society that support sustainable development by improving relationships and trust between decision-makers and the public.

2.2 National Capacities for Innovation System

For a long time, scholars have realized that there is an association between universities and economic development (Malecki, 1991) (Matlay et al., 2010) (Brekke, 2020). This relationship became apparent after the discovery of the role of innovation and entrepreneurial activity in economic development (Bercovitz & Feldman, 2006) (Taatila, 2010). For that, most governments have started to reform their science and technology policy and focus on a national innovation system to achieve their long-term goals such as increasing research and knowledge production, social development, economic development, and private sector partnership and establishing entrepreneurial universities. With the appearance of knowledge-based innovation, the academic entrepreneurial transition has become an urgent need by the consistency of the internal development of higher education institutions with external influences on academic structures (Etzkowitz, 2016). A traditional university needs policies and governmental regulations to be reformed and developed a new framework of relationships to transform into an entrepreneurial (Mora and Villarreal, 2001, p. 61).

2.3 Integrated metrics

Entrepreneurial universities are one of the vital drivers to underpin innovation (Clark,1998). They are considered as knowledge producers and disseminating organizations to broader society (Guerrero et al., 2014). The European Commission and OECD initiated HEInnovate framework (OECD, 2018). It is a self-assessment tool for Higher Education Institutions that wish to explore their innovative potential. It guides

individuals in an organization through a process of identification, prioritisation and action planning in eight dimensions; Leadership and Governance, Organisational Capacity, Digital Transformation and Capability, Entrepreneurial Teaching and Learning, Preparing and Supporting Entrepreneurs, Knowledge Exchange and Collaboration, The Internationalised Institution, Measuring Impact. (OECD, 2018). HEInnovate is easy to apply as a self-assessment framework. However, it needs to be administered in a determined, forceful, and honest way as possible (Matlay & Henry, 2015). This issue encourages the users of the HEInnovate framework to think of ways to make this application more precise and reliable.

Transforming into entrepreneurial societies requires the involvement of several actors including, government, universities, entrepreneurs, investors, etc. (Herrera, Guerrero & Urbano, 2018). According to Etzkowitz (2016), there are five elements that make for a completely developed entrepreneurial university include: (1) The organization of group research; (2) The creation of a research base with commercial potential; (3) The development of organizational mechanisms to move research out of the university as protected intellectual property; (4) The capacity to organize firms within the university; and (5) The integration of academic and business elements (Etzkowitz, 2016). Klofsten et al. (2019) explain the implications of the strategies that the universities can adopt to act effectively as economic and societal change agents (Klofsten et al., 2019). Understanding these strategic challenges are important to those who are concerned with entrepreneurial university development, such as policymakers, university leaders, and other academic stakeholders. These strategic challenges have been divided into three factors: internal

factors, external or environmental factors, and teaching and learning entrepreneurship (Klofsten et al., 2019). For example, internal factors such as the investment and transformation procedures of traditional into effective organizational capabilities (leadership, gifted people, financial bases, new organizational structures, incentive and reward systems, and other resources) (Guerrero and Urbano, 2012). Guerrero et al. (2015) contribute to providing a better understanding of the economic effect of entrepreneurial universities' teaching, research, and entrepreneurial activities by proposing a conceptual model (Guerrero, Cunningham & Urbano, 2015). Their study found that endogenous growth models show the economic impacts across entrepreneurial universities' teaching, research, and entrepreneurial activities (Guerrero, Cunningham & Urbano, 2015). For that, policymakers need to realize that national education policies form the strategic guidance within universities and their activities (Rinne, 2008). Etzkowitz (2013) provides the Global Entrepreneurial University (GEUM). According to Etzkowitz (2013), "the GEUM project is designed to go beyond a critique of university ranking systems by creating an assistive programme with tools for self- and external evaluation to provide a better understanding of an 'ideal' metrics system may be developed and introduced, modifying and complementing existing schemes, and militating against the tendency for a quantified category to become an end in itself, which brings with it a competitive dynamic that drives out or devalues other desirable goals and objectives" (Etzkowitz, 2016). The GEUM can address some critical issues such as designing university metrics that generate ideas that encourage organizational learning and creative innovation, considering the particular strategic goals and conceptualization of academic and societal

innovation, and combining comparative case studies with disparate quantitative measures in a global longitudinal research design to boost the sustainability of university ranking schemes (Etzkowitz 2016).

2.4 Qualitative metrics

Etzkowitz (2016) suggests using qualitative metrics to measure capacities for entrepreneurial universities because humanistic techniques of rhetorical analysis may be used as well as social science case studies (Etzkowitz, 2016). It is not easy for decision-makers to use exact numerical values to show the strength of the preferences (Somsuk & Laosirihongthong, 2014). Thus, Mavi (2014) proposes a hierarchical structure based on the fuzzy TOPSIS methods to provide a comprehensive criterion set for evaluating entrepreneurial universities (Mavi, 2014). The criteria of the model are based on Guerrero and Urbano (2010)criteria, formal factors (entrepreneurial organizational and governance structure, support measures for entrepreneurship, and entrepreneurship education), informal factors (university community's attitudes towards entrepreneurship, entrepreneurial teaching methodologies, role models, and reward system), Resources (human capital, financial, physical, and commercial), Capabilities (status and prestige, networks and alliances, and localization) (Guerrero & Urbano, 2012)(Mavi, 2014). Also, Mavi (2014) adds more criteria that are proposed by other scholars include work discretion/autonomy (Kuratko et al., 2014), unconventionality, industry collaboration (Todorovic et al., 2011), entrepreneurial culture (Turró et al., 2013), and sustainability consideration (Mavi, 2014). Mavi finds that a private alternative university is more

entrepreneurial than a state university and quasi-state university despite the last two have more resources and more supports from state universities (Mavi, 2014). However, in this study, the author assumed that entrepreneurial university criteria are independent from each other (Mavi, 2014). The new methodology considers that all elements of the system are linked to each other to some extent. In the entrepreneurial university ecosystem, it is important to have a comprehensive insight and understand dynamic relationships between the elements (Gür, Oylumlu & Kunday, 2017).

Researchers are continuing attempts to develop metrics to measure capacities for entrepreneurial universities. Evaluating the entrepreneurial universities and their performance in economic and social development needs to develop a metrics measuring capacity for entrepreneurial universities (Clark,1998) to assess internal academic progress; identify and quantify the impact of the university on surrounding regional innovation ecosystems at different levels of decline and development (Etzkowitz, 2016) and innovation (Tornatzky & Rideout, 2014). Todorovic, McNaughton & Guild (2011) develop ENTRE-U to support empirical research on entrepreneurial orientation within public universities and evaluate the culture of university departments. It can forecast spinout and patenting activity successfully in university departments with four dimensions, research mobilization, unconventionality, industry collaboration, and perception of university policies (Todorovic, McNaughton & Guild, 2011). ENTRE-U can be useful to provide an assessment of the entrepreneurship environment within a university. Todorovic, McNaughton & Guild (2011) apply and test their ENTRE-U scale to measure the faculty members' attitudes in computer science, health sciences, and

engineering departments at four universities in southern Ontario. Then, Dabic, González-Loureiro & Daim (2015) provide evidence that there are different types of supportive faculty members by using ENTRE-U scale. They apply it to a sample of Croatian and Spanish universities. Both universities have different university systems, economic contexts and innovation systems. Their goal behind choosing two different universities is obtaining the common characteristics between these two scenarios which help to define a certain type of faculty members who support the entrepreneurial university (Dabic, González-Loureiro & Daim, 2015). Also, in their test, they don't include the research mobilization as a factor, but they add department reputation-orientation and knowledge mobilization as factors that are suited to their case. By applying Todorovic et al. approach, Dabic et al. proved the validity of the Entre-U scale and found that there are three different groups of attitudes that exist among supportive professors in an entrepreneurial university. These three groups of supportive professors are not context-dependent, even the two case studies are quite different scenarios, universities in Croatia and Spain. Also, they found that there is no proof of any statistically considerable difference because of the country (Dabic, González-Loureiro & Daim, 2015). Regardless of the country, entrepreneurial universities are a complex phenomenon, comprising varying academic traditions, decision-making levels, research values, and sub-organization cultures (Klofsten et al., 2019). This leads to the possibility of a similar path when establishing entrepreneurial universities, regardless of the context (Dabic, González-Loureiro & Daim, 2015). However, Kalar and Antoncic (2015) followed the future research for Todorovic et al. (2011), and they based on their analyzing academics'

survey responses at four European universities (University of Amsterdam, University of Antwerp, University of Ljubljana and the University of Oxford), they found that the local contexts of entrepreneurial universities possess have distinct characteristics so that lead to that one size fits all approach can not a possible every time (Kalar & Antoncic, 2015). Because of the diversified structures and contexts of universities, a new perspective is required to enhance the concept of measuring the entrepreneurial performance of universities (Gür, Oylumlu & Kunday, 2017). Also, Riviezzo et al. (2019) found that entrepreneurial orientation has a positive relationship to the total of spin-offs produced, and this positive relationship is based on the age and the size of the university departments and the nation or state GDP per capita and R&D expenditure (Riviezzo et al., 2019). On the other hand, entrepreneurial orientation has a negative relationship with the number of patents, which is surprising (Riviezzo et al., 2019). According to Riviezzo et al. (2019) study, this relationship is affected by context variables and performance variables (Riviezzo et al., 2019).

CHAPTER 3: RESEARCH GAPS AND GOALS

3.1 Gap Analysis

Many academic journals, conference articles, web articles, and books are talking about innovation ecosystem assessment were reviewed as a part of the literature review for this study. Table 1 provides a summary of the findings on metrics measuring innovation ecosystem and entrepreneurship adoption from the literature review. The literature review covered the areas below:

- Variables and perspectives for sustainable entrepreneurship adoption and the effectiveness of innovation ecosystem instruments
- National innovation ecosystem planning and the effect of different policies on the adoption of sustainable entrepreneurship
- Decision-making methodologies in innovation ecosystem instruments and assessment

Study	Gaps	Reference
Global Entrepreneurship Monitor (GEM) provides Entrepreneurial Framework Conditions (EFCs) as a comprehensive national and regional framework that represent the political, economic, social and cultural perspectives	EFCs has a lack of nationally harmonized measures such as the environmental perspective. For that, GEM has The National Experts Survey (NES) as part of the standard GEM methodology and it assesses various EFCs as well as some other topics related to entrepreneurship such as environmental perspective	(Bosma, 2013)

Applying the twelve GEM's NES criteria for the competitiveness analysis of the entrepreneurial ecosystems of nine countries, Argentina, Bulgaria, Croatia, Cyprus, Greece, Ireland, FYROM, Portugal, and Turkey by using the application of a Non-Weighted Method	The limitation of their study is the small number of alternatives and criteria used, and there is still a need for applying the pairwise comparison weighted method to support the robustness and reliability of the method.	(Sitaridis & Kitsios, 2019)
Entrepreneurship Indicators Program (EIP) is based on the economic and innovative value of the entrepreneurial activity. It consists of six themes (access to capital, access to R&D & technology, capabilities, market conditions, regulatory framework, and culture) as determinants impacting entrepreneurial performance.	The OECD-Eurostat program is still not a fully developed phase and new countries and indicators are added annually	(Hoffman and Ahmad, 2007)
The European Commission and OECD initiated the HEInnovate framework that is a self-assessment tool for Higher Education Institutions that wish to explore their innovative potential	HEInnovate needs to be administered in a determined, forceful, and honest way as possible to be more precise and reliable	(OECD, 2018)
Proposing a hierarchical structure based on the fuzzy TOPSIS methods to provide a comprehensive criterion set for evaluating entrepreneurial universities	The author assumed that entrepreneurial university criteria are independent from each other	(Mavi, 2014)
Developing ENTRE-U to support empirical research on entrepreneurial orientation within public universities and evaluate the culture of university departments	ENTRE-U can be useful to provide an assessment of the entrepreneurship environment within a university	(Todorovic, McNaughton & Guild, 2011)

Table 1:Selected Literature on the Research area and Gaps in the literature

Table 1 shows some studies in research areas and the gaps in the innovation ecosystem assessment area which were also confirmed by the research of several other scholars and earlier studies. Those gaps are:

- Current assessment models consider the limited point of view.
- There is not a comprehensive multi-criteria decision-making model that measures the effect of the innovation ecosystem on the input of the sustainable entrepreneurship adoption process in a qualitative, quantitative, and systematic way.
- Most literature presents case studies or single criterion methodology emphasis on the current situation. These studies have a lack of sensitivity analysis for macro and micro alteration. The impacts of changing priorities in future strategy planning areas and the analysis of different scenarios are not completely explored.

3.2 Research Questions

This research will answer the following research questions that have been formulated to address the current gaps and support the research objective (see Figure 2):

- What are the strategy targets for assessing the effectiveness of innovation ecosystems on increasing the adoption of innovation in sustainable entrepreneurship?
- What is the current innovation ecosystem employed to increase the adoption of innovation in entrepreneurship?

- Which innovation ecosystem strategy has the highest impact on accelerating sustainable entrepreneurship?

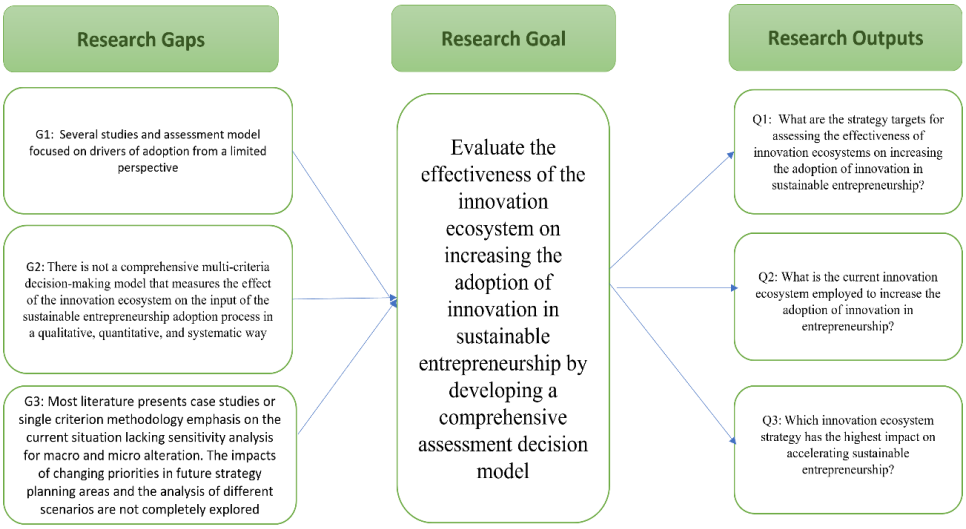


Figure 2:Connecting the gaps to research questions

CHAPTER 4: RESEARCH METHODOLOGY AND APPROACH

4.1 Research Methodology

4.1.1 Multi-criteria Decision-Making Methods (MCDM)

Entrepreneurship and innovation ecosystem instrument decision making can be viewed as a multiple criteria decision-making problem with correlating criteria and alternatives. This action should address several conflicting aspects regarding the increasing complication of technological, regulatory, social, and economic factors (Gupta, & Barua, 2016). Decision-making problems are usually complex and single criteria decision-making approaches cannot be considered to deal with the complexity of current systems to find the optimum decision. Multi-criteria decision-making methods (MCDM) provide an effectively handled tool that can help to synthesize and appraise a broad range of variables in different paths and give useful comprehension to the decision-maker in mapping out the problem. MCDM can provide a technical-scientific decision-making support tool that can help to explain its options clearly and consistently, especially in the sustainable entrepreneurship sector.

Evaluating the entrepreneurship and innovation ecosystem needs a comprehensive assessment that able to be defined as a multi-dimensional space of various indicators and objectives (Sitaridis & Kitsios, 2019). The multi-criteria decision analysis (MCDA) is a reliable methodology that is utilized to rank alternative sustainable entrepreneurship and innovation strategy, technologies, and projects in the presence of various objectives and limitations. There are no better or worse approaches between all available MCDA. However, each one of them has a technique that is appropriate for a particular situation.

Multiple criteria analysis methods were created to fulfil the increasing requirements of human society and the environment (Zavadskas & Turskis, 2011). These methods can deal with qualitative and quantitative criteria as well as analyze conflict in criteria and decision making (Önüt, Efendigil & Kara, 2010). The main objective of MCDM is to select the alternative that has the highest score according to the set of evaluation criteria. There are several different methods of MCDM, such as Analytic Hierarchy Process (AHP), The Elimination and Choice Translating Reality (ELECTRE), Multi-Attribute Utility Theory (MAUT), Preference Ranking Organization Method for Enrichment Evaluation (PROMETHEE), and The Hierarchical Decision Model (HDM).

4.1.1.1 Strengths of Using MCDM

MCDM help individuals and organizations to make better decisions. These methods have basic steps that support the decisions and help the decision-maker to select the more rational and efficient one: a) Establishing system evaluation criteria that relate system capabilities to goals. b) Generating alternatives. c) Determining criteria weights. d) Applying value judgments concerning acceptable tradeoffs and evaluation. e) Evaluating alternatives and making a decision (Opricovic, & Tzeng, 2004) (Pohekar, & Ramachandran, 2004).

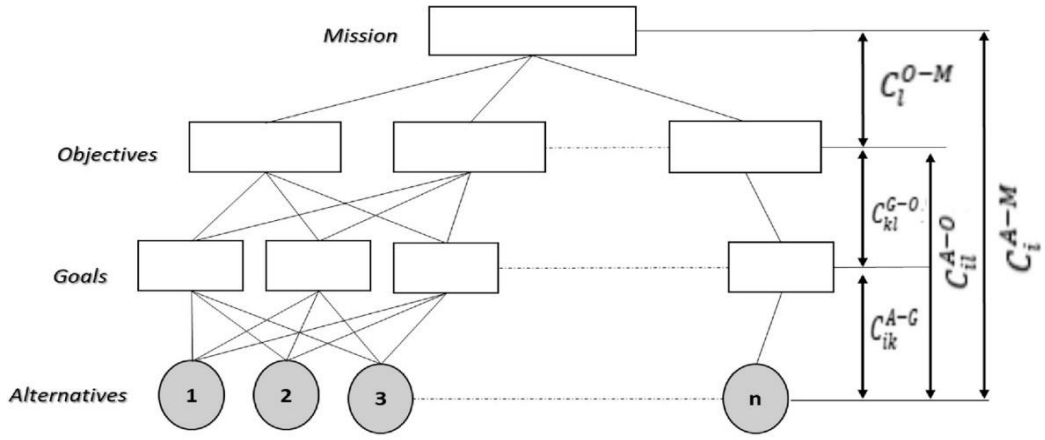
4.1.1.2 Limitations of Using MCDM

As previously mentioned, MCDM methods can help individuals and organizations to make better decisions. However, MCDM methods do not provide the automatic result of an MCDM. The final decision needs to be made by the decision-makers. Also, there are many MCDM methods. Nevertheless, none of them can be considered the “best” and/or appropriate for all situations or problems (Kujawski, 2003). Also, in MCDM, the definition of criteria is significant and changes the outcome of the model.

CHAPTER 5: RESEARCH APPROACH AND HIERARCHICAL MODEL DEVELOPMENT

5.1 Hierarchical Decision Model

The Hierarchical Decision Model (HDM) method is utilized as a strategy assessment tool for strategy decision-makers to analyze strategy instruments and create the ideal innovation ecosystem to increase the adoption of innovation in sustainable entrepreneurship. HDM has the ability to divide the problem into smaller entities for making the decision more accurate. Furthermore, the HDM can screen and select a large number of alternatives, as well as criteria, and sub-criteria (Kocaoglu, 1983). In a hierarchical structure, HDM can analyze the relationship between model mission, objectives, and alternatives (Figure 3). HDM applies a pairwise comparison process to convert experts' qualitative input into numerical values.



Where:		
O_l: Objectives, l= 1,2,..,l	C_l^{O-M} : relative contribution of the Lth objective to the mission	
G_k: Goals, k=1,2,…,k	C_{kl}^{G-O}: relative contribution of the kth goal to the Lth objective	
A_i: Alternatives, i=1,2,…i	C_i^{A-M} : Overall contribution of the ith alternative to the mission	C_{ik}^{A-G}: relative contribution of the ith alternatives to the kth goal
		C_{il}^{A-O}: relative contribution of the ith alternative to the kth objective

Figure 3:General form of HDM with four decision levels (Khalifa & Daim, 2021)

For each level, the judgments will be collected and converted to weights. The model is expected to expand more in the future to include more strategy targets and criteria. From the literature review, there are several gaps that have been identified; one is the absence of a comprehensive model that evaluates the innovation ecosystem from different perspectives. This research has filled this gap by developing a multi-criteria assessment that considers five perspectives for strategy goals: economic, social, environmental, ethical, and technical. These perspectives are located in as Level 2 of the HDM model. The objective of the proposed research is to evaluate and analyze the effectiveness of current innovation ecosystem instruments on the adoption of sustainable entrepreneurship by developing a hierarchical decision model according to the perspectives that were mentioned earlier. The Level 3, model goals are selected based on the literature review.

5.1.1 Justification of the Method

The objective of this research is to evaluate the effectiveness of entrepreneurship and innovation ecosystem strategy on increasing the adoption of innovation in sustainable entrepreneurship by developing a comprehensive assessment decision model. Adopting sustainable entrepreneurship is a multidimensional decision process that involves a number of different variables and several perspectives: economic, social, environmental, technical, and ethical (Sitaridis, & Kitsios, 2019). Understanding these characteristics of sustainable entrepreneurship is needed to improve the current entrepreneurship and innovation ecosystem strategy and strategy performance in the entrepreneurship sector. Apparently, the multi-criteria analysis is an appropriate tool to merge and analyze all perspectives concerned with the decision-making process, by creating a relationship among all alternatives and factors that affect decisions. It helps to give a technical-scientific decision-making support tool that has the ability to justify preferred choices clearly as well as consistently in the entrepreneurial business sector (Cavallaro, 2010).

However, there are still no models to assess the effectiveness of different strategies that can combine multiple perspectives of sustainable entrepreneurship adoption with different policies. In this research research, I am developing a research framework that can assist decision-makers in the entrepreneurship sector to develop a comprehensive entrepreneurship and innovation strategy while taking into consideration different perspectives that involve various goals in order to find the optimal strategy pathways. It is important to state that the “best” option resulting from applying multi-criteria decision

analysis (MCDM) methods would be the best negotiated solution and unnecessary the clearly optimum one (Taha, & Daim, 2015).

The hierarchical Decision Model (HDM) is one of the most suitable methodologies that can generate a model that has all the characteristics needed to fulfill the research goal and answer the research questions.

In this research Hierarchical Decision Model (HDM) approach has been chosen for many reasons:

1- Hierarchical Decision Model provides a comprehensive evaluation of all factors that influence adopting sustainable entrepreneurship such as economic, social, environmental, technical, and ethical.

2- Decision making to construct a generalized ecosystem assessment framework in entrepreneurial sectors with a high level of complexity requires qualified people who have significant experience to provide their evaluation in the decision-making process. Implementing HDM allows using quantify expert qualitative judgments and convert them to numerical values using a pair-wise comparison method.

3- HDM has been used successfully for assessing different strategy planning for different objectives (Daim et al., 2010; Taha, & Daim, 2015) (Kim, Sheikh, & Stokes, 2019) because by using HDM the decision maker can divide the problem into its smaller entities, which helps to analyze the problem and find any unclear relationship between elements.

4- HDM approach provides insight into information that is sometimes not considered in the literature such as existing strategies and criteria that are changing constantly in response to future changes (Cerna, 2013).

5- In this study with a large amount of information, HDM allows using a large number of criteria and sub-criteria, which helps to analyze and investigate the problem from different aspects.

6- HDM translate qualitative data into quantitative information as results that allow identifying other priorities within the same criteria. For that, Hierarchical Decision Model is a great tool for the proposed model. Strategy analysis needs to be a comprehensive analysis of the integrated linkage among objectives, obstacles, and benefits. On the other hand, TOPSIS and PROMETHEE do not provide a structured approach to weight the criteria, and they do not determine the criteria that caused one alternative to be closer to the ideal solution obviously.

5.1.2 Hierarchical Decision Model Development

The finding from the literature review was used as the basis to develop the Hierarchical Decision Model (HDM) and define the model initial elements.

5.1.2.1 Mission

This level of the HDM model describes the mission of the research. The mission is to evaluate the innovation ecosystem for the adoption of sustainable entrepreneurship. To achieve the research mission, a case study will be applied in order to evaluate the

effectiveness of its innovation ecosystems on increasing the adoption of sustainable entrepreneurship.

5.1.2.2 Level 2: Perspectives for Assessment

Perspective	Objective	Description
Economic	Economic Feasibility	Entrepreneurs have a substantial role in economic development and include poverty alleviation and the economic well-being and quality of life of a nation, region, local, or an individual are improved. Worldwide, policymakers recognize the value of innovation and sustainable entrepreneurship (Cohen & Winn, 2007; Klofsten et al., 2019).
Ethical	Achieving Ethics and Social Responsibility	Achieving ethics to entrepreneurship is a broad and ongoing initiative. There are many essential ethical issues in sustainable entrepreneurship development such as promoting conduct based on integrity and that engenders justice (Manzini, 2006). Also, there are some complicated issues such as accommodating diversity, empathetic decision-making, and compliance and governance consistent with the economic values of social life (Lundvall, & Borrás, 2005; Özdemir & Springer, 2018)
Social	Community Support Encouragement	Community support encouragement affects sustainability innovation and entrepreneurship. It allows creating new business processes for competitive and sustained economic country growth (Ueda, et al., 2009). It has played an increasing role in understanding the motivation of entrepreneurship behavior and future transitions that have to be done for sustainable entrepreneurship and development (Guerrero, Cunningham & Urbano, 2015; Klofsten et al., 2019).
Technical	Technical System Development	Realizing the innovation and technological changes and the need for technical development is important for improving current strategy and future strategy

		planning. The goals that are listed under this perspective are important to encourage entrepreneurs for promoting sustainable entrepreneurial activity. This variable measures the importance of a strategy to support development in the technical development to be considered efficient in increasing the adoption of sustainable entrepreneurship (Mason & Brown, 2014; Farinha & Ferreira, 2017; Wang et al., 2020).
Environmental	Improve Environmental Protection and Productivity Growth	Environmental protection is the main concern of the future of humanity. Entrepreneurship and innovation provide sustainable business. These businesses are providing innovative solutions to meet many challenges (Rodriguez et al., 2002). One of these challenges is environmental. The environment is critical for both society and businesses together (Youssef et al., 2018; Iqbal et al., 2020).

