

2015

# Clarifying Assessment Outcomes for a University- Based Technology Park

Joaquin Guerra Achem  
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Joaquin Guerra Achem

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Walden University  
2015

Abstract

Clarifying Assessment Outcomes for a University-Based Technology Park

by

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BS, Tecnológico de Monterrey, Campus Laguna, 1990

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Education

Walden University

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## Abstract

A private, nonprofit university in Mexico invested millions of U.S. dollars in a strategic initiative to build and operate technology-knowledge transfer parks (TKTP) with the mission of supporting the development of Mexican society's entrepreneurial capabilities. The university, however, lacked an assessment policy for gauging the effectiveness of the TKTP initiative. The purpose of this study was to explore stakeholder values about TKTP effectiveness in order to inform future assessment of TKTPs. The triple helix conceptual framework of collaboration between universities, business and industry, and government informed the design of this study. The central question for this study sought to clarify what stakeholders perceive to make TKTPs effective. The study employed stratified random sampling and cross-sectional stakeholder survey data ( $N = 129$ ). Data analysis included descriptive statistics to present common themes about TKTP stakeholder values, as well as ANOVA to discern significant differences in TKTP valuations between the stakeholder groups. A key finding was that stakeholder groups lack enough information to assess whether the university achieved its original objectives by using the TKTP initiative. Other findings revealed that the stakeholder groups agreed on several criteria for TKTP assessment. A policy recommendation for TKTP assessment, based on the research findings, is provided as part of the project component of this study. This project study supports positive social change by encouraging the region's transformation into a more entrepreneurial, innovative, and knowledge-based economy through continued but more accountable use of TKTPs in Mexico.

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## Dedication

I dedicate my doctoral study to my wife Monica and my daughters Irma and Samia.

## Acknowledgments

I want to thank my family for their support and for giving up much family time so that I could work on this doctoral study.

I want to thank my university and their leaders for supporting me with the financial and time resources for my doctoral study.

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## Section 1: The Problem

### **Introduction**

A Mexican, private, and nonprofit university with the pseudonym of The Innovation University (TIU) created a Technology and Knowledge Transfer Park (TKTP) initiative to support the development in Mexico of an economy based on knowledge and innovation. TIU does not have an outcomes assessment plan to measure the impacts of this initiative. I am currently an employee of TIU and for five years, I led the implementation of the TKTP initiative at one of TIU's campus. In this doctoral project study, I focused on providing a solution to a gap in TIU's practice of assessing the outcomes of its TKTP initiative. At TIU, technology parks are infrastructures designed to foster an entrepreneurial ecosystem or an environment that promotes the development of companies based on knowledge and innovation. In addition, this entrepreneurial ecosystem includes the attraction, acceleration, and incubation of technology-based firms. The technology parks at TIU perform a process of knowledge and technology transfer from the university to the firms and vice versa.

This section provides the definition of the problem for this project study. The problem relates to the lack of a formal assessment policy for a technology park initiative. In addition, there is a discussion of the evidence of the problem at the local context, and the evidence of the problem from the educational context in professional literature. TIU invested millions of U.S. dollars in the implementation of the initiative, but there is little evidence-based information on the outcomes of the initiative. Professional literature acknowledged the need for more research on the benefits of science-technology parks,

especially for parks located at university campuses (Albahari, Catalano, & Landoni, 2013; Caldera & Debande, 2010; Mian & Hulsink, 2009; Phan et al., 2005; Van Looy et al., 2011). The triple helix model informed this study through identifying the effect of university-government-industry relations on the success of science-technology-transfer parks and the promotion of a knowledge-innovation-based economy. In addition, the review of professional literature allowed procuring key success factors and outcomes for science-technology-transfer parks.

The study of this problem generated valuable information to TIU leaders on outcomes assessment of the initiative. This information may help the leaders in decision-making processes on the initiative. Moreover, the information could support an accountability analysis and the investment of additional resources on the initiative.

### **Definition of the Problem**

TIU invested an estimated 150 million U.S. dollars in the TKTP initiative. Proponents' primary objective for this initiative is to contribute to regional economic development by fostering a knowledge-innovation-based economy (Park Definition, 2015). TIU cooperation with organizations from the private and public sectors is necessary in supporting the achievement of the initiative's objective. The TKTP's functions include

- the incubation of technology-innovation firms or the creation of new businesses that offer products or services based on technology;
- the acceleration of businesses or the support to speed-up and augment the sales of already existing businesses; and

- the attraction of technology-innovation firms or the support to provide a landing platform for technology businesses that come from the outside of the local community or region.

In all these functions, TIU faculty and students must participate.

The foundation of TIU occurred in the first half of the 20th century. The historical context in which the university's foundation happened was the period in history between 1870 and 1944 when industrialization of nations generated change in universities (Cohen and Kisker, 2010). This was a period characterized by the creation of universities that supported the development of industry in nations through education of industry professionals. These universities received support from government and individuals who, during this period, generated great wealth because of industrialization. This historical period marked the increased participation of non-clergy in the development of universities and the establishment of secular education at institutions of higher education (Cohen & Kisker, 2010).

This period in the history of universities influenced Mexico. This influence was strong among a group of businessmen who played a key role in industrializing a northern Mexican city. The leader of the founding group was an engineer who studied at a prestigious American institute of technology. This leader had a vision of creating a university that educated technical professionals who supported the operation of the city's newly-established industries. Some of these industries fabricated beer, paper, glass, tin, and cement. He created a private, nonprofit, and secular university. Throughout its history, the university expanded in Mexico with dozens of campuses and generated

college graduates and leaders who supported the economic, social, political, and cultural growth of Mexico.

The founders' entrepreneurial tradition marked the whole institution. The university continuously innovates to support regional economic development. In the past 10 years, the university created 15 on-campus TKTPs to support the development of regional knowledge-based economy. One of these parks is located at the campus where I worked. The financial investment to date on the TKTP infrastructure at my former campus is approximately 30 million U.S. dollars (campus financial administrator, personal communication, 2012). The definition of TIU 2005 vision spawned the TKTP initiative. Proponents' vision saw the university as a strong promoter of a knowledge-based economy by the year 2015. In addition, TIU president from 1985-2011 strongly supported the TKTP initiative and served as an architect of it.

Although advocates began implementing the TKTP initiative 10 years ago, they have yet to develop a formal policy for assessing it. In 2013, I moved to TIU's central offices with a new responsibility. As a leader at my university, I believe that my former campus's TKTP is attaining the objectives set in its creation. Reports of the TKTP operation have some quantitative information like number of incubated firms, number of new jobs, and number of attracted firms to support my perception, but the effectiveness of the local TKTP program has yet to be formally assessed or evaluated. Also, the new president of TIU questions the TKTP's effect or benefit on faculty and students, as well as the TKTP's financial sustainability (TIU Northern Zone President, personal communication, 2012). Therefore, I believe that it is important to measure the TKTP's

outcomes to provide information to TIU leaders for accountability and decision-making purposes. In this doctoral study project, I developed an assessment policy recommendation for the technology park at one university's campus.

Today, higher education institutions around the world face the challenge to “increase revenue, decrease expenses, improve quality, and strengthen reputation” (Dickeson, 2010, p.1). Universities are increasingly focusing on program accountability for improving the efficient use of public and private resources (Dickeson, 2010; Fullan & Scott, 2009; Newman, Couturier, and Scurry, 2004). The process of informing internal and external stakeholders of programs' outcomes is essential. For example, in the United States, the National Commission on Accountability in Higher Education (NCAHE) offered recommendations for universities as they seek to enact such accountability processes (Dickeson, 2010). Among the accountability recommendations from NCAHE that relate to this project study are

- define goals that are linked to priorities;
- supervise advancement of goals;
- apply assessment instruments and deliver results to stakeholders; and
- assess continuously all priorities and execute policy to ameliorate efficiency and reduce costs (Dickeson, 2010).

In addition, authors of the Spellings Commission Report (Dickeson, 2010) on the future of higher education provide some recommendations that are pertinent to this project study. Authors of the report recommend that universities implement benchmarks for efficient operation and the evaluation of students' learning and skills enhancement

(Dickeson, 2010). The assessment policy recommendation of this study includes the recommendation to assess how the TKTP initiative supports students' entrepreneurial learning and skills acquisition.

Furthermore, with this project study, I also seek to help university leaders in their program evaluation efforts. A program evaluation is executed when decisions need to be made about resource allocation, results, or future of a particular program (McNamara, n.d.; Spaulding, 2008). The university leaders need to assess the initiative to inform resolutions for additional resource allocation. Moreover, the assessment of the initiative supports the decision-making process for the continuance and improvement of the initiative. A successful assessment of the TKTP initiative would provide evidence-based information to TIU leaders that would aid them in their decisions on the future of the initiative.

## **Rationale**

### **Evidence of the Problem at the Local Level**

In the past 10 years, TIU decided to build TKTPs. The purpose of these technology parks is to incubate, accelerate, and attract technology-related businesses (Park Definition, 2015). These TKTPs facilities help the university assist private and government organizations in technology transfer. According to one of the leaders in the initiative implementation, from 2005-2010, 13 parks were constructed, and the financial resources invested in creating the technology parks amounted to 100 million U.S. dollars. The university contributed 55% of this amount, the federal government 18%, states governments 15%, and private businesses and trustees 12% (Directors Office of

Technology Parks [DOTP], 2011). Furthermore, the estimated investment in 2011 was \$33 million (DOTP, personal communication, 2012). The technology park initiative had much support from TIU leaders until the former president retired in 2011. In addition, the chairman of the Board of Trustees stepped down in 2012. The new leaders at TIU defined a new vision and strategic plan with different priorities for the university.

Today, the new leaders at TIU have initiated an institutional transformation process that includes a new vision (University, 2013). In addition, they mandated that the university's strategies and priorities undergo revision process. The new leadership is questioning the results of the TKTP initiative (University's Northern Zone President, personal communication, 2012). Sufficient data to demonstrate that the initiative reached its original objectives are lacking. Furthermore, the new leadership wants to assure that students and faculty are the main beneficiaries of the TKTP initiative (Board of Trustees Member, 2013). The initiative received a significant amount of financial, time, and human resources from the university. TIU new leaders need to determine whether these resources produced the desired outcomes. In addition, the new president questions the effectiveness of the initiative and does not have clear information to address his concerns. In carrying out this study, I hope to provide TIU leaders with an assessment policy recommendation that is data-driven.

### **Evidence of the Problem from the Professional Literature**

Two of the strategies in TIU's strategic plan from 2005 refer to the creation of business incubators and centers for technology transfer. These strategies address the perennial issues and challenges in higher education of supporting the economic and social



development of society and serving global interests (Fullan & Scott, 2009) through the commercialization of knowledge and the creation of new technology-based businesses. Technology transfer and the incubation of businesses or start-ups are activities performed by an entrepreneurial university. Universities such as the Massachusetts Institute of Technology, Cambridge University in the United Kingdom, and Stanford University in the Silicon Valley of California are examples of such entrepreneurial university (Mian & Hulsink, 2009; Van Looy, Landoni, Callaert, van Pottelsberghe, Sapsalis, & Debackere, 2011). Changes in governmental funding and tax incentives on research investments are some of the factors that influence universities to become more entrepreneurial (Van Looy et al., 2011).

In addition, universities need alternative ways to generate monetary income to respond to recent changes in funding policy and to become more entrepreneurial (Mian & Hulsink, 2009; Van Looy et al., 2011; Weisbrod, Ballou, & Asch, 2008). Moreover, recent world economic crises, diminished public financial support, and new for-profit competitors are factors that augment the need for alternative sources of income. These factors caused “universities in many countries to focus on profit and commodification of knowledge and its marketing” (Fullan & Scott, 2009, p. 13). TIU and most of the higher education institutions in Mexico face more competition and less public funding. Therefore, it is important to have initiatives such as TKTP. For example, a study in Spain comparing the outputs of universities with and without technology parks showed that universities with a park have 30% more research and development income (Caldera

& Debande, 2010). This shows how technology parks aid universities in generating additional income.

The globalization of higher education created a bigger field of competition for universities. Globalization thrust universities into a relevant role of fostering a knowledge-innovation economy (Wildavsky, 2010). Universities have to support their regions' success in a new global economy environment where knowledge and technology are among the main drivers of economic growth. The production, transfer, and commercialization of knowledge and innovation by universities support the success of regions in the highly competitive global economy. Furthermore, the highly competitive global marketplace in which they operate requires universities to implement strategies of disruptive innovation to radically transform the market (Christensen & Eyring, 2011) by generating new products or services based on knowledge and technology. Through an initiative like its TKTP, TIU generates disruptive innovation for the emergent knowledge economy of Mexico.

Poor accountability methods are an obstacle that impedes change management at universities (Fullan & Scott, 2009). Newman, Couturier, and Scurry (2004) stated, "in country after country, academic and political leaders have been crafting policies that provide the opportunity and the incentive for institutions to become more autonomous and entrepreneurial while holding institutions more accountable for performance" (p. 104). TIU's TKTP initiative is entrepreneurial; it supports the economic development of communities, and it is receiving financial support from the university, private, and public sectors. It seems imperative to the stakeholders of the TKTP initiative to have

information for the accountability of the initiative. At TIU, there is no practice for assessing the outcomes of the TKTP initiative.

The problem of lack of outcome assessment in technology parks appears to be consistent in different parts of the world. Some researchers have identified weaknesses in TKTP assessment policy. Phillimore (1999) commented that there is a void in the assessment of technology parks in Australia. Furthermore, academic research on technology parks criticizes the lack of results and objective attainment (Phillimore, 1999). Bakouros, Mardas, and Varsakelis (2002) stated that technology park literature focuses primarily on parks located in advanced economies. Researchers have not examined the outcomes of technology parks in under-developed economies like Greece (Bakouros et al., 2002). Bigliardi, Ivo Dormio, Nosella, and Petroni (2006) performed case study research on science parks in Italy. They stated about science parks “what has not yet been thoroughly addressed by previous research is the development of formal performance measurement techniques based on robust interpretive paradigms and sound analytical framework” (p. 489).

Assessing the success of innovation-based economic policy is a significant issue for research (Bigliardi et al., 2006). For example, the country of Portugal, with relatively new and few science parks and business incubators, faces complications to assess parks' contribution to a knowledge-innovation economy and hence, there are few research studies on this matter (Ratinho & Henriques, 2010). Moreover, the justification of the investment on innovation policies in Portugal requires the study of models of innovation

implemented around the world and the generation of metrics specific for the Portuguese context (Gibson & Naquin, 2011).

Phan, Siegel, and Wright (2005) reported that in 2003, the United States had 123 university-based science parks. In addition, the number of business incubators in the United States went from 12 in 1980 to 950 in 2002 (Phan et al., 2005). The United Nations Educational, Scientific and Cultural Organization (UNESCO) reported over 400 science parks around the world (UNESCO, 2013). The boom in the creation of science parks and business incubators generated a discussion among academics about how these infrastructures ameliorate the performance of higher education institutions, knowledge-based economies, and regional economic development (Phan et al., 2005; Smulders, 2011). Furthermore, because of their nascent and nonprofit status, few research works exist on science parks and incubators. Additionally, no public data is available to study the performance and effects of science parks on higher education institutions and regional economic development (Phan et al., 2005). This lack of data supports the need for the outcomes assessment policy recommendation of this study.

More recent literature emphasizes the need for evaluation of the results from universities' entrepreneurial activities including technology or science parks (Albahari, Catalano, & Landoni, 2013; Caldera & Debande, 2010; Mian & Hulsink, 2009; Van Looy et al., 2011). Mian and Hulsink (2009) acknowledged, "there has been no single framework available to assess how they are working and thereby improve their effectiveness" (p. 5). Caldera and Debande (2010) affirmed, "we go one step further than the existing literature and not only investigate the role of technology transfer offices

(TTOs) on performance, but also of university science parks” (p. 1161). Van Looy et al. (2011) stated, “large-scale empirical studies on the relationship between university characteristics, the economic texture in which their activities are embedded, and entrepreneurial performance are lacking” (p. 554).

Albahari et al. (2013) concluded that there is insufficient research on the role and performance of national science park systems. This conclusion also supports the pertinence of the assessment policy recommendation from this project study. TIU has a national presence and supports a network of 15 parks. These parks can be classified as a national park system managed by the university. The assessment policy recommended by this project study may benefit TIU’s whole parks network. The body of professional literature on technology parks around the world suggests the need for academic research on the performance and outcomes of university-based technology parks.

This doctorate project study provides essential information for what must be measured to validate the effectiveness of the TKTP at TIU. In addition, the implementation of the assessment policy may offer evidence-based information that will allow TIU leaders to take corrective action if needed to improve performance. The implementation of the assessment policy would support the decision process to continue or not the investment of resources in creating or expanding other technology parks. This project study generated a policy recommendation to assess the outcomes for one campus TKTP. This policy recommendation includes a scheme that delineates the process to measure the outcomes of the park. Furthermore, since the implementation of TKTP initiative is standard throughout the country, the assessment policy could support the

outcomes measurement at other TIU campus TKTPs. The information from the assessment may support the decision-making process for continuance of resource allocation and improvement of the TKTP initiative.