Table 2: Perspectives for Assessment

5.1.2.3 Level 3: Strategy targets in the HDM Model

Criteria	Details	References
Environmental Perspective		
Solving environmental problems and reduce the costs	Environmental regulations have important roles in addressing many environmental problems. According to Mont & Lindhqvist, usually, company owners do not account for external factors in market prices. In this case, they do not take into account these factors when they take action or make decisions about product design (Mont & Lindhqvist, 2003). For that reason,	(Mont & Lindhqvist, 2003; Harrington & Morgenstern, 2007; Iqbal et al., 2020)

	there is a need of implementing ecosystem measures that can drive entrepreneurs to internalize environmental externalities. That can help to stimulate the decrease in these costs and related harmful environmental influences through various measures such as introducing pollution charges or taxes.	
Appreciable reductions in environmental damage	Sustainable innovation practices have positive and remarkable impacts on environmental performance. A business that involves sustainable innovation will generate better environmental performance (Weng, Chen & Chen, 2015). Firms can reduce pollution and waste, consider the environment, and concomitantly raise their competitiveness by implementing sustainable innovation practices.	(Prause, 2014; Weng, Chen & Chen, 2015; Omriet al., 2015; Rodriguez-Gonzalez et al., 2018; Iqbal et al., 2020)
Ethical Perspective		
Social justice in Innovation	Social justice in innovation is that everyone in society has the responsibility and right to create a better world by attempting to quantify and incorporate certain elements of social value. Since social justice was considered as an essential perspective informing the analyses of educational practices that seek to make education relevant to the understanding of social issues and the contexts in which these problems occur (Ayers, 2004), implementing the entrepreneurship programs in education equally	(Ayers, 2004; Oppenheimer, 2012; Janssen et al., 2018)

	contributes to making a positive economic change while remaining profitable for both individuals and the government (Bakry, Khalifa & Dabab, 2019). Social justice is served when the benefits and policies in society are distributed in congruence with principles that rational people would accept as proportionate to their interests (Oppenheimer, 2012) as well as entrepreneurship supportive policies. Accordingly, sustainable entrepreneurship is an integral part of a social system (Janssen et al., 2018).	
Ethics in Technology Innovation and Human Wealth	Government regulations might support technology and innovation. Eventually, the way of dealing with the regulation of emerging technologies will definitely have wide implications. This is not for security and ethics only; it is also for the definition of human dignity and the equality of individuals. Individuals are considered as a resource. That means this individual has some potential advantages that are essential for organizational needs in the way of affecting the organizational, social, and national goals (Clegg et al., 1997). Nowadays, with the economic volatility and changeability, every factor of the process of developing is being re-examined for its value in creating and supporting successful growth. In the past, human wealth has been described in the form of individual knowledge, talents, skills,	(Clegg et al., 1997; Mason & Brown, 2014; Nyberg et al., 2014; Ployhart, 2015)

	and other characteristics (Ployhart, 2015). However, in the previous decade, the researchers have investigated human wealth as a cooperative resource that can participate in economic performance and competitive advantage (Nyberg et al., 2014).	
Intellectual Property Rights (IPR)	An intellectual property right is considered as part of such institutional frameworks that create the necessary conditions for entrepreneurship and innovation progress and economic growth (Neves et al., 2021). The existence of intellectual property law with planned benchmarks that are applied by different public institutions to small innovative enterprises is one of the reasons for the efficient use of domestic sources (Zakieva et al., 2019). It helps to prevent the occurrence of unsystematic and spontaneous support, which leads to a conflict of various development and implementation.	(Miles, Munilla & Covin, 2004; Zakieva et al., 2019; Neves et al., 2021)
Stemming the Gender Gap	This variable measures the importance of enhancing a gender lens to innovation and sustainable entrepreneurship. Both women and men have a major role to promote innovation and be a part of sustainable development (Abreu, 2020). Policymakers need to recognize the importance of gendered innovations for sustainable development.	(Marlow & Patton, 2005; Vossenberg, 2013; Gicheva & Link, 2015; Abreu, 2020)
Social Perspective		

Social Consciousness	Social consciousness can affect sustainable enterprise and innovation. This will lead entrepreneurs to consider a sustainability strategy necessary to foster their business longevity. Also, it will help to keep customers coming back for more. Innovative and sustainable consciousness has a role in overcoming crisis situations.	(İrengün, O., & Arıkboğa, 2015; Farinha & Ferreira, 2017; Han et al., 2021)
Educational Levels on Sustainability Innovation	Education has a role in the formation of people's thinking to shape and transform social reality towards sustainable development. It has a particularly crucial role to instill the concept of sustainability in the next generations (Komiyama & Takeuchi, 2006). Basically, the economy of the country relies on the standard of education that it provides to the human resources (Robertson & Dale, 2015). Furthermore, high education and science levels are considered as one of the factors that are necessary to deal with sustainability entrepreneurship issues. Science can help the sustainability transition by giving knowledge and directing for navigating the journey from unsustainable contemporary patterns to a sustainable future (Uvarova, Mavlutova & Atstaja, 2021).	(Malecki, 1991; Komiyama & Takeuchi, 2006; Matlay et al., 2010; Robertson & Dale, 2015; Farinha & Ferreira, 2017; Brekke, 2020; Uvarova, Mavlutova & Atstaja, 2021)

Government Entrepreneurship Programs and Transformative Activity	Establishing innovation entrepreneurship programs is important to promote and enhance the culture of sustainable entrepreneurship amongst youth (Lee, C., Hallak & Sardeshmukh, 2016). The government always looks for making the most of the potential of the country workforce by encouraging a culture of high performance. For that, the implementation of new programs focused on innovation and sustainability is very important to develop the entrepreneurial mindset in their leaders and employees.	(Mavi, 2014; Kalar & Antoncic, 2015; Wang et al., 2020)
Economic Perspective		
Responses to the Economic Crisis as Opportunities	Economic crises are considered a factor that increases the probability of success for new business innovation and opportunity recognition. Deep economic shocks generate the need for local adaptation by identifying new opportunities for growth (Bishop, 2019). However, government strategy should support the economy to achieve the goals of development, full employment, and price stability (Mitchell & Muysken, 2010). Entrepreneurship and innovation can be drivers of economic growth and organizational renewal (Rüdiger, Peris-Ortiz, & Blanco-González, 2014). When entrepreneurs find the chance to thrive, they are going to respond to the shortage market equilibrium by seizing the opportunities that will inevitably	(Kirzner & Sautet, 2006; Mitchell & Muysken, 2010; Rüdiger, Peris-Ortiz, & Blanco-González, 2014; Bishop, 2019)

	appear (Kirzner & Sautet, 2006). They will create solutions to these opportunities and solve social and environmental problems.	
Tackling youth Unemployment	Implementing an innovation ecosystem and supporting the potential of young entrepreneurs is a great way to create jobs. One of the economic problems is unemployment, and it becomes more serious when the rate of unemployment rises among young people. Inspiring entrepreneurs and developing the entrepreneurship ecosystem helps to resolve the problem of unemployment.	(Deebom & Baridoma, 2017; Chao, 2020; Happiness & Salomi, 2021)
Taxes and Disciplining the bureaucracy	According to the GEM conceptualization, "taxes and bureaucracy reflect the degree to which experts think current taxes are affordable and balanced for entrepreneurs, or whether they constitute a burden to starting and growing businesses. The innovation ecosystem should target the welfare economy and eliminate bureaucratic selfishness (Ott, 2006) (Bhatt, Sharma & Kaushal, 2020).	(Ott, 2006; Klein et al., 2013; Bhatt, Sharma & Kaushal, 2020)
Technical Perspective		

Facilitating Access to Benefits for Entrepreneurs	Because of a lack of collateral and credit history, youth entrepreneurs often face major challenges in accessing start-up financing. For that, innovation strategy in turn calls for facilitating access loan guarantees, microfinance, and a range of alternative instruments and markets for entrepreneurs. policymakers need to ensure that financing initiatives match the needs of youth entrepreneurs and are suitable for the types of businesses that youth operate in order to facilitate access to start-up financing for youth entrepreneurs.	(Mason & Brown, 2014; Zhornokui et al., 2019;Wang et al., 2020)
Improving Physical and Services Infrastructure	Physical infrastructure refers to the basic physical structures required for an economy to function and survive, such as transportation networks, a power grid, and sewerage and waste disposal systems. Physical infrastructure facilitates the production of goods and services. Improve quality, reliable, sustainable, and resilient infrastructure, including regional and transborder infrastructure, to boost economic development and human well-being, with a focus on affordable and equitable access for all.	(George & Prabhu, 2003; Abhyankar, 2014; Wang et al., 2020)
Developing Positive Attitudes Towards Sustainability	To avoid any conflict in outputs, the politicians have the biggest role to enhance citizens' response to promoting entrepreneurship for sustainable development. They have the potential to shape an entire generation of cultural attitudes and	(Komiyama, & Takeuchi, 2006; Heilbrunn, 2010; Farinha & Ferreira, 2017)

	beliefs. The power of politicians leads to subtly reshape citizens' key demographics and evolve them in the new era and make cultural attitudes fit any changes. Since researchers predict that the world will face limitations of natural resources in general (Komiyama, & Takeuchi, 2006), governments need to invest in science and research to make changes in global, social, and human behavior that happen over the long term with full consideration of sustainability. For example, the government strategy needs to involve education and learning in order to create a framework of the effects of its policies to create cultural attitudes towards entrepreneurship as an essential element for addressing sustainable development challenges. This process will give the government a better understanding and having a knowledge of what is going on around it and making efficient decisions for the future.	
R&D Transfer	According to the GEM conceptualization, R&D transfer is "the extent to which national research and development will lead to new commercial opportunities and is available to SMEs" (Amorós and Bosma, 2014: 45).	(George & Prabhu, 2003; Amorós and Bosma, 2014; Medeiros et al., 2020)

Table 3: HDM Model Criteria and Strategy Targets

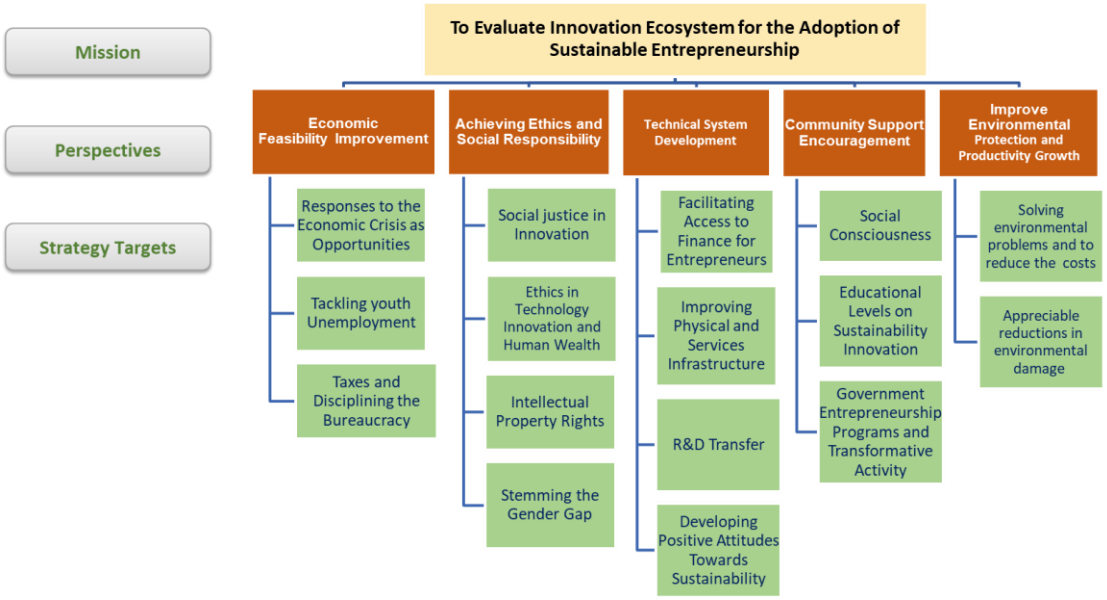


Figure 4: The initial model

5.2 Generalizing the Final Model

According to the previous HDM-based research approach (Abotah 2014; Gibson & Daim, 2016; Barham, 2019), there are four measures of the research validity were utilized to ensure re that the academic rigor was maintained. Then, the research can be judged with confidence that its outcome addressed the research gaps, objective, and questions in a suitable scientific way:

5.2.1 Content validity

This step is important to verify the variables of the model can measure what they are planned to measure and that the data collection instruments are suitable and ready for data collection.

5.2.2 Construct validity

This step is during model development and data collection from the experts. It measures the capacity of the proposed model to achieve the objective of the research in employing it as an assessment tool.

5.2.3 Criterion-related validity

This step provides the degree to which the proposed model is effective in performing in real-world situations. That means the outcomes and recommendations that are resulted from the model are applicable, accurate, and valid.

5.3 Model Generalization

Based on the literature reviews, the model captures most of the strategy targets that are important to evaluate the effectiveness of the innovation ecosystem for the adoption of sustainable entrepreneurship and develop a comprehensive assessment decision model. This model can be used globally in different countries. The assessment depends on five perspectives that are perceived by decision-makers as important for the adoption process. The decision model linked the perspectives to ecosystem targets and various innovation

ecosystem instruments. These perspectives are economic, social, environmental technical, and ethical. The research implemented the hierarchical decision model (HDM) to construct a generalized ecosystem assessment framework. Generalizing and applying the model to different countries indicates the success of the model.

5.3.1 Generalizing the Model Using Validation Panels Method

Validation is a significant action to make sure that the research model is appropriate to achieve the required outcome. The validation process has two steps. Firstly, validate the perspectives that contribute to the evaluation of the innovation ecosystem for the adoption of sustainable entrepreneurship. Secondly, validate the strategy targets that contribute to the evaluation of the innovation ecosystem for the adoption of sustainable entrepreneurship.

Experts from different countries and various organizations will be included in the validation panel in order to ensure model generalization. Also, it is important to have experts from different backgrounds and experiences to validate the model. This helps to ensure that the research framework can be utilized in different countries. The validation panel process has been applied in many successful studies (Chan, 2013; Sheikh, 2013; Barham, 2019).

5.3.2 Generalizing the Model Using Validation Panels of the Desirability Matrices

Validation Panels of the Desirability Matrices step will be taken to ensure the model generalization to all countries of the world. The desirability metrics validation process is done by experts from different organizations and countries. The standard of desirability matrices will not change by the change of countries.

5.4 Expert Panels Formation

In this phase, eligible experts will be invited to join expert panels. More on the experts identification and panels formation in sections 6.2 and 6.3.

5.5 Model Validation and Quantification

In this phase, the experts will be asked to validate the model by using a validation survey. Qualtrics software is used to develop a validation survey. (See Figure 6). If a majority of three-quarters of the experts approve every element in the model, then all the elements in the model are considered validated. However, if a specific element failed to achieve this threshold, it will be eliminated. Also, if more than three experts suggest a new element at any level, this element will be added to the model. Then, the model will be validated again. After model validation, the experts will quantify the model. in this step, Hierarchical Decision Model (HDM) will be used. Weights will be calculated according to the constant-sum approach.

The development of a desirability curve is a technique to convert either qualitative or quantitative data used for measuring a decision element to a scaled quantitative value

(Barham, 2019). The purpose of these curves is to identify how desirable a metric is for a decision maker.

5.6 Desirability Curves Determination

The development of a desirability curve is a technique to convert either qualitative or quantitative data used for measuring a decision element to a scaled quantitative value (Barham, 2019). The purpose of these curves is to identify how desirable a metric is for a decision maker. In this phase, based on the experts' experience, the experts will be asked to identify possible statuses a government might have against each strategy target. Desirability curves use in cases where the model will be used more than once. In this step, experts will be asked to give each level a scaled quantitative value (between 0 and 100). the purpose of that is to assess common metrics for each criterion (desirability matrix).

For example, Typical situations governments might have for each factor related to the innovation ecosystem. During running the HDM model, each entity being evaluated by the HDM model can be specified to a level that well-suited it for each criterion. In particular, the current innovation strategy situation for each factor affecting sustainable entrepreneurship will be identified by the policymaker after investigating the innovation strategy capabilities. Then, the policymaker will employ the Value Curve (VC) of each factor to define which level in that value curve is expressing the innovation strategy identified situation. Then, according to that, the innovation ecosystem will be assigned that level’s score. In case facing an element with high disagreement (> 0.1), the expert is met to discuss his/her opinion and judgment. The expert who causes a high disagreement

can be identified by using standard deviation. Disagreement may happen because the expert is not eligible to serve as an expert in this area of study or the question needs to be explained clearly to this expert. In a misunderstanding case, the expert will be asked to redo the pairwise comparisons after clarifying the question to him/her. Otherwise, the expert may have a logical point of view that needs to be taken into account by the researcher. In this situation, this point must be discussed with the other experts. Then, the experts will do their pairwise comparisons again. The unit of measurement for each strategy target is explained below:

Desirability question and metrics for Developing Positive Attitudes Towards Sustainability strategy Target

-Does the government have the power to enhance citizens' response to promoting entrepreneurship for sustainable development?

- No Control
- Limited Control
- Conditional Control
- Full Control

Desirability question and metrics for R&D Transfer strategy Target

-Does the government expenditure on R&D support the improvements to processes where efficiency can be increased, and costs reduced?

- Low (limited availability of all sources)
- Mediocre
- Medium
- High
- Optimal (all of the sources are sufficiently available)

Desirability question and metrics for Taxes and Disciplining the Bureaucracy strategy Target

-What is the level of bureaucracy that impacts creating the type of tax morale conducive to both tax compliance and economic development?

- Simple
- Reasonable
- Some Complexity
- Complex
- Very Complex

Desirability question and metrics for social justice in Innovation strategy Target

-Does the government integrate social justice into its innovation strategy and achieve a positive economic change while remaining profitable for both individuals and the government?

- Extremely positive
- Somewhat positive
- Neither positive nor negative
- Somewhat negative
- Extremely negative

Desirability question and metrics for Ethics in Technology Innovation and Human Wealth strategy Target

-Does innovations and entrepreneurship ecosystem have the ability to lead to more job and income opportunities, and to more equal societal outcomes instead of blaming technology?

- Confidence
- Low uncertainty
- Average uncertainty
- High uncertainty

Desirability question and metrics for Intellectual Property Rights (IPR) strategy Target

-What is the degree of the support of intellectual property that is considered in the innovation ecosystem and supports innovation and creativity?

- Very low (intellectual property is not aligned with innovation strategy goals)
- Low
- Medium
- High
- Mature (intellectual property is aligned with innovation strategy goals)

Desirability question and metrics for Stemming the Gender Gap strategy Target

-What is the level of innovation ecosystem impact on gender equality and their contribution to innovation and creativity?

- No Impact
- Some Impact
- Medium Impact
- High Impact
- Full Impact

Desirability question and metrics for Social Consciousness strategy Target

-Is the community willing to change existing and creating new social practices for building a sustainable economy and lifestyle?

- Not Willing
- Reluctant
- Partially Willing
- Mostly Willing
- Completely Willing

Desirability question and metrics for Educational Levels on Sustainability Innovation strategy Target

-How involved is the innovation ecosystem in designing, adapting, and implementing new technologies in education to devise solutions to future challenges?

- Low involvement
- Some involvement
- Medium involvement
- High involvement
- Full involvement

Desirability question and metrics for Government Entrepreneurship Programs and Transformative Activity strategy Target

- -Does Government Entrepreneurship Programs, such as accelerators and hackathons, work to engage effectively with external stakeholders and communities to contribute and share resources (e.g., talent, ideas, infrastructure, money, and connections)?
- No support
- Some support
- Medium support
- High support
- Full support

Desirability question and metrics for Responses to the Economic Crisis as Opportunities strategy Target

-What is the level of innovation ecosystem impact in entrepreneurs respond to the economic crises and seizing the opportunities that will inevitably appear?

- Low
- Medium
- High
- Mature (innovation ecosystem supports responding to the Economic Crisis as Opportunities)

Desirability question and metrics for Tackling youth Unemployment strategy Target

-Does the innovation and entrepreneurship ecosystem promote to inspire entrepreneurs to start their own business which helps to resolve the problem of unemployment?

- Low
- Mediocre
- Medium
- High
- Optimal

Desirability question and metrics for Solving environmental problems and reducing the costs strategy Target

-Does implementing innovation ecosystem measures have the ability to drive entrepreneurs, to internalize environmental externalities?

- No Impact
- Some Impact
- Medium Impact
- High Impact
- Full Impact

Desirability question and metrics for Appreciable reductions in environmental damage strategy Target

-What is the impact level of implementing sustainable innovation practices on oblige firms to reduce pollution and waste, consider the environment, and concomitantly raise their competitiveness?

- No Impact
- Some Impact
- Medium Impact
- High Impact
- Full Impact

Desirability question and metrics for Facilitating Access to Benefits for Entrepreneurs strategy Target

-What is the level of the challenge that the youth entrepreneurs often face in order to access start-up financing?

- Low (resources and funding are fully available)
- Medium
- High
- Very high

Desirability question and metrics for Improving Physical and Services Infrastructure strategy Target

-Does the innovation help to address reliable infrastructure to connect supply chains and efficiently move goods and services across borders by using new ideas, materials, methods, and tools?

- No Impact
- Some Impact (on non-core features)
- Medium Impact (mainly on non-core features but few core features as well)
- High Impact
- Full Impact

5.7 Results Analysis

Disagreement and inconsistency analysis will be conducted to detect how reliable experts' individual and collective judgment is. High inconsistency will be discussed with the experts who have it in order to make sure they understand what is needed. Then, that expert will be asked to do their quantification again. The expert who still has a high inconsistency in his/her outcomes, he/she will be eliminated as an expert.

5.8 Discussion, and Conclusions

The pairwise comparisons that are done by experts will be first validated using sensitivity and disagreement analysis. Then, innovation strategies conducted by a government will be analyzed and compared with the HDM model outcomes. Lastly, the effectiveness of the innovation ecosystem for the adoption of sustainable entrepreneurship will be discussed.

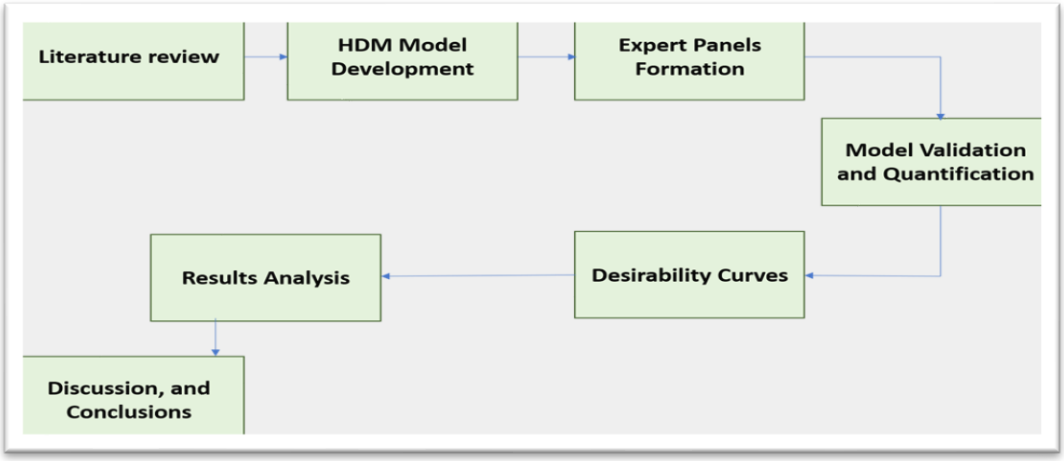


Figure 5: Research Phases

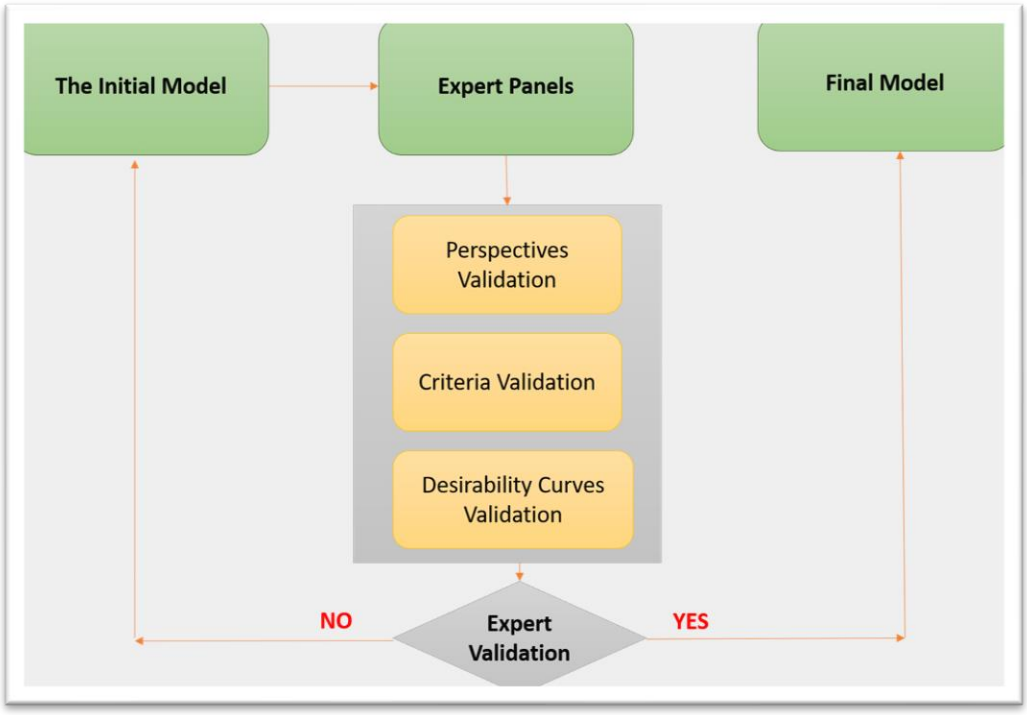


Figure 6:Model Validation

5.9 Inconsistency Analysis and Group Disagreements

5.9.1 Inconsistency

Human judgment cannot be always perfect and consistent. For that, some inconsistency can be measured and tolerated. However, this inconsistency should not drive to chaotic answers (Giadedi & Daim, 2018). Inconsistency is a measure that shows how reliable and homogeneous in each experts' answers was through the whole survey (Abotah, 2014). An acceptable level of inconsistency is known to be ≤0.1 when calculated for each respondent. If any expert had an inconsistency indicator of more than 0.1, this expert should be asked to revise his or her inputs.

According to Abbas study, there are two categories of inconsistency that could happen through the expert's judgment within the HDM, there are 1- ordinal, 2- cardinal. Ordinal consistency requires order of preference of the ranked elements to be maintained. For example, if the expert preferred A1 over A2, and preferred A2 over A3. It will be violated to the ordinal consistency if he/she preferred A3 over A1 (Abbas, 2016). The second category of inconsistency is cardinal which requires preservation of preference proportions. For example, if A1 is preferred twice over A2, and A2 is preferred thrice over A3, then A1 must be preferred 6 times over A3. It will be violated to the cardinal consistency if the expert chooses A1 to be 5 times preferred over A3 (Abbas, 2016).

Calculating inconsistency can be explained as follows:

In HDM, inconsistency is measured by calculating the sum of the standard deviations. For example, in conducting pairwise comparisons. First, n! vectors of relative values T1, T2, T3, …, Tn based on constant sum calculation of the factors are built. Each vector presents an orientation of the elements. For example: if we have three factors A, B, C then we will do 3! = 6 orientations as follow: ABC, ACB, BAC, BCA, CAB, and CBA. For that, if the expert was consistent, each orientation should lead to the same relative values. However, if the expert was inconsistent, different orientations would lead to different relative values. Consequently, inconsistency can be measured by the variance of relative values (Barham, 2019).

5.9.1.1 Measuring the Inconsistency Using the Variance Method

Inconsistency index can be determined by following equations (Phan, 2013):

r_{ij}: relative value of the i[th] element in the j[th] orientation of an expert

$\bar{r_i}$: mean relative value of the i[th] element for the same expert

$$\frac{1}{n!}\sum_{j=1}^{n!} r_{ij}$$

Inconsistency of the i[th] element is

$$\sqrt{\frac{1}{n!}\sum_{j=1}^{n!}(\bar{r_i}\_r_{ij})^2}$$

for i= 1, 2…,,n where n is the number of elements compared.

The variance of the expert in providing relative values for n elements is the inconsistency index:

Inconsistency=

$$\frac{1}{ni}\sum_{j=1}^{n} \sqrt{\frac{1}{ni}\sum_{j=1}^{ni} (\underline{ri} - r_{ij})2}$$

5.9.1.2 Measuring the Inconsistency Using the Root Sum of the Variance (RSV)

Abbas introduced an approach to calculate inconsistency based on the Root of the Sum of Variances (RSV) (Abbas, 2016):

$$\text{Inconsistency (RSV)} = \sqrt{\sum_{i=1}^{n} \sigma_i^2}$$

5.9.2 Disagreements

Disagreement among Experts

In HDM, it is expected that experts will have different opinions or inputs of the model which leads to possible disagreement among these experts. In the same analysis, disagreements amongst experts can present different quantifications and different perspectives. There is group disagreement if the disagreement is more than a value of 0.10 and a value of 0 would imply complete agreement among the experts (Costa Santos, Costa Pereira & Bernardes, 2005). Since the experts have different ways of thinking and experiences that probably will increase the level of disagreements amongst these experts.

Intraclass Correlation Coefficient (ICC) is a statistical method to calculates the degree of disagreement among experts for a relative number of elements. ICC provides the degree to which x experts agree with one another on the relative value of n elements (Weir, 2005; Koo & Li, 2016). Calculating ICC as following equations (Bartko, 1966).

$$\frac{MS_R - MS_E}{MS_R + (K-1)MS_E + \frac{k}{n}(MS_C - MS_E)}$$

Where:

MSR = mean square for rows.

MSW = mean square for residual sources of variance.

MSE = mean square for error.

MSC = mean square for columns.

n = number of subjects.

k = number of raters/measurements.

The value of ICC can be -1 < ICC < 1. Any value of ICC between 0 and 1 shows a degree of agreement between judges and the higher the value, the greater the level of agreement. However, the gap from -1 to 1 makes ICC open for a different interpretation of the results and not a very reliable coefficient for judgment (Abotah, 2014)

In the HDM software tool, calculating disagreements is based on the hierarchical agglomerative clustering (HAC) as the following equations:(Barham, 2019):

Let *m* be the number of experts and *n* be the number of decision variables.

r_{ik} be mean relative value of the i^{th} decision variable for k^{th}expert.

Group relative value of the i^{th}decision variable for *m* experts is

$$\boldsymbol{R_i}=\sum_{k}^{m} \boldsymbol{r_{ik}}.\frac{1}{m} \quad \text{for i = 1,2,….,n}$$

The standard deviation of the relative value of the i^{th} decision variable is

$$\text{STDi} = \sqrt{\frac{1}{m}\sum_{k=1}^{m}(R_i - r_{ik})^2}$$

Disagreement for *m* experts is calculated as the mean standard deviation of the group *n* relative values of variables.

$$\text{D}=\frac{1}{n}\sum_{i=1}^{n} STDi$$

Different previous studies used F-test as a statistical approach to determine if there is significant disagreement in the experts' judgments. The Null Hypothesis (H0) for the F-test is that there is an absolute disagreement between the experts' judgment, or H0: ric = 0. The F-value of a pairwise comparison procedure is calculated and compared against the F-critical value of the procedure to determine whether the Null Hypothesis can be rejected or not. Rejecting the Null Hypothesis means that there is no significant disagreement among the experts (Sheikh, 2013).

In this research, because of the different expertise and area of knowledge between the experts, finding disagreement among experts' judgments is an expected issue. Classifying the experts based on their common characteristics will be a facilitated way to have insight into the analysis of the outcomes and to treat disagreements among experts.

5.10 Sensitivity Analysis

Implementing Sensitivity Analysis

Sensitivity analysis (SA) can be utilized to analyze the effect of potential changes in the values at any level of the model. It helps to identify the experts' inputs with insignificant impact, the quantifying of uncertainty in model output, and to manage model calibration (Barham, 2019). In this research, SA will be applied to analyze the effect of potential changes in the values at any level of the hierarchy (perspectives or criteria) of the HDM model and what are the stability intervals for the original scores of the decision elements in each level of the hierarchical model (Abotah, 2014; Barham, 2019). In HDM, because this model is based on human subjective judgment the local contribution of factors is seldom known at 100% confidence level (Chen & Kocaoglu, 2008). Furthermore, it is subject to variations as the environment change and introducing new experts. By assessing the effect of experts' disagreement and the potential influence of making changes to the expert panel on the overall model robustness, SA analysis will be utilized to examine the impact of changes in priorities of the objectives or goals on the

ultimate decision and develop a general strategy to face any possible future circumstance. Also, conducting a SA for HDM can generate scenarios of potential rankings of decision alternatives under different situations (Winebrake and Creswick, 2003) and provide answers to “what if” questions (Chen & Kocaoglu, 2008).

Different relative criteria weights have an important impact on the selection of the most suitable alternatives. In multiple criteria decision-making (MCDM) problems the data are often changeable. For that, implementing sensitivity analysis based on the input data is a significant step in various applications of multiple criteria decision-making (Chen et al., 2009; Mukhametzyanov & Pamucar, 2018). In order to apply sensitivity analysis several scenarios can be conducted to test how much the ranking would be altered in a specific condition.

CHAPTER 6: DATA COLLECTION

6.2 Forming Experts

There are always critical issues in forming an expert panel and selecting the experts. In this research, the considerations associated with formatting expert panels are:

-Qualified experts should typically have more than 5 years in the innovation strategy and entrepreneurship field. Finding the right expert can be a challenging issue.

-Experts with a lack of experience would necessarily lack contextual understanding of the research objective.

- Sometimes understanding the purpose of the panel requires highly skilled experts to achieve significant outcomes.

- A long lead-time may be needed to meet the appropriate experts.

- The characteristics of the expert may affect the purpose of the panel negatively, such as experts are not willing to commit to an issue.

- Conflict-of-interest: when the experts share different basic values and goals of the research objective.

- The experts have a lack of foresight that is necessary to develop a longer-term vision of the topic of the study.

6.3 Selecting Experts

Experts are identified using several approaches:

- Researcher personal connections: the researcher has several connections related to innovation ecosystem and sustainable entrepreneurship, based on her previous work experience and current engagement with committees related to sustainable government projects.
- Social network analysis (SNA): This process can be used to investigate social structures by identifying networks and people in the centers of those networks (Daim et al., 2016). SNA is used to identify experts related to this research that can be potential candidates to join the expert panels.

The invitation has been sent to 72 people and 21 experts showed their willingness to contribute and serve as an expert in the research subject. All the experts have received an invitation letter to determine their abilities to participate. Experts were invited using email and linkedin.com, see Appendix A. This invitation includes the details for participating in the model validation and the model quantification, see Appendix B and C. Qualtrics surveys and one-on-one interviews were used to collect experts' judgment and responses for both the validation and quantification steps of the research model. Then, results from quantification were re-entered by the researcher into HDM tool for further analysis.