### **Definitions**

*Knowledge-innovation economy:* An economy that is sustained and developed by knowledge and innovation. There are four stages in the evolution of economy in human civilization: first the agricultural, second the industrial, third information, and fourth the knowledge-innovation or creative (Dubina, Carayannis, & Campbell, 2012). Knowledge and innovation are the primary economic resource (Dubina et al., 2012). According to Bedford (2013), “a knowledge economy is the one in which knowledge in the form of intellectual capital is a primary factor of production” (p. 278). Knowledge and innovation become key drivers of economic development. It is an economy where knowledge and innovation produce wealth.

*New Economy:* The economy that dominates this early part of the twenty-first century. The term new economy is equivalent to the term knowledge economy (Giju, Badea, Ruiz, & Peña, 2010). In addition, Giju et al. (2010) stated, “knowledge gained in our time is the main propellant of competitiveness and creating wealth in the company” (p. 28). It is the economy produced by globalization processes and the influence of knowledge and innovation as the main drivers of economic growth.

*Spin-offs:* Wallin (2012) explained, “in business and economic literature the spectrum runs from divestitures of whole business units to university researchers who bring some idea from the laboratory to start their own business” (p. 163). In the

university context subject of this project study, these are technology-based businesses created by faculty, students, or other professionals with support of the TKTP business incubator.

*Technology-Knowledge transfer:* According to Liyanage, Elhag, Ballal, and Li (2009), “It is the conveyance of knowledge from one place, person or ownership to another. Successful knowledge transfer means that transfer results in the receiving unit accumulating or assimilating new knowledge” (p. 122). Technology-knowledge transfer is the process by which the knowledge or technology produced at a university is communicated or learned by a business. This process can happen both ways; a university may also obtain technology or knowledge produced by firms.

*Technology-Knowledge Transfer Park (TKTP):* A technology or science park at a university campus. A university-based park fosters the collaboration between enterprises in the park and the university, in addition to sponsoring the creation or acceleration of firms from university research technology (Caldera & Debande, 2010). This infrastructure fosters the transfer of technology and knowledge from the university to businesses and vice versa. The park supports the incubation of new technology-based firms, the acceleration of already existing firms, and the attraction of technology-based companies. It is not an industrial-real estate development. It does consist of a group of buildings and facilities hosted and managed at a university’s campus.

### **Significance**

In the university globalization stage context, the last 20 years have seen a growth in technology-knowledge transfer parks or science parks. An example of this is TIU, the

institution where this project study's problem emerged. TIU is a private, nonprofit, multi-campus university in Mexico that invested an estimated 150 million U.S. dollars in a TKTP initiative in the last 10 years. The problem is a lack of sufficient information on the outcomes and objectives attainment of the initiative. In addition, the resources came from university, government, and private sector. Therefore, accountability information on the initiative is important. Accountability to stakeholders is one recommendation by The World Bank in the process of creating high class, world-competitive universities (Salmi, 2009). The recently appointed leaders of TIU and members from the Board of trustees question the success and benefits of the initiative.

Moreover, there is little research on the performance and outcomes of technology or science parks (Albahari et al., 2013; Bigliardi et al., 2006; Caldera & Debande, 2010; Mian & Hulsink, 2009; Phan et al., 2005; Van Looy et al., 2011). This lack of research is evident at university-based parks. Research on university-based parks' outcomes will benefit their primary beneficiaries: universities, governments, and businesses.

### **Guiding/Research Question and Hypothesis**

This project study's central question, R1, was "What is the process required for an outcomes assessment plan of a university-based TKTP?" This project study's procedural sub-questions included:

R2. What are the required inputs for the assessment process?

R3. What outputs (short-term results) should the assessment process measure?

R4. What outcomes (long-term impacts) should be considered for the assessment of the TKTP?



R5. Do the campus stakeholder groups agree on assessment criteria for the TKTP? In addition, this project study null hypothesis  $H_0$  was that there is no statistically significant difference in the opinions of the different stakeholder groups for various composite scale measures based on R5.

There exists a gap in research on the outcomes of university-based technology parks. The body of literature acknowledges the need to investigate the outcomes of knowledge transfer, innovation, economic policy, and the benefits of technology parks. In addition, the significant resources invested in deploying the TKTP initiative at TIU must be justified. A formal assessment on the outcomes of the initiative has not been made and there is no process in place for assessing TKTPs. TIU leaders question the results of the initiative and its benefits. They want to know how the initiative supports students' learning, faculty engagement, technology-based businesses creation, and local economy development.

### **Review of the Literature**

In this section, I review the literature on the conceptual framework that relates to this project study's problem and discuss several key current issues that influence TKTP processes, especially at universities. I used the following databases to search for literature: Academic Search Complete, Business Source Complete, Education Research Complete, Educational Resource Information Center (ERIC), ProQuest Central, SAGE Premier, ScienceDirect, Google Scholar, and Dissertations & Theses. Some of the keywords I used were *knowledge economy*, *knowledge-based economy*, *innovation economy*, *technology transfer*, *technology-knowledge transfer*, *university*

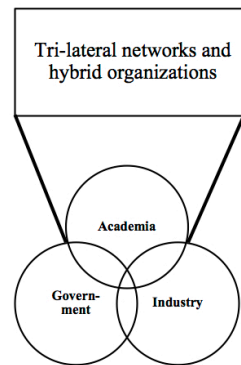
*entrepreneurship, spin-offs, start-ups, technology parks, science parks, research parks, university-based science parks, academic capitalism, triple helix model, assessment-evaluation of technology parks, technology commercialization, and Bayh-Dole Act.*

### **Theories Related to the Problem**

I used the triple helix model (Etzkowitz & Leydesdorff, 2001) as the conceptual framework for the study project. The premise of the triple helix model is that the relationships between university, industry-business, and government are a central factor in fostering a knowledge-innovation economy (Etzkowitz & Leydesdorff, 2001). The exchange of information, resources, knowledge, and technology occurs among university, industry, and government (Etzkowitz & Leydesdorff, 2001). Figure 1 from Etzkowitz (2003) describes a visual model of how the triple helix model operates. Moreover, Etzkowitz (2003) explained,

The Triple Helix thesis postulates that the interaction in university-industry-government is the key to improving the conditions for innovation in a knowledge-based society. Industry operates in the Triple Helix as the locus of production; government as the source of contractual relations that guarantee stable interactions and exchange; the university as a source of new knowledge and technology, the generative principle of knowledge-based economies. (p. 295)

Therefore, the assessment process of a TKTP requires considering the needs of stakeholders from university, industry, and government according to the triple helix model.



*Figure 1.* Triple Helix Model. From “Innovation in innovation: The triple helix of university-industry-government relations,” by H. Etzkowitz, 2003, *Social Science Information*, 42(3), p. 302. Reprinted with permission.

The triple helix model is based on several postulates (Etzkowitz, 2003). Two of these postulates have a direct relation to this project study problem. One postulate states that through the assimilation of novel technologies, universities and new firms contribute to local problem solution and the exchange of innovations (Etzkowitz, 2003). A second postulate addresses the creation of entrepreneurial ecosystems through the development of innovation-technology parks adjacent to universities with support from government resources (Etzkowitz, 2003). In addition, Etzkowitz (2003) stated, “The organizing principle of the Triple Helix is the expectation that the university will play a greater role in society as an entrepreneur” (p. 300). TIU’s strategic plan focuses on developing a more entrepreneurial university and supporting the development of a more entrepreneurial community around the university (University, 2013). The TKTP initiative helps in supporting TIU’s entrepreneurial role in society. And, the triple helix

model serves as a framework to inform this study on the elements that characterize an entrepreneurial university.

Furthermore, the factors from the triple helix model that contribute to successful relations among university, industry and government informed this project study. The triple helix model supports a third role for the university. Etzkowitz and Leydesdorff (2001) referred to this role as “The direct relation with society” (p. 11). Etzkowitz and Leydesdorff (2001) explained, “the university has become a direct producer of goods and services for end-users... . This third role has brought about a deep revolution within the university itself” (p. 11). TKTPs require continuous collaborations to produce knowledge and technology for the benefit of the university, industry, and government. The assessment policy recommendation product of this project study includes the measurement of collaborative work and networking among university, industry, and government.

Leydesdorff and Etzkowitz (1996) discussed that relations between universities, industry, and government provide support to the creation of structures that foster technology-based start-up companies. In addition, global organizations like the European Union, the World Bank, and the United Nations promote a knowledge-based economy through promoting alternative collaboration schemes among universities, businesses, and governments (Etzkowitz & Leydesdorff, 1995). Zheng (2010) explained that the triple helix model elevates the university to an “equal partner” figure among industry and government. Zheng (2010) concluded that through the triple helix model, the university has a tool for better collaboration with industry and government. The element of

collaboration between university, business, and government is the basis for success under triple helix model operation.

Saad (2004) discussed the application of the triple helix model as innovation policy in less developed countries, specifically the African country of Algeria. The findings by Saad relate to Mexico and informed this project study by providing potential obstacles and success conditions in the implementation of the triple helix model as innovation policy. Among the obstacles Saad found are the absence of close relations between businesses and higher education institutions, and a bureaucratic economy. Saad's success conditions that foster innovation through the triple helix model are a culture of alliance and networking, and structures that promote "communication, interaction, and sharing" (p. 31). In addition, the interaction between research institutions and industry in Mexico was the subject of study in De Fuentes and Dutrénit (2012). Innovation policy in Mexico should support the development of technology transfer offices at higher education institutions and strengthen the relations between researchers and firms through casual places of collaboration, De Fuentes and Dutrénit (2012) contend. Moreover, Luengo and Obeso (2013) empirically obtained evidence that the triple helix model supports innovation at Spanish firms and how important is the generation of spaces for interaction between triple helix stakeholders. In accordance with Luengo and Obeso (2013) conclusions, TKTPs are structures that aim to foster networking, communication, interaction, and sharing among stakeholders.

Triple helix model influence on entrepreneurial behaviors in the United States was the subject of study in Kim, Kim, & Yang (2012). The triple helix model of

relationships between university, industry, and government sustains a knowledge-innovation economy through the conversion of knowledge and technology products into economic growth (Kim et al., 2012). In addition, Kim et al. (2012) empirically found some factors that foster regional entrepreneurship in the United States. Among these factors were “higher education attainment, lower tax rates, lower housing prices, and wider health insurance coverage” (p. 164). In addition, universities are key players in the promotion of entrepreneurial activity through research and development (Kim et al., 2012; Mian & Hulsink, 2009). These findings show the important role that American universities have in developing regional entrepreneurial cultures and fostering knowledge-innovation economies. In the same direction, TIU plays a role as a mediator with industry and government in promoting regional entrepreneurial activity through TKTPs.

### **The University in the Post-Industrial Era**

In looking back at the history of universities, the world has observed an evolution of the university institution. Harris (2011) explained this evolution by identifying various university stages. One stage is the old university or the medieval university, where religious instruction was predominant and limited to church scholars; Latin was the language of academia. Another stage is the modern university influenced by philosopher Immanuel Kant’s thought, where reason and impartiality displaced religion. A next stage, where Wilhelm von Humboldt’s model dominated Western world universities. Under Humboldt’s model, the university was a research institution that produced knowledge to enrich culture. Finally, there is the post-industrial or globalization stage

that is influenced by neoliberal policy (Harris, 2011). In today's globalization stage, the dominant language is English, more people have access to higher education, and the university must serve as a tool to support economic competitiveness. This contemporary stage of the university has converted knowledge transfer into a market product (Harris, 2011). The words of former European Union Commissioner for Research, Janez Potoenik, (cited in Harris, 2011) best explained the change process of contemporary universities: "Universities are powerhouses of knowledge generation...that will need to adapt to the demands of a global knowledge-based economy, just as other sectors of society and economy have to adapt" (p. 18). Throughout the world, there is a strong effort to make universities key participants and promoters of the knowledge-innovation economy.

The following subsections present several key findings from the body of literature related to technology-science parks, knowledge-technology transfer, and knowledge-innovation economy.

### **Relations with Society**

As mentioned previously, the interaction of universities with society is important to sustain a knowledge-based economy. Harris (2011) described the new relation of universities to society by stating "society's needs, conceived primarily in economic terms, orientate the contemporary university; the university no longer provides an orientation for society" (p. 19). Burkhardt (2007) studied the issue of how universities serve society in the New Economy and how donations to universities are shifting from mere philanthropy to giving money predicated on solving societal problems by

universities. Burkhardt concluded that there is a new transformational-leadership model that is reframing how universities relate with the community, especially with conditioned donations and their accountability. This project study offers to engender positive social change by offering a TKTP accountability policy that leads to university transformational leadership of the kind articulated by Burkhardt.

### **Influence of Globalization on Higher Education**

Globalization is transforming higher education. Deem, Mok, and Lucas (2008) studied how universities in Europe and Asia are duplicating western policies, especially from American universities, to support economic development. The authors warned about the need for higher education institutions to consider local context when implementing actions that follow global trends. On the same note, Olaniran and Agnello (2008) studied how globalization and the western world dominate the economies of the developing countries. In addition, the authors found that globalization education prepares people to succeed in the information-knowledge economy. Globalization-oriented education in developed countries generates an economic advantage over countries that are not educating their citizens in the needs of the New Economy. Both of these papers addressed globalization strategies by American universities and the need for replication in developing countries.

### **Influence of University Proximity on Regional Economic Development**

Universities can contribute in making their regions more internationally competitive. “There is ample evidence of a positive link between economic competitiveness and investments in regional innovation system, which connects higher



education institutions, public authorities, and business and industry” (Puukka & Marmolejo, 2008, p. 242). In addition, geographical proximity is an important ingredient to global competitive regions. The geographical proximity of university and industry ameliorates successful university-firm collaborations, and it fosters new firm creation from university research technology (Caldera & Debande, 2010). Communities and networks of research teams, universities, and industrial clusters in the same region generate regional economic development (Tate, 2008). For example, in the United Kingdom, Laursen, Reichstein, and Salter (2011) found that geographic proximity between firms and research universities generates more collaboration for innovation and trust between people through social immediacy. Likewise, Meyer (2006) presented a study of information technology clusters in Canada where the author analyzed the links between information technology companies and local universities. Meyer found that companies are closely located, and these company clusters tend to establish in the proximity of higher education institutions. The TKTP initiative seeks to promote the benefits of collaboration between the university and businesses by providing geographical proximity.

### **Transfer of Knowledge and Generation of New Businesses by Universities**

Universities foster the creation of new businesses through knowledge transfer. Agrawal (2001) examined over 25 articles related to how knowledge is transferred from universities to companies. Agrawal offered various structures over which knowledge transfer happens between higher education institutions and industry. Djokovic and Souitaris (2008) provided another major study of literature on university-generated spin-

offs. The paper concluded that there is a significant increase of theory-driven studies on how universities generate spin-off companies. Both papers addressed the way universities transfer knowledge and generate new businesses.

Universities are key in promoting economic development. Geiger (2006) studied some actions American research universities executed to foster economic development. Geiger concluded that significant actions were the attraction of more external funding, the creation of models to commercialize research outcomes, the establishment of technology transfer offices, and the building of research parks. In addition, Golob (2006) studied how two important research universities in New York contributed to regional economic development. Golob found key elements such as a sustained effort to promote technology transfer processes, and the support of business start-ups from academic entrepreneurs. Moreover, Wang and Lu (2007) presented a framework that models efficient processes of knowledge transfer between universities and industries in China. The study concluded that institutional support is a key factor to foster knowledge transfer and technology commercialization from universities to industry. There is ample evidence of the key role that knowledge-technology transfer from universities plays in supporting economic development.

Additional evidence of TKTP influence on economic development includes the paper by Breznitz, O'Shea, and Allen (2008) who discussed two case studies of the creation of biotechnology clusters by two American universities. They found that different strategies for implementing technology transfer processes at two distinct universities generated local economic development. One university followed a high

support strategy and built technology parks; the other university applied a low support strategy relying on its entrepreneurial culture and environment. Both cases led to regional economic development by increasing the number of biotechnology firms and the number of employees in the biotechnology sector.

Clark, Dawes, Heywood, and McLaughlin (2008) presented a study on the success factors for technology transfer processes that involved students from universities in England. Furthermore, Lockett, Kerr, and Robinson (2008) studied a technology-knowledge transfer center in a university from England. Their focus for the study was to understand what issues support or restrain knowledge transfer. One key issue found was “process management and evaluation” (p. 674). They proposed further research by stating, “the focus of research should therefore move from defining and justifying KT [knowledge transfer] to its exploitation, through understanding the commercialization process and effective evaluation” (p. 675). In addition, Teng (2010) proposed a technology transfer model based on the experience of the business sector in Xi’an China. The model aimed to provide a technology transfer framework for success and economic development. Caldera and Debande (2010) found that Spanish universities performed better at technology transfer activities through the support of university-based science parks. Mian and Hulsink (2009) identified technology and science parks as influential in generating a regional knowledge-innovation environment. Also, Åstebro, Bazzazian, and Braguinsky (2012) studied the cases of three entrepreneurial universities, one in the USA and two in Sweden. They found that university graduates’ start-ups outnumber the spin-offs created by universities’ faculty. In addition, graduates that apply their education in

developing their start-up companies had better performance and survival rate (Åstebro et al., 2012). Reviewed literature showed that universities can play a relevant role in supporting their graduates' entrepreneurial attitude and actions.