The following table includes information of experts who participate as an expert for this research. See table 4.

Experts	Title	Country
Expert 1	Government Sector	Saudi Arabia
Expert 2	Assistant Professor of Entrepreneurship	USA
Expert 3	National Innovation Expert	Egypt
Expert 4	Head of Major Projects Department of Industry, Innovation and Science	Australia
Expert 5	Advisor to the Deputy Minister of Education	Saudi Arabia
Expert 6	Professor of Economics & Development Studies	Nigeria
Expert 7	Professor of Innovation Management and Policy	Brazil
Expert 8	Professor of innovation and start-up activities	Germany
Expert 9	Associate Professor in Innovation and Entrepreneurship	UK
Expert 10	Professor of Entrepreneurship & Innovation Group	Italy
Expert 11	Professor of Innovation Management and Policy	UK
Expert 12	professor of the Economics and Management of Innovation	Turkey
Expert 13	Professor of Innovation Management and Policy	Saudi Arabia
Expert 14	Professor and holder of the Paul T. Babson Chair in Entrepreneurship	USA
Expert 15	Faculty of Economics and International Relations	Poland
Expert 16	Independent Business Consultant	Libya
Expert 17	A professor and the founding director of the Institute of Service Science	Taiwan
Expert 18	professor of the Economics and Management of Innovation	Denmark
Expert 19	Associate Professor in Enterprise Dynamics	Australia
Expert 20	Professorship for Sustainability Management, Centre for Sustainability	Germany
Expert 21	Professor of Economics	China

Table 4: Experts' Profiles

Table 5 represents the role of each expert's panel and the number of the experts in each panel.

Panels	Expert role		Number of experts
	Step 1	Step 2	
EP1	Validate the relative importance of assessment perspectives with respect to the mission		15
EP2	Validate relative priorities of strategy with respect to the economic perspective.	Validate relative contribution of strategy instruments with respect to the economic targets.	14
EP3	Validate relative priorities of strategy targets with respect to the Environmental perspective.	Validate relative contribution of strategy instruments with respect to the Environmental targets.	14
EP4	Validate relative priorities of strategy targets with respect to the social perspective.	Validate relative contribution of strategy instruments with respect to the social targets.	14
EP5	Validate relative priorities of strategy targets with respect to the technical perspective.	Validate relative contribution of strategy instruments with respect to the technical targets.	14
EP6	Validate relative priorities of strategy targets with respect to the Ethical perspective.	Validate relative contribution of strategy instruments with respect to the Ethical targets.	14
EP7	Quantify the relative importance of assessment perspectives with respect to the mission		6
EP8	Quantify relative priorities of strategy with respect to the economic perspective.	-Quantify relative contribution of strategy instruments with respect to the economic targets. -Quantify the related desirability curves.	6
EP9	Quantify relative priorities of strategy targets with respect to the Environmental perspective.	-Quantify relative contribution of strategy instruments with respect to the Environmental targets. -Quantify the related desirability curves.	6
EP10	Quantify relative priorities of strategy targets with respect to the Ethical perspective.	-Quantify relative contribution of strategy instruments with respect to the Ethical targets. -Quantify the related desirability curves.	6
EP11	Quantify relative priorities of strategy targets with respect to the social	-Quantify relative contribution of strategy instruments with respect to the social targets.	6

	perspective.	-Quantify the related desirability curves.	
EP12	Quantify relative priorities of strategy targets with respect to the technical perspective.	-Quantify relative contribution of strategy instruments with respect to the technical targets. -Quantify the related desirability curves.	6

Table 5: Role of Each Expert Panel

Table 6 shows the distribution of 21 experts over the panels.

Experts	EP1	EP2	EP3	EP4	EP5	EP6	EP7	EP8	EP9	EP10	EP11	EP12
Expert 1	X	X	X	X	X	X	X		X	X	X	
Expert 2	X	X	X	X	X	X	X	X	X	X	X	
Expert 3	X	X	X	X	X	X	X	X	X	X	X	X
Expert 4	X	X	X	X	X	X	X	X				
Expert 5	X	X	X	X	X	X						X
Expert 6	X	X		X	X			X			X	
Expert 7	X	X	X		X	X			X			
Expert 8		X	X	X	X	X						X
Expert 9	X	X	X	X		X	X	X		X	X	
Expert 10					X							X
Expert 11	X			X		X				X		
Expert 12		X						X				
Expert 13	X	X	X	X		X			X			
Expert 14	X	X	X	X	X	X						X
Expert 15												
Expert 16	X		X		X	X						X

Expert 17		X		X	X							
Expert 18	X	X	X	X		X		X				
Expert 19											X	
Expert 20	X		X	X	X	X			X			
Expert 21	X		X		X		X					
Total	15	14	14	14	14	14	6	6	6	6	6	6

Table 6: Distribution of Experts over Panels

6.1 Expert Panel Defined

Expert panels are a group of experts who can be used to evaluate specialized input and opinion (Department of Sustainability and Environment, 2005). In general, a variety of experts are engaged based on various fields of expertise to debate and discuss various courses of action and make recommendations (Department of Sustainability and Environment, 2005). Formatting expert panels helps stakeholders and decision-makers to hear a variety of informed (expert) opinions from which to decide on recommendations or courses of action in relation to an issue or proposal. During the expert panel formatting, there are some important things that need to be considered such as the technical ability and experience of the expert. Also, the expert panels should have the broadest possible universal representation in terms of a variety of knowledge, experience, and approaches in the fields for which the panels are established (Roweal et al., 2013). On the other hand, identifying the size of the panel would be one of the critical issues in forming an expert panel. The objective of formatting the panel and the qualification of the experts can impact the number of experts in this panel. According to “Effective Engagement: building relationships with community and other stakeholders - Book 3 the

engagement toolkit" that was published in 2005, each panel requires from 2-12 experts. However, there are successful studies find that having a small number of experts, such as 6-12 experts, in each panel is quite effective to achieve significant outcomes (Libby & Blashfield, 1978) (Ashton & Ashton, 1985) (Tran, 2013) (Abotah, 2014) (Gibson & Daim, 2016).

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6-12 experts, in each panel is quite effective to achieve significant outcomes (Libby & Blashfield, 1978) (Ashton & Ashton, 1985) (Tran, 2013) (Abotah, 2014) (Gibson & Daim, 2016).

CHAPTER 7: RESEARCH APPLICATION

This chapter introduces the research model Validation and quantification results, and how the desirability curves were determined.

7.1 Research Model Validation

In this phase, six panels have been created and are split as perspectives validation, strategy target validation and desirability metrics validation.

Panel (1) consisted of fifteen experts who responded to validate the model. The panel was asked to validate the perspective level and its contribution to the decision level. Please see the table below for a summary of experts' opinions, see Table 7.

Perspectives	Experts (Agree)	Experts (Disagree)	Agreement %	Accepted
Economic Feasibility	15	0	100%	Yes
Achieving Ethics and Social Responsibility	15	0	100%	Yes
Community Support Encouragement	14	1	93%	Yes
Technical System Development	15	0	100%	Yes
Improve Environmental Protection and Productivity Growth	15	0	100%	Yes

Table 7: Expert Panel 1, Perspectives Level Validation

The expert panel (2) focused on validating the suitability of economic strategy targets in response to the economic crisis as opportunities, tackling youth unemployment, and Taxes and Disciplining the Bureaucracy. As a result, three economic strategy targets were accepted and included in the final model, see Table 8.

Economic strategy Targets	Experts (Agree)	Experts (Disagree)	Agreement %	Accepted
Responses to the Economic Crisis as Opportunities	14	0	100%	Yes
Tackling youth Unemployment	13	1	92.86%	Yes
Taxes and Disciplining the Bureaucracy	14	0	100%	Yes

Table 8: Expert Panel 2, Economic Strategy targets Validation

Also, in Panel (3) the experts accepted the two environmental strategy targets, see Table 9.

Environmental strategy Targets	Experts (Agree)	Experts (Disagree)	Agreement %	Accepted
Solving environmental problems and to reduce the costs	14	0	100%	Yes
Appreciable reductions in environmental damage	14	0	100%	Yes

Table 9: Expert Panel 3, Environmental Strategy targets Validation

The expert panel (4) focused on validating the suitability of social strategy targets in increasing social consciousness, educational levels on sustainability innovation, and government entrepreneurship programs and transformative activity. As a result, all social strategy targets were accepted and included in the final model. Also, in the panel (5) the majority of the experts accepted all technical strategy targets to include in the final model, see table 10 and table 11.

Social strategy Targets	Experts (Agree)	Experts (Disagree)	Agreement %	Accepted
Social Consciousness	13	1	92.86%	Yes
Educational Levels on Sustainability Innovation	14	0	100%	Yes
Government Entrepreneurship Programs and Transformative Activity	14	0	100%	Yes

Table 10: Expert Panel 4, Social strategy targets Validation

Technical strategy Targets	Experts	Experts	Agreement	Accepted

	(Agree)	(Disagree)	%	
Facilitating Access to Benefits for Entrepreneurs	13	1	92.86%	Yes
Improving Physical and Services Infrastructure	13	1	92.86%	Yes
R&D Transfer	14	0	100%	Yes
Developing Positive Attitudes Towards Sustainability	13	1	92.86%	Yes

Table 11: Expert Panel 5, Technical strategy targets Validation

In Expert Panel (6), validating the suitability of ethical strategy targets, one expert does think that Stemming the Gender Gap needs to be under social strategy target instead of under ethical strategy target. On the other hand, all other experts agreed and accepted all ethical strategy targets to include in the final model, see table 12.

Ethical strategy Targets	Experts (Agree)	Experts (Disagree)	Agreement %	Accepted
Social justice in Innovation	14	0	100%	Yes
Ethics in Technology Innovation and Human Wealth	14	0	100%	Yes
Intellectual Property Rights (IPR)	14	0	100%	Yes
Stemming the Gender Gap	13	1	92.86%	Yes

Table 12: Expert Panel 6, Ethical strategy targets Validation

7.2 Research Model Quantification

Expert Panel 7 Results (Perspective Level Quantification)

The experts in this panel have been asked to evaluate the relative weight of five perspectives for the innovation ecosystem strategies to be effective for the adoption of sustainable entrepreneurship. The arithmetic means, of the relative importance of considered perspective derived from the expert's judgments, are shown in Figure 7 below.

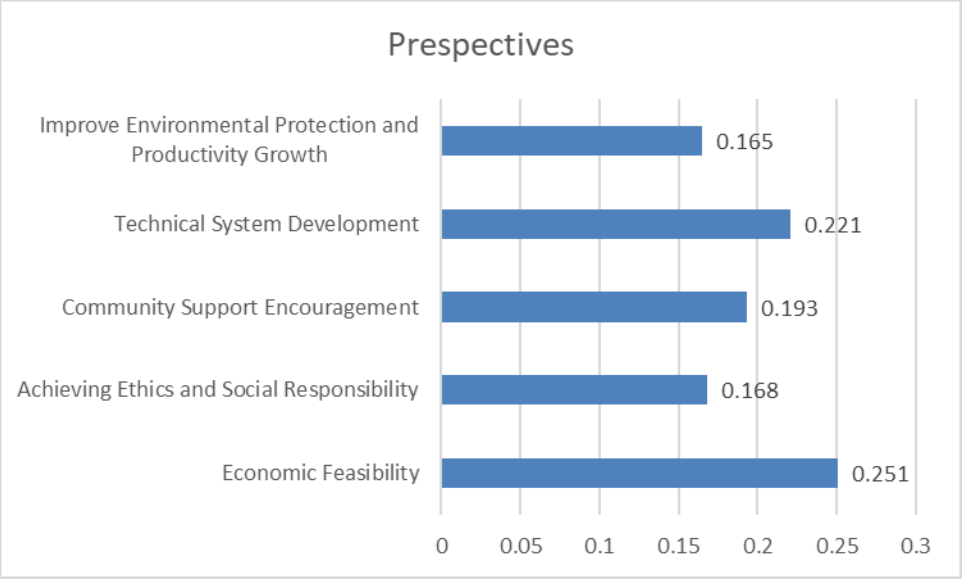

Figure 7 :Relative Importance of Innovation Ecosystem Strategies Criteria

From the results, Economic Feasibility Improvement (25%) ranked as the most important perspective with respect to the mission. Technical System Development (22%) ranked as the second important perspective with respect to the mission. Community Support Encouragement (19.3%) ranked as the third important perspective with respect to the mission. Achieving Ethics and Social Responsibility (16.8%) and Environmental Protection (16.5%) have almost equal relative importance and ranked fourth, and fifth.

Analysis of Expert Panel 1 Results

Individual results of the relative importance and the mean of six experts from Expert Panel 7 are listed in Table 13. The results show that all of the experts reflect an acceptable level of consistency in their judgments (<0.1). Moreover, there is no significant level of disagreement among the experts (0.052).

Perspective Level						
	Economic Feasibility	Achieving Ethics and Social Responsibility	Community Support Encouragement	Technical System Development	Improve Environmental Protection and Productivity Growth	Inconsistency
Expert (1)	0.34	0.11	0.17	0.23	0.14	0.03
Expert (2)	0.16	0.27	0.28	0.15	0.14	0.01
Expert (3)	0.20	0.15	0.17	0.23	0.25	0.00
Expert (4)	0.22	0.17	0.18	0.24	0.20	0.01
Expert (5)	0.25	0.17	0.18	0.23	0.17	0.00
Expert (6)	0.34	0.14	0.18	0.25	0.09	0.03
Mean	0.251667	0.168333	0.193333	0.221667	0.165	
Std. Deviation	0.074409	0.054559	0.04274	0.036009	0.055408	
Disagreement						0.052625

Table 13: Analysis of Expert Panel Results, Assessment Perspectives with Respect to the Mission

In expert panel 7, all experts agreed that economic feasibility improvement is the most important perspective for innovation ecosystem strategy effectiveness evaluation. Accordingly, the best innovation ecosystem strategy should have strategy targets that make sustainable entrepreneurship economics competitive and develop new types of competitive advantages by sustainability, innovation.

Expert Panel 8 Results (Economic strategy Targets Quantification)

In expert panel 8, six experts were asked to evaluate the relative importance of three strategy targets with respect to economic perspective (Economic Feasibility Improvement). The arithmetic means of experts' judgments for the relative importance of considered strategy targets are presented in Figure 8 below.

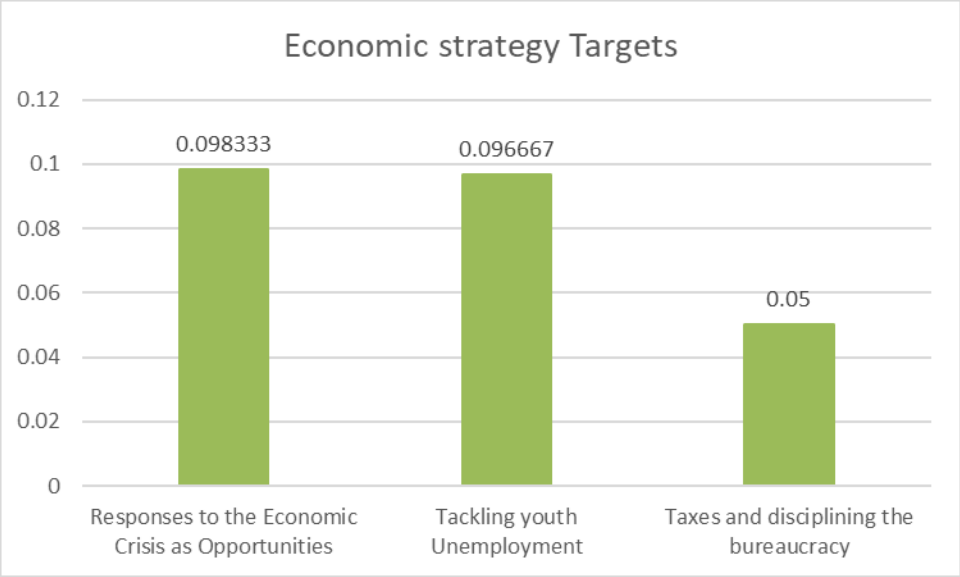

Figure 8 : Relative Importance of Economic strategy Targets to Economic Feasibility Improvement.

From the results, Responses to the Economic Crisis as Opportunities and Tackling youth Unemployment have almost equal relative importance and ranked (98%) and (96%).

Analysis of Expert Panel 8 Results

Individual results of the relative importance and the mean of the six experts from expert panel 8 are shown in Table 14. As result in panel 8, the inconsistency within each expert is acceptable (all < 0.10). There was a level of disagreement among the experts (0.029).

Economic Feasibility				
	Responses to the Economic Crisis as Opportunities	Tackling youth Unemployment	Taxes and disciplining the bureaucracy	Inconsistency
Expert (1)	0.13	0.13	0.07	0.00
Expert (2)	0.1	0.04	0.02	0.03
Expert (3)	0.06	0.1	0.03	0.02
Expert (4)	0.09	0.09	0.03	0.00
Expert (5)	0.08	0.09	0.07	0.00
Expert (6)	0.13	0.13	0.08	0.00
Mean	0.098333	0.096667	0.05	
Std. Deviation	0.027869	0.033267	0.026077	
Disagreement				0.029071

Table 14: Analysis of Expert Results, Economic strategy Targets concerning Perspective

Expert Panel 9 Results (Environmental strategy Targets Quantification)

In expert panel 9, six experts were asked to evaluate the relative importance of two strategy targets with respect to environmental perspective (Improve Environmental Protection and Productivity Growth). The arithmetic means of experts' judgments for the relative importance of considered strategy targets are presented in Figure 9 below.

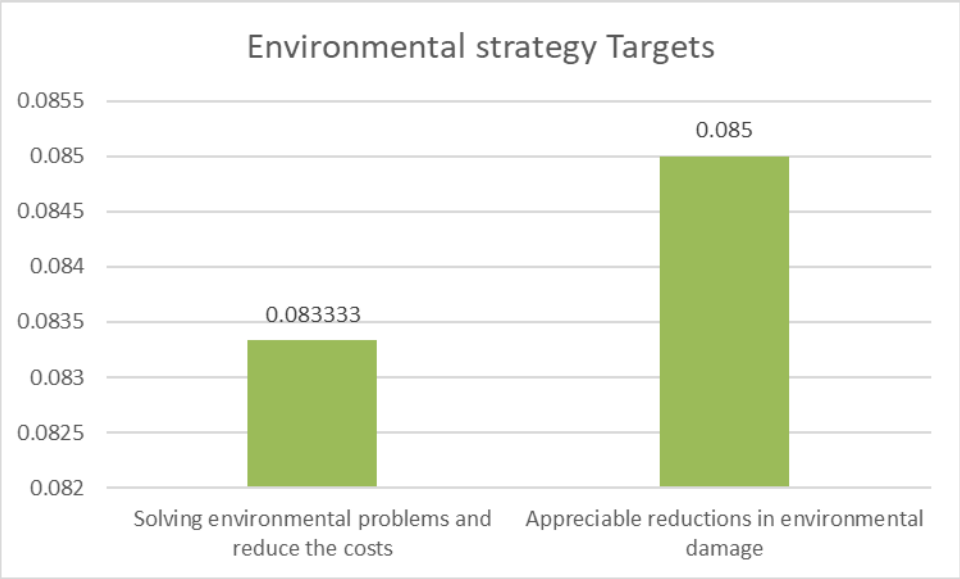

Figure 9 : Relative Importance of environmental strategy Targets Improve Environmental Protection and Productivity Growth

From the results, solving environmental problems and reduce the costs and Appreciable reductions in environmental damage have almost equal relative importance and ranked (85%) and (83%).

Analysis of Expert Panel 9 Results

Individual results of the relative importance and the mean of the six experts from expert panel 9 are shown in Table 15. As result in panel 9, the inconsistency within each expert is acceptable (all < 0.10). There was a level of disagreement among the experts (0.037).

Improve Environmental Protection and Productivity Growth			
	Solving environmental problems and reduce the costs	Appreciable reductions in environmental damage	Inconsistency
Expert (1)	0.07	0.07	0.00
Expert (2)	0.11	0.03	0.00
Expert (3)	0.08	0.18	0.00
Expert (4)	0.1	0.1	0.00
Expert (5)	0.09	0.08	0.00
Expert (6)	0.05	0.05	0.00
Mean	0.083333	0.085	
Std. Deviation	0.021602	0.05244	
Disagreement			0.037021

Table 15: Analysis of Expert Results, Environmental strategy Targets concerning Perspective

Expert Panel 10 Results (Ethical Strategy Targets Quantification)

In expert panel 10, six experts were asked to evaluate the relative importance of four strategy targets with respect to Ethical perspective (Achieving Ethics and Social Responsibility). The arithmetic means of experts' judgments for the relative importance of considered strategy targets are presented in Figure 10 below.

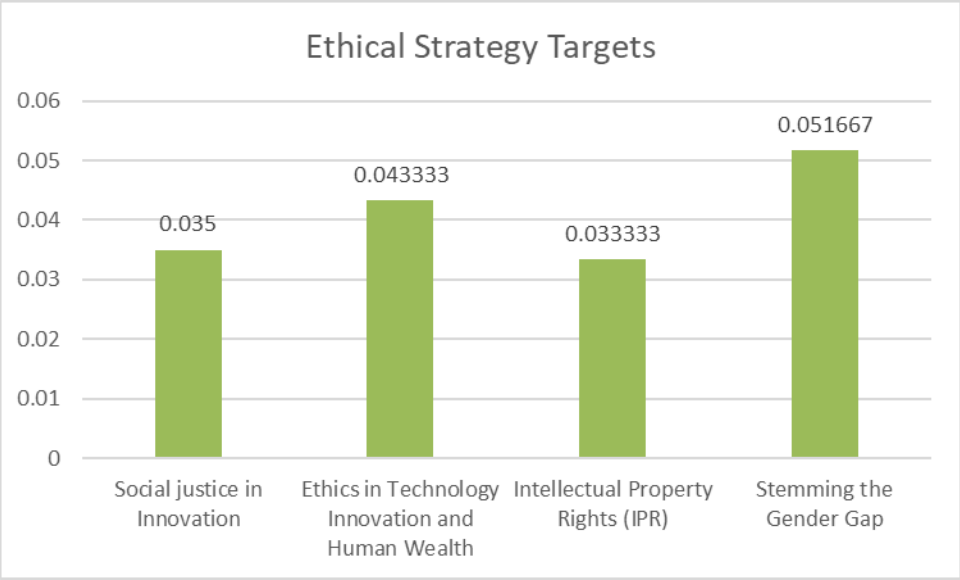

Figure 10: Relative Importance of Ethical Strategy Targets to Achieving Ethics and Social Responsibility

According to the results, Stemming the Gender Gap is ranked as the most important strategy target with respect to Achieving Ethics and Social Responsibility. Then, Ethics in Technology Innovation and Human Wealth. Social justice in innovation and intellectual property right have almost equal relative importance strategy target with respect to Ethical Strategy Targets to Achieving Ethics and Social Responsibility. They are ranked last.

Analysis of Expert Panel 10 Results

Individual results of the relative importance and the mean of the six experts from expert panel 10 are shown in Table 16. As result in panel 10, the inconsistency within each expert is acceptable (all < 0.10). There was a level of disagreement among the experts (0.020).

Achieving Ethics and Social Responsibility					
	Social justice in Innovation	Ethics in Technology Innovation and Human Wealth	Intellectual Property Rights (IPR)	Stemming the Gender Gap	Inconsistency
Expert (1)	0.03	0.03	0.02	0.03	0.00
Expert (2)	0.04	0.04	0.03	0.15	0.1
Expert (3)	0.02	0.07	0.04	0.02	0.02
Expert (4)	0.04	0.04	0.04	0.04	0.00
Expert (5)	0.04	0.04	0.05	0.03	
Expert (6)	0.04	0.04	0.02	0.04	0.00
Mean	0.035	0.043333	0.033333	0.051667	
Std. Deviation	0.008367	0.013663	0.012111	0.048751	
Disagreement					0.020723

Table 16: Analysis of Expert Results, Ethical Strategy Targets concerning Perspective

Expert Panel 11 Results (Social strategy Targets Quantification)

In expert panel 11, six experts were asked to evaluate the relative importance of three strategy targets with respect to social perspective (Community Support Encouragement). The arithmetic means of experts' judgments for the relative importance of considered strategy targets are presented in Figure 11 below.

Figure 11: Relative Importance of Social Strategy Targets to Community Support Encouragement

According to the results, Educational Levels on Sustainability Innovation is ranked first. Then, Social Consciousness and Government Entrepreneurship Programs and Transformative Activity have almost equal relative importance strategy target with respect to Community Support Encouragement.

Analysis of Expert Panel 11 Results

Individual results of the relative importance and the mean of the six experts from expert panel 11 are shown in Table 17. As result in panel 6, the inconsistency within each expert is acceptable (all < 0.10). There was a level of disagreement among the experts (0.023).

Community Support Encouragement				
	Social Consciousness	Educational Levels on Sustainability Innovation	Government Entrepreneurship Programs and Transformative Activity	Inconsistency
Expert (1)	0.06	0.06	0.06	0.00
Expert (2)	0.09	0.15	0.04	0.01
Expert (3)	0.07	0.03	0.07	0.00
Expert (4)	0.04	0.07	0.08	0.01
Expert (5)	0.06	0.05	0.07	0.00
Expert (6)	0.06	0.06	0.06	0.00
Mean	0.063333	0.07	0.063333	
Std. Deviation	0.01633	0.041473	0.013663	
Disagreement				0.023822

Table 17: Analysis of Expert Results, Social Strategy Targets concerning Perspective

Expert Panel 12 Results (Technical strategy Targets Quantification)

In expert panel 12, six experts were asked to evaluate the relative importance of two strategy targets with respect to technical perspective (Technical System Development). The arithmetic means of experts' judgments for the relative importance of considered strategy targets are presented in Figure 12 below.

Technical System Development					
	Facilitating Access to Benefits for Entrepreneurs	Improving Physical and Services Infrastructure	Developing Positive Attitudes Towards Sustainability	R&D Transfer	Inconsistency
Expert (1)	0.07	0.06	0.06	0.04	0.03
Expert (2)	0.07	0.02	0.04	0.02	0.05
Expert (3)	0.07	0.04	0.08	0.04	0.08
Expert (4)	0.04	0.08	0.06	0.05	0.02
Expert (5)	0.07	0.06	0.06	0.05	0.00
Expert (6)	0.08	0.07	0.05	0.05	0.01
Mean	0.066667	0.055	0.058333	0.04166	
Std. Deviation	0.013663	0.021679	0.013292	0.0116	
Disagreement					0.055417

Table 18: Analysis of Expert Results, Technical strategy Targets concerning Perspective

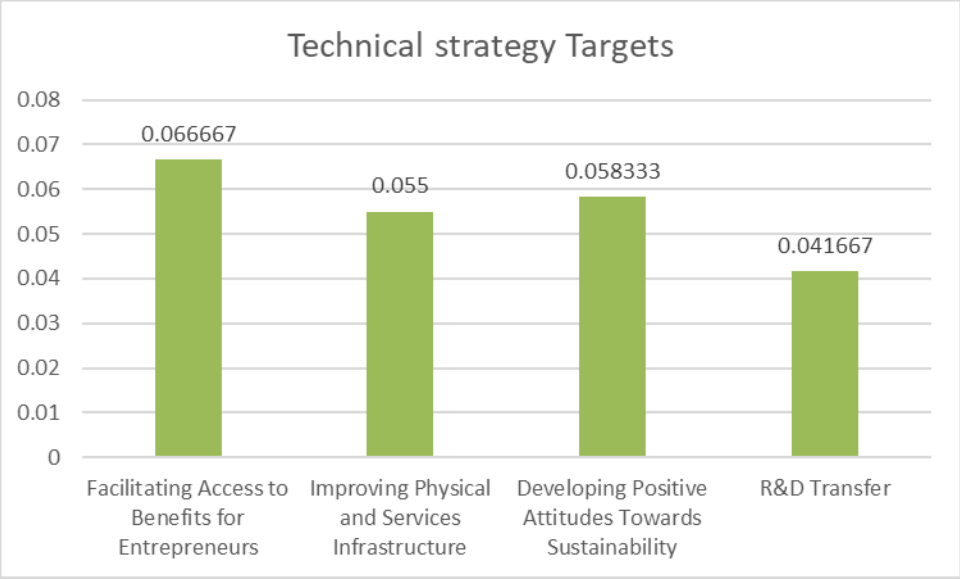

Figure 12: Relative Importance of Technical strategy Targets to Technical System Development

According to the results, Facilitating Access to Benefits for Entrepreneurs is ranked as the most important strategy target concerning Technical System Development. Then, Developing Positive Attitudes Towards Sustainability and Improving Physical and Services Infrastructure have almost equal relative importance strategy target with respect to Technical System Development. Finally, R&D Transfer is ranked last.

Analysis of Expert Panel 12 Results

Individual results of the relative importance and the mean of the six experts from expert panel 12 are shown in Table 18. As result in panel 12, the inconsistency within each expert is acceptable (all < 0.10). There was a level of disagreement among the experts (0.055).

Final Model Weights

The final relative weights of five perspectives for the innovation ecosystem strategies to be effective for the adoption of sustainable entrepreneurship and global relative value of strategy targets are summarized in in Table 19 below, and Figure 13,14 captures the final HDM with relative weights. Economic Feasibility Improvement is considered to be the most important perspective for increasing the adoption of innovation in sustainable entrepreneurship. Also, Responses to the Economic Crisis as Opportunities and Tackling youth Unemployment are given the most weight of strategy targets with a mean of 0.098 and 0.096.

Then, Technical System Development is the next perspective that is considered to be an important perspective for increasing the adoption of innovation in sustainable entrepreneurship. However, Appreciable reductions in environmental damage is considered to be the next important strategy target for increasing the adoption of innovation in sustainable entrepreneurship.

perspectives	Value	Strategy Target	Local Weights of Strategy Target	Global Weights
Economic Feasibility Improvement	0.251	Responses to the Economic Crisis as Opportunities	0.39	0.098
		Tackling youth Unemployment	0.382	0.096
		Taxes and Disciplining the Bureaucracy	0.199	0.05
Technical System Development	0.221	Facilitating Access to Finance for Entrepreneurs	0.298	0.066
		Improving Physical and Services Infrastructure	0.248	0.055
		Developing Positive Attitudes Towards Sustainability	0.263	0.0583
		R&D Transfer	0.188	0.0416
Community Support Encouragement	0.193	Social Consciousness	0.327	0.0633
		Educational Levels on Sustainability Innovation	0.36	0.07
		Government Entrepreneurship Programs and Transformative Activity	0.327	0.0633
Achieving Ethics and Social Responsibility	0.168	Social justice in Innovation	0.2	0.035
		Ethics in Technology Innovation and Human Wealth	0.25	0.0433
		Intellectual Property Rights	0.196	0.0333
		Stemming the Gender Gap	0.3	0.0516
Improve Environmental	0.165	Solving environmental problems and to reduce the costs	0.5	0.0833

Protection		Appreciable reductions in environmental damage	0.5	0.085
Total	1			1.000

Table 19: The result of experts' judgment quantification and Final Weights

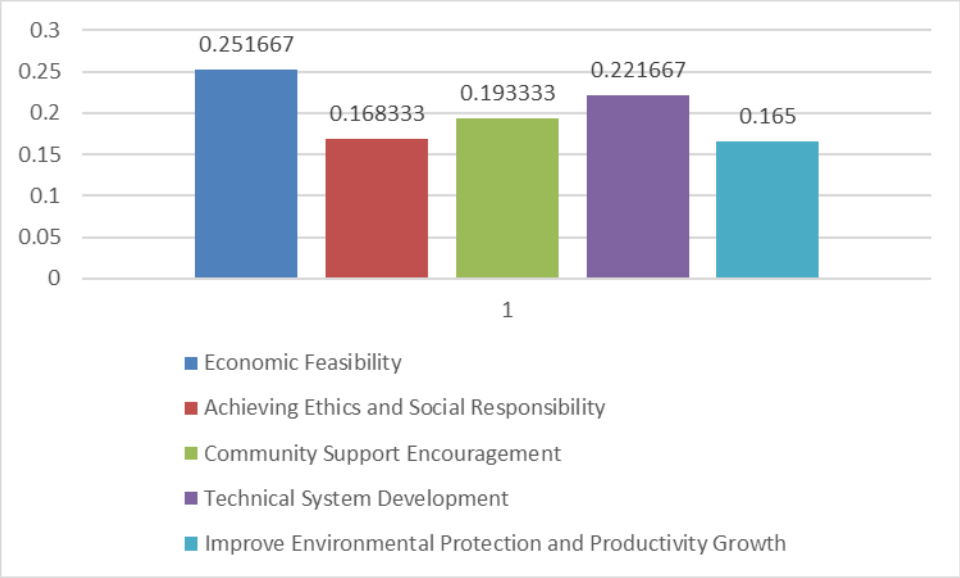

Figure 13: Relative Importance of Innovation Ecosystem Strategies Criteria

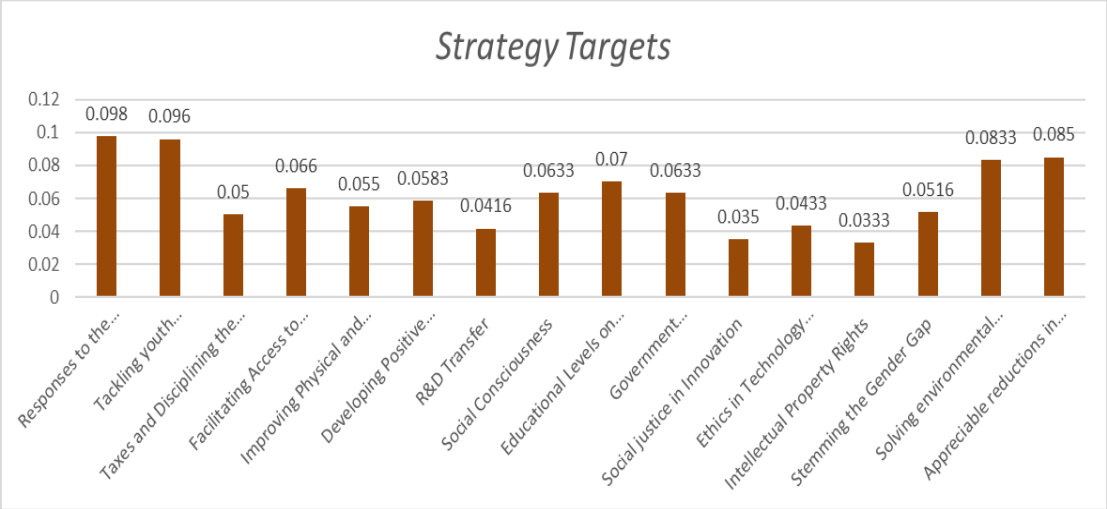

Figure 14: Relative importance of Innovation Ecosystem Strategy Targets

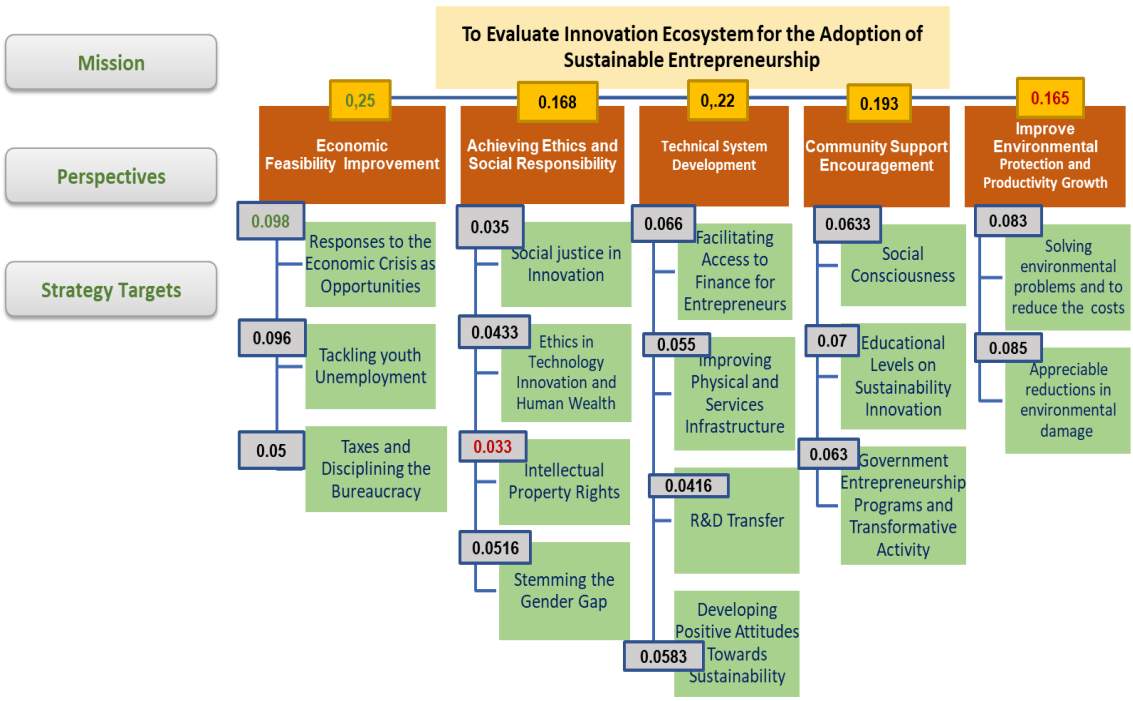

Figure 15:Final Model Weights

7.3 Desirability Metrics

The experts from EP8 to EP 12 have been asked through the Qualtrics survey tool to quantify the levels of desirability for each strategy target, enabling the establishment of desirability curves. As mentioned in previous researches (Barham, 2018) (Khanam, 2020), the average value of experts' judgments was considered as the final value for the curves creation. Below are each expert judgments along with the mean values and the curves for each strategy target.

7.3.1 Economic Strategy Targets

The outcomes of the desirability metrics quantifications of the economic strategy targets are shown in tables 20,21,22.

Experts	Low	Medium	High	Mature
Expert1	0	10	35	100
Expert2	0	30	62	100
Expert3	0	30	60	100
Expert4	0	38	88	100
Expert5	0	30	62	100
Expert6	0	10	35	100
Mean	0	25	57	100

Table 20: Desirability Metrics Quantification Outcomes for Responses to the Economic Crisis as Opportunities

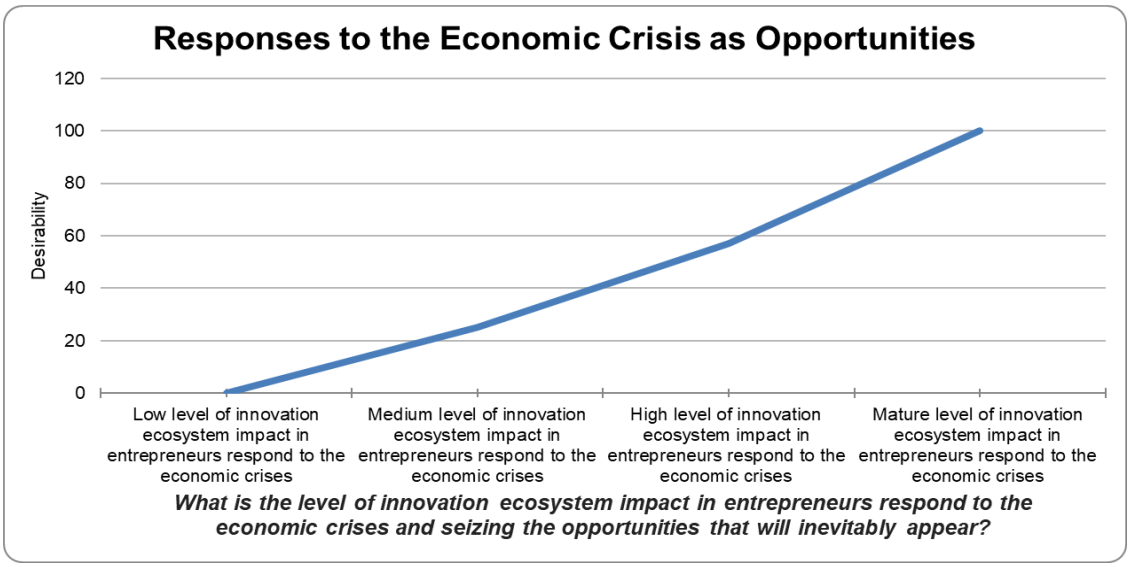

Figure 16: The level of innovation ecosystem impact in entrepreneurs respond to the economic crises and seizing the opportunities that will inevitably appear

Experts	Low	Mediocre	Medium	High	Optimal
Expert1	0	15	35	60	100
Expert2	0	24	52	77	100
Expert3	0	32	50	70	100
Expert4	0	15	45	79	100
Expert5	0	24	48	60	100
Expert6	0	10	34	44	100
Mean	0	20	44	65	100

Table 21:Desirability Metrics Quantification Outcomes for Tackling youth Unemployment

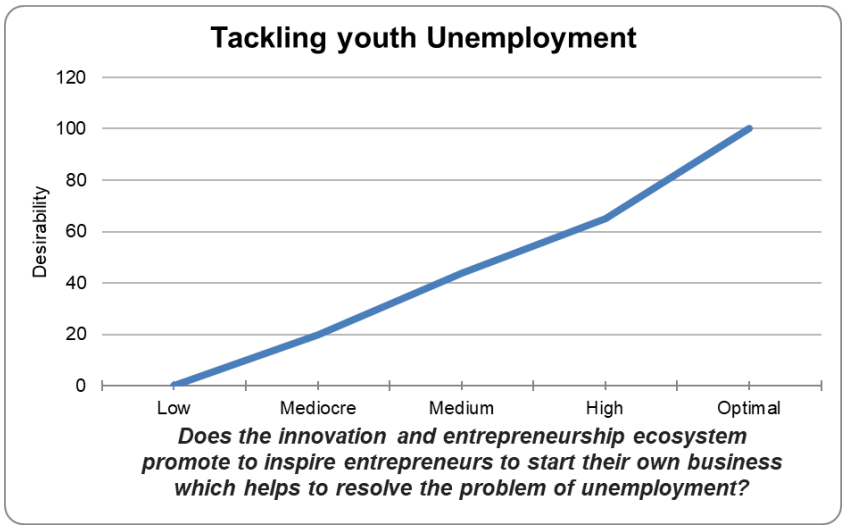

Figure 17: Desirability Metrics Quantification Outcomes for Tackling youth Unemployment

Experts	Simple	Reasonable	Some Complexity	Complex	Very Complex
Expert1	100	10	20	30	0
Expert2	100	81	59	34	0
Expert3	100	80	50	10	0
Expert4	100	85	10	0	0
Expert5	100	42	40	47	0
Expert6	100	80	60	33	0
Mean	100	63	39.8	25.6	0

Table 22: Desirability question and metrics for Taxes and Disciplining the Bureaucracy strategy Target

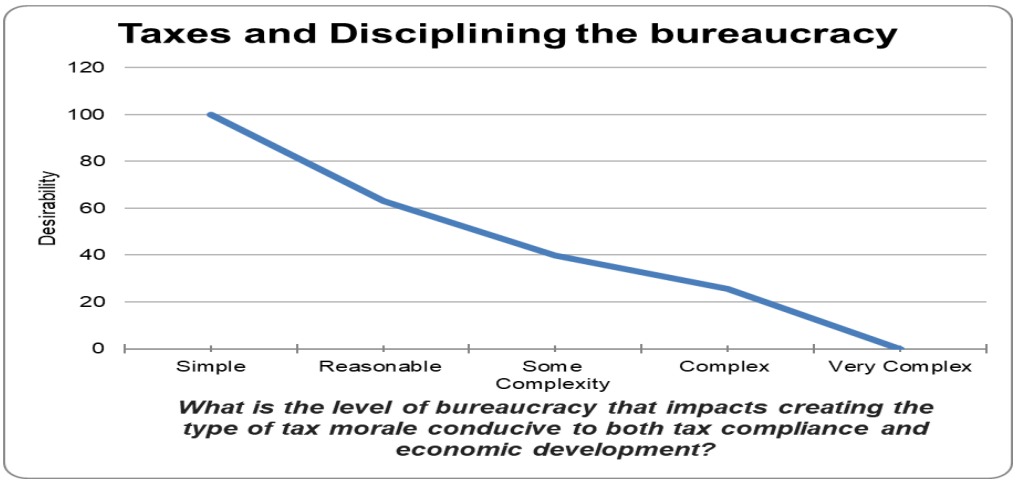

Figure 18: The level of bureaucracy that impact creating the type of tax morale conducive to both tax compliance and economic development

7.3.2 Technical Strategy Targets

The outcomes of the desirability metrics quantifications of the technical strategy targets are shown in tables 23,24,25 and 26.

Experts	Low	Medium	High	Very High
Expert1	100	50	35	0
Expert2	100	70	40	0
Expert3	100	40	30	0
Expert4	100	32	15	0
Expert5	100	70	50	0
Expert6	100	60	30	0
Mean	100	53.7	33.3	0

Table 23: Desirability question and metrics for Facilitating Access to Benefits for Entrepreneurs strategy Target

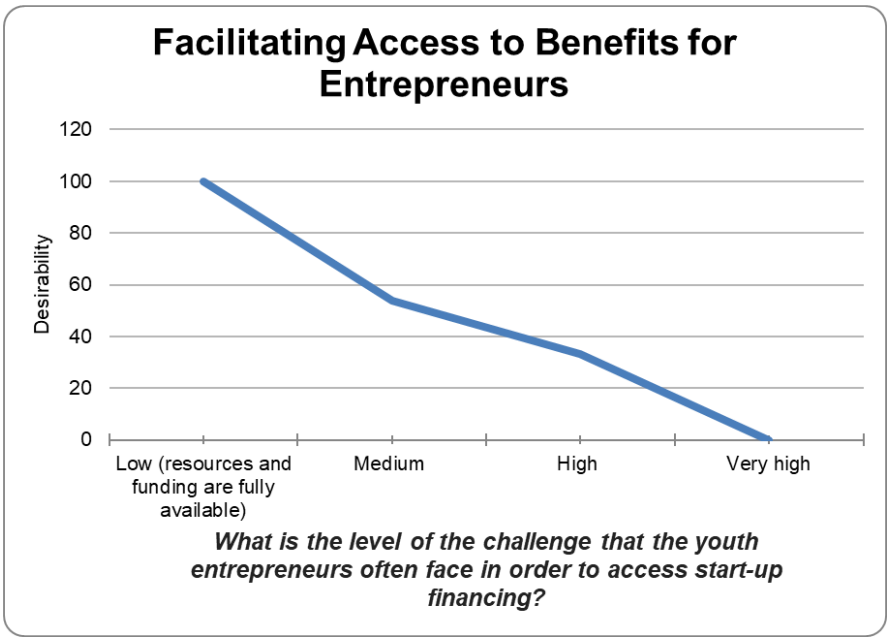

Figure 19: The level of the challenge that the youth entrepreneurs often face in order to access start-up financing

Experts	No Impact	Some Impact	Medium Impact	High Impact	Full Impact
Expert1	0	10	20	60	100
Expert2	0	31	57	77	100
Expert3	0	30	60	80	100
Expert4	0	28	41	81	100
Expert5	0	20	40	70	100
Expert6	0	40	60	80	100
Mean	0	26.5	46.3	74.7	100

Table 24: Desirability question and metrics for Improving Physical and Services Infrastructure strategy Target

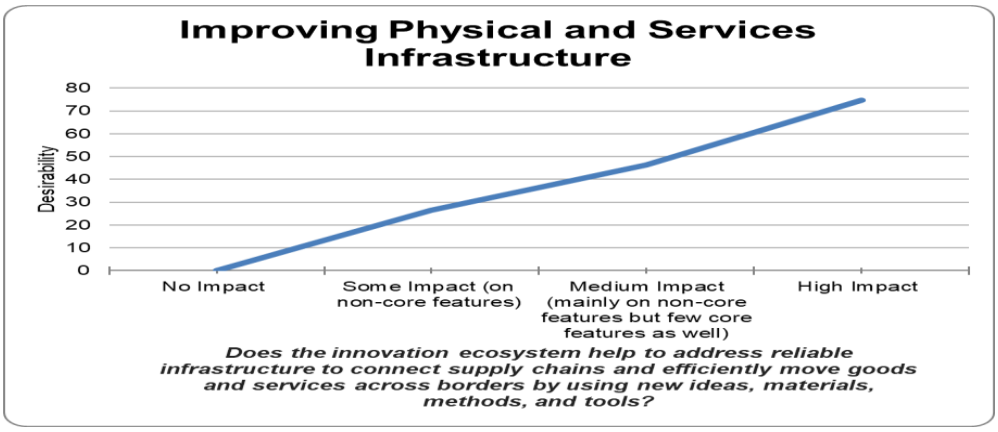

Figure 20: Desirability question and metrics for Improving Physical and Services Infrastructure strategy Target

Experts	No Control	Limited Control	Conditional Impact	Full Control
Expert1	0	15	70	100
Expert2	0	28	56	100
Expert3	0	20	40	100
Expert4	0	30	30	100
Expert5	0	21	32	100
Expert6	0	22	33	100
Mean	0	22.7	43.5	100

Table 25: Desirability question and metrics for Developing Positive Attitudes Towards Sustainability strategy Target

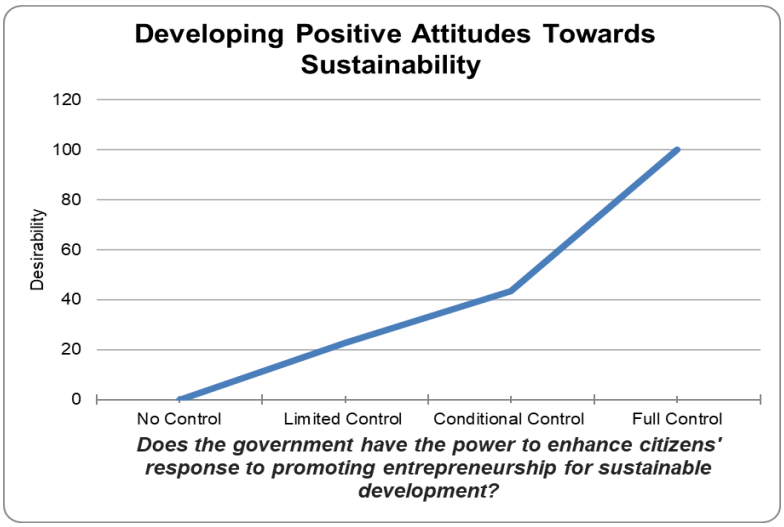

Figure 21: Desirability question and metrics for Developing Positive Attitudes Towards Sustainability strategy Target

Experts	Low	Mediocre	Medium	High	Optimal
Expert1	0	10	20	40	100
Expert2	0	31	63	84	100
Expert3	0	10	40	60	100
Expert4	0	50	0	78	100
Expert5	0	49	44	45	100
Expert6	0	10	21	41	100
Mean	0	26.6	31.3	58	100

Table 26: Desirability question and metrics for R&D Transfer strategy Target

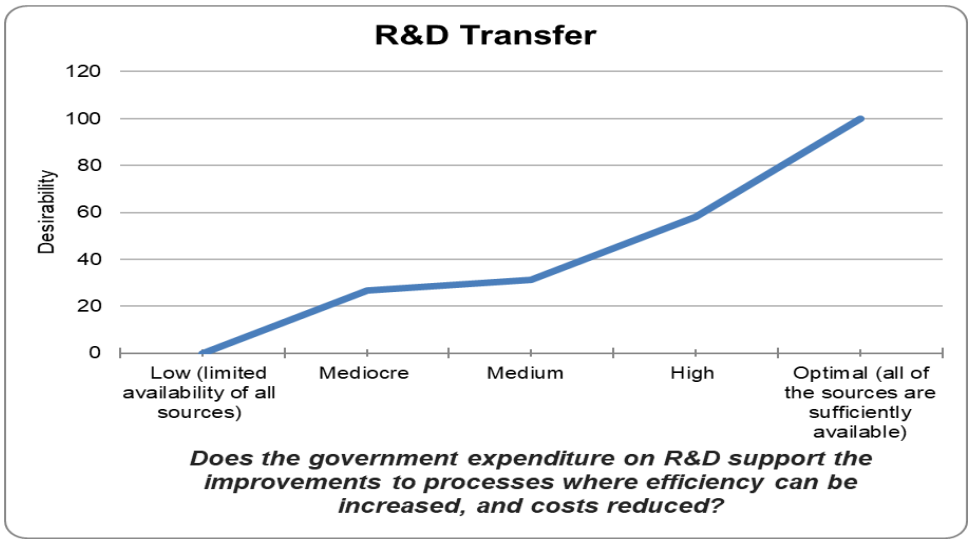

Figure 22: Desirability question and metrics for R&D Transfer strategy Target

7.3.3 Environmental Strategy Targets

The outcomes of the desirability metrics quantifications of the environmental strategy targets are shown in tables 27, and 28.

Experts	No Impact	Some Impact	Medium Impact	High Impact	Full Impact
Expert1	0	10	20	30	100
Expert2	0	25	57	80	100
Expert3	0	20	40	70	100
Expert4	0	30	40	81	100
Expert5	0	15	70	79	100
Expert6	0	25	55	82	100
Mean	0	20.8	47	70.3	100

Table 27: Desirability question and metrics for Solving environmental problems and reducing the costs strategy Target

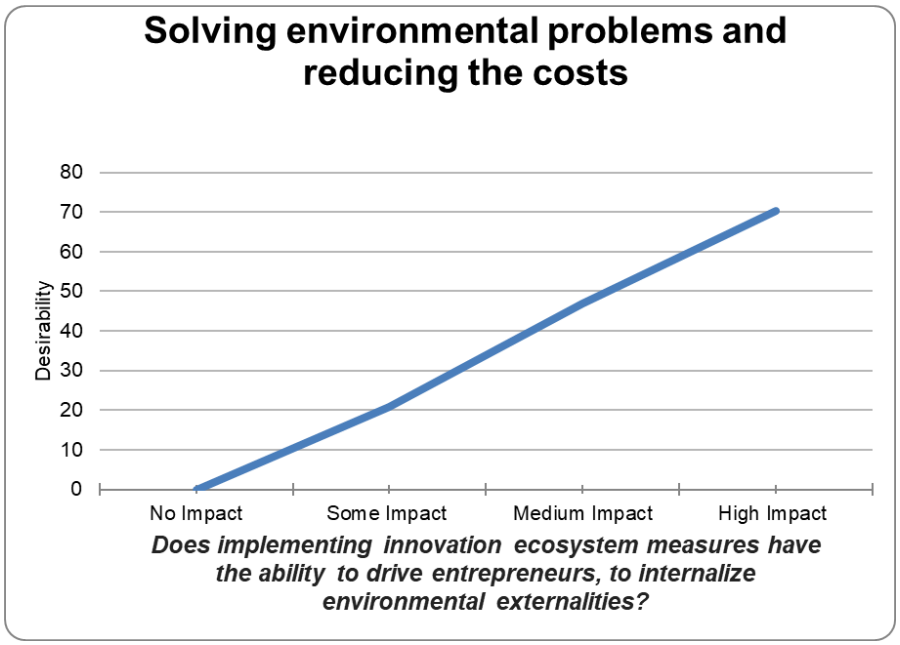

Figure 23: Desirability question and metrics for Solving environmental problems and reducing the costs strategy Target

Experts	No Impact	Some Impact	Medium Impact	High Impact	Full Impact
Expert1	0	15	25	40	100
Expert2	0	27	51	78	100
Expert3	0	20	40	60	100
Expert4	0	28	54	78	100
Expert5	0	40	60	79	100
Expert6	0	28	52	78	100
Mean	0	26.3	47	68.8	100

Table 28: Desirability question and metrics for Appreciable reductions in environmental damage strategy Target

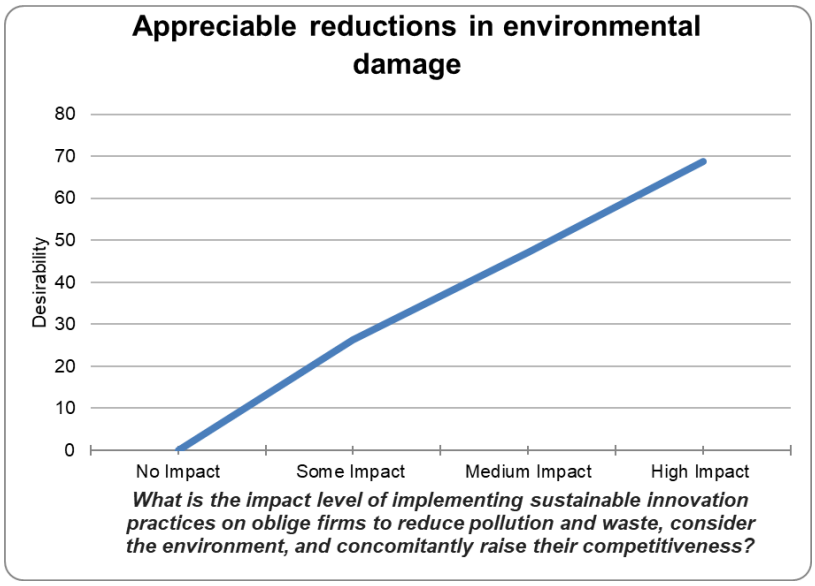

Figure 24: Desirability question and metrics for Appreciable reductions in environmental damage strategy Target

7.3.4 Ethical Strategy Targets

The outcomes of the desirability metrics quantifications of the ethical strategy targets are shown in tables 29,30, 31 and 32.