University trustees are key actors in fostering university-industry relations. Mathies and Slaughter (2013) recognized the important role a university trustee plays in linking industry with the university. Further research is required to explore how today's university trustees contribute to strengthening the relations between corporations and universities (Mathies & Slaughter, 2013). In the TKTP initiative subject of this study project, the Board of trustees of the university is one of the stakeholder groups that influence the inputs, activities, outputs, and outcomes of the initiative.

### **Role of Government in Supporting a Knowledge-Innovation Economy**

Governments have significant influence in nurturing a New Economy. Hu and Mathews (2009) performed a study of how the triple helix model was applied in Taiwan. They analyzed links between universities, industry, and government. Hu and Mathews concluded that Taiwan's knowledge-innovation economy grows through strong support from government and contributions from small to medium enterprises and start-ups from advanced technology sectors. In addition, Niosi (2006) made an analysis of spin-offs from universities in Canada and contributions from the government, industry, and university relations. Niosi found the importance of government financial support over venture capital for spin-offs growth. In addition, De Fuentes and Dutrénit (2012) argued in favor of public policy in Mexico that fosters the creation of infrastructures as spaces for informal collaboration between researchers and firms. The organization of

technology transfer offices into linked groups or associations shown to improve their functioning in Korea and a public policy recommendation for developing economies (Park, Ryu, & Gibson, 2010). The body of literature reviewed for this study supports the importance of the role of government policies that foster a knowledge- or innovation-based economy.

### **Role of Universities in Developing Emergent Economies**

Universities have a central role in supporting economic development in emergent countries. Saginova and Belyansky (2008) studied how universities provide support to economic growth in Russia. A key finding was that innovation in designing and providing education services fosters strong advancements in Russia's economy. In addition, the relationship between education and economic competitiveness in Finland was the subject of Sahlberg's (2006) study. Sahlberg found several factors that support the growth of a knowledge-based economy. Among these factors are educational reform, making learning interesting for students, collaboration between education stakeholders and institutions, flexibility in education, promotion of creative thinking, and developing a culture that accepts risks. Both papers provided information on how policies and actions implemented by universities and governments in Russia and Finland generated economic competitiveness in the New Economy.

In the same direction, Liagouras (2010) offered a discussion on the factors that contribute to failure in the implementation of technology and innovation policies in less developed European economic regions. Liagouras analyzed the cases for Greece, Spain, Portugal, and central-eastern European countries. These countries have similar

conditions to Mexico. Liagouras concluded that applying or imitating policies from advanced economies to less developed ones is not adequate. Low to medium technology sectors in less developed European countries do not benefit from public research or innovation and research-development policies.

### **Technology Parks in Mexico**

Research on the performance of technology parks in Mexico is partial. Molina, Aguirre, Breceda, and Cambero (2011) presented a case study of the implementation of a technology park at the flagship campus of a private university in Mexico. The case study included information from a technology park with similar conditions to the TKTP subject of this project study. However, the evaluation scheme for the technology park presented in the case study was not comprehensive. Specifically, the evaluation scheme limited its analysis to a few performance indicators.

### **Importance of Educating Citizens for the New Economy**

Entrepreneurship education should be part of the new curriculum in higher education. Etkowitz, Ranga, and Dzisah (2012) proposed a new undergraduate curriculum for an entrepreneurial university. The proposal included three elements (a) the education in discipline or specialization subjects, (b) entrepreneurship education, and (c) multicultural education. The authors argued that entrepreneurial universities have to educate their students in this proposed program regardless of students' academic field orientation. Through this proposed curricula, 21st century entrepreneurial universities will have more impact on social and economical development. In addition, Etkowitz et al. (2012) delineated key elements of a nascent entrepreneurial university. Among these

elements are “the capacity to organize firms within the university, and the integration of academic and business elements into new formats such as university–industry research centres” (p. 159). The TKTP initiative relates to these elements of an entrepreneurial university.

In the quantitative study conducted by Reese and Minting (2011), the authors researched the relations among local conditions, geography, weather, economic development policies, public services policies, and economic health in several American cities. They concluded that investment in education; specifically having more people attaining a higher education degree significantly influenced economic health. The university-educated individuals that collaborate in a technology-knowledge transfer process are the main drivers of regional economic development.

### **Conclusion**

The review of current literature related to this project study’s problem suggested a common issue. This common issue is technology-knowledge transfer (TKT). TKT is the process by which the academic knowledge and technology produced at universities, mainly in its research centers is passed to the industry or production sectors of society. One criterion I used to select the articles focused on how universities contribute to the development of a knowledge-based economy. Therefore, this suggested the existence of some kind of relation between knowledge-based economy and TKT from higher education institutions.

Knowledge generates economic development. Agrawal (2001) stated, “the creation and application of new knowledge is the primary factor that drives economic

growth” (p. 285). The Association of University Technology Managers (AUTM) estimated for the fiscal year of 1999 that the licensing of innovations made at academic institutions contributed over \$40 billion in economic activity and supported more than 270,000 jobs in the United States and Canada. Also, Duderstadt (2000) mentioned, “a survey made on economists, which asked to identify the one federal policy that could most increase the long-term economic growth rate, they put further investment in education and research at the top of the list” (p. 114). In addition, Fullan and Scott (2009) established that universities in the 21st century face several challenges including “changes in funding and pressure to generate new sources of revenue” (p. 11). Because of this change force, universities must use TKT as an alternate source of income. Fullan and Scott (2009) also recognized the important role of continuous knowledge commercialization as an alternative source of income for universities.

The review of literature suggested that TKT generates for universities and society economic growth through new jobs, new firms, new entrepreneurs, and innovation. All of these products of TKT were considered in the assessment policy recommendation of this project study.

### **Implications**

The review of literature showed the need for more research to understand the benefits of university-based science-technology parks (Albahari et al., 2013; Bigliardi et al., 2006; Caldera & Debande, 2010; Mian & Hulsink, 2009; Phan et al., 2005; Smulders, 2011; Van Looy et al., 2011). In addition, some of the sources from the literature review provided guidelines to factors that could be part of an assessment policy (Albahari et al.,



2013; Bedford, 2013; Caldera & Debande, 2010; Giju et al., 2010; Smulders, 2011; Van Looy et al., 2011). Furthermore, other assessable factors were relations with society (Harris, 2011), influence of globalization on higher education (Deem et al., 2008), regional economic development because of university proximity (Caldera & Debande, 2010), creation of new technology-based businesses by university (Caldera & Debande, 2010; Mian & Hulsink, 2009), government participation (Hu & Mathews, 2009), and educating citizens for the new economy (Etzkowitz et al. 2012; Reese & Minting, 2011). The TKTP initiative involves several stakeholders. The study of the views and opinions from these stakeholders guided the assessment policy recommendation. The findings from this project study provided direction for a policy recommendation to assess one TKTP at one university's campus. The assessment policy recommendation from this project study could provide additional suggestions to the assessment of other university's parks and to other parks in emerging economies like Mexico. The proliferation of technology parks around the world in the last 20 years (Phan et al., 2005; Smulders, 2011; UNESCO, 2013), the expansion of some of these parks, and the construction of new parks in the next years generates a need to support decision-making and accountability processes through formal assessment practices.

### **Summary**

In Section 1, I discussed the problem for this study project. The problem is the lack of existence of a formal assessment policy for a multi-million initiative at TIU, a private, nonprofit university in Mexico. The initiative is the creation of knowledge-technology transfer parks. The new leadership at TIU requires evidence-based

information for accountability and decision-making purposes on the initiative. The main research question for this study project is what is the process required for an outcomes assessment plan of a university-based TKTP?

The triple helix model framework informed the study of the problem. In this model, the formal relations between university, industry, and government are essential to the success of TKTPs. Therefore, stakeholders from these three sectors were considered in the study. In addition, the review of literature generated several issues related to the success of TKTPs. These issues from the literature about knowledge-innovation economy, knowledge-technology transfer processes, and science-technology park assessment informed the project of this study. Section 2 provides a discussion and justification for the research methodology applied in this project study.

## Section 2: The Methodology

### **Introduction**

In this section, I discuss the research methodology that I used for this project study. I discuss several topics, including my research design, sampling procedure, instrument and measures, data analysis procedure, and key findings. I also consider the assumptions underlying my study and its limitations and explain how I protected participants' rights. In carrying out my research, I investigated the question: What is the process required for an outcomes assessment plan of a university-based TKTP? In addition, the following more specific questions supported the central question.

- What are the required inputs for the assessment process?
- What outputs (short-term results) should the assessment process measure?
- What outcomes (long-term impacts) should be considered for assessment by the plan?
- Do the campus stakeholder groups agree on assessment criteria for the TKTP?

### **Research Design and Approach**

I conducted a survey research to identify and describe important variables related to the assessment and success of TIU's TKTP initiative. Survey studies permit researchers to investigate tendencies of issues from the surveyed population (Creswell, 2012). Researchers use a survey method when they want to acquire relevant information for program assessment (Creswell, 2012). Some of the reasons for conducting survey research are for assessing a program's effectiveness, designing a program, and obtaining

data to monitor programs (Fink, 2013). The data procured informed the TKTP assessment policy recommendation of this project study.

For example, Van Looy et al. (2011) applied survey research when studying universities' entrepreneurial activities. According to Van Looy et al. (2011),

The collection of data on universities' entrepreneurial activities (patenting, contract research and spin-offs), scientific productivity and the control variables (university size and scope, presence and size of the TTO, regional business R&D intensity) required a combination of survey data and data obtained from secondary sources. (p. 556)

In addition, Basile (2011) conducted survey research to investigate how Italian technology parks generated innovation through networking between organizations and people located inside or outside the technology parks. These examples inform the use of survey research when investigating problems similar to the problem of this project study.

My project study aimed at obtaining data through survey research and appropriate statistical analyses. The type of survey design for this project study was cross-sectional. In this type of design, "the researcher collects data at one point in time" (Creswell, 2012, p. 377) from stakeholders with diverse interests. The survey cross-sectional design facilitated the gathering of information from TKTP stakeholders about what should be assessed to better understand the effectiveness of TKTPs. Researchers use the stakeholder survey method instead of other research methods when stakeholders are numerous and/or distantly located, when multiple views from stakeholders exist, and

when time is short to access stakeholders (Sadashiva, n.d.). All of these factors weighed heavily on my decision to use a cross-sectional stakeholder survey method.

This project study's central question sought to emerge a research-based recommendation for assessing the outcomes of a university TKTP. Through the support of survey research methodology, this study procured data from various stakeholders at a TKTP at one of TIU's campus. These data, in turn, informed the resulting project study. In the next section, I elaborate on the study population.

### **Setting and Sample**

My study population consisted of the TKTP's stakeholders of one of TIU's campus. This section includes a description of the population, an estimated number of each population stakeholder group, the sampling method, sample size, and characteristics of each sample group.

#### **Population**

I studied a Mexican, technology-oriented university in the northern part of the country. The population for this study was comprised of all definable stakeholders from a TKTP at one of TIU's campus. This project study aimed at identifying and understanding key elements that needed to be assessed in a university-based TKTP. These elements relate to the TKTP's mission of supporting the development of society's entrepreneurial capabilities. Therefore, I deemed it essential to collect information from the TKTP's stakeholders about what makes a TKTP successful. Table 1 includes the listing of stakeholders, as well as the estimated population and sample sizes. For this project study, the population included the following persons:

- *University leaders and administrators*: Decision makers, policy makers, and resource managers, including the university's president, vice-president for research, vice-president for entrepreneurship, campus director, deans of schools, and the TKTP's director.
- *Faculty*: Any professor from the campus involved with TKTP work.
- *2014 undergraduate students*: These are students who graduated during 2014 from any undergraduate program at the campus.
- *2014 graduate students*: These are students who graduated in 2014 from any graduate program at the campus.
- *Alumni*: Any person who completed an undergraduate or graduate program at the campus in the three years preceding the study. This stakeholder group has access to TKTP's services. Therefore, their opinion of the value they may obtain from TKTP's services may be relevant to inform an assessment plan.
- *Board of Trustees members*: Stakeholders including the president of the Board and other members who invested financial resources in the TKTP initiative. Their opinion on relevant aspects and outcomes of the initiative is important to this project study.
- *TKTP administrators*: The financial manager, physical plant manager, operations manager, and technology business incubator and accelerator manager who oversee the daily operation of the park and can provide valuable information on issues of park assessment.

- *Individuals working at the campus TKTP's business incubator, accelerator, and firms:* This group of stakeholders is a direct beneficiary of the park's services. Their view of the process to assess the park's operation is valuable.
- *Industry and government leaders from the campus region:* Presidents of firms and business chambers and government representatives for economic development and technology transfer. In the triple helix framework, the collaboration of industry, government, and university is pivotal for successful local economic development (Etzkowitz & Leydesdorff, 2001). Hence, the opinion of industry and government leaders should be part of the data collection process of this study.

Table 1

*Estimated Population and Stratified Samples from Stakeholders of the TKTP at One University Campus*

Stakeholder group	Population size	Desired stratified sample size*
1. University leaders and administrators	15	14
2. Faculty	50	44
3. Students (undergraduates)	300	169
4. Students (graduates)	100	79
5. Alumni	1,000	278
6. Board of trustees members	20	19
7. TKTP administrators	5	4
8. People working at the TKTP	300	169
9. Industry leaders	20	19
10. Government leaders	20	19

*Note.* Stratified samples calculated using a sample size calculator from National Statistical Service of Australia. The calculation considered a 95% confidence level and a confidence interval of 5%.

### **Sampling Method**

I applied stratified random sampling. Fowler (2009) recommended having a comprehensive sampling frame or an ample representation of the population under study. Hence, I may achieve a better representation of the population of this study. The composition of the stratified samples came from this study's population. Special characteristics of the population define stratified samples (Fowler, 2009). For this study, stratified samples consisted of the different groups of stakeholders defined by the special characteristics of the group they belong to (administrators, faculty, trustees, etc.). I used a random number generator function from database software. A random number was assigned to each individual in the database. I selected a specific random number to obtain the individual for the sample.

### **Sample Size**

In descriptive studies, the specification of the confidence level, confidence interval, and estimated standard deviation informs the calculation of sample sizes through value tables or formulas (Hulley, 2007). Likewise, Groves, Fowler, Couper, Lepkowski, Singer and Tourange (2009) explained that a confidence interval number and an estimated standard deviation support the calculation of samples sizes for survey studies. I strove to have largest possible sample as recommended by Creswell (2012) and Fowler (2009). Creswell (2012) noted, "in survey research, it is important to select as large a sample as possible, so that the sample will exhibit similar characteristics to the target population" (p. 381). Moreover, sample accuracy rises in sample sizes in the range of



150 and 200 individuals (Fowler, 2009). For the stakeholder groups with sufficient population, I was able to have the sample sizes recommended by Fowler.

Table 1 shows the estimated population and stratified samples for each type of stakeholder. Stratification is by stakeholder group. Following Fowler's (2009) recommendation, I used a web-based sample size calculator from the National Statistical Service of Australia (NSSA) to compute stratified samples' size (NSSA, n.d.). Using the NSSA web-based sample size calculator, for example, a sample size of 169 was sufficient given a population size of 300, a confidence level of 95%, and confidence interval of 5%. All sample size computations reported in Table 1 considered a confidence level of 95% and a confidence interval of 5%.

### **Eligibility Criteria for Study Participants**

Eligible study participants included stakeholders of the target university campus's TKTP. The stakeholders were people who work at the park, who were involved in administration of the park, who provided funding for the park, and who were beneficiaries of the park's outcomes.

### **Characteristics of the Selected Sample**

The distinguishing characteristic of the selected stratified samples was that each group contained stakeholders having similar functions. For example the essential characteristics of the stratified sample *university leaders and administrators* were that all sample members were people with leadership positions or with administrative responsibilities. Table 2 delineates the characteristics of the stratified samples.

Table 2

*Characteristics of Individuals for Each Stratified Sample Group*

Stratified sample	Characteristics
1. University leaders and administrators	People with leadership or administrative positions at the university
2. Faculty	Professors with teaching or mentorship functions involved with the TKTP
3. Students (2013-2014 Undergraduates)	Enrolled last year undergraduate students at the campus
4. Students (2013-2014 Graduates)	Enrolled last year graduate students at the campus
5. Alumni	People that finished either a graduate or undergraduate degree in the last three years
6. Board of trustees members	Members from the Board of trustees at the campus
7. TKTP administrators	People with administrative responsibilities at the park
8. People working at the TKTP	People working at the campus's park through one of the park's services (business incubation, business acceleration, and attracted business)
9. Industry leaders	People recognized as business/industry leaders in the local community of the campus
10. Government leaders	People at the federal, state, and municipal governments that supported the TKTP initiative or work for economic development

## **Instrumentation and Materials**

I collected data using a questionnaire that I designed specifically for this study. This section provides justification for creating the instrument used in the study. The instrument characteristics are also presented and discussed.