Experts	Extremely positive	Somewhat positive	Neither positive nor negative	Somewhat negative	Extremely negative
Expert1	100	70	20	30	0
Expert2	100	50	55	25	0
Expert3	100	40	60	15	0
Expert4	100	66	30	35	0
Expert5	100	40	50	20	0
Expert6	100	38	30	20	0
Mean	100	51	40.8	24.2	0

Table 29: Desirability Metrics Quantification Outcomes for Social justice in Innovation

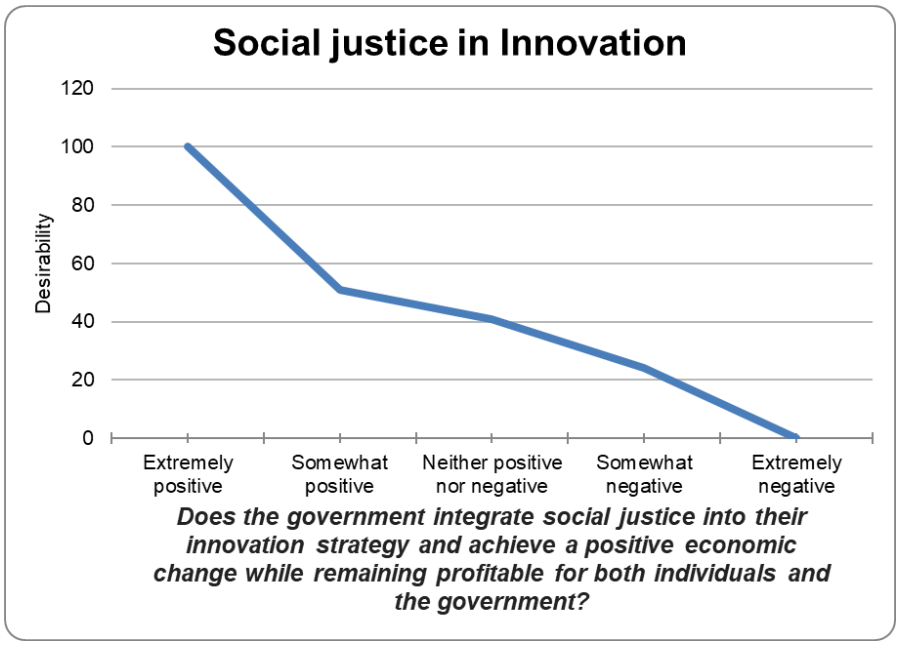

Figure 25: Desirability Metrics Quantification Outcomes for Social justice in Innovation

Experts	Confidence	Low uncertainty	Average uncertainty	High uncertainty
Expert1	100	15	25	0
Expert2	100	74	50	0
Expert3	100	70	40	0
Expert4	100	62	26	0
Expert5	100	39	47	0
Expert6	100	15	25	0
Mean	100	45.8	35.5	0

Table 30: Desirability Metrics Quantification Outcomes for Ethics in Technology Innovation and Human Wealth

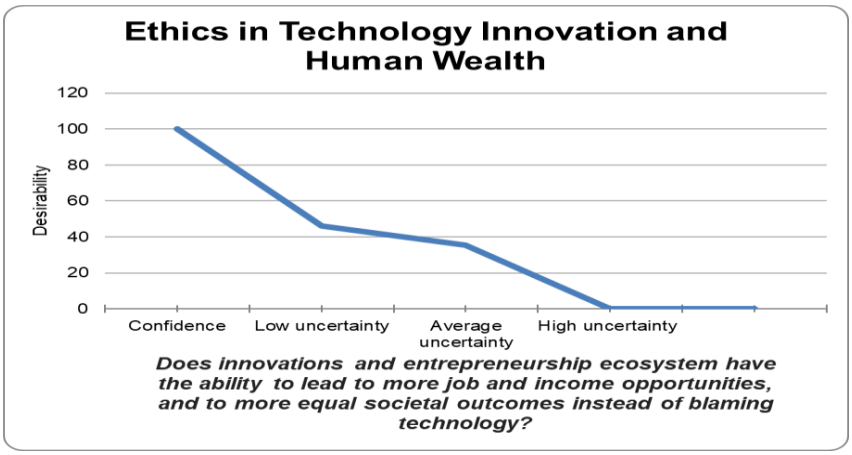

Figure 26: Desirability Metrics Quantification Outcomes for Ethics in Technology Innovation and Human Wealth

Experts	Very Low	Low	Medium	High	Mature
Expert1	0	28	53	75	100
Expert2	0	40	50	70	100
Expert3	0	17	20	83	100
Expert4	0	20	43	46	100
Expert5	0	5	15	30	100
Expert6	0	30	60	70	100
Mean	0	23.3	40.2	62.3	100

Table 31: Desirability Metrics Quantification Outcomes for Intellectual Property Rights (IPR)

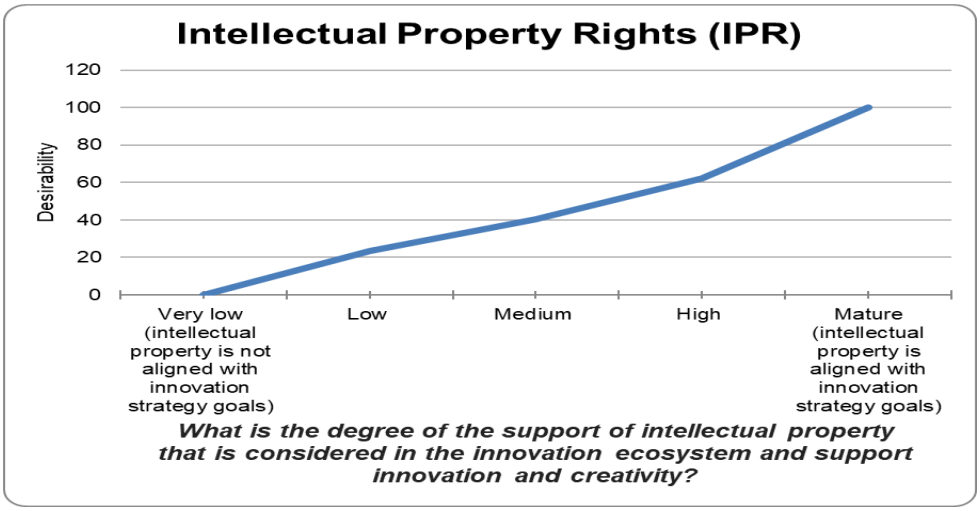

Figure 27: Desirability Metrics Quantification Outcomes for Intellectual Property Rights (IPR)

Experts	No Impact	Some Impact	Medium Impact	High Impact	Full Impact
Expert1	0	10	20	30	100
Expert2	0	20	51	70	100
Expert3	0	10	20	30	100
Expert4	0	38	42	57	100
Expert5	0	44	61	75	100
Expert6	0	38	41	58	100
Mean	0	26.7	39.2	53.3	100

Table 32: Desirability Metrics Quantification Outcomes for Stemming the Gender Gap

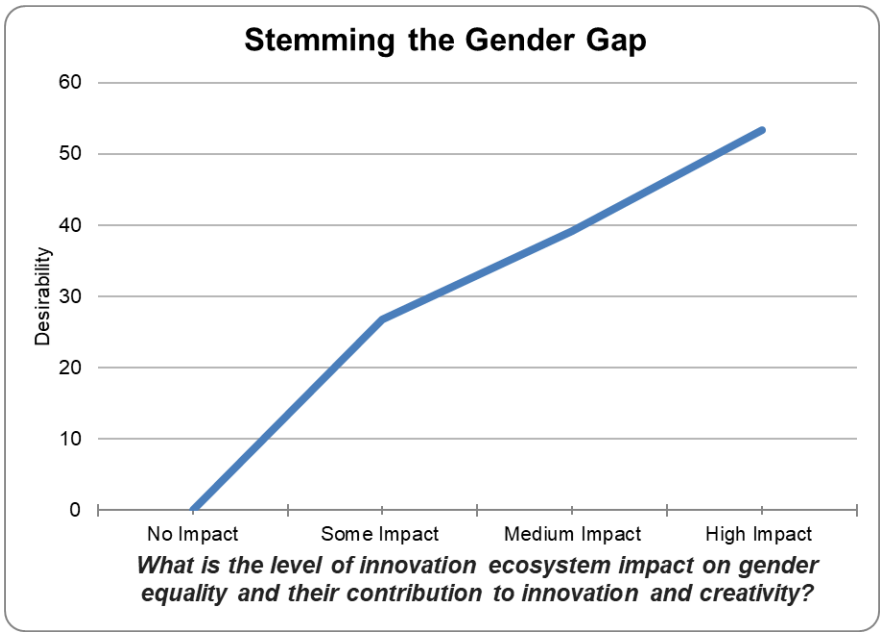

Figure 28: The level of innovation ecosystem impact on gender equality and their contribution to innovation and creativity

7.3.5 Social Strategy Targets

The outcomes of the desirability metrics quantifications of the social strategy targets are shown in tables 33,34, and 35.

Experts	Not Willing	Reluctant	Partially Willing	Most Willing	Completely Willing
Expert1	0	30	20	40	100
Expert2	0	19	46	77	100
Expert3	0	10	30	20	100
Expert4	0	22	50	60	100
Expert5	0	14	27	81	100
Expert6	0	15	30	20	100
Mean	0	18	34	50	100

Table 33: Desirability Metrics Quantification Outcomes for Social Consciousness

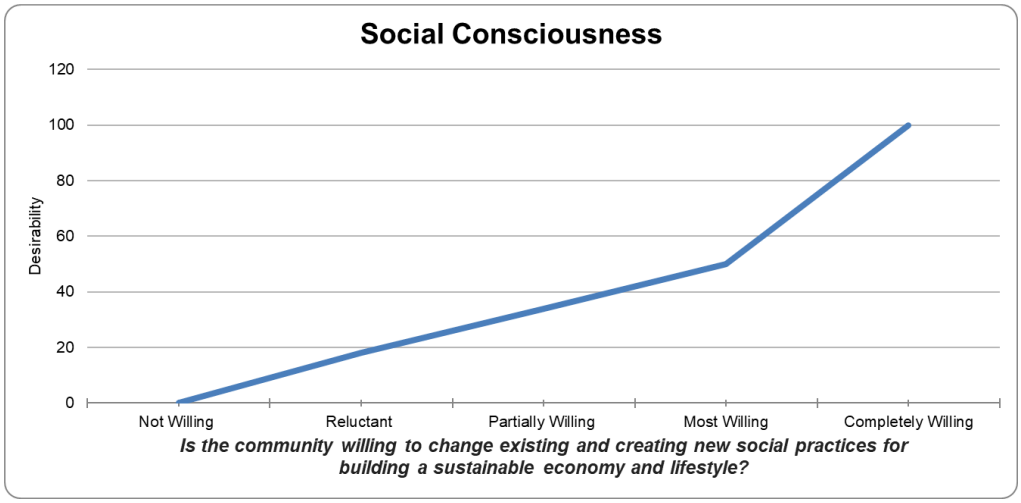

Figure 29: Desirability Metrics Quantification Outcomes for Social Consciousness

Experts	Low Involvement	Some Involvement	Medium Involvement	High Involvement	Full Involvement
Expert1	0	3	7	40	100
Expert2	0	22	53	76	100
Expert3	0	20	50	70	100
Expert4	0	17	47	84	100
Expert5	0	34	51	72	100
Expert6	0	20	50	70	100
Mean	0	19.2	42	68.4	100

Table 34: Desirability Metrics Quantification Outcomes for Educational Levels on Sustainability Innovation

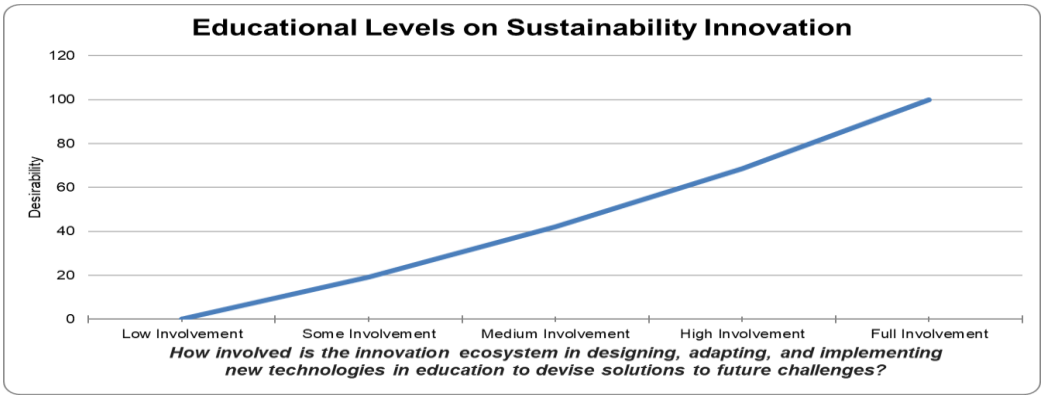

Figure 30: Desirability Metrics Quantification Outcomes for Educational Levels on Sustainability Innovation

Experts	No Support	Some Support	Medium Support	High Support	Full Support
Expert1	0	5	15	31	100
Expert2	0	23	50	78	100
Expert3	0	30	60	80	100
Expert4	0	18	47	89	100
Expert5	0	35	90	72	100
Expert6	0	23	50	78	100
Mean	0	22.2	52.4	70	100

Table 35: Desirability Metrics Quantification Outcomes for Government Entrepreneurship Programs and Transformative Activity

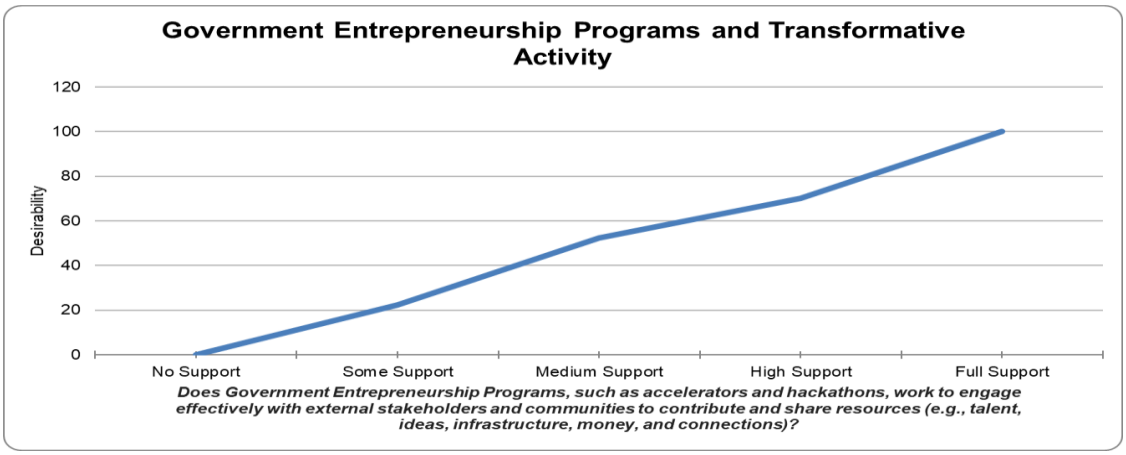

Figure 31: Desirability Metrics Quantification Outcomes for Government Entrepreneurship Programs and Transformative Activity

CHAPTER 8: ANALYSIS OF CASE AND SENSITIVITY ANALYSIS

In this chapter, the model developed in this research was applied to identify the overall evaluation scores of Saudi Arabia's and China's Innovation ecosystems in facilitating the adoption of sustainable entrepreneurship. Literature review and studies were used to assign a value curve score for each case.

8.1 Saudi Arabia's and China's Innovation Ecosystem

These countries have been chosen as case studies in this research for many reasons. First, the government admin offices, universities, R&D institutions of both countries have started to build a clear structure to explore their innovation ecosystem (Khorsheed, 2015) (Ma et al., 2019). Second, both countries have strong government controls over major economic activities (Moshashai et al., 2018) (Tang et al.,2020). Third, both countries are not recognized as a democratic political system (Mounk & Foa, 2018) (Liu et al., 2020). Fourth, both countries have been taken great strategies to develop the industrial economy through entrepreneurship and innovation (Umarovna, 2021) (Bakry et al., 2019). Also, according to The Heritage Foundation Annual report (2022), both countries have almost the same score on Business Freedom. Saudi Arabia's business freedom score is 68.1, and China's business freedom score is 68.8 (Miller et al., 2022). Furthermore, Saudi Arabia's economy is the 118th freest in the 2022 Index, it is ranked 9th among 14 countries in the Middle East and North Africa region, and its overall score is below the regional and world averages (Miller et al., 2022). Also, China's economy is the 158th freest in the 2022 Index, it is ranked 35th among 39 countries in the Asia–Pacific region, and its overall score is below the regional and world averages (Miller et al., 2022).

8.1.1 Saudi Arabia's Innovation Ecosystems in Facilitating the Adoption of Sustainable

Saudi Arabia is a rich country (Hasanov et al., 2022) with a gross domestic product (GDP) of 833 USD billion (The World Bank, 2021), which enjoys high financial potential. It remains the world's largest oil producer (Blondeel & Bradshaw, 2022). According to the General Authority for Statistics in Saudi Arabia the population is 34,1 million, and more than half of them are below the age of 25 years (Aloulou & Alarifi, 2022). Most of the youths in Saudi Arabia have graduated from prestigious universities in the world in various fields. Some of them are holding degrees in business, others in engineering, and many of them have graduated with different degrees in different sciences majors. It is time to employ all these valuable resources and implement them into something that can improve the individual and society (K. Salman, 2018).

Recently, the Saudi Arabia government has sponsored the field of technology transfer, innovation, and entrepreneurship because of its effect on its knowledge economy. The government can use this knowledge for decision support systems to produce economic value in many different fields. However, Saudi Arabia is still needed to invest in science and research as stated in Vision 2030 to continue developing the entrepreneurship ecosystem. Also, the government needs to foster the creation of entrepreneurial ecosystems in strategic locations through the analysis of the internal market distribution (GEM, 2017). The Saudi Arabia government is working in attracting and retaining innovation factors, such as human resources development, Government support & investment in R&D, and improving knowledge through Education-Industry linkages (Iqbal, 2011). However, there is a need to a determination of the optimal policies to

improve innovation. The policy makers are working for consistent and long-term policies (Duarte & Carvalho, 2020). Certainly, they need a comprehensive view of these policies to make progress on the innovation dimen-sion through the optimal policies.

Innovation Ecosystem Instruments in Saudi Arabia

There are several innovation ecosystem strategies that are intended to promote the deployment of sustainability. Today, with the digital revolution that accelerates and expands in the business world, governments need to transform and lead the workforce experience that will drive the economy to where it should go with the change of the future. Innovation ecosystems should promote technological science and education with suitable funding. According to the American scientist and policy advisor Lewis M. Branscomb, technology policy talks about the "*public means for nurturing those capabilities and optimizing their applications in the service of national goals and interests*". Branscomb defines technology in this context as *"the aggregation of capabilities, facilities, skills, knowledge, and organization required to successfully create a useful service or product*" (Branscomb,1995). The Saudi Arabia government has adopted an ecosystem and incentives, whether they be regulation, start-up costs and access to capital markets, and legal protection and property rights, to support innovation and sustainability.

Government Expenditure on Research and Development

Recently, Saudi Arabia has directed a good share of its revenue to improving education and scientific research in order to shift the country towards a knowledge-based economy, reducing the country's reliance on fossil fuels (K. Salman, 2018). It believes that the investment in this field will increase the strength of its economy and improve its citizens' life. Implementing these goals needs all the universities in Saudi Arabia to perform high-quality research. For that, Saudi Arabia government allocates a total budget of SR6 billion ($1.6 billion) to support of R&D at institutions through 2020, according to the Saudi Arabia's Ministry of Education. The Research and Development Office of the Ministry of Education was established in 2017 to convert the R&D ecosystem over strategic initiatives to boost the research capacity in Saudi Arabia. Its R&D ecosystem has improved significant progress in recent years, and has promoted clear strengths. The Ministry of Education in Saudi Arabia has created a program to support Research and Development in universities. There are six pillars that are defined by the Ministry of Education, Saudi Arabia as a strategic framework of the R&D ecosystem. It includes the following:

- Aligning Priorities: to ensure that Research and Development funding is aligned to continuing national priorities.
- Ensuring Appropriate Funding: to make sure that the accurate level of funding is provided to ensure high quality results.

- Performance Measurement: A focus on economic outcomes, not just measurement of the output such as the number of publications.
- Talent: to ensure that the human capital has the right capabilities across the end to end Research and Development sector.
- Partnerships: With both the private sector and eminent Research and development organizations around the world.
- Entrepreneurialism: to encourage entrepreneurship and innovation across the country to inspire the demand for Research and Development.

In the last decade, Saudi Arabia has witnessed the emergence of an array of increasingly movements to invest in science and technology in the seeking for a transition toward sustainability. With applying the research and R&D program, the Saudi Arabia government has started to harness the concept of "Sustainability Science".

Strengthen the Human Resource Development (HRD)

In order to spread the culture of sustainable entrepreneurship, there are antecedents of entrepreneurship. First, it is essential to prepare human resources and develop them. Since human resources add value in sustainability development and technology cannot replace this value. Matter of fact, this human wealth needs to be taught the new skills that are appropriate with the ever-changing global environment. Human capital fulfils the criteria for sustained competitive advantage in that they are valuable, unique, and non-substitutable (Lee, 2019). The efficiency of human resources is a product of the quality of the educational system and government investment in technology science and education. For that, governments need to employ technology science and education as a tool to

achieve a competitive position through people. Sustainable entrepreneurship and innovation need building skills to solve big problems through human ingenuity, imagination and entrepreneurialism that can come from anywhere (Ellis, 2010). Since 2005, the Saudi government has launched the King Abdullah Scholarship Program (KASP), It is the largest student overseas program worldwide (Bukhari & Denman, 2013). The Ministry of Higher Education in Saudi Arabia (2014) had stated that the mission of KASP is[1]:

> To prepare and qualify Saudi human resources in an effective manner so that they will be able to compete on an international level in the labor market and the different areas of scientific research, and thereby become an important source of supply of highly qualified individuals for Saudi universities as well as the government and private sectors.

In accordance with the mission and vision of KASP, the main reason for founding KASP is an economic basis and promoting a transition to a knowledge economy. According to Bin Taleb (2013), "The extent to which education helps in achieving the economic development depends on the standard and the quality of education and because scholarships for studying abroad is one of the educational areas which provide distinguished and sophisticated standard of education that contributing to the development of the cultural and educational standard on society. The economic return will undoubtedly be great (Bin-Taleb, 2013)."

[1] Ministry of Education, Saudi Arabia. [online] Available at: https://www.moe.gov.sa/en/news/Pages/an74.aspx

Education-Industry Linkage

Today, King Salman adopts a new method for the implementation of the scholarship program. This method makes a direct linkage between jobs and scholarships given to students to study majors needed by the country. It is based on the development of partnerships with public institutions to assess their needs of human resources, disciplines, and academic levels. Overseas scholarships are given accordingly. The goal of the new mechanism adopted is to properly distribute manpower resources and make sure that these resources are not focused in disciplines not linked to the needs of the labor market, and direct these resources to rare and required disciplines[2]. Also, it helps keeping pace with the fast-changing in the requirements of innovation and sustainable development, contributing to strengthening Saudi Arabia competitiveness and upgrading the country to the level of developed nations.

Government Entrepreneurship Programs

In 2007, the King Abdulaziz City for Science and Technology had launched an initiative the Badir Program for Technology Incubators[3] .Now, this program has five incubators spread across the cities of Riyadh, Jeddah, and Taif. The program aims to promote and enhance the culture of innovation and independent business amongst Saudi

[2] Ministry of Education, Saudi Arabia (2020). [online] Available at: https://www.moe.gov.sa/en/studyaboard/The%20CustodianOfTheTwoHolyMosquesOverseasScholarshipProgram/Pages/YourJobFirstAndThenYourScholarshipProgram.aspx

3 The Badir Program for Technology Incubators: https://www.badir.com.sa/en/about-us/

youth; it has served more than 200 startups since it launched. Their numbers are expected to increase soon (GEM, 2017).

Moreover, King Abdullah University of Science and Technology (KAUST) helps Saudi scientists and students, who are looking to spin out their inventions into new companies and making their business idea a reality[4]. It offers training and mentorship to entrepreneurs both on and off campus. The university targets Saudi business' owners who are interested in adopting an entrepreneurial approach to business growth. KAUST supports entrepreneurs at all the process: ideation, launch, funding and beyond. Also, it helps inventors to protect and commercialize their inventions. KAUST is supporting new ventures that have local or regional impacts and create jobs. Since entrepreneurship education contributes to building a culture of innovation and entrepreneurship, King Abdullah University of Science and Technology has an Entrepreneurship Center. It has an evolution program of the three-month-long, which helps to develop some of KAUST's first startups. Besides, there is another program of six months long and is mentor-led by a cadre of seasoned entrepreneurs and investors. The Jeddah Chamber of Commerce and Industry (JCCI) has started a business training program, which is entitled entrepreneurship education for young children[5]. The purpose of this program is spreading a culture of financial and commercial awareness among the younger generation and instill an entrepreneurial spirit in them from an early age. Also, it helps them to promote their ability for the implementation of future projects. Recently, forty young children aged between 10 and 15 years have participated in the program from different schools to learn

4 King Abdullah University of Science and Technology: https://innovation.kaust.edu.sa/entrepreneurs/
5 Jeddah Chamber of Commerce and Industry in Saudi Arabia: https://www.chamber-commerce.net/dir/3722/Jeddah-Chamber-of-Commerce-and-Industry-in-Jeddah

the basics of business skills under the supervision of the JCCI. This program was prepared by the youth's consultation and community department at the King Abdulaziz University.

Saudi Arabia's entrepreneurial ecosystem has been growing fast during the past seven years. Public and private sector got more involved in supporting the ecosystem. The entrepreneurial ecosystem improves the network and cooperation between the country cities and regions. However, the ecosystem has been implemented to be flexible and sustainable in order to bring various opportunities for startups. As a result, the country has started to have several rewarding industries for startups, including different industries such as healthcare and EdTech. For example; the EdTech industry, which is expected to grow by about 8% per year in Saudi Arabia (Assaf, 2017).

Small & Medium Enterprises General Authority SMEA (Monshaat)

Saudi government trying to simplify administrative framework and reduce barriers to encourage business entrepreneurship. Monshaat is launched by Saudi Arabia government to remove obstacles that are facing enterprises. It was established in 2016 (Assaf, 2017). The most important role of General Authority for Small and Medium Enterprises "Monshaat" is to address three challenges: human resources, government bureaucracy, financing opportunities, and apply mechanisms to address them through partnership with related entities, as SMEs are considered a key pillar in economic development anywhere in the world (Assaf, 2017). Monshaat is an accelerator and incubator firm that invests in small and medium enterprises. It supports the establishment of specialized companies in

financing, activates the role of banks and lending funds and stimulates them to play a larger and more effective role in financing and investing in enterprises (Assaf, 2017). The establishment of this General Authority for Small and Medium Enterprises and the support of its revenues reflects the keen interest of the policy makers in the importance of the SME sector as it believes in its role in increasing the contribution of GDP from 20% to 35% according to Kingdom's Vision 2030 (K. Salman, 2018). The Authority seeks to provide technical support, consultancy and development of small and medium enterprises. Also, it helps to increase enterprises' competitiveness in order to add value to the national economy (Assaf, 2017). That reflects the keen belief of the policy makers in small and medium enterprises has a major role in enhancing economy and economic diversification and contribute effectively to sustainable development, job creation and create a supportive and incubating environment for creativity and innovation.

Perspectives	**Value**	**Strategy Target**	**Weights**	**(VC) Score**	**Final Sore (Weight* VC)**	**Perspectives Sum**
Economic Feasibility Improvement	0.251	Responses to the Economic Crisis as Opportunities	0.098	70	6.86	16.54
		Tackling youth Unemployment	0.096	80	7.68	
		Taxes and Disciplining the Bureaucracy	0.05	40	2	
Technical System Development	0.221	Facilitating Access to Finance for Entrepreneurs	0.066	100	6.6	18.825
		Improving Physical and Services	0.055	80	4.4	

		Infrastructure	0.0583	70	4.081	
		Developing Positive Attitudes Towards Sustainability	0.0416	90	3.744	
		R&D Transfer				
Community Support Encouragement	0.193	Social Consciousness	0.0633	70	4.431	16.428
		Educational Levels on Sustainability	0.07	90	6.3	
		Innovation	0.0633	90	5.697	
		Government Entrepreneurship Programs and Transformative Activity				
Achieving Ethics and Social Responsibility	0.168	Social justice in Innovation	0.035	85	2.975	14.979
		Ethics in Technology Innovation and Human Wealth	0.0433	85	3.6805	
		Intellectual Property Rights	0.0333	95	3.1635	
		Stemming the Gender Gap	0.0516	100	5.16	
Improve Environmental Protection	0.165	Solving environmental problems and to reduce the costs	0.0833	40	3.332	7.327
		Appreciable reductions in environmental damage	0.085	47	3.995	
Total	1		1.000		74.099	

Table 36: Saudi Arabia's Innovation Ecosystem Assessment Score

8.1.2 China’s Innovation Ecosystems in Facilitating the Adoption of Sustainable

China is the second largest global economy with a gross domestic product (GDP) of 17.73 USD trillion (The World Bank, 2021), and it has the world's largest population (Gu & Liu 2022), China population is 1,4 billion (Hazarika et al.,2022). China’s economic transformation from a planned economy to a market economy started in 1978 (Naughton,1996) with the beginning of reform and Opening-Up policies (He et al., 2016). In 2015, the Chinese government started to adopt entrepreneurship and innovation as the new national economic development strategy, and the government has devoted formidable amounts of resources to innovative startups (He et al., 2019).

Economic Feasibility Improvement

The government of China launched Entrepreneurship and Innovation program to achieve the country’s goal to shift from labour-intensive manufacturing to growth driven by innovation (Cai, 2013). The government has also attached great importance to the core position of innovation in national economic development (Ding & Li, 2015).

Regulatory Implementation Considerations

The innovation ecosystem of China is characterized by the strong position of local government and official research institutes (Ding & Li, 2015). However, governance has been transformed from a government-run central management system for R&D projects to a macro-level coordination system of science and technology development (Liu et al., 2011). Also, universities are increasingly pursuing exciting joint projects with enterprises (Kang,2020). They are also setting up their own technology enterprises (Knox, 2020).

Technology parks and incubators connect entrepreneurs with local resources (Armanios et al., 2017). In this country, substantial resources, policy support and energy are being dedicated to upgrading value chains, improving technology and boosting innovation (Chi, 2011).

Government interference still is a key barrier to new venture creation in China, also, bureaucratic and regulatory burdens as key barriers to new businesses (Min et al., 2021).

Technical System Development

The government-owned Big banks control about 50% of the country's banking assets (Liu et al., 2022). Banks are the lenders of last resort for incubators in an environment marked by a fledgling stock market and lack of many other funding alternatives (Huang, 2021).

The incubation environment in China is rich in physical resources but needs to address the issue of deepening its management capability (Yuan et al., 2022). A government dominated banking sector that is averse to making small loans to undercapitalized new businesses is another hindrance for new ventures seeking to obtain risk capital.

Community Support Encouragement (Lyu, et al.,2021)

In vocational and higher education, there are an increasing number of forward-looking programs focusing on entrepreneurship. However, the rote learning and examination-oriented education model in colleges and universities is not conducive to creative thinking. Under the current system, scientific and technological engineers do not enjoy any real benefits from being innovative. Recently, China has been gradually reforming

the way in which higher education and research institutes are managed. Spending on basic research has increased and the government also funds institutes to carry out independent projects. The government has started a new strategy to raise the role of universities and research-related institutions. They play two vital roles in AI development: (i) the provision of talent, and (ii) and the production of knowledge, which are achieved not only by training new scientific and technological talent but also by conducting basic research (Mok et al., 2020).

Achieving Ethics and Social Responsibility

The Chinese government introduced relevant laws and regulations to create a pro-innovation legal environment (Jia et al., 2019). The IPR system, protection, and management have all been strengthened (Zhan & Cao, 2013). Although the present government of this country's efforts and policies on entrepreneurship education are strong and effective, the universities need to build an entrepreneurship education ecosystem, adopt appropriate education models, develop their own infrastructure and curriculum and invest in teacher training and practice activities (Yu, 2018). In innovation and entrepreneurship, access matters as much as capital and capabilities.

Improve Environmental Protection

The Chinese government is tackling environmental issues. For example, it launched a program in 2014 to upgrade about 100 environmental technologies and has developed

incentives and pollutant discharge standards for multiple industries (Cao et al., 2021). This is intended to reduce emissions of volatile organic compounds (Yin et al., 2015).

perspectives	Value	Strategy Target	Weights	(VC) Score	Final Sore (Weight* VC)	Perspectives Sum
Economic Feasibility Improvement	0.251	Responses to the Economic Crisis as Opportunities	0.098	70	6.86	10.28
		Tackling youth Unemployment	0.096	20	1.92	
		Taxes and Disciplining the Bureaucracy	0.05	30	1.5	
Technical System Development	0.221	Facilitating Access to Finance for Entrepreneurs	0.066	40	2.64	15.93
		Improving Physical and Services Infrastructure	0.055	60	3.3	
		Developing Positive Attitudes Towards Sustainability	0.0583	100	5.83	
		R&D Transfer	0.0416	100	4.16	
Community Support Encouragement	0.193	Social Consciousness	0.0633	34	2.1522	10.783
		Educational Levels on Sustainability Innovation	0.07	60	4.2	
		Government Entrepreneurship Programs and Transformative Activity	0.0633	70	4.431	

Achieving Ethics and Social Responsibility	0.168	Social justice in Innovation Ethics in Technology Innovation and Human Wealth Intellectual Property Rights Stemming the Gender Gap	0.035 0.0433 0.0333 0.0516	60 85 100 100	2.1 3.68 3.33 5.16	14.27
Improve Environmental Protection	0.165	Solving environmental problems and to reduce the costs Appreciable reductions in environmental damage	0.0833 0.085	47 70	3.9151 5.95	9.8651
Total	1		1.000		61.1281	

Table 37: China's Innovation Ecosystem Assessment Score

Table 36, and 37 show that the result of the research shows that case of Saudi Arabia has higher evaluation scores than China. The total evaluation score of case of Saudi Arabia is 74.099 out of 100 while the total evaluation score of China is 61.128 out of 100.