### **Name and Type of Instrument**

I named the instrument that I designed for this study project the TKTP Assessment Tool (TKTP-AT). I performed a literature search to find an existing questionnaire that would address TKTP assessment, but I did not find any questionnaire. Therefore, the TKTP-AT instrument was designed to collect data to answer the specific research questions developed for this study.

I designed the survey instrument to be web-based and self-administered. Web-based questionnaires have several advantages (Creswell, 2012). One advantage is faster collection of great amounts of data. Another advantage is the increased access to and use of the Internet, especially on college campuses, the environment of interest of this study. The web-based protocol facilitated the data collection process and made use of readily available software programs for administering web-based surveys. I used the web-based software SurveyMonkey to collect data for this study. I accessed this software through the web link [www.surveymonkey.com](http://www.surveymonkey.com).

### **Concepts Measured by Instrument**

The TKTP-AT instrument was divided into the five sections shown in Table 3. Questions for the instrument were derived from three sources. First, the research questions were informed by the triple helix model that served as the theoretical basis for

the study in order to include the diverse TKTP interests from the university, local industry, business, and government. Second, the initial questions that populated the instrument were surfaced from the study's research questions. Finally, a group of other campus TKTP experts were consulted in order to improve the survey items. In some cases, suggestions from the TKTP experts were integrated with the new instrument to create new survey items.

Table 3

*TKTP-AT Instrument Sections and Relation to Research Questions*

Section	Research question
A	Identification of stakeholder type
B	Identification of inputs. Research question R2
C	Fundamental activities. Research question R1
D and E	Short-term and long-term results. Research questions R3 and R4

The object of the data collection instrument was to obtain information from TKTP's stakeholders on what they consider to be the key components of an assessment plan. In addition, the instrument asked for the stakeholders' requirements for a successful TKTP. The instrument relied primarily on close-ended questions. Close-ended questions offered a series of options from which to choose.

The first research question asked, "What is the process required for an outcomes-based assessment plan of a university-based TKTP? The 15 questions in Section C of the survey included different activities that were deemed relevant in the operation of a TKTP. Creation, acceleration, and attraction of firms are highlighted activities from this section.

Activities assessed by the instrument in other areas were projects executed by faculty and students, the commercialization of knowledge and technology, creation of new jobs, and innovation. R2 research question addressed in section B of the survey asked about input resources for a TKTP. Among these inputs are financial resources, faculty and student involvement, governing policies, and governance involvement by stakeholders. R3 and R4 research questions addressed in sections D and E of the survey asked about TKTP's outputs and outcomes related to the generation of an entrepreneurial academic community, close relations with private and public sectors, generation of new publications and patents, university's prestige, and local community's economic development.

### **Calculation and Meaning of Scores**

Central tendency and variability of responses were calculated. This study's data collection instrument aimed to identify issues that TKTP's stakeholders considered relevant for outcome assessment. Therefore, for each item in the survey, the distribution of responses was analyzed to determine the mode or most frequent response, the median or the response located at the middle of the distribution of responses, and the variability or the dispersion of responses around the most frequent one (Lodico, Spaulding, & Voegtle, 2010). In the data analysis, I interpreted a response with a high frequency rate (mode) and relative low dispersion (variability) as having relevance for this response from the stakeholder population of this study.

### **Instrument Reliability and Validity**

Validity of the TKTP-AT instrument was established by focusing on content validity. Creswell (2012) and Fink (2013) suggested that content validity may be demonstrated by asking a group of experts to evaluate the instrument's items in order to verify that they are both acceptable and actually measure the construct intended for assessment. For the instrument's validity, a group of experts from other campus TKTPs were asked to read and make recommendations to improve the instrument. Employing other campus TKTP experts aided in not diminishing the sample size of the campus targeted for this study. The other campus TKTP experts evaluated TKTP-AT items for clarity from the viewpoints of multiple TKTP stakeholders.

Beginning with an explanation of the study's goals, six experts and leaders from other TKTP campuses were invited to participate in assessing the instrument's content validity. They were asked to respond to the instrument's items and to provide feedback regarding the instrument's content validity. In addition, they were asked to make recommendations for improving the instrument. All experts agreed that the original instrument contained face validity because it included essential qualities needed to assess a TKTP's effectiveness from the perspectives of multiple stakeholders. In addition, all six experts suggested specific ways to improve the instrument by providing additional items. In total, six new items were added based on the experts' feedback. The new items, based on the expert recommendations, are annotated with asterisks in the TKTP-AT, provided in Appendix B. A summary of all recommendations given by the TKTP other campus experts is provided in Appendix C.

After making all the adjustments to the original instrument based on the TKTP experts' recommendations, the instrument was mailed back to the experts for a final approval. All six experts approved the final version of the instrument. In response to this final round of instrument review, one expert commented

Congratulations sincerely for your work, it really is a difficult topic, because I consider that the only way to study technology parks in Latin America is through empiric evidence. There is no indicators database that allows the assessment of tech parks, and in some cases, neither data from government or tech park operators.

Another expert commented, "the instrument is adequate and correct, and without doubt, it is an instrument that supports the analysis of a TKTP." These comments were very encouraging and supported the research project overall.

### **Processes Needed to Complete Instrument by Participants**

Appendix B includes the full TKTP-AT instrument used in this study. The items in the instrument aimed to evaluate TKTP stakeholders' opinions on the most important TKTP's inputs, activities, outputs, outcomes, and issues. The TKTP-AT began by asking the respondent to identify his or her stakeholder type. The instrument's close-ended items assessed important issues for a successful TKTP. These close-ended items offered five choices as answers through a Likert-scale format. In addition, there were two answer choices for situations when the respondent of an item did not have enough information or chose not to answer the item. Table 4 shows the values of the Likert scale options and their meanings.

Table 4

*Scale Values for TKTP-AT Instrument*

Option	Value	Meaning
Strongly disagree	-2	Full/total opposition to the item's statement
Disagree	-1	Regular/medium opposition to the item's statement
Neither agree or disagree	0	There is a neutral position about the item's statement
Agree	+1	Regular/medium accordance with the item's statement
Strongly agree	+2	Full/total accordance with the item's statement
Not enough information or context background to answer the item	5	There is not enough information or context background to answer the item
No Response	6	Chose not to answer the item

**Data Handling**

Data from the study's participants were collected through the web-based application, SurveyMonkey. The collected data could only be accessed through a password protected user account. For analysis purposes, I downloaded the data file to my office computer for processing. This local computer data file was also protected with a password. In addition, the local computer was located at an office with limited access. The database file is available upon written request and authorization by this study project's committee chairperson. All study participants were identified with a numeric code to protect their identities.

**Description of Data**

The variable type used to identify the type of stakeholder was categorical as it considered 10 categories of stakeholders. These categories included university leader or



administrator, faculty, undergraduate student, graduate student, alumni, member of the board of trustees, TKTP administrator, TKTP firm employee, industry or private sector leader, and government sector leader. The remaining Likert scale items were generally treated as ordinal data.

### **Data Collection and Analysis**

Data were collected through stakeholder survey research. TKTP stakeholders through the web-based application, SurveyMonkey, responded the data-collecting instrument TKTP-AT. Data obtained from the TKTP-AT instrument were initially analyzed using descriptive statistics. The use of descriptive statistics aimed to identify trends on key inputs, activities, outputs, outcomes, and issues perceived by the study's participants to be relevant for TKTP assessment (Lodico, Spaulding, & Voegtler, 2010). The analysis of the data procured from the survey research informed the overall project or product of this study. After the initial analysis using descriptive statistics, internal estimates of reliability were run to see if any summated scales could be defined for analysis using inferential statistics. As a result, five new scales with Cronbach's alphas ranging from .70 to .90 were identified for ANOVA analysis to more fully address R5 (stakeholder group agreement on assessment themes).

### **Statistics**

Descriptive statistics analyses include measures of central tendency and variability (Creswell, 2012; Lodico, Spaulding, & Voegtler, 2010). For ordinal data, the mode or the median measure central tendency (Boone Jr & Boone, 2012; Lodico, Spaulding, & Voegtler, 2010), and the interquartile range measures variability (Frankfort-

Nachmias & Leon-Guerrero, 2010). I used IBM's Statistics Package for the Social Sciences (SPSS) to calculate the mode, the median, and the interquartile range for each item on the instrument. The mode and the median response for each item represent an overall trend based on stakeholder perspectives (Boone & Boone, 2012). For example, if the median had a value of two for a specific instrument item's response, this meant that the stakeholders for a category tended to *strongly agree* on the item's issue. Moreover, if the interquartile range representing the variability or dispersion of the responses around the median was low, then the responses were close to the median or not widely spread (Fink, 2013). I interpreted this result as higher level of agreement by the stakeholders on the median response for that item.

Inferential statistics were used to obtain conclusions from the collected data through a test of significance on a null hypothesis (Lodico, Spaulding, & Voegtle, 2010). The test of significance used was analysis of variance (ANOVA). ANOVA is applied when analyzing the difference of means among groups (Lodico, Spaulding, & Voegtle, 2010). SPSS calculated ANOVA analysis to compare the mean differences between the stakeholder groups on five TKTP measures of (a) TKTP success fundamentals, (b) TKTP activities, (c) TKTP result fundamentals, (d) TKTP desired contributions, and (e) TKTP entrepreneurial contributions.

### **Assumptions, Limitations, Scope and Delimitations**

This section delineates this study's assumptions, limitations, and scope. Assumptions represent the suppositions or starting points of this study. Therefore, I find important to declare this study's premises. Limitations are the restrictions found in this

study. This study's limitations present the issues that restrained the development and findings of the study. The scope is the range or extent of the study. The scope explains the focus on the investigated issues of this study.

### **Assumptions**

In this project study, I assumed that participants in the research study would be candid in their responses to the survey instrument. In addition, I assumed that the findings from a well-designed survey instrument administered to diverse stakeholders from one university's campus TKTP could inform an outcomes assessment policy recommendation, which was the proposed project for this study.

### **Limitations**

This study is limited by the survey response rate from some stratified samples at a particular institution. There were low response rates in some stratified samples that could generate a misrepresentation of the opinions of a group of stakeholders. In addition, these low response rates may limit generalizability to the study's population of TKTP stakeholders at the campus studied.

### **Scope**

I focused on research variables informed by the guiding framework of the triple helix model for describing effective processes. These variables included the assessment process's inputs, activities, outputs, outcomes, and issues as perceived by diverse stakeholders from university, industry, business, and government. In addition, this study is bounded by the research of one TIU's campus TKTP.

### **Measures for Protecting Participant Rights**

Participants in this study were all adults. No minors were involved. In addition, before answering the questionnaire, participants were asked to read and reply to an informed consent form that explained the study's purpose, the implications of participation in the study, and how the provided information will be kept confidential. The study did not mention any names of people or institutions. The electronic files with the answers to the questionnaire were locked with a password and will remain under lockage for five years. Therefore, no one had access to the data except for this study's researcher and dissertation committee, the latter only upon request. People involved in the study were required to answer a web-based questionnaire and provide informed consent before responding. After careful consideration of research ethics, the risk to participants in this study was deemed as low overall.

### **Measures from Data Collection**

In this section, I explain the process used to collect the data for this study. The section includes an explanation of the survey's response rate, and how the data were measured for its analysis.

I received approval from Walden University's Institutional Review Board (IRB) to collect data on April 21, 2014. My approval number is 04-21-14-0273548 and expired on April 20, 2015. The permission to collect data from IRB included the process of submitting this project study's data collection instrument for revision in two stages. The first stage was the original version of the instrument, and the second stage was the instrument's version with the feedback from the group of experts. First, I obtained

authorization to acquire the stakeholders' population database from the campus President where the TKTP is located. The campus President instructed the TKTP Director to assist me in obtaining the database. The TKTP Director gave me an Excel spreadsheet for each stakeholder group. The spreadsheets contained the emails of the stakeholders. Each stakeholder's email was assigned randomly with a number one, two, or three.

I constructed the sample for each stakeholder group by selecting an email from the stakeholder list with a specific number. The specific number that I chose was three. Therefore, every email from the database that was randomly assigned with the number three constituted the sample list. The desired sample size for each stakeholder group from Table 1 was used to generate the final sample lists. Each member of the sample lists received an email from my Walden University email account. The email explained the purpose of my study and invited the stakeholder to read first the informed consent form. This form was attached to the email. The last section of the informed consent form included a web link to the survey.

I sent the first emails at the beginning of August 2014. In total, 814 emails were sent. The survey web software aided me in monitoring the responses. Five reminders were sent to each of the 814 members from the sample groups. The data collection process took six weeks. After five reminders and considering that my original plan was to finish my data collection by the end of September 2014, I decided to end the data collection process and start the analysis of the data. Table 5 shows the survey response rate for each stakeholder group.

I obtained from the survey web software an Excel spreadsheet file that contained the answers to 129 surveys. For the descriptive statistics analyses, the spreadsheet file was recoded to change the answers to the Likert-scale values provided in Table 4. The stakeholder category variable A was coded as categorical. The remaining Likert-scale items in the instrument's Sections B, C, D, and E were coded as ordinal. In total, there were 59 ordinal variables based on the Sections B-E items.

Table 5

*Survey Response Rate for Each Stakeholder Group*

Stakeholder group	Stratified sample	Surveys answered	Response rate
1. University leaders and administrators	14	14	100%
2. Faculty	44	16	36%
3. Students (undergraduates)	169	13	8%
4. Students (graduates)	79	29	37%
5. Alumni	278	20	7%
6. Board of trustees members	19	8	42%
7. TKTP administrators	4	4	100%
8. People working at the TKTP	169	14	8%
9. Industry leaders	19	11	58%
10. Government leaders	19	0	0%
Total	814	129	16%

**Data Analysis**

This section presents the data analysis conducted for this project study. The data analysis consisted of two parts. One part was descriptive statistics analysis and the other part was inferential statistical analysis. In preparation for the data analysis, I loaded the collected data to the SPSS statistics software and created a data file for all the answers ( $N$

= 129 surveys). During this process a variable name was created for each of the survey's items. The name used for the variable was the same one used on the TKTP-AT instrument itself. All data were specified to be an integer number in SPSS.

### **Descriptive Statistical Analysis**

I received 129 surveys from the study's participants. After computing the frequency, I calculated the median, mode, and interquartile range (IQR) for each item variable. Tables 6, 7, 8, and 9 show the descriptive statistics for Sections B, C, D, and E of the TKTP-AT instrument's items.

Table 6 presents the item responses from all stakeholder groups regarding the second research question (TKTP-AT, Section B) addressing needed inputs for a successful TKTP. With medians and modes running between +1 and +2, the data indicated a tendency among stakeholders to agree that the majority of Section B items reflected a level of importance regarding TKTP financial support, the location of the TKTP at the university campus, the involvement of stakeholders, and the definition of governing or managing policies. The exceptions were items B9 and B12. The IQR variability measure had a range of 2. For this study's analysis, I considered a high variability for an IQR equal to or greater than 2. An IQR of 0 or 1 was considered a low variability. The high variability, as assessed by IQR for items B9 and B12, therefore, demonstrated a level of disagreement among participants for those two items. Apparently, some participants deemed involvement in the campus's TKTP management by the Board of trustees (B9) and the alumni (B12) as less critical.







The TKTP-AT Section E addressed the third and fourth research questions about additional expected outputs and outcomes for a successful TKTP. Table 9 shows the opinions from stakeholders. With medians and modes running between -2 and +2, the data indicated a tendency among stakeholders to agree that half the items of Section E reflected a level of importance regarding the TKTP initiative as follows:

- having success up to now;
- improving the creation of new knowledge and technology by the faculty;
- improving the university's entrepreneurial ecosystem;
- having success highly dependent on the involvement and engagement of university leaders;
- expanding the initiative to other university's campus;
- investing additional resources by the university to expand the initiative;
- and
- not eliminating the initiative.

Table 9

*Median, Mode, and Interquartile Range (IQR) on Additional TKTP Outputs and Outcomes for Success*

	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14
Number	119	119	119	119	119	119	119	119	119	119	119	119	119	119
Missing	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Median	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	1.00	2.00	-2.00	-2.00
Mode	1	1	1	1	0	1	1	5	2	2	1	5	-2	-2
IQR	1	2	1	1	5	2	2	5	1	1	1	6	1	2

For the rest of the items, the IQR variability measure was equal to 2 or higher. The reason that the IQR variability measure was higher than 2 is because the answer options of 5 (not enough information) and 6 (no response) were included in the analysis. The purpose of their inclusion was to assess the level of insufficient information on an item through the high variability value. The high variability value of the IQR demonstrated a level of discrepancy among stakeholder groups. Apparently, some participants deemed a level of dissatisfaction or not having enough information to assess the TKTP initiative on the Section E items that dealt with the following:

- improving students' learning and skill development;
- supporting a more entrepreneurial faculty;
- supporting a more entrepreneurial student body;
- supporting a university more in touch with the outside world's needs;
- improving the university programs' curricula;
- not delivering the intended objectives and goals, therefore needing revision; and
- not having a place in the current university's vision and strategic plans.

Furthermore, I computed the median, mode, and IQR for each stakeholder group who had a response rate above 35%. This criterion was used to recognize stakeholder groups with more representation. Appendix D contains the full analysis and results of the descriptive statistical analyses.

### **Inferential Statistical Analysis**

I used inferential statistics to address the final research question R5, a question that was added after running internal estimates of reliability to verify five reliable scales

produced by the TKTP-AT. As shown in Table 10, all five scales demonstrated evidence of internal reliability with Cronbach's Alpha of .7 or higher (Hair, Anderson, Tatham & Black, 1998). The related null hypothesis  $H_0$  was designed to confirm the findings from the descriptive statistical analyses used to address R1-R4. The null, therefore, hypothesized no statistically significant difference in the opinions from the TKTP stakeholder groups on the five TKTP-AT scale measures of TKTP effectiveness.

Table 10

*TKTP-AT Scales for ANOVA Analysis*

Scale	Name	Scale Items	Cronbach's Alpha
1	TKTP success fundamentals	B5–B12	.76
2	TKTP activities	C1–C15	.86
3	TKTP result fundamentals	D1–D8	.76
4	TKTP desired contributions	D14–D16	.70
5	TKTP entrepreneurial contributions	D17, E4–E6	.75

**TKTP success fundamentals.** A one-way ANOVA was conducted to determine if there was a significant difference in the average TKTP success fundamentals scores between the nine groups of participants. As shown in Table 10, items B5-B12 comprised this scale. Items B9 and B12 demonstrated high variability based on the IQR analysis, so the success fundamentals scale was retested for internal reliability with the two items omitted from the scale. With the two items omitted, the scale's Cronbach's Alpha decreased to an unacceptable .60, so the two items were retained in the scale for the ANOVA test.

As assessed by boxplots, three outliers were removed from the analysis, one each from groups five, six, and eight. In each case, the three participant scores were extremely divergent from the others in their respective groups and were much lower. The remaining participants were classified into nine groups that included (a) university leadership ( $n = 14$ ), (b) faculty ( $n = 16$ ), (c) undergraduate students ( $n = 11$ ), (d) graduate students ( $n = 22$ ), (e) alumni ( $n = 13$ ), (f) trustees ( $n = 6$ ), (g) TKTP administrators ( $n = 4$ ), (h) TKTP staff ( $n = 10$ ), and (i) industry leaders ( $n = 11$ ). The data were normally distributed for each group, as assessed by the Shapiro-Wilk test ( $p > .05$ ); and there was homogeneity of variances, as assessed by the Levene's test of homogeneity of variances ( $p = .669$ ). The ANOVA revealed that the TKTP success fundamentals score was statistically significantly different  $F(8, 98) = 2.8, p = .008, \omega^2 = .1186$ . The descriptive statistics for the TKTP success fundamentals scores are provided in Table 11. The Tukey post-hoc analysis revealed that only two groups were statistically significantly different. The alumni group (4.88, 95% CI [.009 to 9.74]) was higher than the TKTP staff ( $p = .049$ ). Nearly 12% of the variance was accounted for by the difference between the two groups. There was a statistically significant difference between means ( $p < .05$ ) and, therefore, the null hypothesis was rejected for the success fundamentals scale. While seven of the nine groups seemed to agree based on the TKTP success fundamentals score, the alumni and TKTP staff groups were divergent on this measure.

Table 11

*Descriptive Statistics for the TKTP Success Fundamentals Scores*

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for the Mean		Min	Max
					Lower Bound	Upper Bound		
1	14	9.4286	4.61960	1.23464	6.7613	12.0958	-2.00	16.00
2	16	10.5625	3.38563	.84641	8.7584	12.3666	5.00	16.00
3	11	6.4545	4.43539	1.33732	3.4748	9.4343	-1.00	15.00
4	22	10.0909	3.44907	.73534	8.5617	11.6201	2.00	16.00
5	13	11.0769	3.75192	1.04060	8.8097	13.3442	5.00	16.00
6	6	10.6667	1.86190	.76012	8.7127	12.6206	8.00	13.00
7	4	10.2500	3.09570	1.54785	5.3241	15.1759	6.00	13.00
8	10	6.2000	3.08401	.97525	3.9938	8.4062	.00	11.00
9	11	10.8182	3.28080	.98920	8.6141	13.0223	4.00	15.00
Total	107	9.5701	3.88784	.37585	8.8249	10.3153	-2.00	16.00

**TKTP activities.** A one-way ANOVA was conducted to determine if there was a significant difference in TKTP fundamental activities scores between the nine groups of participants. As shown in Table 10, items C1-C15 comprised this scale. All 15 items were acceptable based on the IQR analysis and together the items yielded an adequate Cronbach's Alpha of .86 for internal reliability.

As assessed by boxplots, four outliers were removed from the analysis, one each from groups eight and nine, and two from group six. In each case, the four participant scores were extremely divergent from the others in their respective groups and three scores were much lower and one higher. The remaining participants were classified into nine groups that included (a) university leadership ( $n = 13$ ), (b) faculty ( $n = 14$ ), (c) undergraduate students ( $n = 9$ ), (d) graduate students ( $n = 25$ ), (e) alumni ( $n = 15$ ), (f)

trustees ( $n = 6$ ), (g) TKTP administrators ( $n = 3$ ), (h) TKTP staff ( $n = 8$ ), and (i) industry leaders ( $n = 9$ ). The data were normally distributed for each group, as assessed by the Shapiro-Wilk test ( $p > .05$ ); and homogeneity of variances was violated, as assessed by Levene's Test of Homogeneity of Variance ( $p < .001$ ). Therefore, the robust ANOVA test Welch's ANOVA was used. Welch's ANOVA revealed that the TKTP fundamental activities score was statistically significantly different  $F(8, 25.14) = 4.82, p = .001$ . The descriptive statistics for the TKTP fundamental activities scores are provided in Table 12.

Table 12

*Descriptive Statistics for the TKTP Fundamental Activities Scores*

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for the Mean		Min	Max
					Lower Bound	Upper Bound		
1	13	23.3077	4.44193	1.23197	20.6235	25.9919	15.00	30.00
2	14	21.4286	6.06014	1.61964	17.9296	24.9276	13.00	30.00
3	9	21.5556	3.43188	1.14396	18.9176	24.1935	17.00	28.00
4	25	20.5200	5.31601	1.06320	18.3257	22.7143	11.00	30.00
5	15	20.7333	6.48588	1.67465	17.1416	24.3251	9.00	30.00
6	6	27.0000	2.28035	.93095	24.6069	29.3931	23.00	29.00
7	3	28.0000	2.00000	1.15470	23.0317	32.9683	26.00	30.00
8	8	19.5000	9.33503	3.30043	11.6957	27.3043	8.00	30.00
9	9	23.6667	3.31662	1.10554	21.1173	26.2161	18.00	28.00
Total	102	21.9216	5.67029	.56144	20.8078	23.0353	8.00	30.00

Games-Howell post-hoc analysis revealed that four groups were statistically significantly different. The trustees group (5.44, 95% CI [.029 to 10.86]) was higher than the undergraduate students ( $p = .048$ ). The trustees group (6.48, 95% CI [1.58 to 11.38]) was

also higher than the graduate students ( $p = .005$ ). The TKTP administrators group (7.48, 95% CI [.641 to 14.32]) was higher than the graduate students ( $p = .033$ ). There was a statistically significant difference between means ( $p < .05$ ) and, therefore, the null hypothesis was rejected for the fundamental activities scale. Based on the results, it seems that the trustees and administrators value TKTP activities more than students.

**TKTP result fundamentals.** A one-way ANOVA was conducted to determine if there was a significant difference in TKTP result fundamentals scores between the nine groups of participants. As shown in Table 10, items D1-D8 comprised this scale. Item D6, however, demonstrated high variability based on the IQR analysis, so the scale was retested for internal reliability with this item omitted. With the item omitted, the scale's Cronbach's Alpha decreased to an unacceptable .68, so the item was retained in the scale for the ANOVA test.

As assessed by boxplots, nine outliers were removed from the analysis, one from group one, two from group four, three each from groups two and five. In each case, the nine participant scores were extremely divergent from the others in their respective groups and were much lower except for the one from group one which was higher. The remaining participants were classified into nine groups that included (a) university leadership ( $n = 13$ ), (b) faculty ( $n = 11$ ), (c) undergraduate students ( $n = 11$ ), (d) graduate students ( $n = 24$ ), (e) alumni ( $n = 14$ ), (f) trustees ( $n = 6$ ), (g) TKTP administrators ( $n = 3$ ), (h) TKTP staff ( $n = 12$ ), and (i) industry leaders ( $n = 10$ ). The data were normally distributed for each group, as assessed by the Shapiro-Wilk test ( $p > .05$ ) except for group five ( $p = .017$ ); and there was homogeneity of variances, as assessed by the Levene's test



of homogeneity of variances ( $p = .068$ ). The ANOVA revealed that the TKTP result fundamentals score was statistically significantly different  $F(8, 95) = 4.96, p < .001, \omega^2 = .2336$ . The descriptive statistics for the TKTP results fundamentals scores are provided in Table 13.

Table 13

*Descriptive Statistics for the TKTP Results Fundamentals Scores*

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for the Mean		Min	Max
					Lower Bound	Upper Bound		
1	13	9.2308	1.87767	.52077	8.0961	10.3654	7.00	13.00
2	11	13.6364	1.28629	.38783	12.7722	14.5005	12.00	16.00
3	11	9.2727	3.40855	1.02772	6.9828	11.5626	3.00	13.00
4	24	11.8750	2.70768	.55270	10.7316	13.0184	5.00	16.00
5	14	13.6429	2.37316	.63425	12.2726	15.0131	8.00	16.00
6	6	10.0000	2.75681	1.12546	7.1069	12.8931	6.00	13.00
7	3	12.6667	2.08167	1.20185	7.4955	17.8378	11.00	15.00
8	12	11.5000	3.06001	.88335	9.5558	13.4442	6.00	16.00
9	10	11.4000	2.31900	.73333	9.7411	13.0589	7.00	15.00
Total	104	11.5192	2.90958	.28531	10.9534	12.0851	3.00	16.00

The Tukey post-hoc analysis revealed that four groups were statistically significantly different. The faculty group (4.41, 95% CI [1.10 to 7.71]) was higher than the university leadership ( $p = .002$ ). The faculty group (4.36, 95% CI [.920 to 7.81]) was also higher than the undergraduate students ( $p = .004$ ). The alumni group (4.41, 95% CI [1.30 to 7.52]) was higher than the university leadership ( $p = .001$ ). The alumni group (4.37, 95% CI [1.12 to 7.62]) was also higher than the undergraduate students ( $p = .002$ ).

Approximately 23% of the variance was accounted for by the difference between the

groups. There was a statistically significant difference between means ( $p < .05$ ) and, therefore, the null hypothesis was rejected for no difference between the groups on the results fundamentals scale. Based on the ANOVA results, it appears that the faculty value TKTP result fundamentals more than do the university leadership and undergraduate students, and alumni also value TKTP result fundamentals more than do the undergraduate students.

**TKTP desired contributions.** A one-way ANOVA was conducted to determine if there was a significant difference in TKTP desired contributions scores between the nine groups of participants. As shown in Table 10, items D14-D16 comprised this scale. Since all three items were also retained as a result of the IQR analysis, no additional reliability test was needed for the scale.

As assessed by boxplots, five outliers were removed from the analysis, three from group two, one from group four, and one from group five. In each case, the five participant scores were extremely divergent from the others in their respective groups and were much lower. The remaining participants were classified into nine groups: (a) university leadership ( $n = 13$ ), (b) faculty ( $n = 11$ ), (c) undergraduate students ( $n = 12$ ), (d) graduate students ( $n = 27$ ), (e) alumni ( $n = 16$ ), (f) trustees ( $n = 6$ ), (g) TKTP administrators ( $n = 3$ ), (h) TKTP staff ( $n = 12$ ), and (i) industry leaders ( $n = 10$ ). The data were normally distributed for university leadership, alumni, and industry leaders, as assessed by the Shapiro-Wilk test ( $p > .05$ ). The same test showed that data were not normally distributed for faculty ( $p = .002$ ), undergraduate students ( $p = .031$ ), graduate students ( $p = .010$ ), trustees ( $p = .004$ ), and TKTP staff ( $p = .043$ ). There was

homogeneity of variances, as assessed by the Levene's test of homogeneity of variances ( $p = .080$ ). The ANOVA revealed that the TKTP desired contributions score was not statistically significantly different  $F(8, 101) = 1.41, p = .203$ . The descriptive statistics for the TKTP desired contributions scores are provided in Table 14. There was no statistically significant difference between means ( $p > .05$ ) and, therefore, it seems the included participants were in relative agreement regarding the TKTP desired contributions scale.

Table 14

*Descriptive Statistics for the TKTP Desired Contributions Scores*

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for the Mean		Min	Max
					Lower Bound	Upper Bound		
1	13	3.8462	1.67562	.46473	2.8336	4.8587	.00	6.00
2	11	5.4545	.68755	.20730	4.9926	5.9164	4.00	6.00
3	12	4.5833	1.62135	.46804	3.5532	5.6135	1.00	6.00
4	27	4.1481	1.70302	.32775	3.4745	4.8218	.00	6.00
5	16	3.9375	1.76895	.44224	2.9949	4.8801	.00	6.00
6	6	4.5000	1.64317	.67082	2.7756	6.2244	3.00	6.00
7	3	6.0000	.00000	.00000	6.0000	6.0000	6.00	6.00
8	12	4.1667	1.85047	.53418	2.9909	5.3424	.00	6.00
9	10	4.1000	1.91195	.60461	2.7323	5.4677	.00	6.00
Total	110	4.3273	1.67063	.15929	4.0116	4.6430	.00	6.00

**TKTP entrepreneurial contributions.** A one-way ANOVA was conducted to determine if there was a significant difference in TKTP entrepreneurial university contribution scores between the nine groups of participants. As shown in Table 10, items D17, and E4-E6 comprised this scale. Items E5 and E6 demonstrated high variability

based on the IQR analysis. However, the scale Cronbach's alpha of .75 would not be improved by deleting any of these items, so all items were retained for the ANOVA test.

As assessed by boxplots, six outliers were removed from the analysis, one each from groups two and eight, and four from group five. In each case, the six participant scores were extremely divergent from the others in their respective groups and four scores were much lower and two higher. The remaining participants were classified into nine groups that included (a) university leadership ( $n = 13$ ), (b) faculty ( $n = 8$ ), (c) undergraduate students ( $n = 9$ ), (d) graduate students ( $n = 26$ ), (e) alumni ( $n = 7$ ), (f) trustees ( $n = 3$ ), (g) TKTP administrators ( $n = 2$ ), (h) TKTP staff ( $n = 4$ ), and (i) industry leaders ( $n = 3$ ). The data were normally distributed only for groups one, two, three, and four, as assessed by the Shapiro-Wilk test ( $p > .05$ ); and homogeneity of variances was violated, as assessed by Levene's Test of Homogeneity of Variance ( $p < .05$ ). Therefore, the robust ANOVA test Welch's ANOVA was used. In order to perform Welch's ANOVA, group five had to be removed from the analysis because its variance was equal to zero. Welch's ANOVA revealed that the TKTP entrepreneurial university contribution score was not statistically significantly different  $F(7, 9.05) = .602, p = .742$ . The descriptive statistics for the TKTP entrepreneurial university contribution score are provided in Table 15. There was no statistically significant difference among means ( $p > .05$ ). The null hypothesis could not be rejected and the ANOVA results seemed to confirm the IQR analysis in the previous section. Based on the ANOVA results, there was relative agreement between the participant groups on the TKTP-AT items regarding the TKTP entrepreneurial contributions for the campus.

Table 15

*Descriptive Statistics for the TKTP Entrepreneurial University Contribution Score*

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for the Mean		Min	Max
					Lower Bound	Upper Bound		
1	13	3.0000	3.93700	1.09193	.6209	5.3791	-4.00	8.00
2	8	3.7500	1.28174	.45316	2.6784	4.8216	2.00	6.00
3	9	3.4444	3.71184	1.23728	.5913	6.2976	-4.00	8.00
4	26	3.5769	2.98226	.58487	2.3724	4.7815	-2.00	8.00
6	3	5.3333	2.88675	1.66667	-1.8378	12.5044	2.00	7.00
7	2	6.5000	2.12132	1.50000	-12.5593	25.5593	5.00	8.00
8	4	3.5000	.57735	.28868	2.5813	4.4187	3.00	4.00
9	3	1.3333	4.61880	2.66667	-10.1404	12.8071	-4.00	4.00
Total	68	3.5294	3.09294	.37507	2.7808	4.2781	-4.00	8.00

**Selecting TKTP Outcome Measures**

In this section, I present TKTP outcome measures selected using consensus input from stakeholder participants. In addition, I explain the results of the data analysis in relation to this study's research questions. Finally, I introduce the project for this doctoral study.