The Saudi Arabia performed high in the Technical, Economic and Social perspectives. These three perspectives were ranked the highest by perspectives. However, China performed higher in the Technical and Ethical perspectives. (See Table 38).

Perspectives	**Saudi Arabia**	**China**
Economic	**16.54**	**10.28**
Technical	**18.825**	**15.93**
Social	**16.428**	**10.783**
Ethical	**14.979**	**14.27**
Environmental	**7.327**	**9.8651**
Readiness Scores	74.099	61.128

Table 38: Case Application & Readiness Score

In the next section, we will point the strengths and weaknesses of each case which help to apply improvement simulation for both cases.

8.2 Strengths and Weaknesses

Table 39 shows up the strengths and weaknesses of each country. This comparison highlights how the model was able to capture different attributes that contribute to each case. On the other hand, Table 40 shows the strengths and weaknesses that appear in both cases.

The Case of Saudi Arabia	Strategy Targets	Strategy Targets Score	Value
Strengths	Social justice in Innovation	The government integrate positively social justice into its innovation strategy and achieve a positive economic change while remaining profitable for both individuals and the government	85
	Facilitating Access to Finance for Entrepreneurs	The level of challenge that the youth entrepreneurs often face in order to access start-up financing is low	100
	Tackling youth Unemployment	The innovation and entrepreneurship ecosystem is high promoting to inspire entrepreneurs to start their own business which helps to resolve the problem of unemployment	80
Weaknesses	Appreciable reductions in environmental damage	Implementing sustainable innovation practices has a medium Impact on oblige firms to reduce pollution and waste, consider the environment, and concomitantly raise their competitiveness	47
The Case of China	Strategy Targets	Strategy Targets Score	Value
Strengths	Developing Positive Attitudes Towards Sustainability	The government has full control and power to enhance citizens' response to promoting entrepreneurship for sustainable development	100

Weaknesses	Tackling youth Unemployment	The innovation and entrepreneurship ecosystem are mediocre promoting to inspire entrepreneurs to start their own business which helps to resolve the problem of unemployment	45
	Facilitating Access to Finance for Entrepreneurs	The level of challenge that the youth entrepreneurs often face in order to access start-up financing is from medium to high	40
	Social Consciousness	The community is partially willing to change existing and creating new social practices for building a sustainable economy and lifestyle	34

Table 39: The Strengths and Weaknesses of each Case

Combined	Strategy Targets	Strategy Targets Score
Strengths	Intellectual Property Rights	The degree of the support of intellectual property that is considered in the innovation ecosystem and support innovation and creativity is high to mature (intellectual property is aligned with innovation strategy goals)
	R&D Transfer	The government expenditure on R&D support the improvements to processes where efficiency can be increased, and costs reduced is high to optimal
	Stemming the Gender Gap	The level of innovation ecosystem impact on gender equality and their contribution to innovation and creativity is full Impact
	Responses to the Economic Crisis as Opportunities	The level of innovation ecosystem impact in entrepreneurs respond to the economic crises and seizing the opportunities that will inevitably appear is high to mature (innovation ecosystem supports responding to the Economic Crisis as Opportunities)
	Ethics in Technology Innovation and Human Wealth	Innovation and entrepreneurship ecosystem has the certainty to lead to more job and income opportunities and to more equal societal outcomes instead of blaming technology

Weaknesses	Solving environmental problems and reducing the costs	Implementing innovation ecosystem measures has some to medium impact to drive entrepreneurs, to internalize environmental externalities
	Taxes and Disciplining the Bureaucracy	There is some complexity of bureaucracy that impact creating the type of tax morale conducive to both tax compliance and economic development

Table 40: The Strengths and Weakness that are Similar between Saudi Arabia and China

8.3 Improvement Simulation

8.3.1 Improvement Simulation – Case of Saudi Arabia

The Saudi Arabia government sponsors the field of technology transfer, innovation, and entrepreneurship because of its effect on its knowledge economy. The government can use this knowledge for decision support systems to produce economic value in many different fields. However, Saudi Arabia is still needed to invest in science and research to continue developing the entrepreneurship ecosystem. For example, economic growth must be balanced with environmental protection. See Table 41.

Perspectives	Value	Strategy Target	Weight	VC Score	Score	New VC Score	New Score	Action
Economic Feasibility Improvement	0.251	Responses to the Economic Crisis as Opportunities	0.098	70	6.86	70	6.86	No Action
		Tackling youth Unemployment	0.096	80	7.68	80	7.68	No Action
		Taxes and Disciplining the Bureaucracy	0.05	40	2	80	4	Reconsidering the amounts of fees and fines, especially those related to municipalities and the departments of labor, and reducing the time for administrative reviews. Also, increasing areas for tax exemption.
Technical System Development	0.221	Facilitating Access to Finance for Entrepreneurs	0.066	100	6.6	100	6.6	No Action
		Improving Physical and Services Infrastructure	0.055	80	4.4	80	4.4	No Action
		Developing Positive Attitudes Towards Sustainability	0.0583	70	4.081	70	4.081	No Action
		R&D Transfer	0.0416	90	3.744	90	3.744	No Action
Community Support Encouragement	0.193	Social Consciousness	0.00633	70	4.431	70	4.431	No Action
		Educational Levels on Sustainability Innovation	0.07	90	6.3	90	6.3	No Action
		Government Entrepreneurship Programs and Transformative Activity	0.0633	90	5.697	90	5.697	No Action
Achieving Ethics and Social Responsibility	0.168	Social justice in Innovation	0.035	85	2.975	85	2.975	No Action
		Ethics in Technology Innovation and Human Wealth	0.0433	85	3.680	85	3.680	No Action
		Intellectual Property Rights	0.0333	95	3.163	95	3.163	No Action
		Stemming the Gender Gap	0.0516	100	5.16	100	5.16	No Action
Improve Environmental Protection	0.165	Solving environmental problems and to reduce the costs	0.0833	40	3.33	75	6.249	There is a need of implementing ecosystem measures that can drive entrepreneurs to internalize environmental externalities
		Appreciable reductions in	0.085	47	3.995	70	5.95	Organizations need to monitor major environmental issues

		environmental damage						and develop plans to deal with them.
Total					74.09		**80.97**	

Table 41: Improvement Simulation – Case of Saudi Arabia

8.3.2 Improvement Simulation – Case of China

The government attempted to provide a better environment for entrepreneurship and innovation, by lowering barriers, strengthening public services. However, the government needs to encourage college students, scientists and engineers to start new businesses. That is important to take advantage of human resource inputs to improve its entrepreneurship ecosystem and culture. Also, the government needs to facilitate access to finance for entrepreneurs. There is a need to ensure that financing initiatives match the needs of youth entrepreneurs and are suitable for the types of businesses that youth operate in order to facilitate access to start-up financing for youth entrepreneurs. For example, encouraging banking and financial institutions to provide loans as financing channels to support small businesses. See Table 42.

Perspectives	Value	Strategy Target	Weight	VC Score	Score	New VC Score	New Score	Action
Economic Feasibility Improvement	0.251	Responses to the Economic Crisis as Opportunities	0.098	70	6.86	70	6.86	No Action
		Tackling youth Unemployment	0.096	20	1.92	65	6.24	There is a need to take advantage of human resource inputs to improve its entrepreneurship ecosystem and culture by directly creating jobs, improving the “labor market” flexibility, and increasing spending on education.
		Taxes and Disciplining	0.05	30	1.5	63	3.15	There is a need to promote bureaucratic reform, such as

		the Bureaucracy						devolution, and privatization
Technical System Development	0.221	Facilitating Access to Finance for Entrepreneurs	0.066	40	2.64	60	3.96	There is a need to ensure that financing initiatives match the needs of youth entrepreneurs and are suitable for the types of businesses that youth operate in order to facilitate access to start-up financing for youth entrepreneurs.
		Improving Physical and Services Infrastructure	0.055	60	3.3	60	3.3	No Action
		Developing Positive Attitudes Towards Sustainability	0.0583	100	5.83	100	5.83	No Action
		R&D Transfer	0.0416	100	4.16	100	4.16	No Action
Community Support Encouragement	0.193	Social Consciousness	0.00633	34	2.152	50	3.165	There is a need to create a dynamic culture that encourages innovation and tolerates failure
		Educational Levels on Sustainability Innovation	0.07	60	4.2	60	4.2	No Action
		Government Entrepreneurship Programs and Transformative Activity	0.0633	70	4.431	70	4.431	No Action
Achieving Ethics and Social Responsibility	0.168	Social justice in Innovation	0.035	60	2.1	60	2.1	No Action
		Ethics in Technology Innovation and Human Wealth	0.0433	85	3.680	85	3.680	No Action
		Intellectual Property Rights	0.0333	100	3.33	100	3.33	No Action
		Stemming the Gender Gap	0.0516	100	5.16	100	5.16	No Action
Improve Environmental Protection	0.165	Solving environmental problems and to reduce the costs	0.0833	47	3.915	75	6.249	There is a need of implementing ecosystem measures that can drive entrepreneurs to internalize environmental externalities
		Appreciable reductions in environmental damage	0.085	70	5.95	70	5.95	No Action

Total					61.12		**71.765**	

Table 42: Improvement Simulation – Case of China

Tables 41 and 42 show actions suggested for each country, and how those actions will result in a higher score. The way the model is intended to work is by identifying the corrective actions, execute them, and then re-assess the status of the innovation ecosystem. Based on the new assessment, new corrective actions should be introduced. Moreover, value curves play a crucial role in this process. They help to identify what is the next level for each strategy and what is the optimal level for that strategy as well. Then, use those levels as goals to target as part of the improvement process.

8.4 Sensitivity Analysis

To better understand the dynamics of the model and the influence of each perspective. In this analysis, five scenarios are suggested, in each scenario, one of the perspectives is boosted with the assumption that it might turn out in reality that this is the most critical perspective (see Table 43).

Base	25.1%	22.1%	19.3%	16.8%	16.5%
Scenario 1: Economic Feasibility Improvement Emphasis	96%	1%	1%	1%	1%
Scenario 2: Technical System Development Emphasis	1%	96%	1%	1%	1%
Scenario 3: Community Support Encouragement Emphasis	1%	1%	96%	1%	1%
Scenario 4: Achieving Ethics and Social Responsibility Emphasis	1%	1%	1%	96%	1%
Scenario 5: Improve Environmental Protection Emphasis	1%	1%	1%	1%	96%

Table 43: Future Scenarios

Conducting sensitivity analysis with the cases. In order to analyze the impacts of potential changes in the values at any level of the model, a sensitivity analysis approach has been used to test the robustness of the model. This analysis aims to measure how the model's final output will react to changes in the relevance of criteria. Multiple scenarios were created to capture the result of the analyses. Each scenario alters the relevance of perspectives by boosting one of the perspectives and the same process will be repeated for the five perspectives. For example, the economical perspective boosted to be 0.96, while the remaining perspective's values will be 0.01 for each. The result of the five scenarios is summarized in the following tables.

Sensitivity Analysis - Economic Emphasis

Scenario 1: Economic Feasibility Improvement Emphasis (boosted to 0.96)

Perspectives	Value	Strategy Target	Local Weight	Global Weight	Saudi Arabia Score	China Score
Economic Feasibility Improvement	0.96	Responses to the Economic Crisis as Opportunities	0.39	0.3744	26.208	26.208
		Tackling youth Unemployment	0.382	0.36672	29.3376	7.3344
		Taxes and Disciplining the Bureaucracy	0.1999	0.191904	7.67616	5.75712
Technical System Development	0.01	Facilitating Access to Finance for Entrepreneurs	0.298	0.00298	0.298	0.1192
		Improving Physical and Services Infrastructure	0.248	0.00248	0.1984	0.1488
		Developing Positive Attitudes Towards Sustainability	0.263	0.00263	0.1841	0.263
		R&D Transfer	0.188	0.00188	0.1692	0.188

Community Support Encouragement	0.01	Social Consciousness	0.327	0.00327	0.2289	0.11118
		Educational Levels on Sustainability Innovation	0.36	0.0036	0.324	0.216
		Government Entrepreneurship Programs and Transformative Activity	0.327	0.00327	0.2943	0.2289
Achieving Ethics and Social Responsibility	0.01	Social justice in Innovation	0.2	0.002	0.17	0.12
		Ethics in Technology Innovation and Human Wealth	0.25	0.0025	0.2125	0.2125
		Intellectual Property Rights	0.196	0.00196	0.1862	0.196
		Stemming the Gender Gap	0.3	0.003	0.3	0.3
Improve Environmental Protection	0.01	Solving environmental problems and to reduce the costs	0.5	0.005	0.2	0.235
		Appreciable reductions in environmental damage	0.5	0.005	0.235	0.35
Total					66.22236	41.9881

Table 42: First Scenario of the Saudi Arabia Case and China Case Outcomes

Sensitivity Analysis - Technical Emphasis

Scenario 2: Technical System Development Emphasis (boosted to 0.96)

Perspectives	Value	Strategy Target	Local Weight	Global Weight	Saudi Arabia Score	China Score
Economic Feasibility Improvement	0.01	Responses to the Economic Crisis as Opportunities	0.39	0.0039	0.273	0.273
		Tackling youth Unemployment	0.382	0.00382	0.3056	0.0764
		Taxes and Disciplining the Bureaucracy	0.1999	0.001999	0.07996	0.05997
Technical System Development	0.96	Facilitating Access to Finance for Entrepreneurs	0.298	0.28608	28.608	11.4432
		Improving Physical and Services Infrastructure	0.248	0.23808	19.0464	14.2848

		Developing Positive Attitudes Towards Sustainability	0.263	0.25248	17.6736	25.248
		R&D Transfer	0.188	0.18048	16.2432	18.048
Community Support Encouragement	0.01	Social Consciousness	0.327	0.00327	0.2289	0.11118
		Educational Levels on Sustainability Innovation	0.36	0.0036	0.324	0.216
		Government Entrepreneurship Programs and Transformative Activity	0.327	0.00327	0.2943	0.2289
Achieving Ethics and Social Responsibility	0.01	Social justice in Innovation	0.2	0.002	0.17	0.12
		Ethics in Technology Innovation and Human Wealth	0.25	0.0025	0.2125	0.2125
		Intellectual Property Rights	0.196	0.00196	0.1862	0.196
		Stemming the Gender Gap	0.3	0.003	0.3	0.3
Improve Environmental Protection	0.01	Solving environmental problems and to reduce the costs	0.5	0.005	0.2	0.235
		Appreciable reductions in environmental damage	0.5	0.005	0.235	0.35
Total					84.38066	71.40295

Table 43: Second Scenario of the Saudi Arabia Case and China Case Outcomes

Sensitivity Analysis - Social Emphasis

Scenario 3: Community Support Encouragement Emphasis (boosted to 0.96)

Perspectives	Value	Strategy Target	Local Weight	Global Weight	Saudi Arabia Score	China Score
Economic Feasibility Improvement	0.01	Responses to the Economic Crisis as Opportunities	0.39	0.0039	0.273	0.273
		Tackling youth Unemployment	0.382	0.00382	0.3056	0.0764
		Taxes and Disciplining the Bureaucracy	0.1999	0.001999	0.07996	0.05997
Technical System Development	0.01	Facilitating Access to Finance for Entrepreneurs	0.298	0.00298	0.298	0.1192

		Improving Physical and Services Infrastructure	0.248	0.00248	0.1984	0.1488
		Developing Positive Attitudes Towards Sustainability	0.263	0.00263	0.1841	0.263
		R&D Transfer	0.188	0.00188	0.1692	0.188
Community Support Encouragement	0.96	Social Consciousness	0.327	0.31392	21.9744	10.67328
		Educational Levels on Sustainability Innovation	0.36	0.3456	31.104	20.736
		Government Entrepreneurship Programs and Transformative Activity	0.327	0.31392	28.2528	21.9744
Achieving Ethics and Social Responsibility	0.01	Social justice in Innovation	0.2	0.002	0.17	0.12
		Ethics in Technology Innovation and Human Wealth	0.25	0.0025	0.2125	0.2125
		Intellectual Property Rights	0.196	0.00196	0.1862	0.196
		Stemming the Gender Gap	0.3	0.003	0.3	0.3
Improve Environmental Protection	0.01	Solving environmental problems and to reduce the costs	0.5	0.005	0.2	0.235
		Appreciable reductions in environmental damage	0.5	0.005	0.235	0.35
Total					84.14316	55.92555

Table 44: Third Scenario of the Saudi Arabia Case and China Case Outcomes

Sensitivity Analysis - Ethical Emphasis

Scenario 4: Achieving Ethics and Social Responsibility Emphasis (boosted to 0.96)

Perspectives	Value	Strategy Target	Local Weight	Global Weight	Saudi Arabia Score	China Score
Economic Feasibility Improvement	0.01	Responses to the Economic Crisis as Opportunities	0.39	0.0039	0.273	0.273
		Tackling youth Unemployment	0.382	0.00382	0.3056	0.0764
		Taxes and Disciplining the Bureaucracy	0.1999	0.001999	0.07996	0.05997
Technical System Development	0.01	Facilitating Access to Finance for Entrepreneurs	0.298	0.00298	0.298	0.1192
		Improving Physical and Services Infrastructure	0.248	0.00248	0.1984	0.1488
		Developing Positive Attitudes Towards Sustainability	0.263	0.00263	0.1841	0.263
		R&D Transfer	0.188	0.00188	0.1692	0.188
Community Support Encouragement	0.01	Social Consciousness	0.327	0.00327	0.2289	0.11118
		Educational Levels on Sustainability Innovation	0.36	0.0036	0.324	0.216
		Government Entrepreneurship Programs and Transformative Activity	0.327	0.00327	0.2943	0.2289
Achieving Ethics and Social Responsibility	0.96	Social justice in Innovation	0.2	0.192	16.32	11.52
		Ethics in Technology Innovation and Human Wealth	0.25	0.24	20.4	20.4
		Intellectual Property Rights	0.196	0.18816	17.8752	18.816
		Stemming the Gender Gap	0.3	0.288	28.8	28.8
Improve Environmental Protection	0.01	Solving environmental problems and to reduce the costs	0.5	0.005	0.2	0.235
		Appreciable reductions in environmental damage	0.5	0.005	0.235	0.35

Total					81.80545	86.185

Table 45: Fourth Scenario of the Saudi Arabia Case and China Case Outcomes

Sensitivity Analysis – Environmental Emphasis

Scenario 5: Improve Environmental Protection Emphasis (boosted to 0.96)

Perspectives	Value	Strategy Target	Local Weight	Global Weight	Saudi Arabia Score	China Score
Economic Feasibility Improvement	0.01	Responses to the Economic Crisis as Opportunities	0.39	0.0039	0.273	0.273
		Tackling youth Unemployment	0.382	0.00382	0.3056	0.0764
		Taxes and Disciplining the Bureaucracy	0.1999	0.001999	0.07996	0.05997
Technical System Development	0.01	Facilitating Access to Finance for Entrepreneurs	0.298	0.00298	0.298	0.1192
		Improving Physical and Services Infrastructure	0.248	0.00248	0.1984	0.1488
		Developing Positive Attitudes Towards Sustainability	0.263	0.00263	0.1841	0.263
		R&D Transfer	0.188	0.00188	0.1692	0.188

Community Support Encouragement	0.01	Social Consciousness	0.327	0.00327	0.2289	0.11118
		Educational Levels on Sustainability Innovation	0.36	0.0036	0.324	0.216
		Government Entrepreneurship Programs and Transformative Activity	0.327	0.00327	0.2943	0.2289
Achieving Ethics and Social Responsibility	0.01	Social justice in Innovation	0.2	0.002	0.17	0.12
		Ethics in Technology Innovation and Human Wealth	0.25	0.0025	0.2125	0.2125
		Intellectual Property Rights	0.196	0.00196	0.1862	0.196
		Stemming the Gender Gap	0.3	0.003	0.3	0.3
Improve Environmental Protection	0.96	Solving environmental problems and to reduce the costs	0.5	0.48	19.2	22.56
		Appreciable reductions in environmental damage	0.5	0.48	22.56	33.6
Total					44.984	58.672

Table 46: Fifth Scenario of the Saudi Arabia Case and China Case Outcomes

In scenario 1, the economic perspective has been boosted to the maximum value of 96%. The result shows that the overall score for the Saudi Arabia case decreased from 74.099 to 66.22 and for the China case decreased as well from 61.128 to 41.98. Both cases were negatively affected. These changes suggest that if there are indications that economic perspective strategies are shown to be the most critical strategies in reality, then the readiness score is to be negatively affected and special considerations should be in place to improve the government performance in these areas. The ranking has not changed. See table 49.

Scenario 1: Economic Feasibility Improvement Emphasis		
	Saudi Arabia Case Score	**China Case Score**
	Score Change	
Original	74.099	61.128
Scenario	66.22	41.98
Change	-7.87	-19.14
	Ranking Change	
Original	1	2
Scenario	1	2

Table 47:Summarizes First Scenario Change of Scores

Table 50 demonstrates the changes in the overall score for Saudi Arabia case and China case. It provides the changes in the technical perspective scores.

Scenario 2: Technical System Development Emphasis		
	Saudi Arabia Case Score	**China Case Score**
	Score Change	
Original	74.099	61.128
Scenario	84.38	71.40
Change	10.281	10.272
	Ranking Change	
Original	1	2
Scenario	1	2

Table 48:Summarizes Second Scenario Change of Scores

In scenario 3, the social perspective has been boosted to the maximum value of 96%. The result shows that the overall score for the Saudi Arabia case increased from 74.099 to 84.14 while for China case negatively impacted which resulted in a decrease from 61.128 to 55.92. The favorable change for Saudi Arabia case suggests that if there are indications that social perspective strategies are shown to be the most critical strategies in reality, then it can be done with more confidence. Also, the Saudi Arabia case has shown that it has more community support encouragement capabilities in reality than China. The ranking has not changed. Table 51 shows the changes in the overall score for both cases and the changes in social perspective scores.

Scenario 3: Support Encouragement Emphasis		
	Saudi Arabia Case Score	**China Case Score**
	Score Change	
Original	74.099	61.128
Scenario	84.14	55.92
Change	10.04	-5.2
	Ranking Change	
Original	1	2
Scenario	1	2

Table 49:Summarizes Third Scenario Change of Scores

In the scenario 4, the ethical perspective has been boosted to the maximum value of 96%. The result shows that the overall score for the Saudi Arabia case increased from 74.099 to 81.80 and the China case increased as well from 61.128 to 86.18. The favorable change for both cases suggests that if there are indications that the ethical perspective strategies are shown to be the most critical strategies in reality, then both cases can be done with more confidence. Also, both cases have scored well in reality for this perspective. The ranking has changed. See table 52.

Scenario 4: Achieving Ethics and Social Responsibility Emphasis		
	Saudi Arabia Case Score	**China Case Score**
	Score Change	
Original	74.099	61.128
Scenario	81.80	86.18
Change	7.7	25.05
	Ranking Change	
Original	1	2
Scenario	2	1

Table 50:Summarizes Fourth Scenario Change of Scores

In scenario 5, the environmental perspective has been boosted to the maximum value of 96%. The result shows that the overall score for the Saudi Arabia case decreased from 74.099 to 44.984 and the China case decreased as well from 61.128 to 58.67. Both cases were negatively affected. These changes suggest that if there are indications that environmental perspective strategies are shown to be the most critical strategies in reality, then the readiness score is to be negatively impacted and special considerations should be in place to improve the innovation ecosystem in these areas. The ranking has changed as well. Table 53 shows the changes in the overall score for both cases and the changes in environmental perspective scores.

Scenario 5: Improve Environmental Protection Emphasis		
	Saudi Arabia Case Score	**China Case Score**
	Score Change	
Original	74.099	61.128
Scenario	44.984	58.67
Change	-29.11	-2.5
	Ranking Change	
Original	1	2
Scenario	2	1

Table 51: Summarizes Fifth Scenario Change of Scores

Scenario	**Boosted Perspective**	**Saudi Arabia Case Score**	**China Case Score**
Original Application	None	74.099	61.128
1	Economic	66.22	41.98
2	Technical	84.38	71.40
3	Social	84.14	55.92
4	Ethical	81.80	86.18
5	Environmental	44.98	58.67

Table 52: Sensitivity Analysis Summary

CHAPTER 9: DISCUSSION

This chapter introduces a discussion about the key findings from the results of the model validation and qualification and about the case study.

Assessment perspectives

Results from the expert panel showed that economic feasibility improvement was the most influential perspective for increasing the adoption of innovation in sustainable entrepreneurship. The fact that technical system development came second emphasizes improving the technical system in order to increase the adoption. Strategy targets are needed to be formed in a way that maximizes the benefits within these two perspectives.

The analysis of experts' opinions provided interesting results and provided insights into the actual important perspectives for increasing the adoption of innovation in sustainable entrepreneurship. Results showed that for increasing the adoption of innovation in sustainable entrepreneurship, increasing economic feasibility and the need for more development of the technical system for the effectiveness of innovation ecosystems are the two most influential variables. Experts from government and academia showed more interest in increasing the economic feasibility of innovation ecosystems which indicates that the government direction for facilitating and increasing the adoption of innovation in sustainable entrepreneurship is by supporting innovation ecosystems financially. The fact that the economic feasibility improvement perspective is the most important perspective confirms that poverty alleviation and the economic well-being and quality of life of a nation, region, local, or individual need to be improved. Analyzing the economic strategy targets further reveals that the government strategy

should support the economy to achieve the goals of development, full employment, and price stability. However, according to the experts' opinions, taxes and bureaucracy can be rated as intermediate inputs and do not have a great impact on the effectiveness of innovation ecosystems in facilitating the adoption of sustainable entrepreneurship.

Achieving Ethics and Social Responsibility and Environmental Protection have almost equal relative importance and ranked to be the least important one for increasing the adoption of sustainable entrepreneurship. This was discussed with experts, and they mentioned that current strategies need to consider more economic, technical, and social issues first and remedy them. Strategy planning always changes according to priorities.

Community Support Encouragement considerations is the third most important perspective for facilitating the adoption of sustainable entrepreneurship. This result signifies the fact that the innovation strategy cannot be effective without understanding the motivation of entrepreneurship behavior and future transitions that have to be done. This will lead entrepreneurs to consider a sustainability strategy necessary to foster their business longevity and that lead to creating new business processes for competitive and sustained economic country growth.

CHAPTER 10: CONCLUSIONS AND CONTRIBUTIONS

This chapter presents the conclusions of this research, with a discussion of how the research gap was addressed. Moreover, the limitations of this research are addressed, and how those limitations could lead to future research.

10.1 CONCLUSIONS

Sustainable entrepreneurship has a substantial role of a steadily growing economy and advanced industrial economies. Several strategies have been formed and employed to support the adoption of innovation and technologies in the sustainable entrepreneurship sector. However, the successful outcome of these strategies in achieving their goals depends on how effective they are in satisfying their objectives and thus increasing innovation adoption. For that, a comprehensive assessment decision model is needed to measure the effectiveness of the innovation ecosystem on increasing the adoption of innovation in sustainable entrepreneurship by examining the performance of every ecosystem from all perspectives. This research focuses on the evaluation of innovation ecosystem strategy effectiveness on sustainable entrepreneurship adoption using the hierarchical decision model (HDM). This was done by addressing three main research gaps and three main research questions. The first research gap was the current assessment models consider the limited point of view. This research gap was addressed by presenting the HDM model is a comprehensive and structured assessment method to evaluate innovation ecosystem strategy effectiveness in sustainable entrepreneurship adoption. The second research gap was there is not a comprehensive multi-criteria decision-making

model that measures the effect of the innovation ecosystem on the input of the sustainable entrepreneurship adoption process in a qualitative, quantitative, and systematic way. This model includes different sixteen strategy targets under five main perspectives with their relative weights and provids desirability curves to measure each criterion. The third research gap was most literature presents case studies or single criterion methodology emphasis on the current situation. These studies have a lack of sensitivity analysis for macro and micro alteration. The impacts of changing priorities in future strategy planning areas and the analysis of different scenarios are not completely explored. This research gap was addressed by using sensitivity analysis through the HDM model, insight into time effect and priority changes on decisions variables importance is provided. Moreover, the HDM model has the ability to be generalizable and can utilize in different regions. Also, in this research, the desirability curves methodology is implemented. This methodology will help the researcher in the future to consider any additional alternatives. As it is mentioned before, Desirability Curve describes how desirable a certain assessment variable is for the decision-maker according to expert judgments. Applying these curves will also help the researcher to compare new alternatives by using the same model frame. Furthermore, the scenario analysis will be helpful to determine the impact of future changes in regional emphasis priorities on the adoption of sustainable entrepreneurship. The first research question that was answered: "what are the strategy targets for assessing the effectiveness of innovation ecosystems on increasing the adoption of innovation in sustainable entrepreneurship?". This research question was answered through the final HDM, which identified a set of perspectives and strategy

targets influencing the innovation ecosystem for the adoption of sustainable entrepreneurship as shown in section 5.1.2.2 and 5.1.2.3. The second research question that was answered: "what is the current innovation ecosystem employed to increase the adoption of innovation in entrepreneurship?". The literature review indicates that the ways in which the adoption of innovation for sustainable entrepreneurship is limited by certain perspectives and challenges, as well as how it supports increasing degrees of entrepreneurial development, see chapter two. The third research question that was answered: "which innovation ecosystem strategy has the highest impact on accelerating sustainable entrepreneurship?". Economic Feasibility Improvement is the most important perspective with respect to the mission Entrepreneurs have a substantial role in economic development and include poverty alleviation and the economic well-being and quality of life of a nation, region, local, or an individual are improved. Worldwide, policymakers recognize the value of innovation and sustainable entrepreneurship. The purpose of an economic feasibility improvement as a perspective with respect to the mission is to demonstrate the net benefit of the strategy for accepting or disbursing funds/benefits and to measure the legitimacy of using national resources for certain projects, considering the benefits and costs to the organization, government agencies, and the general public as a whole.

10.2 CONTRIBUTIONS

The Theoretical Contributions of this study are defined below:

1. The academic literature shows that there is a lack of a comprehensive multi-criteria decision making the model that measures the effectiveness of the innovation ecosystem on the input of the sustainable entrepreneurship adoption process in a qualitative, quantitative and comprehensive way, from various perspectives. Developing a comprehensive assessment framework that can be utilized for evaluating the effectiveness of the innovation ecosystem on increasing the adoption of innovation in Sustainable entrepreneurship is the major contribution of the proposed research in order to fulfill the research gap.
2. The comprehensive framework that is proposed in this research is the first assessment tool that is able to consider a larger number of perspectives and assess their weights of impacts as well as associate with sensitivity analyses to make an estimate of multiple scenarios.
3. The innovation and entrepreneurship sector are probably the most significant factor driving the evolution of global competition (Windrum, 2008). The outcomes of the proposed research will grow the contribution of the ETM in the public sector in general and government intervention.
4. The proposed research will provide a more exhaustive framework of analysis that will take into account future uncertainties and the effect of future changes in the

sustainability planning and innovation ecosystem priorities on ranking innovation strategy tools.