Data analysis was divided in two parts. The first part was descriptive statistics. This analysis focused on identifying the central tendency (mode and median) and variability (IQR) of the 59 items collected from the TKTP-AT instrument. The second part of the analysis was inferential statistics. Five scale measures were composed from several of the 59 items in the TKTP-AT instrument. The focus of the inferential analysis was to compare the composite five scale measures through ANOVA analysis. The null hypothesis  $H_0$  hypothesized that there is no statistically significant difference in the

opinions of the different stakeholder groups for the composite five scale measures. Table 16 presents a summary of the findings from both analyses.

The results provided in Table 16 allowed me to answer the research questions developed for this study. For research question R1, what is the process required for an outcomes assessment plan of a university-based TKTP? Table 16 indicates that the stakeholders from the TKTP tend to agree on addressing the following TKTP's activities:

- C1. The support for creation/incubation of new technology firms/start-ups.
- C2. The support for acceleration success of existing firms.
- C3. The attraction to the TKTP of existing technology firms.
- C4. Faculty participation on projects from TKTP's firms/start-ups.
- C5. Students' participation on projects from TKTP's firms/start-ups.
- C6. The transference of knowledge and technology from the university to the TKTP's firms/start-ups.
- C7. The transference of knowledge and technology from the firms/start-ups to the university.
- C8. The commercialization or selling of research, knowledge, and technology from the university to the TKTP's firms/start-ups.
- C9. The creation of new jobs through technology-based firms.
- C10. The constant generation of innovation in technology and services for firms/start-ups to take advantage.
- C11. The fostering of links between businesses, students, and professors.

- C12. The commercialization of research, knowledge, technology, or innovation from the university to the productive sectors.
- C13. The generation of innovation and ideas for creating technology-based start-ups.
- C14. The connection between start-ups and angel/venture capital funds.
- C15. The development of an ecosystem that fosters and promotes ideas, innovation, research, development, entrepreneurship, and angel/venture capital.

However, the ANOVA rejected the null hypothesis  $H_0$  for the composite scale measure of TKTP activities (C1-C15). Significant differences emerged between stakeholder groups 6 (trustees) and 7 (TKTP administrators) with groups 3 and 4 (undergraduate and graduate students). While the IQR analysis confirms a general agreement between the groups for items C1-C15, the ANOVA results provided additional granularity to inform the specific groups where perspectives on TKTP activities may differ. Based on the ANOVA results, it seems that the trustees and administrators value TKTP activities more than students.

For research question R2, which addressed required inputs for the assessment process, Table 16 results suggest that the stakeholders from the TKTP tend to agree on addressing the following TKTP's process inputs:

- B1. Private financial resources.
- B2. Public financial resources.
- B3. University financial resources.

- B4. The location of the TKTP at the university campus.
- B5. University faculty involvement with the TKTP.
- B6. University students' involvement with the TKTP.
- B7. The involvement of talented/high skilled workers in the TKTP.
- B8. University definition of TKTP's governing/managing policies.
- B10. The involvement in TKTP's governance of members from the private sector.
- B11. The involvement in TKTP's governance of members from the public sector.

However, the ANOVA rejected the null hypothesis  $H_02$  for the composite scale measure of TKTP success fundamentals (B5-B12). Significant differences emerged between stakeholder groups 5 (alumni) and 8 (TKTP staff). While the IQR analysis confirm a general agreement between the groups for items B1-B11, the ANOVA results provided additional granularity to inform the specific groups where perspectives on TKTP success fundamentals, as measured by items B5-B12 only, may differ. While 7 of the nine groups seemed to agree based on the TKTP success fundamentals score, the alumni and TKTP staff groups were divergent on this measure.

For research questions R3 and R4, addressing TKTP outputs and outcomes, Table 16 indicates that TKTP stakeholders tend to agree on addressing the following TKTP's outputs and outcomes:

- D1. The creation of new jobs.
- D2. The creation of new firms or start-ups.



- D3. The creation of entrepreneurial students.
- D4. Innovation on technology and knowledge for firms or companies to exploit.
- D5. Close relations between TKTP and industry.
- D7. The generation of new publications (research papers, case studies, etc.) on the work done at the TKTP.
- D8. The generation of new patents (from research and development).
- D9. The TKTP financial operation should be self-sufficient without support from the university.
- D11. The TKTP development and transfer of technology from the university to the business/industry sector.
- D12. The TKTP commercialization of research, knowledge, technology, or innovation from the university to the productive sectors.
- D13. The TKTP contribution to improve the prestige of the university.
- D14. The physical presence of the TKTP at the university campus contributing to improve transfer of knowledge and technology to businesses and industry.
- D15. The physical presence of TKTP at the university campus contributing to improve the number of new firms created by people from the university.
- D16. The physical presence of the TKTP at the university campus contributing to make the local community (city/region) more attractive to

new economic investment from outside sources (international firms, global institutions, federal government, etc.).

- D17. The TKTP serving as an instrument for supporting the generation of an entrepreneurial university, entrepreneurial faculty, and entrepreneurial students.

However, the ANOVA rejected the null hypothesis  $H_03$  for the composite scale measure of TKTP result fundamentals (D1-D8). Significant differences emerged between stakeholder groups 2 (faculty) and 5 (alumni) with groups 1 and 3 (university leaders and students). Conversely, the ANOVA could not reject the null hypothesis  $H_04$  because there was no significant difference to the composite scale measure of TKTP desired contributions (D14-D16). Therefore, the ANOVA provided additional granularity about differences in perspectives related to result fundamentals as measured by items D1-D8, where it appears that the faculty value TKTP result fundamentals more than do the university leadership and undergraduate students, and alumni also value TKTP result fundamentals more than do the undergraduate students. ANOVA results confirmed the IQR analysis of group agreement regarding desired contributions, as measured by items D14-D16.

The following considerations related to research questions R3 and R4, outputs and outcomes, respectively, show a tendency of agreement between TKTP stakeholders (Table 16).

- E1. The implementation of the TKTP initiative has been successful up to now.

- E3. Faculty creation of new knowledge and technology has been improved by the TKTP initiative.
- E4. The university entrepreneurial ecosystem has been improved by the TKTP initiative.
- E9. The involvement and engagement of university leaders in the TKTP.
- E10. The expansion of the TKTP initiative to other university's campuses.
- E11. The investment by the university of additional resources to expand its TKTP initiative.

Table 16 results show that TKTP stakeholders supported a tendency of disagreement with item E13. This item is about the university eliminating the TKTP initiative. In addition, Table 16 shows that stakeholders did not support items E12 and E14. However, it is important to note that for items

- E12. The TKTP initiative has not delivered the intended objectives and goals, therefore it should be revised; and
- E14. The TKTP initiative has no place in the current university's vision and strategic plans;

the stakeholder groups from the board of trustees and private sector leaders tend to show a lack of information to express an opinion. This observation is suggested by the information in Appendix D Table D16 and Table D24. I take this result as an indication that the level of available information on the TKTP initiative to all stakeholder groups is an important issue to assess. In addition, the stakeholder group of university leaders and

administrators indicated having no information to express their opinion on item E12, see Table D4 in Appendix D. Overall, this result further justified this research project study.

Table 16

*Summary of TKTP Item and Scale Analyses*

Item	IQR Analysis		Analyzed as Part of Scale	ANOVA Analysis	
	Analyzed as Item	Item Inclusion Supported		Scale Name	Scale Inclusion Supported
B1	Yes	Yes	No	NA	NA
B2	Yes	Yes	No	NA	NA
B3	Yes	Yes	No	NA	NA
B4	Yes	Yes	No	NA	NA
B5	Yes	Yes	Yes		
B6	Yes	Yes	Yes		
B7	Yes	Yes	Yes		
B8	Yes	Yes	Yes	TKTP Success Fundamentals	Groups 5 & 8 mean scores significantly different.
B9	Yes	No	Yes		
B10	Yes	Yes	Yes		
B11	Yes	Yes	Yes		
B12	Yes	No	Yes		
C1	Yes	Yes	Yes		
C2	Yes	Yes	Yes		
C3	Yes	Yes	Yes		
C4	Yes	Yes	Yes		
C5	Yes	Yes	Yes		
C6	Yes	Yes	Yes	TKTP Activities	Group 6 mean score significantly different than groups 3 & 4. Group 7 mean score significantly different than group 4.
C7	Yes	Yes	Yes		
C8	Yes	Yes	Yes		
C9	Yes	Yes	Yes		
C10	Yes	Yes	Yes		
C11	Yes	Yes	Yes		
C12	Yes	Yes	Yes		
C13	Yes	Yes	Yes		
C14	Yes	Yes	Yes		
C15	Yes	Yes	Yes		
D1	Yes	Yes	Yes		
D2	Yes	Yes	Yes		
D3	Yes	Yes	Yes		
D4	Yes	Yes	Yes	TKTP Result Fundamentals	Group 2 mean score significantly different than groups 1 & 3. Group 5 mean score significantly different than groups 1 & 3.
D5	Yes	Yes	Yes		
D6	Yes	No	Yes		
D7	Yes	Yes	Yes		
D8	Yes	Yes	Yes		

*(table continues)*

Item	IQR Analysis		ANOVA Analysis		
	Analyzed as Item	Item Inclusion Supported	Analyzed as Part of Scale	Scale Name	Scale Inclusion Supported
D9	Yes	Yes	No	NA	NA
D10	Yes	No	No	NA	NA
D11	Yes	Yes	No	NA	NA
D12	Yes	Yes	No	NA	NA
D13	Yes	Yes	No	NA	NA
D14	Yes	Yes	Yes		Supported. No
D15	Yes	Yes	Yes	TKTP Desired	statistically significant
D16	Yes	Yes	Yes	Contributions	difference in mean scores across the groups.
D17	Yes	Yes	Yes	TKTP Entrepreneurial Contributions	Supported. No statistically significant difference in mean scores across the groups.
D18	Yes	No	No	NA	NA
E1	Yes	Yes	No	NA	NA
E2	Yes	No	No	NA	NA
E3	Yes	Yes	No	NA	NA
E4	Yes	Yes	Yes	TKTP	Supported. No
E5	Yes	No	Yes	Entrepreneurial	statistically significant
E6	Yes	No	Yes	Contributions	difference in mean scores across the groups.
E7	Yes	No	No	NA	NA
E8	Yes	No	No	NA	NA
E9	Yes	Yes	No	NA	NA
E10	Yes	Yes	No	NA	NA
E11	Yes	Yes	No	NA	NA
E12	Yes	No	No	NA	NA
E13	Yes	Yes	No	NA	NA
E14	Yes	No	No	NA	NA

Note: NA = Not Applicable; 1 = University Leadership; 2= Faculty; 3 = Undergraduate Students; 4 = Graduate Students; 5 = Alumni; 6 = Trustees; 7 = TKTP Administrators; 8 = TKTP Staff; 9 = Industry Leaders

The ANOVA results were not statistically significant and so the null hypothesis  $H_0$  of no differences between the groups for the composite scale measure of TKTP entrepreneurial contributions (D17, E4-E6) could not be rejected. While no differences emerged between stakeholder groups based on this scale, it should be noted that the scale evaluated with ANOVA did not include the aforementioned problematic items (E12 or E14) from the IQR analysis.

The project for this study is a policy recommendation for outcomes assessment on a university-based technology park. The further implementation of this policy may deliver necessary assessment information. This information could help university leaders and administrators to assess if the TKTP initiative has delivered or not the original intended objectives and goals. Therefore, a TKPT assessment policy could support university leaders in the process of revising and improving the TKTP initiative.

### **Conclusion**

I presented the research methodology for this project study. The research design was cross-sectional survey research. The stakeholders of the university campus's TKTP represented the population of study. I generated stratified samples from different stakeholders groups through random selection of individuals. I collected data using a web-based and close-ended survey. My data analysis applied descriptive and inferential statistics methods. A low response rate from the stratified sample groups may represent a limitation for this study. This study's limitations may include the misrepresentation of the different TKTP's stakeholders groups, but careful data analyses, both descriptive and inferential, helped to mitigate this limitation.

In addition, I explained the data collection process. Data measurement was as categorical and ordinal. For the stakeholder type it was categorical, and ordinal for the Likert-scale answers to the items related with the research questions of this study. The data analysis process was delineated. Data analysis applied descriptive statistics including median, mode, and interquartile range. The median and mode provided central tendency analysis. The interquartile range supported the analysis of data variability or

dispersion. In addition, inferential statistics analyzed the difference of means between stakeholder groups from five composite scale scores. The inferential statistics analysis applied one-way ANOVA test. The null hypothesis  $H_0$  was rejected for three out of the five composite scale scores, and I provided rationale for retaining items based on all five TKTP-AT assessment areas.

The findings from the data analysis informed the project of an assessment policy recommendation for a university-based technology park. I present and discuss this project in Section 3.

## Section 3: The Project

### **Introduction**

I developed this project study to address the lack of a policy for assessing the outcomes for a TKTP at TIU, a private, nonprofit university in Mexico. This section contains the project's goals, rationale, literature review, description, evaluation, and implications for social change. The project is a policy recommendation on the assessment of outcomes for the TKTP at TIU. The stakeholders of the TKTP, especially the university leaders and TKTP's administrators, comprise the primary target audience for this policy recommendation. The policy recommendation project is contained in Appendix A. This section provides an overview and foundation for understanding the policy recommendation project within the context of the overall study.

### **Goals of the Project**

I have various goals for the policy recommendation that I make here. One goal is to offer a general guideline for how to assess the TKTP initiative, which was implemented without an assessment plan for ongoing evaluation and improvement. The implementation of this policy recommendation may help TKTP stakeholders obtain information on the outcomes of the TKTP initiative. A second goal is to emphasize the importance of TIU developing and implementing policy for the TKTP's outcome assessment. The research findings revealed that some stakeholder groups lacked sufficient information to assess the original objectives attainment of the TKTP initiative. A third goal of this project is to provide the inputs, activities, outputs, and outcomes that should be assessed based on the research findings and extant literature on assessment



policy. These goals provide a justification for the policy recommendation. In addition, in the following section, I present the rationale for using policy recommendation for my project study.

### **Rationale for Project Genre**

The problem underlying my research study is that TIU does not have an outcomes assessment system for its network of TKTPs. In addition, the leaders at TIU question the TKTP's effect or benefit on faculty and students, as well as the TKTP's financial sustainability (TIU Northern Zone President, personal communication, 2012). Therefore, I believe that it is important to measure the TKTP's outcomes to provide information to TIU leaders for accountability and decision-making purposes. The findings from the research demonstrated several key needs for a successful TKTP related to inputs, activities, outputs, and outcomes. These needs represent the perception of the stakeholders at one TKTP from a TIU campus. The project product of this study provides a research-based solution to the problem in the form of a policy recommendation.

Of the four project genres considered, a policy recommendation was deemed best. I am addressing an ongoing problem with considerable interest from a diverse group of stakeholders from one of TIU's TKTPs (TIU Northern Zone President, personal communication, 2012). The other project genres considered from the project options offered by my doctoral program included evaluation report, curriculum plan, and professional development curriculum (Walden U., 2015). My findings were insufficient to develop a program evaluation report, and neither curriculum plan nor PD training

addressed stakeholder needs identified in my data collection, analyses, and findings. A relevant finding was that university leaders and TKTP administrators expressed that they did not have enough information to assess the attainment of the original TKTP's objectives and goals. Therefore, the implementation of a policy recommendation for an assessment of outcomes for a TKTP may yield necessary information for university leaders and TKTP administrators. I believe that the findings from my literature review and research provide a foundation for the development of a reliable TKTP assessment process.

### **Review of the Literature**

This section includes a review of current literature on policy making and topics related to this project's research findings. I searched several databases from the Walden University Library. These databases include Academic Search Complete, Business Source Complete, eBook Collection (EBSCOhost), Educational Research Complete, and ERIC. The keywords used for the search were *policy*, *assessment policy*, *evaluation policy*, *policy design*, *policy development*, *outcomes assessment policy*, and *impact assessment policy*. Among the journals I consulted, I found the *Journal of Higher Education and Management* to be very helpful.

### **Policy Making**

Views from stakeholders are an important input for designing policy. Policy is the "actions aiming to solve specific problems" (Teirlinck, Delanghe, Padilla, & Verbeek, 2013, p. 367). "Policy provides direction" (Kennedy, 2011, p. 215), policy specifies guidelines for people when executing the many tasks required in a working organization.

The practice of assessment impacts the creation of policy (Teirlinck et al., 2013; Torriti & Löfstedt, 2012). Therefore, the relevance of executing assessment processes in organizations that want to develop good policy. In addition, the promotion of participation of stakeholders in policy generation is fundamental because often stakeholder participation comes up short for policy making (Teirlinck et al., 2013). For example, the European Union implemented Impact Assessment (IA) for evaluating social, economic, and environmental effects on policy design and the inclusion of stakeholder opinions (Torriti, 2010; Torriti & Löfstedt, 2012). Hence, the policy recommendation for this project study is primarily based on stakeholder opinions from survey data.