Practical Contributions of The Research to The Industry in General

1. Assessing and prioritizing innovation strategy instruments in terms of their contribution to the mission of increasing adoption of sustainable entrepreneurship will be useful for measuring the effectiveness of the innovation ecosystem and can be applied as a strategy check tool.
2. The proposed framework will help decision-makers in the public sector classify and organize their priorities and supports their judgment through the identification of the critical strategy targets that require to be accurately addressed to facilitate the adoption of the innovation and ensure the increasing adoption of sustainable entrepreneurship.
3. The proposed model will enable governmental entities to evaluate the innovation ecosystem comprehensively from multiple perspectives.

Methodological Contributions

This research will evaluate innovation ecosystem tool effectiveness in terms of its increasing adoption of sustainable entrepreneurship. This is useful for innovation planning and situation assessment. It also can be utilized as a strategy check tool. The assessment model contained a set of variables and elements that are of significance for sustainable entrepreneurship adoption. These variables are identified as significant variables that have an impact on the input of the adoption process that can drive the adoption rather than maximizing the results of such adoption. Besides assessing the current innovation ecosystem, the proposed model can test future innovation strategy planning perspectives and their impact on policymaking. This research provides a more exhaustive framework of analysis that can develop scenarios to clearly show how this tool can be applied to different situations. This assessment model is flexible to provide insight into what the outcomes would be in the condition of any future changes.

In this research, the HDM model has been chosen as a beneficial methodology to obtain clear judgments and provide a better understanding of what is really critical for decision-makers and experts in the innovation and entrepreneurship field. Using this methodology, a new innovation ecosystem evaluation approach will be developed and validated. This methodology can consider multiple perspectives. It also considers the input of multiple decision-makers and stakeholders. Furthermore, The HDM model has the ability to assess individual and group rankings of the perspectives for comprehensive analysis, in a qualitative, quantitative, and systematic way.

CHAPTER 11: LIMITATIONS AND FUTURE WORK

11.1 LIMITATIONS

This study provides a comprehensive approach that takes account of the effectiveness of innovation ecosystems to increase the adoption of innovation in sustainable entrepreneurship, assessing the strategy targets weights of impact as well as those associated with desirability matrices and sensitivity analyses to estimate multiple scenarios. The structure of the model is ready for future use and should not change significantly. However, the model can be expanded to other types of strategy targets and relative importance can be re-evaluated by collecting new judgment quantifications from new experts. Sensitivity analysis can help minimize this limitation and give more accurate perception of future changes, but it is not enough just by itself to address the impact of changing variables.

Also, in this research, with limited access to a larger group of subject matter experts, the judgments of experts may get impacted by biases. Conducting suitable procedures in the formatting of the expert panels and the analysis of the results helps to minimize that.

11.2 FUTURE WORK

This research focused on an evaluation of the effectiveness of innovation ecosystems in facilitating the adoption of sustainable entrepreneurship using the hierarchical decision model and provided a comprehensive literature review which covers strategy and policy that may change over time, depending on planning and policy needs. The proposed research could be expanded by integrating the differences and potentials of several strategy targets in line with future priorities. Also, in future research, innovation ecosystem strategies toward digitalization will be considered. For example, Artificial Intelligence (AI) has not received much attention in innovation and sustainable entrepreneurship research yet.

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APPENDIX A: LETTERS OF INVITATION TO EXPERTS

Dear XXX,

My name is Dana Bakry, PhD student in Engineering and Technology Management Department (ETM) at Portland State University (PSU). I am conducting my dissertation research entitled "Evaluation of Innovation Ecosystem for the Adoption of Sustainable Entrepreneurship".

As part of my research, I am forming expert panels to help me validate and quantify my research model. I have identified you as an expert in the field. Your knowledge, background, experience, and expertise will be very helpful for my research.

If you agree to participate in this research, please sign the consent form that is attached to this email. After I receive the signed form, I will send you web-based data collection instruments for you to provide your response. The research instruments will take about 5~15 minutes each to complete.

I will be honored if you could accept my invitation and join the expert panel. I would also appreciate greatly if you could suggest other experts who have expertise or experiences in the innovation strategy and entrepreneurship field.

I look forward to receiving your reply!

Best Regards,

Dana S. Bakry
PhD Student
Engineering and Technology Management Department (ETM)
Portland State University (PSU)
Phone: (949) 910-7481
Email: dbakry@pdx.edu

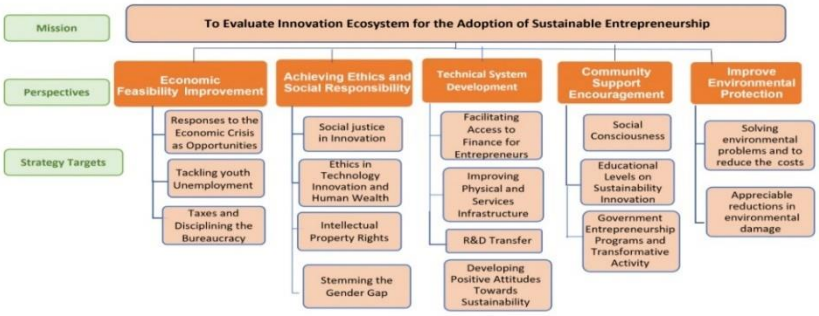
APPENDIX B: QUALTRICS SURVEYS TO VALIDATE THE MODEL

Research Model:

This model aims to evaluate the effectiveness of entrepreneurship and innovation ecosystem strategy on increasing the adoption of innovation in sustainable entrepreneurship.

Thank you for your valuable participation in evaluating my research model.

The first step is evaluating the perspectives that have been identified to assess and measure ecosystem innovation strategy overall performance.



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Validating the model's perspectives

Perspective	Description
Economic Feasibility	Entrepreneurs have a substantial role in economic development and include poverty alleviation and the economic well-being and quality of life of a nation, region, local, or an individual are improved. Worldwide, policymakers recognize the value of innovation and sustainable entrepreneurship (Cohen & Winn, 2007; Klofsten et al., 2019).
Achieving Ethics and Social Responsibility	Achieving ethics to entrepreneurship is a broad and ongoing initiative. There are many essential ethical issues in sustainable entrepreneurship development such as promoting conduct based on integrity and that engenders justice (Manzini, 2006). Also, there are some complicated issues such as accommodating diversity, empathetic decision-making, and compliance and governance consistent with the economic values of social life (Lundvall, & Borrás, 2005; Özdemir & Springer, 2018)
Community Support Encouragement	Community support encouragement affects sustainability innovation and entrepreneurship. It allows creating new business processes for competitive and sustained economic country growth (Ueda, et al., 2009). It has played an increasing role in understanding the motivation of entrepreneurship behavior and future transitions that have to be done for sustainable entrepreneurship and development (Guerrero, Cunningham & Urbano, 2015; Klofsten et al., 2019).
Technical System Development	Realizing the innovation and technological changes and the need for technical development is important for improving current strategy and future strategy planning. The goals that are listed under this perspective are important to encourage entrepreneurs for promoting sustainable entrepreneurial activity. This variable measures the importance of a strategy to support development in the technical development to be considered efficient in increasing the adoption of sustainable entrepreneurship (Mason & Brown, 2014; Farinha & Ferreira, 2017; Wang et al., 2020).
Improve Environmental Protection and Productivity Growth	Environmental protection is the main concern of the future of humanity. Entrepreneurship and innovation provide sustainable business. These businesses are providing innovative solutions to meet many challenges (Rodriguez et al., 2002). One of these challenges is environmental. The environment is critical for both society and businesses together (Youssef et al., 2018; Iqbal et al., 2020).

Please click "Yes" if you think that the specific perspective has been identified is necessary for Evaluation of Innovation Ecosystem for the Adoption of Sustainable Entrepreneurship, and "No" if you think that the specific perspective has been identified is not necessary for Evaluation of Innovation Ecosystem for the Adoption

Responsibility

Technical System Development

Community Support Encouragement

Improve Environmental Protection

- Yes
- No

If there are any other perspectives that you think should be considered in this model, please list them below:

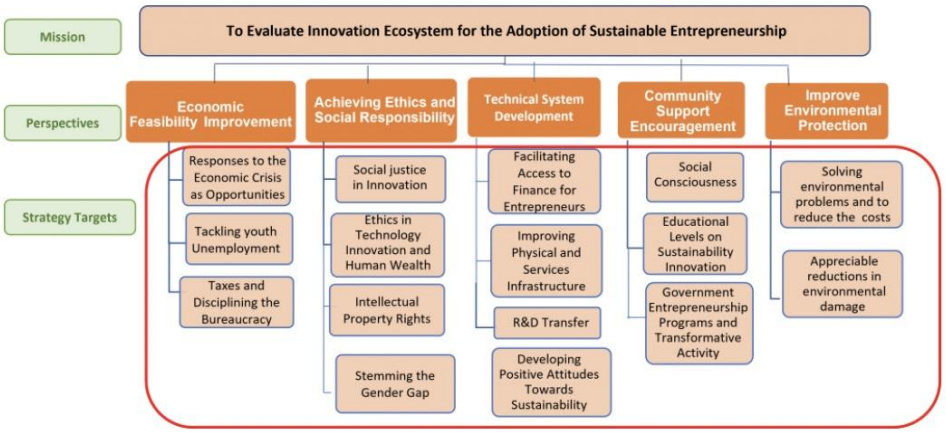
→

sustainable entrepreneurship.

Thank you for your valuable participation in evaluating my research model.

The second step is evaluating the strategy targets (criteria) that have been identified to assess and measure ecosystem innovation strategy overall performance

Validating the model's criteria



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Economic Perspective

Responses to the Economic Crisis as Opportunities

Tackling Youth Unemployment

Taxes and Disciplining the Bureaucracy

- ○ Yes
- ○ No

If there are any other criteria that you think should be considered in this model, please list them below:

→

Please click "Yes" if you think that the specific criteria have been identified under each perspective are necessary for Evaluation of Innovation Ecosystem for the Adoption of Sustainable Entrepreneurship, and "No" if you think that the specific criteria have been identified are not necessary for Evaluation of Innovation Ecosystem for the Adoption of Sustainable Entrepreneurship.

Economic Perspective	
Responses to the Economic Crisis as Opportunities	Economic crises are considered a factor that increases the probability of success for new business innovation and opportunity recognition. Deep economic shocks generate the need for local adaptation by identifying new opportunities for growth (Bishop, 2019). However, government strategy should support the economy to achieve the goals of development, full employment, and price stability (Mitchell & Muysken, 2010). Entrepreneurship and innovation can be drivers of economic growth and organizational renewal (Rüdiger, Peris-Ortiz, & Blanco-González, 2014). When entrepreneurs find the chance to thrive, they are going to respond to the shortage market equilibrium by seizing the opportunities that will inevitably appear (Kirzner & Sautet, 2006). They will create solutions to these opportunities and solve social and environmental problems.
Tackling youth Unemployment	Implementing an innovation ecosystem and supporting the potential of young entrepreneurs is a great way to create jobs. One of the economic problems is unemployment, and it becomes more serious when the rate of unemployment rises among young people. Inspiring entrepreneurs and developing the entrepreneurship ecosystem helps to resolve the problem of unemployment.
Taxes and Disciplining the bureaucracy	According to the GEM conceptualization, "taxes and bureaucracy reflect the degree to which experts think current taxes are affordable and balanced for entrepreneurs, or whether they constitute a burden to starting and growing businesses. The innovation ecosystem should target the welfare economy and eliminate bureaucratic selfishness (Ott, 2006) (Bhatt, Sharma & Kaushal, 2020).

Please Validate the criteria included in the Economic Perspective

Responses to the Economic Crisis as Opportunities

Ethical Perspective	
Social justice in Innovation	Social justice in innovation is that everyone in society has the responsibility and right to create a better world by attempting to quantify and incorporate certain elements of social value. Since social justice was considered as an essential perspective informing the analyses of educational practices that seek to make education relevant to the understanding of social issues and the contexts in which these problems occur (Ayers, 2004), implementing the entrepreneurship programs in education equally contributes to making a positive economic change while remaining profitable for both individuals and the government (Bakry, Khalifa & Dabab, 2019). Social justice is served when the benefits and policies in society are distributed in congruence with principles that rational people would accept as proportionate to their interests (Oppenheimer, 2012) as well as entrepreneurship supportive policies. Accordingly, sustainable entrepreneurship is an integral part of a social system (Janssen et al., 2018).
Ethics in Technology Innovation and Human Wealth	Government regulations might support technology and innovation. Eventually, the way of dealing with the regulation of emerging technologies will definitely have wide implications. This is not for security and ethics only; it is also for the definition of human dignity and the equality of individuals. Individuals are considered as a resource. That means this individual has some potential advantages that are essential for organizational needs in the way of affecting the organizational, social, and national goals (Clegg et al., 1997). Nowadays, with the economic volatility and changeability, every factor of the process of developing is being re-examined for its value in creating and supporting successful growth. In the past, human wealth has been described in the form of individual knowledge, talents, skills, and other characteristics (Ployhart, 2015). However, in the previous decade, the researchers have investigated human wealth as a cooperative resource that can participate in economic performance and competitive advantage (Nyberg et al., 2014).
Intellectual Property Rights (IPR)	An intellectual property right is considered as part of such institutional frameworks that create the necessary conditions for entrepreneurship and innovation progress and economic growth (Neves et al., 2021). The existence of intellectual property law with planned benchmarks that are applied by different public institutions to small innovative enterprises is one of the reasons for the efficient use of domestic sources (Zakieva et al., 2019). It helps to prevent the occurrence of unsystematic and spontaneous support, which leads to a conflict of various development and implementation.
Stemming the Gender Gap	This variable measures the importance of enhancing a gender lens to innovation and sustainable entrepreneurship. Both women and men have a major role to promote innovation and be a part of sustainable development (Abreu, 2020). Policymakers need to recognize the importance of gendered innovations for sustainable development.

Please Validate the criteria included in the Ethical Perspective

Social justice in Innovation

- ○ Yes
- ○ No

Ethics in Technology Innovation and Human Wealth

Intellectual Property Rights (IPR)

Social Perspective	
Social Consciousness	Social consciousness can affect sustainable enterprise and innovation. This will lead entrepreneurs to consider a sustainability strategy necessary to foster their business longevity. Also, it will help to keep customers coming back for more. Innovative and sustainable consciousness has a role in overcoming crisis situations.
Educational Levels on Sustainability Innovation	Education has a role in the formation of people's thinking to shape and transform social reality towards sustainable development. It has a particularly crucial role to instill the concept of sustainability in the next generations (Komiyama & Takeuchi, 2006). Basically, the economy of the country relies on the standard of education that it provides to the human resources (Robertson & Dale, 2015). Furthermore, high education and science levels are considered as one of the factors that are necessary to deal with sustainability entrepreneurship issues. Science can help the sustainability transition by giving knowledge and directing for navigating the journey from unsustainable contemporary patterns to a sustainable future (Uvarova, Mavlutova & Atstaja, 2021).
Government Entrepreneurship Programs and Transformative Activity	Establishing innovation entrepreneurship programs is important to promote and enhance the culture of sustainable entrepreneurship amongst youth (Lee, C., Hallak & Sardeshmukh, 2016). The government always looks for making the most of the potential of the country workforce by encouraging a culture of high performance. For that, the implementation of new programs focused on innovation and sustainability is very important to develop the entrepreneurial mindset in their leaders and employees.

Please Validate the criteria included in the Social Perspective

Social Consciousness

- ○ Yes
- ○ No

Educational Levels on Sustainability Innovation

Government Entrepreneurship Programs and Transformative Activity

If there are any other criteria that you think

Environmental Perspective	
Solving environmental problems and reduce the costs	Environmental regulations have important roles in addressing many environmental problems. According to Mont & Lindhqvist, usually, company owners do not account for external factors in market prices. In this case, they do not take into account these factors when they take action or make decisions about product design (Mont & Lindhqvist, 2003). For that reason, there is a need of implementing ecosystem measures that can drive entrepreneurs to internalize environmental externalities. That can help to stimulate the decrease in these costs and related harmful environmental influences through various measures such as introducing pollution charges or taxes.
Appreciable reductions in environmental damage	Sustainable innovation practices have positive and remarkable impacts on environmental performance. A business that involves sustainable innovation will generate better environmental performance (Weng, Chen & Chen, 2015). Firms can reduce pollution and waste, consider the environment, and concomitantly raise their competitiveness by implementing sustainable innovation practices.

Please Validate the criteria included in the Environmental Perspective

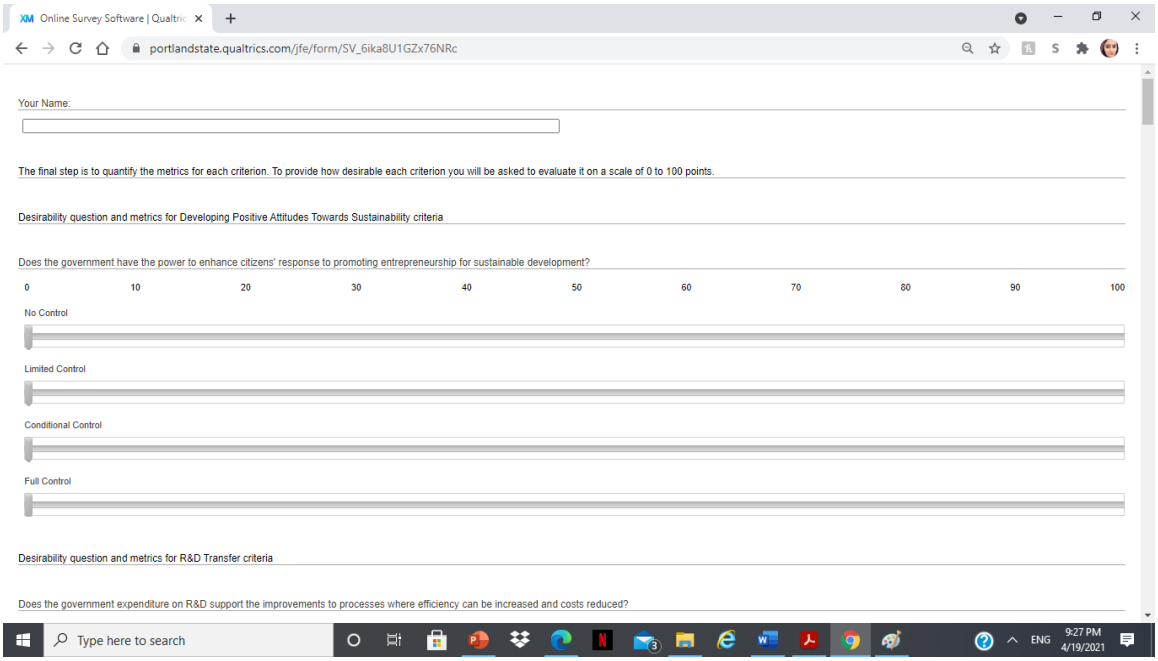
Solving environmental problems and to reduce the costs

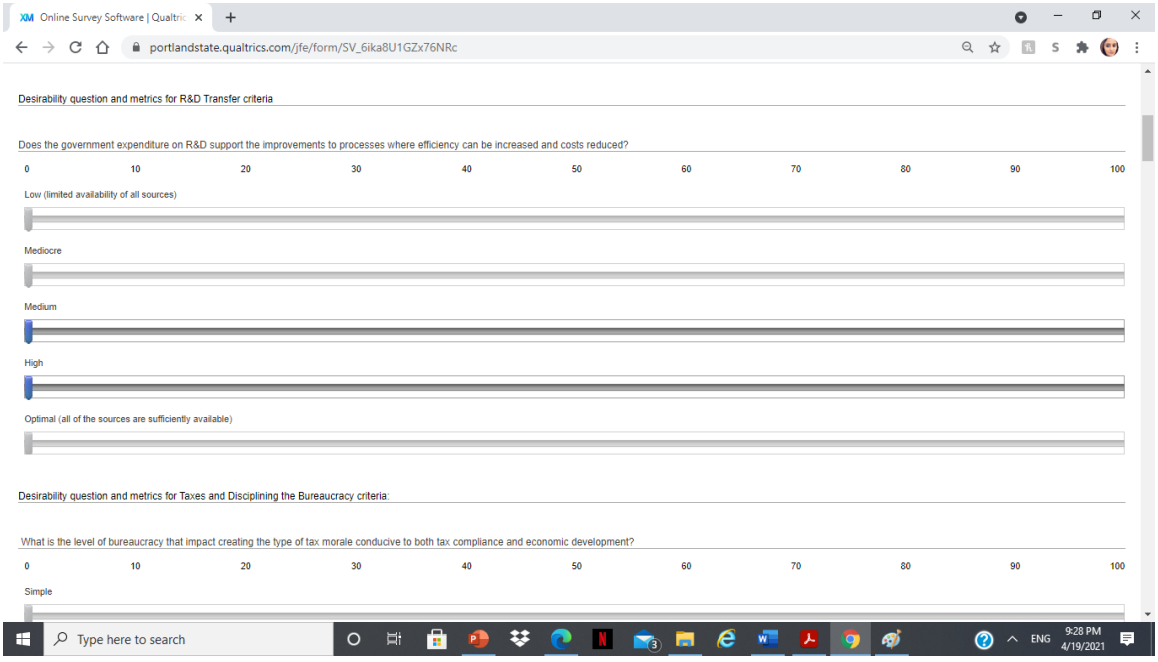
- ○ Yes
- ○ No

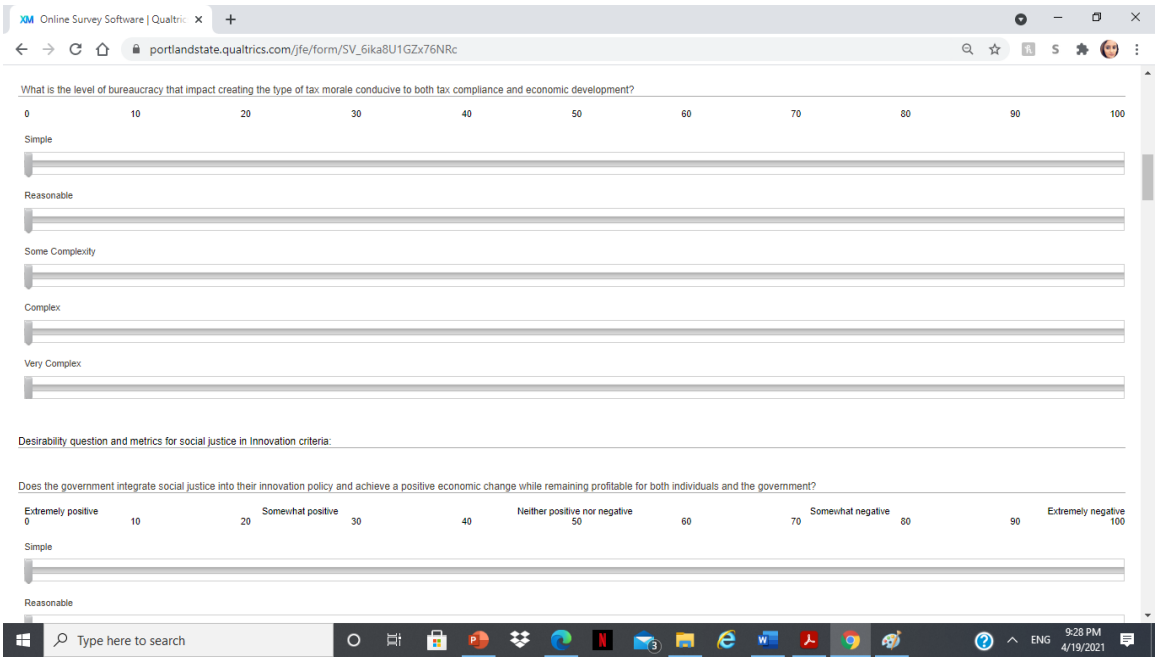
Appreciable reductions in environmental damage

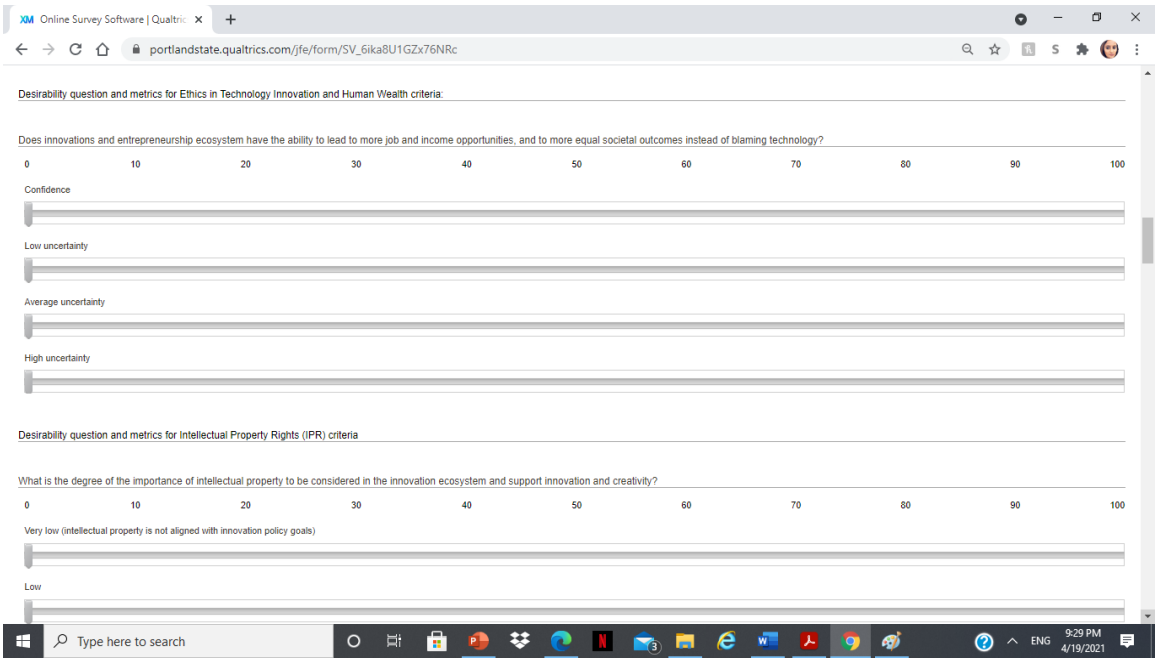
If there are any other criteria that you think should be considered in this model, please list them below:

APPENDIX C: THE DESIRABILITY VALUES QUANTIFICATION SURVEY






Online Survey Software | Qualtric
portlandstate.qualtrics.com/jfe/form/SV_6ika8U1GZx76NRc
What is the level of bureaucracy that impact creating the type of tax morale conducive to both tax compliance and economic development?
0 10 20 30 40 50 60 70 80 90 100
Simple
Reasonable
Some Complexity
Complex
Very Complex
Desirability question and metrics for social justice in Innovation criteria:
Does the government integrate social justice into their innovation policy and achieve a positive economic change while remaining profitable for both individuals and the government?
Extremely positive
Somewhat positive
Neither positive nor negative
Somewhat negative
Extremely negative
0 10 20 30 40 50 60 70 80 90 100
Simple
Reasonable
Type here to search
ENG
9:28 PM
4/19/2021


Online Survey Software | Qualtric
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Desirability question and metrics for Ethics in Technology Innovation and Human Wealth criteria:
Does innovations and entrepreneurship ecosystem have the ability to lead to more job and income opportunities, and to more equal societal outcomes instead of blaming technology?
0 10 20 30 40 50 60 70 80 90 100
Confidence
Low uncertainty
Average uncertainty
High uncertainty
Desirability question and metrics for Intellectual Property Rights (IPR) criteria
What is the degree of the importance of intellectual property to be considered in the innovation ecosystem and support innovation and creativity?
0 10 20 30 40 50 60 70 80 90 100
Very low (intellectual property is not aligned with innovation policy goals)
Low
Type here to search
ENG
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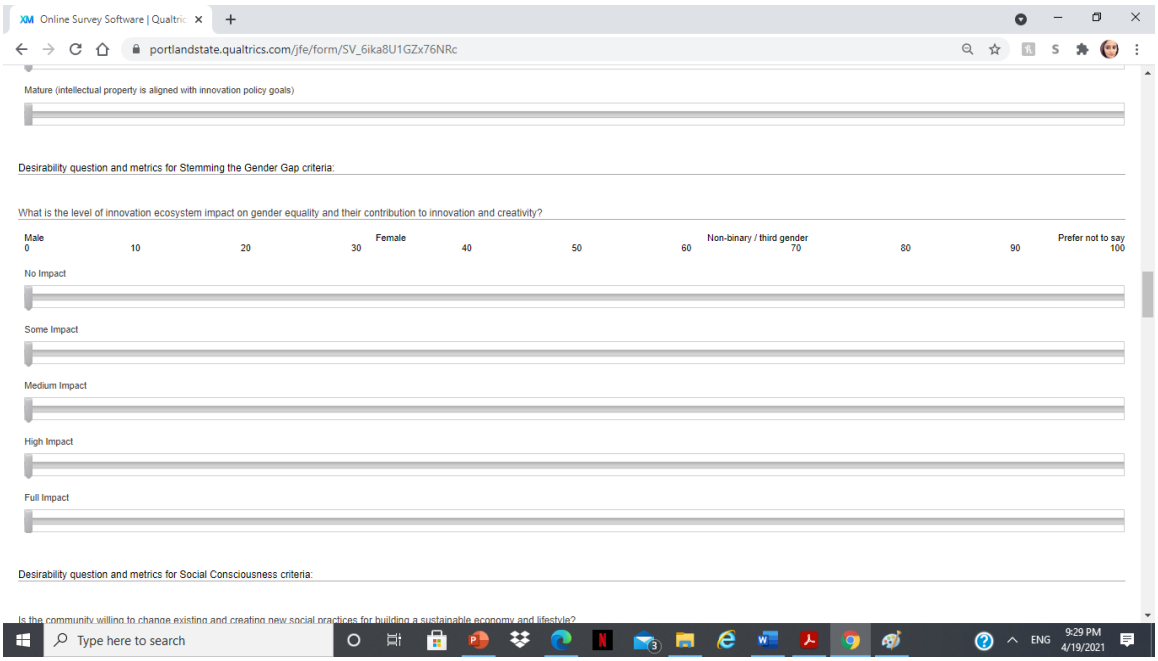
4/19/2021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Mature (intellectual property is aligned with innovation policy goals)
Desirability question and metrics for Stemming the Gender Gap criteria:
What is the level of innovation ecosystem impact on gender equality and their contribution to innovation and creativity?
Male
Female
Non-binary / third gender
Prefer not to say
0 10 20 30 40 50 60 70 80 90 100
No Impact
Some Impact
Medium Impact
High Impact
Full Impact
Desirability question and metrics for Social Consciousness criteria:
Is the community willing to change existing and creating new social practices for building a sustainable economy and lifestyle?
Type here to search
ENG
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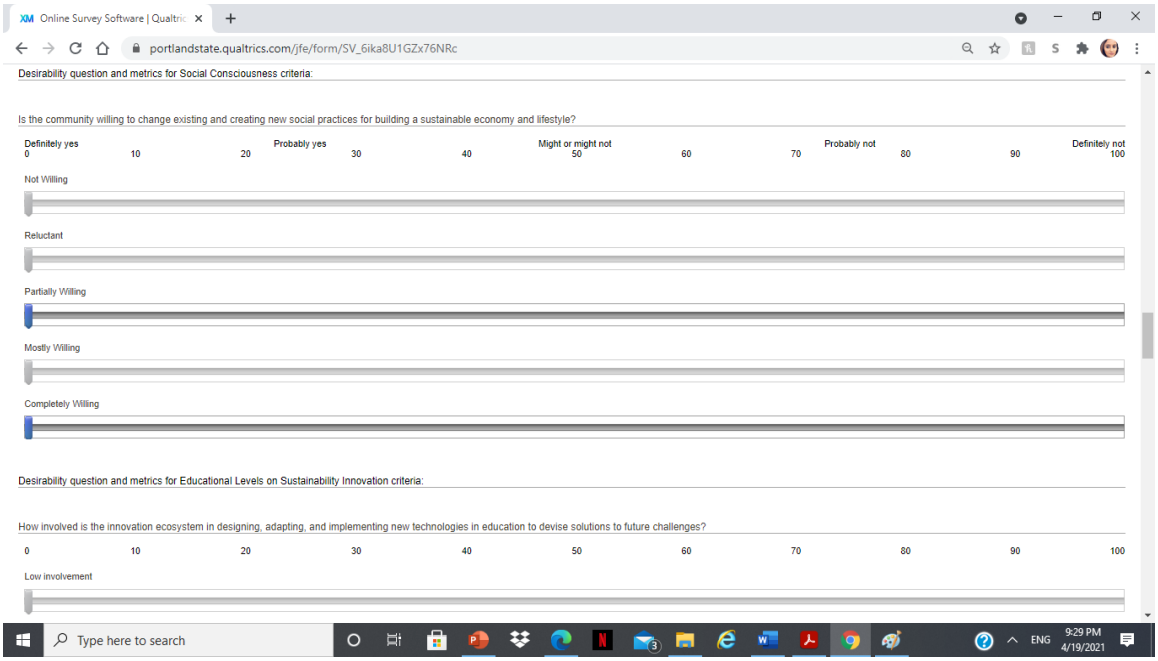
4/19/2021