Worldwide, policy making on the economic impact of universities on their local economies increased in recent years (Cowan & Zinovyeva, 2013; Kretz & Sá, 2013; Lawton Smith, Glasson, Romeo, Waters, & Chadwick, 2013; Teirlinck et al., 2013). In addition, policy development surged for assessing the performance and outcomes of research activity and technology transfer supported by public funding (Curi, Daraio, & Llerena, 2012; Palomares-Montero & García-Arcil, 2011; Sá, Kretz, & Sigurdson, 2013; Stone & Lane, 2012). According to Sá et al. (2013), the requirements to generate assessment policy “have led to the on-going search for effective evaluation systems, comprising methodologies, indicators, and standards for the measurement and reporting of research outcomes” (p. 110). The U.S. Congress passed the Government Performance and Results Act in 1993, which mandated the development of assessment rating tools for public programs. More recently, the U.S. Congress passed the Government Research and

Performance Modernization Act in 2010 (Stone & Lane, 2012). These are all relevant examples of assessment policy because they address policies that have been implemented for accountability purposes, as well as to justify funding for technology and knowledge transfer.

### **Logic Model Evaluation**

A logic model of four components may describe educational programs. These components are resources or inputs, activities or aspects of implementation, outputs or observable products, and outcomes or effects or changes in different time periods (Frye & Hemmer, 2012; Lawton, Brandon, Cicchinelli, & Kekahio, 2014). According to Lawton et al. (2014) and Stone and Lane (2012), logic model evaluation (LME) is a useful tool for designing and supervising program evaluations, specifically, when evaluating research and knowledge transfer activity. Therefore, LME could serve as a good model for assessing TKTPs.

LMEs may serve as a model for social impact assessment. According to Onyx (2014), LME processes have several phases. These phases include inputs that are the required resources for the process, activities that are the events happening in the process, outputs or short-term results, outcomes or long-term benefits, and impacts that are the transformations of the whole setting outside the process. Frye and Hemmer (2012) stated, “if carefully implemented, [LME] can generate ample descriptive data about the program and the subsequent outcomes” (p. 296). Stone and Lane (2012) applied LME to the policies, planning, and assessment of technology-based innovation programs. The assessment policy recommendation for this project study is based on the LME approach

for conceptualizing plans and recommendations because of its success record for structuring good policy in the recent research literature.

### **Economic and Social Impact**

Literature on evaluation of medium- and long-term impacts of universities on local economies is lacking (Pastor, Pérez, & Fernández de Guevara, 2013). In addition, information on the impact of universities at the macroeconomic level is scarce (Kroll & Schubert, 2014). The influence of German universities in the macro-economy between the years 2000 and 2009 was the subject of a research study by Kroll and Schubert (2014). The authors found that German universities had an impact on value creation by increasing the Gross Domestic Product (GDP) for the country. Kroll and Schubert also found that, in the long term, there was an increase in employment and regional economic development within the area studied. TIU's envisions positive regional economic impact as a desirable outcome from the TKTP initiative.

Pastor et al. (2013) established that income generated by universities and direct employment created by universities are two factors to assess when evaluating the impact of universities on the local economy. For example, in the city of Valencia in Spain, researchers found an impact on the local economy of 2.25 times on average for every euro spent by the university, students, and visitors (Pastor et al., 2013). Pastor et al. (2013) concluded, "universities become drivers of socio-economic development in the area in which they are located" (p. 562). Therefore, assessment policies should consider the impact of university initiatives on social and economic development within their communities and surrounding areas.

Communities that develop social capital achieve benefits beyond economic development. They also achieve better health, less crime, and better education performance (Onyx, 2014). Nevertheless, few institutions use an assessment model for social impact. For example, a study of 237 nonprofit institutions in Chicago showed that only around 50% of them had tools to measure social impact (Onyx, 2014). As in the previous example, TIU is a nonprofit institution that aims at having societal impact through economic development using TKTPs.

Lawton Smith et al. (2013) studied two entrepreneurial regions in the United Kingdom. They found positive growth in entrepreneurial resources like strength, depth, and mobility of skilled workforce. The universities had an important role in generating entrepreneurship programs and being inviting places to live and work. In addition, they found the importance of formal networks as an indicator in developing vibrant entrepreneurial regions. In the same vein, the understanding of what is an entrepreneurial university may help policy makers in developing a policy that fosters the creation of entrepreneurial universities (Yadollahi Farsi, Imanipour, & Salamzadeh, 2012). Factors that assess economic impact of universities and universities' entrepreneurial capacities are entrepreneur generation, applied research, knowledge and technology transfer, contribution to socio-economic development, developing an entrepreneurial culture, and collaborative actions between triple helix networks and partners (Lawton Smith & Bagchi-Sen, 2012; Svensson, Klofsten, & Etzkowitz, 2012; Yadollahi Farsi et al., 2012). These themes are similar and support the research findings of this study.

## **Entrepreneurship Education**

University education focused on student success in the global market is important. Discussing the importance of teaching and learning of students and society, Kennedy (2011) said, “given that universities increasingly operate in a competitive international market, they must be able to demonstrate that they can supply human capital capable of meeting the needs of a globalized marketplace” (p. 205). Therefore, it seems essential to focus assessment not only on the outcomes of research and technology or knowledge transfer, but also in the teaching and learning process.

Policymakers around the world are interested in entrepreneurship education as a means of generating jobs and spurring economic development (Kretz & Sá, 2013). Technology transfer centers at universities may support the acceleration of entrepreneurship education in university students (Kretz & Sá, 2013). There are more universities educating in entrepreneurship, and a deficiency in entrepreneurship learning evaluation exists (Kretz & Sá, 2013, Welsch & Tullar, 2014). Welsch and Tullar (2014) developed a test for entrepreneurship education that measured nine constructs: change, risk taking, goal setting, feedback, achievement, responsibility, success motivation, intentions, and fate control. Goal setting, need for achievement, moderate risk taking, responsibility, intentions, and success motivation scored higher in a pretest, posttest application when a group of students received entrepreneurship education. Therefore, a well-run TKTP that included entrepreneurship education as a goal would contribute to the development of related knowledge, skills, and values in students.

## **Technology Park Assessment Around the World**

The literature documents various efforts worldwide in the area of technology park assessment. Fuyang, Yong'an, and Wei (2014) designed and conducted an assessment of a university-based technology park in China. They defined an “evaluation index system” composed of the following dimensions: industry-academy research, development philosophy, team management, management system, human resources, park culture, intermediary service, and financing ability. Fuyang et al. (2014) stated, “Nothing can be accomplished without norms and standards. Thus, it is necessary to establish a scientific evaluation index system for soft power under the principle of objectivity, scientific, systematic, feasibility, simplicity, combining quantitative and qualitative features” (p. 578). The indices found by Fuyang et al. (2014) to be the most important were the following: development vision, innovation culture, development strategy, team cohesion, team management ability, service culture, ratio of personnel with higher education, and consulting and training system. These indices were included in the policy recommendation of this project study.

In Spain, Jimenez-Zarco, Cerdan-Chiscano, and Torrent-Sellens (2013) designed and tested a technology park management tool. Jimenez-Zarco et al. (2013) stated, “park managers need tools that in a simple and objective way ensure correct decision-making” (p. 365). The authors found that there was a positive relationship between company growth and the availability of private financing. In France, Curi et al. (2012) studied the performance of technology transfer offices (TTOs). Overall, they found that science and engineering universities’ TTOs performed better than those that focused on other



disciplines. One reason offered was that science and engineering TTOs have a more applied knowledge and better market chances. In addition, Curi et al. (2012) found that university TTOs' efficiency is enhanced through faculty collaboration and the support of spending from private companies. Similar themes emerged as a result of this study.

The following literature describes some indicators for technology park assessment. Rodeiro-Pazos and Calvo-Babio (2012) and Palomares-Montero and García-Aracil (2011) proposed a series of indicators to measure the capacity of technology parks and universities in Spain in supporting technology transfer and the creation of spin offs. Among these cited indicators were spin offs created or located in the technology park, university personnel involved in companies, number of contracts and collaboration projects with companies, number of patents and products developed with companies, number of licensed technologies to companies, number of companies attracted to the TKTP locations, number of companies created at the TKTPs, number of internationalized companies, companies' viability, employment development, and revenue development. Overall, the TKTP assessment indicators cited by the researchers were analogous in many ways to the themes emerged in this study.

In Croatia, Brčić, Brodar, and Vugrinović (2010) studied technology and science parks. They found some relevant success factors for assessment in a technology park's services. For them, success factors included a sales increase during the first year after company installation in the park, level of park management support, level of cooperation with universities and research centers, level of access to international networks for marketing, quality of the park's facilities for informal and formal meetings, relaxation,

and eating, level of prestige of the park, and level of networking between companies in the park. In Italy, Bigliardi, Galati, and Verbano (2013) identified several characteristics to assess the performance of academic spin-off companies. They recognized four financial indicators to measure spin-off performance. These financial indicators were sales increases, employment increases, revenue increases, and net cash flow. TKTPs bring benefits to their campuses worldwide. Assessment of TKTP performance, however, is seldom attempted.

Stone and Lane (2012) argued that outcomes assessment in technology and knowledge transfer should deliver beyond simple output measures like number of patents or number of publications. Outcomes assessment should provide evidence-based results to stakeholders on the socio-economic effects of the TKTP as well. One of the goals of this study, therefore, was to provide TKTP stakeholders with evidence from research on the relevant factors for assessing TKTP outcomes on a university campus in Mexico.

### **Project Description**

In this section, I discuss the implementation process for this project study. The required resources, existing supports, potential barriers, and solutions to barriers are presented. I also provide a concluding discussion of the roles and responsibilities of major stakeholders.

### **Needed Resources and Existing Supports**

The implementation of a policy recommendation for the assessment of outcomes of the TKTP will require financial and human resources. I recommended that the university hire a person who would be dedicated to implementing the policy

recommendation and for monitoring an outcomes assessment process at TIU's TKTP. For the purposes of this report, the person responsible for the outcomes assessment process will be referred to as the TKTP assessment coordinator. The TKTP assessment coordinator will require office space including telephone, computer, printer, and Internet access. The office space could be an existing support from the TKTP. I recommend that the TKTP assessment coordinator's office be located at the TKTP. In addition, the office would require an operational annual budget of approximately \$60,000 for the outcomes assessment process. I estimated this budget on the level of interaction required from the TKTP assessment coordinator across the campus and local economy. The budget includes the salary for the TKTP assessment coordinator.

### **Potential Barriers and Recommended Solutions**

One potential barrier is securing authorization from TIU decision makers to implement a new TKTP policy that will include a new assessment coordinator and outcomes assessment process. In addition, a potential barrier exists for assigning sufficient resources for the implementation of the assessment policy. Another possible barrier may be insufficient cooperation from companies at the TKTP for sharing assessment information.

A potential solution for bridging these barriers could be that I organize meetings with TKTP stakeholders and present them with the problem, research findings, and the assessment policy recommendation. The purpose of these meetings would be to convince stakeholders of the benefits from implementing the policy recommendation of this project study. Specifically, university leaders, the board of trustees, company leaders, and

TKTP's administrators are the stakeholders that must be persuaded to cooperate in order to reduce potential barriers.

### **Implementation and Timetable**

Once this project study is approved and published, I plan to schedule a meeting with TIU leaders to present a summary of this project study and the policy recommendation generated from the research findings. Table 17 offers a timetable for the implementation of the assessment policy recommendation.

Table 17

#### *Timetable for the Implementation of TKTP's Outcomes Assessment Policy*

Activity	Target Date
Meeting with University's leaders to present project study and policy recommendation	January 2016
Lobby with key stakeholders on the benefits of the policy implementation	February 2016
Obtain approval for the policy implementation and resource allocation	March 2016
Hire the person that will lead the implementation and get office ready	April 2016
The implementation leader studies and designs TKTP's outcomes assessment action plan based on policy recommendation	May-June 2016
The outcomes assessment plan for the TKPT begins execution and permanent monitoring	July 2016

## **Roles and Responsibilities of Stakeholders**

TIU leaders will be responsible for authorizing and allocating resources for the implementation of the outcomes assessment policy. TKTP administrators will be responsible for hiring the TKTP assessment coordinator and assigning office space and resources to the coordinator. The TKTP assessment coordinator will review the outcomes assessment policy recommendation, design, and execute the outcomes assessment plan for the TKTP. University leaders, faculty, students, the board of trustees, TKTP administrators, TKTP companies, alumni, and private and public sector leaders will be responsible for continuously reviewing the outcomes assessment information and providing feedback. The following section provides an overview for stakeholders to monitor the outcomes assessment process.

### **Project Evaluation**

Evaluation of this project study will be accomplished through the generation of assessment reports once the policy recommendation is implemented through an assessment plan. The TKTP assessment coordinator will design and execute the outcomes assessment plan using the recommendations from the policy recommendation of this project study. The outcomes assessment plan implementation should include an outcomes assessment report (OAR). In accordance with the policy recommendation contained in Appendix A, the TKTP OAR should include the key indicators, results, and outcomes to facilitate actions from TIU leaders and TKTP administrators in critical planning and decision-making for the operation of TKTP. A logical periodicity would be to generate the OAR twice per year at the end of each academic semester.

Another purpose of the OAR would be to provide evidence of key assessment indicators for the inputs and activities of the TKTP. In addition, the OAR will include the relevant outputs and outcomes assessed for the TKTP. The OAR will inform key stakeholders like university leaders, the trustees, and TKTP administrators of the state of the TKTP and the attainment of TKTP's goals and objectives. The stakeholders, in turn, could use the OAR when making decisions about the future of the TKTP. In addition, the OAR would provide stakeholders with accountability information on the TKTP initiative, and help stakeholders in supporting the investment of additional resources. Other stakeholders, including faculty, students, alumni, TKTP's firms, and private and public sector leaders would receive information from the OAR on the situation and progress of the campus TKTP program.

### **Project Implications**

The TKTP initiative aids TIU in its role of supporting regional economic development through the generation of a cross-disciplinary, campus-based, entrepreneurial ecosystem. The systematic, goal-based assessment of TKTP outcomes may provide TIU with information on the accountability of invested resources. In addition, the assessment of TKTP outcomes informs the planning and decision-making process of the related key stakeholders. A successful implementation of the TKTP initiative and the assurance of the TKTP's goals and objectives engenders positive social change throughout TIU's region of influence. A positive social change is based on assessment evidence that informs on the region's transformation into a more entrepreneurial, innovation, and knowledge-based economy. This project study provides

TKTP's stakeholders with a tool for assessment of the implementation, accountability, and future of the TKTP initiative, and its impact on regional social and economic change.

### **Conclusion**

I presented the project for this doctoral study. The project is a policy recommendation for the assessment of outcomes of a TKTP. The findings from the research on the opinions and values of stakeholders from a TKTP informed this project. In addition, a current literature review provided further support for the project's definition. The implementation of the policy recommendation will require financial and human resources from TIU. The lack of support from TIU leadership may represent a potential barrier for the successful implementation of the policy recommendation. The project's implementation may take approximately 7 months. An outcomes assessment report generated twice a year will support the evaluation of the project. The successful implementation of the project would provide TIU and its stakeholders with information for assessing the outcomes of the TKTP initiative. Therefore, the project would aid in the accountability of the TKTP initiative through assessing the initiative's positive social and economic impact. Furthermore, the project would aid TIU leadership in the decision making process for the future development of the initiative.

## Section 4: Reflections and Conclusions

### **Introduction**

I developed this project study to address the lack of a policy for assessing the outcomes for a TKTP at one private, nonprofit university in Mexico. In this section, I present a reflection on the project study's strengths and limitations. Also, I discuss recommendations for alternative approaches. In addition, I share my reflection on personal learning and growth together with implications for social change and recommendations for future research.

### **Project Strengths and Limitations**

TIU a private, nonprofit university in Mexico invested millions of dollars in a TKTP initiative to support the economic and entrepreneurial development of local communities. This initiative has the objective to contribute to regional economic development by fostering a knowledge-innovation-based economy where knowledge and innovation are the primary drivers of the economy (Bedford, 2013; Dubina et al., 2012). University collaboration with private and public sectors is necessary for the objective of the initiative based on the triple helix model that informed this study (Etzkowitz & Leydesdorff, 2001). Although the TKTP initiative started 10 years ago, its effectiveness has yet to be formally assessed or evaluated to provide relevant information to stakeholders for accountability and decision-making purposes (Curi, Daraio, & Llerena, 2012; Palomares-Montero & García-Arcil, 2011; Sá, Kretz, & Sigurdson, 2013; Stone & Lane, 2012). Therefore, this study provided an important first step for assessment by determining stakeholder values for how the successful TKTP would be.



The higher education world faces strong market competition and budget cuts. Thus, the increased demand for establishing policies for accountability and generation of information for university stakeholders (Dickeson, 2010; Fullan & Scott, 2009; Newman, Couturier, and Scurry, 2004). More recent literature emphasizes the need for evaluation of the results from universities' entrepreneurial activities including technology or science parks (Albahari, Catalano, & Landoni, 2013; Caldera & Debande, 2010; Mian & Hulsink, 2009; Van Looy et al., 2011). A key outcome of this project study is the development of an assessment policy recommendation for a technology park at one of TIU's campus. I developed this policy recommendation using information derived from stakeholders at one TKTP and the research literature related to TKTPs and related to policymaking.