Online Survey Software | Qualtric
portlandstate.qualtrics.com/jfe/form/SV_6ika8U1GZx76NRc
Desirability question and metrics for Social Consciousness criteria:
Is the community willing to change existing and creating new social practices for building a sustainable economy and lifestyle?
Definitely yes
Probably yes
Might or might not
Probably not
Definitely not
0 10 20 30 40 50 60 70 80 90 100
Not Willing
Reluctant
Partially Willing
Mostly Willing
Completely Willing
Desirability question and metrics for Educational Levels on Sustainability Innovation criteria:
How involved is the innovation ecosystem in designing, adapting, and implementing new technologies in education to devise solutions to future challenges?
0 10 20 30 40 50 60 70 80 90 100
Low involvement
Type here to search
ENG
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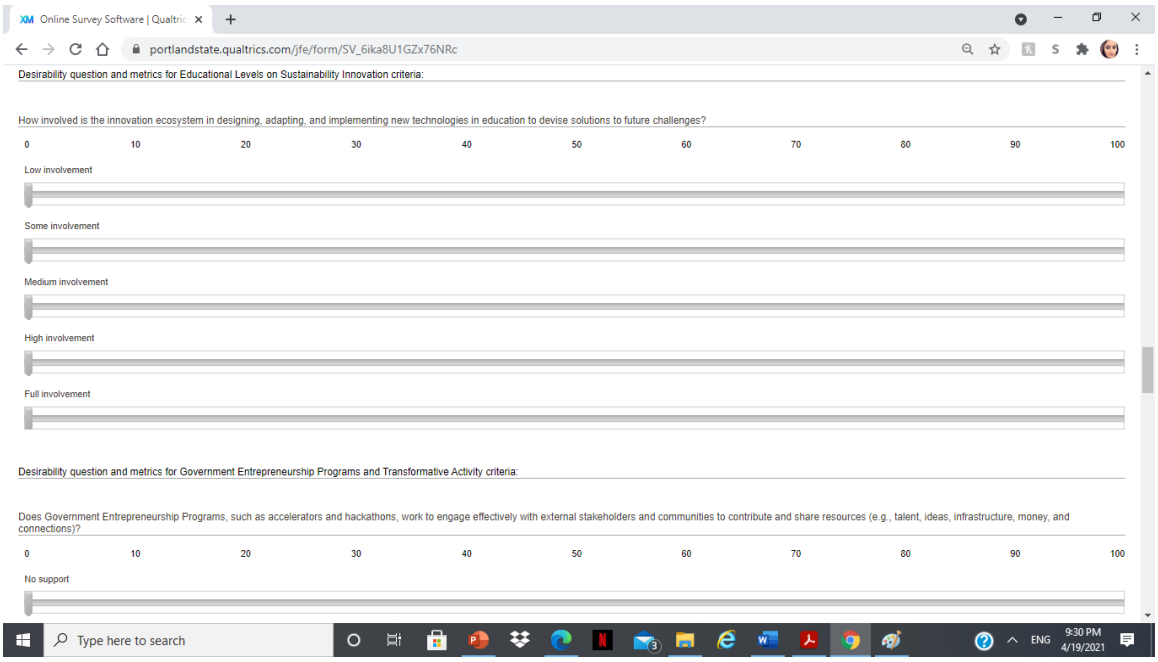
4/19/2021


Online Survey Software | Qualtric
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Desirability question and metrics for Educational Levels on Sustainability Innovation criteria:
How involved is the innovation ecosystem in designing, adapting, and implementing new technologies in education to devise solutions to future challenges?
0 10 20 30 40 50 60 70 80 90 100
Low involvement
Some involvement
Medium involvement
High involvement
Full involvement
Desirability question and metrics for Government Entrepreneurship Programs and Transformative Activity criteria:
Does Government Entrepreneurship Programs, such as accelerators and hackathons, work to engage effectively with external stakeholders and communities to contribute and share resources (e.g., talent, ideas, infrastructure, money, and connections)?
0 10 20 30 40 50 60 70 80 90 100
No support
Type here to search
ENG
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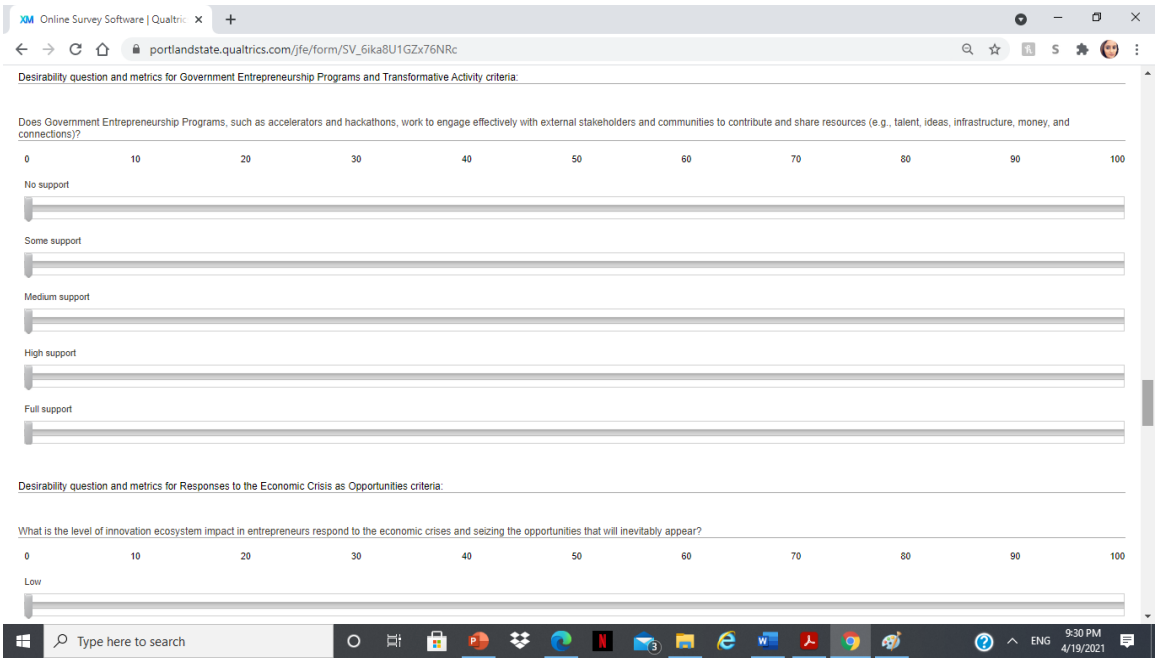
Online Survey Software | Qualtric
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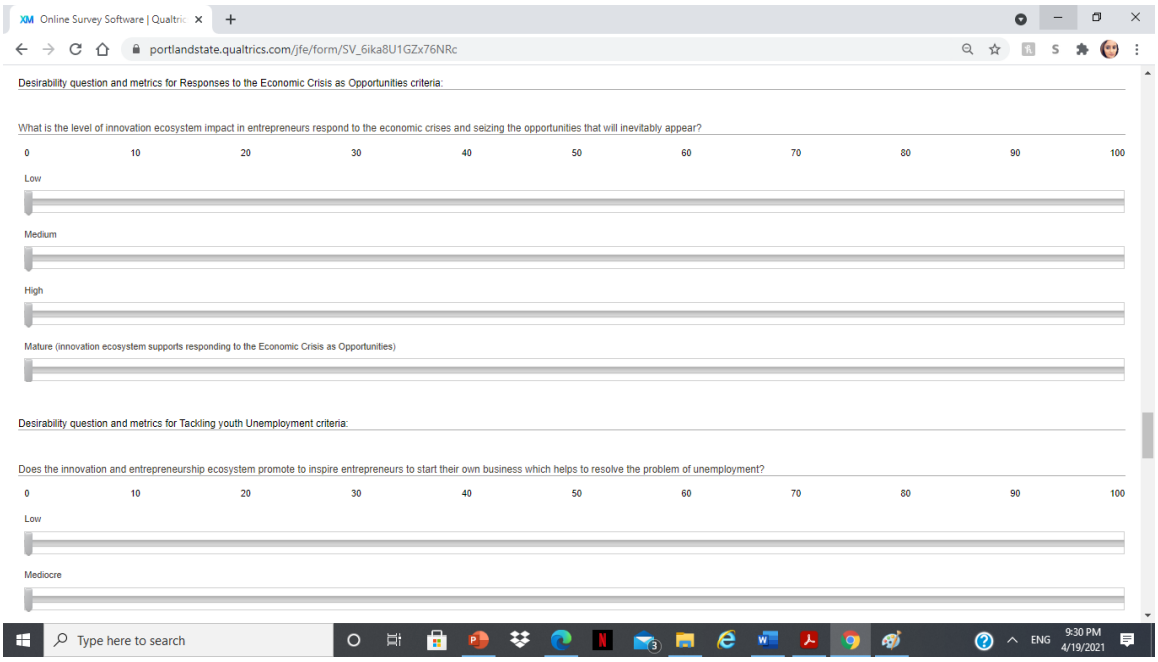
Desirability question and metrics for Government Entrepreneurship Programs and Transformative Activity criteria:
Does Government Entrepreneurship Programs, such as accelerators and hackathons, work to engage effectively with external stakeholders and communities to contribute and share resources (e.g., talent, ideas, infrastructure, money, and connections)?
0 10 20 30 40 50 60 70 80 90 100
No support
Some support
Medium support
High support
Full support
Desirability question and metrics for Responses to the Economic Crisis as Opportunities criteria:
What is the level of innovation ecosystem impact in entrepreneurs respond to the economic crises and seizing the opportunities that will inevitably appear?
0 10 20 30 40 50 60 70 80 90 100
Low
Type here to search
ENG
9:30 PM
4/19/2021


Online Survey Software | Qualtric
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Desirability question and metrics for Responses to the Economic Crisis as Opportunities criteria:
What is the level of innovation ecosystem impact in entrepreneurs respond to the economic crises and seizing the opportunities that will inevitably appear?
0 10 20 30 40 50 60 70 80 90 100
Low
Medium
High
Mature (innovation ecosystem supports responding to the Economic Crisis as Opportunities)
Desirability question and metrics for Tackling youth Unemployment criteria:
Does the innovation and entrepreneurship ecosystem promote to inspire entrepreneurs to start their own business which helps to resolve the problem of unemployment?
0 10 20 30 40 50 60 70 80 90 100
Low
Mediocre
Type here to search
ENG
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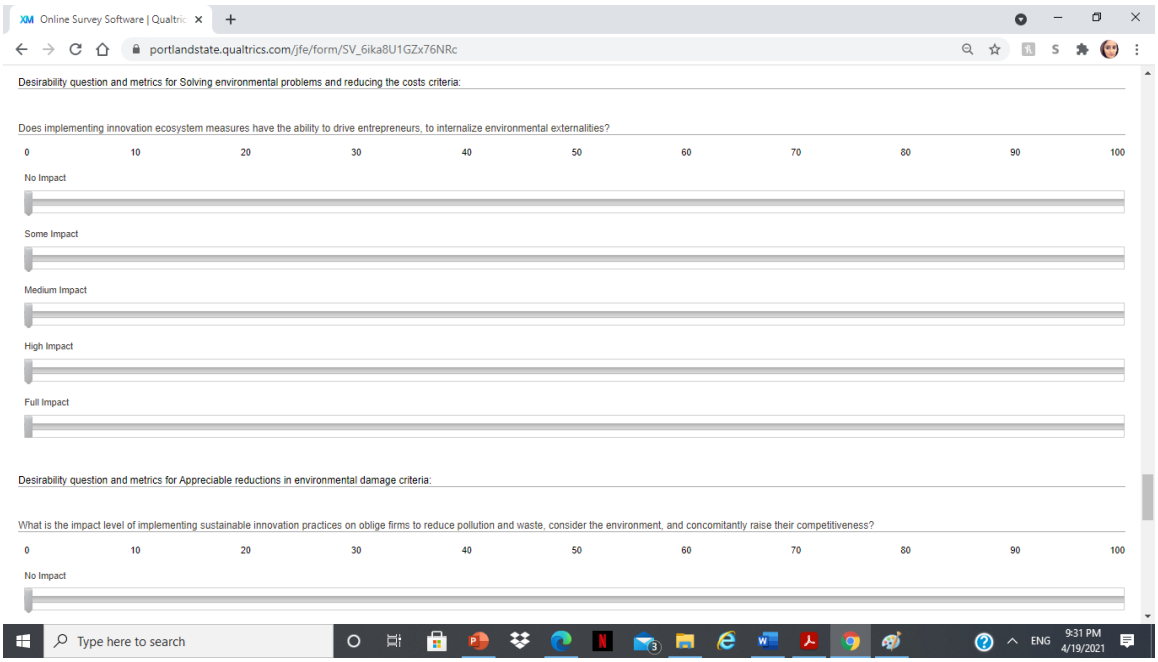
4/19/2021


Online Survey Software | Qualtric
portlandstate.qualtrics.com/jfe/form/SV_6ika8U1GZx76NRc
Desirability question and metrics for Solving environmental problems and reducing the costs criteria:
Does implementing innovation ecosystem measures have the ability to drive entrepreneurs, to internalize environmental externalities?
0 10 20 30 40 50 60 70 80 90 100
No Impact
Some Impact
Medium Impact
High Impact
Full Impact
Desirability question and metrics for Appreciable reductions in environmental damage criteria:
What is the impact level of implementing sustainable innovation practices on oblige firms to reduce pollution and waste, consider the environment, and concomitantly raise their competitiveness?
0 10 20 30 40 50 60 70 80 90 100
No Impact
Type here to search
ENG
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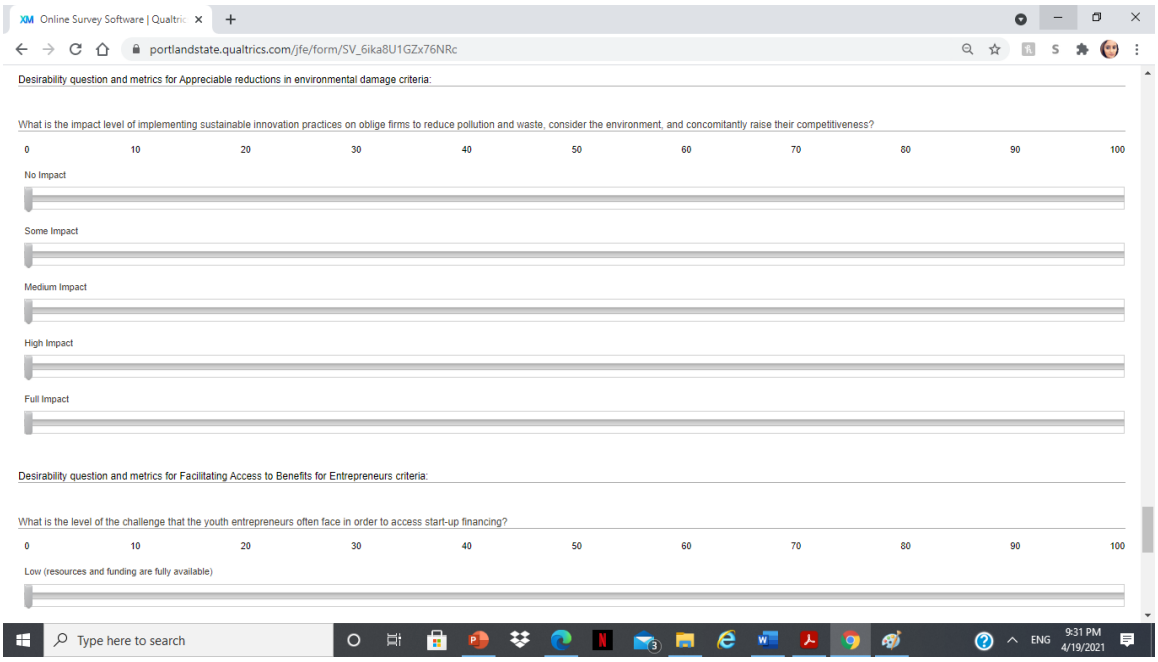
Online Survey Software | Qualtric
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Desirability question and metrics for Appreciable reductions in environmental damage criteria:
What is the impact level of implementing sustainable innovation practices on oblige firms to reduce pollution and waste, consider the environment, and concomitantly raise their competitiveness?
0 10 20 30 40 50 60 70 80 90 100
No Impact
Some Impact
Medium Impact
High Impact
Full Impact
Desirability question and metrics for Facilitating Access to Benefits for Entrepreneurs criteria:
What is the level of the challenge that the youth entrepreneurs often face in order to access start-up financing?
0 10 20 30 40 50 60 70 80 90 100
Low (resources and funding are fully available)
Type here to search
ENG
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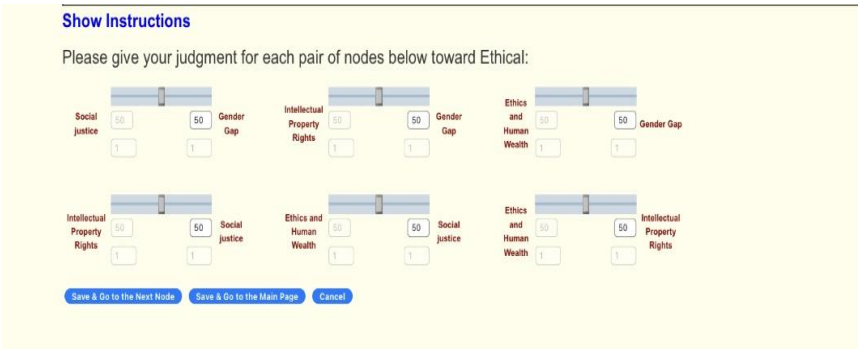
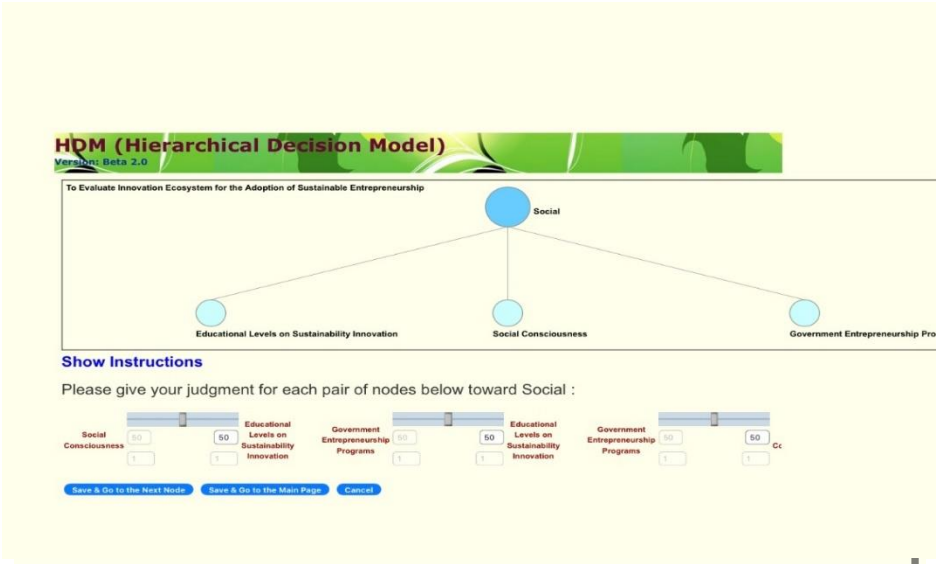
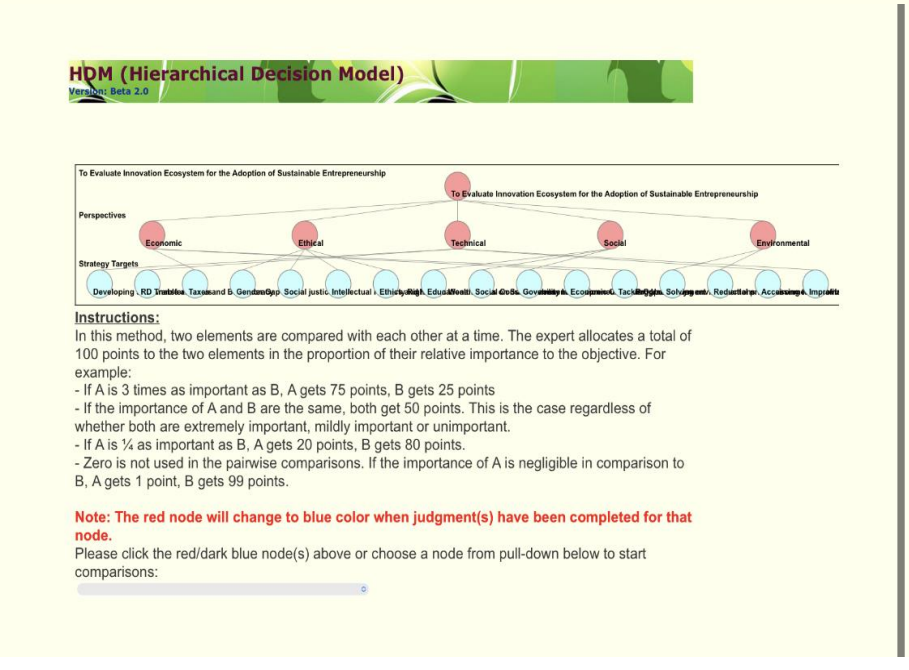
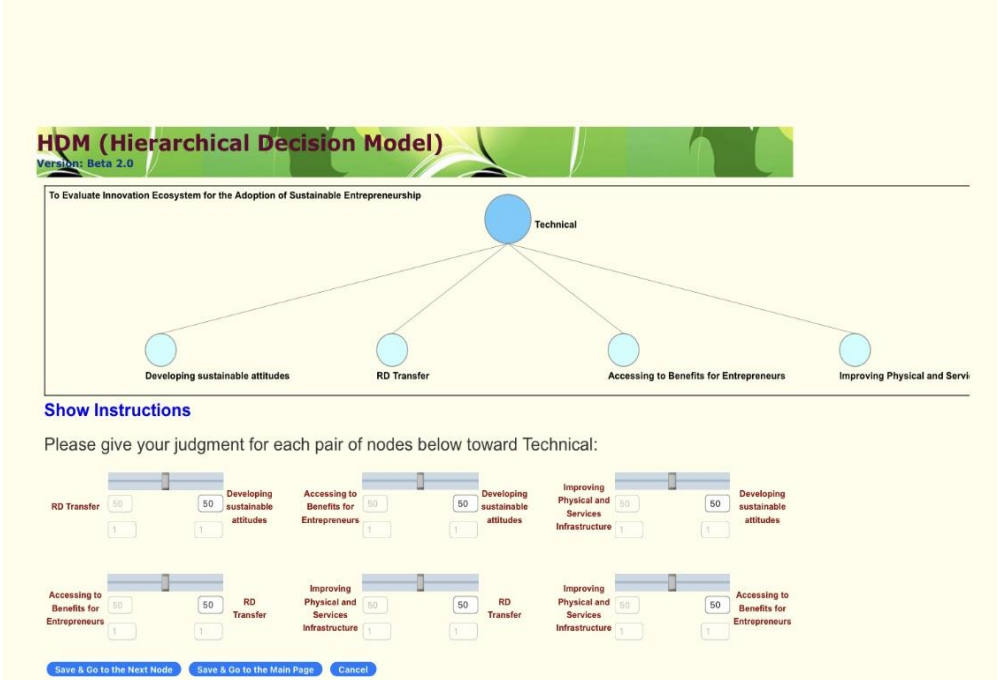
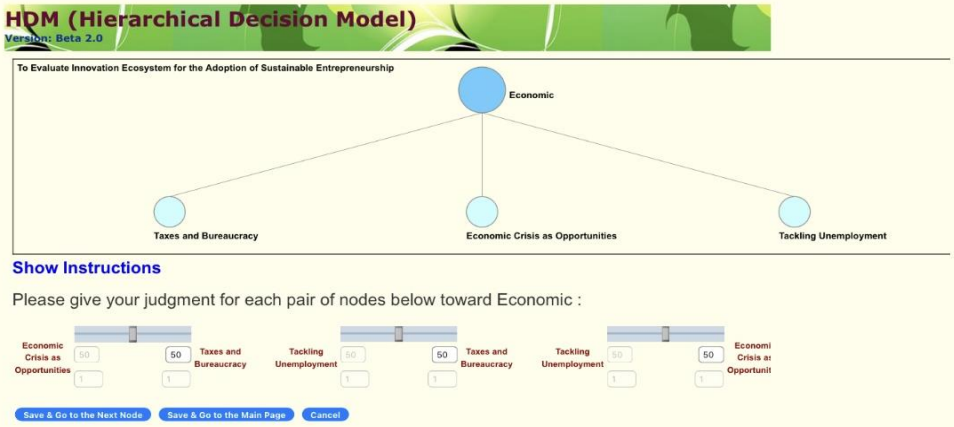
APPENDIX D: THE RESULT OF MODEL QUANTIFICATION

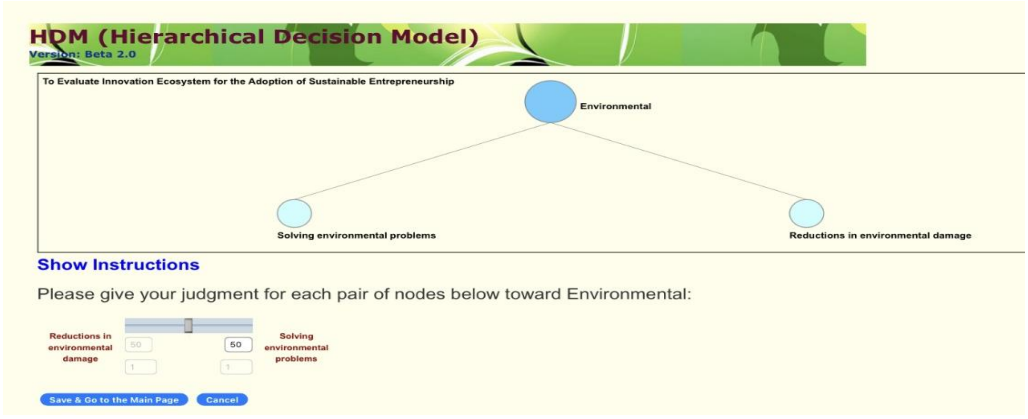







HDM (Hierarchical Decision Model)
Version: Beta 2.0
To Evaluate Innovation Ecosystem for the Adoption of Sustainable Entrepreneurship
Technical
Developing sustainable attitudes
RD Transfer
Accessing to Benefits for Entrepreneurs
Improving Physical and Servi
Show Instructions
Please give your judgment for each pair of nodes below toward Technical:
RD Transfer
Developing sustainable attitudes
Accessing to Benefits for Entrepreneurs
Developing sustainable attitudes
Improving Physical and Services Infrastructure
Developing sustainable attitudes
Accessing to Benefits for Entrepreneurs
RD Transfer
Improving Physical and Services Infrastructure
RD Transfer
Improving Physical and Services Infrastructure
Accessing to Benefits for Entrepreneurs
Save & Go to the Next Node
Save & Go to the Main Page
Cancel


HDM (Hierarchical Decision Model)
Version: Beta 2.0
To Evaluate Innovation Ecosystem for the Adoption of Sustainable Entrepreneurship
Economic
Taxes and Bureaucracy
Economic Crisis as Opportunities
Tackling Unemployment
Show Instructions
Please give your judgment for each pair of nodes below toward Economic :
Economic Crisis as Opportunities
Taxes and Bureaucracy
Tackling Unemployment
Taxes and Bureaucracy
Tackling Unemployment
Economi Crisis as Opportunit
Save & Go to the Next Node
Save & Go to the Main Page
Cancel


HDM (Hierarchical Decision Model)
Version: Beta 2.0
To Evaluate Innovation Ecosystem for the Adoption of Sustainable Entrepreneurship
Environmental
Solving environmental problems
Reductions in environmental damage
Show Instructions
Please give your judgment for each pair of nodes below toward Environmental:
Reductions in environmental damage
Solving environmental problems
Save & Go to the Main Page
Cancel