Other strengths for this project include

- The implementation of the recommendations would deliver valuable information to TKTP stakeholders for accountability and decision-making purposes.
- A simple and structured logic model evaluation (LME) framework with inputs, activities, results, and outcomes for evaluation is recommended for the implementation of the project.
- A recommendation for the evaluation of entrepreneurship education and the entrepreneurial ecosystem at the University.
- A twice a year generation of an outcomes assessment report that would be distributed among TKTP stakeholders.

- A recommendation for stronger involvement of university leaders in the TKTP through the clear definition and communication of how the TKTP fits the University's current vision and strategic plan.
- The recommendation of an information campaign for students on the benefits of the TKTP.

One of the limitations of this project study is that its implementation depends on the determination or disposition of TIU leaders to invest on the recommended resources. Another limitation is that the project implementation requires the alignment of all the different views of TIU leaders. This alignment might be difficult to achieve.

### **Recommendations for Alternative Approaches**

I conducted a needs assessment to better understand how a diverse group of stakeholders valued the TKTP initiative. The approach was selected after discussions with TIU leadership. An alternative approach could have been a program evaluation and report. Instead of having an assessment policy recommendation, an outcomes program evaluation could have been designed for measuring specific TKTP impacts. Measuring and collecting data from the TKTP would have then generated a program evaluation report. I selected to do a needs assessment because of the importance of understanding the opinions of TKTP stakeholders on required issues for assessment.

In a TKTP program evaluation report, I recommend to focus on the initiative's output and outcomes. Candidate outputs and outcomes include

- Number of new jobs created by TKTP's firms, start-ups, and accelerated companies.

- Number of new firms or start-ups incubated at the TKTP that are operating outside the TKTP.
- Number of students that participated in TKTP projects that created their start-up.
- Number of start-ups created by personnel from the University (faculty, students, staff, administrators, etc.)
- How close are the relations between TKTP and industry.
- How the TKTP contributed to improving the prestige of the University.
- How the physical presence of the TKTP in the University campus contributed to make the local community (city or region) more attractive to new economic investment from outside sources (international firms, global institutions, federal government, etc.).
- How the TKTP initiative improved faculty's creation of new knowledge and technology.
- Number of firms incubated or accelerated at the TKTP that operate internationally.

In the previous list, I offered a group of relevant outputs and outcomes that could inform an evaluation program for TIU's TKTPs. In the following section, I present my conclusions on how this project study helped me in developing my academic scholarship.

### **Scholarship**

A scholar is "one who has profound knowledge of a particular subject" ("Scholar", n.d.). Scholarship is defined as "the qualities, skills, or attainments of a

scholar” (“Scholarship”, n.d.). Throughout my doctoral study, I learned various qualities that made me a better person and a better scholar. I learned about the research process. I learned the importance of defining clearly a problem and its research question. I learned about research methodologies and especially about doing quantitative research. I learned about the imperative of accountability and the assessment of outcomes. These learning experiences provided me with better research skills.

I further developed my critical thinking skills. I learned about the importance of having different reliable sources for information validation. I learned about the relevance of having evidence-based data for decision-making purposes. I have worked for over 20 years in the higher education field, with most of my time spent in administrative and leadership positions. I now have better understanding of how and why my colleagues with a doctoral degree think the way they do. I also feel more empathic toward researchers at my institution and beyond, and I have a better appreciation for the research process in general.

### **Project Development and Evaluation**

After collecting and analyzing data for this project study and consulting with my committee members and TIU leadership, I decided that the best way to address my research question was through a policy recommendation. From the four project genres authorized by Walden University, I deemed a policy recommendation to be the best genre to address the problem. I deemed the other project genres (evaluation report, curriculum plan, and professional development curriculum) to be inadequate based on my findings and the nature of the problem. My findings could inform better a policy recommendation

instead of the other project genres. Moreover, I decided on the policy recommendation genre because the findings from the study's research are critical assessment issues agreed upon by TKTP stakeholders. The evaluation of the project will be through the implementation of an outcomes assessment report. This report would be generated twice a year at the end of each academic semester. The outcomes assessment report will inform on the main issues for assessment for a successful TKTP as indicated in the policy recommendation of this project study.

### **Leadership and Change**

Change is life; stasis is death. To live is to change; therefore, and to change effectively is to lead. I have always been passionate about leadership and change. I worked for over 15 years in leadership positions at my institution. I enrolled in the Walden University education doctoral program because it offered a specialization in higher education leadership. I felt I needed to learn more and grow more in the area in which I was working every day. Throughout my doctoral study, I came to confirm many of the issues that I had learned by experience. One relevant conclusion that I drew about leadership after years of experience and studying a higher education leadership program is that leadership is about change. In our families, in our work, in our communities, we are always facing the need for change. Therefore, to see change coming and to implement change we need leaders. Whoever can see a change on the horizon and then implement that change in a way that benefits the majority of those affected has the potential to be a great leader.

### **Analysis of Self as Scholar**

Today, I find that becoming a scholar is hard. With the increased production of knowledge at a faster pace and the availability of vast quantities of knowledge through information technologies, it is very hard to keep pace with information in any particular knowledge field. However, this doctoral study journey strengthened in me a need to clarify ambiguity and pursue knowledge grounded in research. I now am more sensitive to the importance of gathering information from multiple reliable sources before making a decision. I use more evidence-based information to make a decision, and that makes me more objective in my approach to solving problems. I think more about the outcomes of programs and how to assess them. I keep consuming information and knowledge to be able to decide better, lead better, have a respected voice, and pursue the truth.

### **Analysis of Self as Practitioner**

My doctoral work helped me master my knowledge on the topic of technology park assessment and program accountability processes. I now feel more confident to apply this knowledge to my job. I can help in mentoring or consulting on technology park assessment methods. Also, my current responsibility at my institution requires me to design and implement various programs focused on the international mobility of students and faculty. I can now perform assessment and accountability processes based on my doctoral work. Moreover, I can work with my colleagues in designing research work to assess the impact of international student mobility in student life success. For example, I could investigate the effect of international mobility in the employment rate of students or even their entrepreneurial capacities.

### **Analysis of Self as Project Developer**

My work regularly involves developing projects. The process I followed in my doctoral project study helped me learn more about developing projects. For example, I recognize the importance of clearly defining a problem, learning about the body of knowledge that exists on a problem, carefully crafting a research question to answer the problem, applying the right research methodology, and using research findings to develop a project that would solve the problem. I feel more confident in using this process at my job. Also, I believe I can make a better contribution to the quality and impact of my work at my institution.

### **Reflection on the Importance of the Work**

This project study provides TKTP stakeholders with a tool for assessing the implementation, accountability, and future of the TKTP initiative and its impact on regional social and economic change. TIU invested many resources in the TKTP initiative. The implementation of the project might provide TIU leaders with information to sustain and improve the deployment of the TKTP initiative. If this project study work helps enhancing the execution of the TKTP initiative, then it could certainly assist in developing the entrepreneurial capacities of the university and its stakeholders. Influencing economic development and positive social change through a stronger knowledge- or innovation-based economy are excellent products of this work.

### **Implications, Applications, and Directions for Future Research**

This project study has a potential impact for positive social change at two levels. At the organizational level, it has the potential to provide a guideline for TKTP

assessment. The information from the assessment and the stakeholder values for a successful TKTP makes it possible for TIU leaders to improve the operation of the TKTP, its outcomes and impacts, and provides evidence for accountability purposes. At the societal level, a well-executed TKTP initiative may aid in enriching the development of a regional knowledge- or innovation-based economy (Harris, 2011; Pastor et al., 2013). TIU may be a key actor in developing the innovation economy in Mexico through TKTPs.

I find to be important the investigation of opinions and values from stakeholders involved in a university initiative. The findings from researching stakeholders' opinions must inform the decision-making process at TIU for improving the initiative and its accountability, therefore, fulfilling stakeholders' expectations.

This project study focused on one TKTP at one campus of TIU. The basis of the findings of this study came from 129 respondents to a survey from a stratified sample size of 814 from 10 stakeholder groups. The overall response rate was 16%. Specifically, some stakeholder groups had a very low response rates. For example, undergraduate students, alumni, and people working at the TKTP had response rates under 10%. Also, I received no responses from persons in the public sector. Further research might focus on

- Repeating the study to have a larger response rate, especially with the stakeholder groups of undergraduate students, alumni, people working at the TKTP, and people from the public sector.



- Applying the study to other TKTPs at different TIU Campuses. This new research could help in investigating if the policy recommendation of this project study could be generalized and implemented in other TKTPs.
- Now that stakeholder values related to the TKTP initiative are better understood and documented, a new evaluation study could be implemented separate from the policy recommendation provided as a result of this study.

### **Conclusion**

Through this project study, I learned about the importance of researching stakeholders' opinions and values for decision-making purposes. At TIU, in general, we are accustomed to implementing initiatives without considering all of the stakeholders' views. This research study helped me in understanding the importance of stakeholder survey research and using findings to implement policy and evaluation programs on how to assess and improve programs at TIU.

This doctoral study has been a pleasant and challenging journey. From beginning to end it has been a fulfilling experience. I learned to do scholarly research work. I improved my writing skills as a scholar, and, most important, I read many peer-reviewed articles that helped me develop extensive knowledge about technology park assessment, knowledge- or innovation-based economy, accountability processes, 21<sup>st</sup> century challenges for universities, and leadership processes to more effectively manage change. Through my research work, I developed research knowledge and skill. I learned about quantitative research, survey research, data collection, data analysis through descriptive and inferential statistics, and reporting research findings.

I am not the same person who started this process several years ago. I feel more confident about my critical thinking skills and about producing, supporting and consuming research work. This process also developed my patience. I had to invest many hours in drafting, reviewing, revising, correcting, and producing research work. I sacrificed time from my family and my personal life to invest it for my doctoral work. I have given so much to this doctoral work endeavor, and I have obtained a lot from this doctoral work. I am a new scholar. I am a new person. I am a new leader. Most of all, I am a new human with a different view of the world and its great need for positive social change.

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## Appendix A: The Project

**To:** The Rector of TIU.

The Vice-Rector for Research at TIU.

The Director for Entrepreneurship at TIU.

The Director of TIU's Campus where the TKTP is located.

The Director of the TKTP.

**From:** Joaquin Guerra Achem, Director for International Affairs at TIU.

**Subject:** Policy recommendation for the assessment of outcomes for a campus Technology Knowledge Transfer Park (TKTP).

**Problem**

TIU invested millions of dollars in a TKTP initiative. This initiative has the goal to contribute to regional economic development by fostering a knowledge- innovation-based economy. University collaboration with private and public sectors is necessary for the success of the initiative. As stated by various TKTP directors, the initiative's functions include

- the incubation of technology-innovation firms or the creation of new businesses that offer products or services based on technology;
- the acceleration of firms or the support to speed-up and augment the sales of already existing firms; and

- the attraction of technology-innovation firms or the support to provide a landing platform for technology firms that come from the outside of the local community or region.

In all these functions, TIU's faculty and students are implicit TKTP participants.

After 10 years of implementing the TKTP initiative, there is no formal assessment policy. As a leader at TIU, I have the impression that my former campus's TKTP is attaining the objectives set in its creation. There is some quantitative information to support my perception, but the effectiveness of the local TKTP program has yet to be formally assessed or evaluated. Specifically, there are some questions among TIU leaders about the TKTP's effects and benefits for faculty and students, as well as the TKTP's financial sustainability. Therefore, it is important to measure the TKTP's outcomes to provide information to TIU leaders for accountability and decisions related to the future of the TKTP. The intention of this policy recommendation is to bridge the gap in the current assessment practice of the university's TKTP by offering a structure and process for the continuous assessment and reporting of TKTP operations based on the research-derived measures of TKTP success.

### **Background**

This policy recommendation is based on a doctoral level survey research study. The stakeholders of a single TKTP at one TIU's campus provided the population for the study. Stratified samples from different stakeholder groups were generated through random selection of individuals. A close-ended survey was used to collect the data. The results from descriptive and inferential statistical analyses informed the assessment policy

and recommendation. To further ground the policy recommendation, Table A1 presents the surveyed stakeholder groups, stratified sample for each group, the number of answered surveys, and the study's response rate.

Table A1

*Survey Response Characteristics for Each Stakeholder Group*

Stakeholder group	Stratified sample	Surveys answered	Response rate
1. University leaders and administrators	14	14	100%
2. Faculty	44	16	36%
3. Students (undergraduates)	169	13	8%
4. Students (graduates)	79	29	37%
5. Alumni	278	20	7%
6. Board of trustees members	19	8	42%
7. TKTP administrators	4	4	100%
8. People working at the TKTP	169	14	8%
9. Industry leaders	19	11	58%
10. Government leaders	19	0	0%
Total	814	129	16%

**Research Findings**

Stakeholders from the TKTP tended to agree that the following TKTP's process inputs should be assessed to reflect TKTP effectiveness

- Private financial resources.
- Public financial resources.
- University financial resources.
- University faculty involvement with the TKTP.
- University students' involvement with the TKTP.

- The involvement of talented/high skilled workers in the TKTP.
- University definition of TKTP's governing/managing policies.
- The involvement in TKTP's governance of members from the private sector.
- The involvement in TKTP's governance of members from the public sector.

The inferential statistical analysis showed that only the alumni and TKTP staff groups were divergent on these process inputs measures.

Stakeholders from the TKTP tended to agree that the following TKTP activities should be assessed to reflect TKTP effectiveness

- The support for creation/incubation of new technology firms/start-ups.
- The support for acceleration success of existing firms.
- The attraction to the TKTP of existing technology firms.
- Faculty participation on projects from TKTP's firms/start-ups.
- Students' participation on projects from TKTP's firms/start-ups.
- The transference of knowledge and technology from the University to the TKTP's firms/start-ups.
- The transference of knowledge and technology from the firms/start-ups to the University.
- The commercialization or selling of research, knowledge, and technology from the University to the TKTP's firms/start-ups.
- The creation of new jobs in technology-based firms.

- The constant generation of innovation in technology and services for firms/start-ups to take advantage.
- The fostering of links between businesses, students, and professors.
- The commercialization of research, knowledge, technology, or innovation from the University to the productive sectors.
- The generation of innovation and ideas for creating technology-based start-ups.
- The connection between start-ups and angel/venture capital funds.
- The development of an ecosystem that fosters and promotes ideas, innovation, research, development, entrepreneurship, and angel/venture capital.

Based on inferential statistical analysis results, it seems that the trustees and TKTP administrators value TKTP activities more than students.

Stakeholders tended to agree that the following TKTP outputs and outcomes should be assessed to reflect TKTP effectiveness

- The creation of new jobs.
- The creation of new firms or start-ups.
- The creation of entrepreneurial students.
- Innovation in technology and knowledge for firms or companies to exploit.
- Close relations between TKTP and industry.

- The generation of new publications (research papers, case studies, etc.) on the work done at the TKTP.
- The generation of new patents (from research and development).
- The TKTP financial operation should be self-sufficient without support from the University.
- The TKTP development and transfer of technology from the University to the business/industry sector.
- The TKTP commercialization of research, knowledge, technology, or innovation from the University to the productive sectors.
- The TKTP contribution to improving the prestige of the University.
- The physical presence of the TKTP in the University campus contributing to improving the transfer of knowledge and technology to businesses and industry.
- The physical presence of TKTP in the University campus contributing to improving the number of new firms created by people from the university.
- The physical presence of the TKTP in the University campus contributing to make the local community (city/region) more attractive to new economic investment from outside sources (international firms, global institutions, federal government, etc.).
- The TKTP serving as an instrument for supporting the generation of an entrepreneurial university, entrepreneurial faculty, and entrepreneurial students.

Based on the inferential statistical analysis results, it appears that the faculty value TKTP result fundamentals more than do the university leadership and undergraduate students, and alumni also value TKTP result fundamentals more than do the undergraduate students.

The following considerations related to outputs and outcomes reflected levels of agreement between TKTP stakeholders

- The implementation of the TKTP initiative has been successful up to now.
- Faculty creation of new knowledge and technology has been improved by the TKTP initiative.
- The university entrepreneurial ecosystem has been improved by the TKTP initiative.
- The involvement and engagement of university leaders in the TKTP.
- The expansion of the TKTP initiative to other university's campus.
- The investment by the university of additional resources to expand its TKTP initiative.

For survey items related to the future of the TKTP, stakeholders did not support the following:

- The TKTP initiative has not delivered the intended objectives and goals. Therefore it should be revised; and
- The TKTP initiative has no place in the current university's vision and strategic plans;



for the previous items, the stakeholder groups from the board of trustees and private sector leaders tend to show a lack of information to express an opinion. This result is an indication that the level of available information on the TKTP initiative accessible to all stakeholder groups is an important issue to assess. In addition, the stakeholder group of university leaders and administrators indicated to have no information to express their opinion on the item about the TKTP initiative not delivering the intended objectives and goals, and its revision.

### **Findings From the Literature**

The research study included a literature review on issues related to TKTP assessment policy. The following are some of the relevant findings in literature

- Worldwide there has been an increase in policy making on the economic impact of universities on their local economies (Cowan & Zinovyeva, 2013; Kretz & Sá, 2013; Lawton Smith, Glasson, Romeo, Waters, & Chadwick, 2013; Teirlinck et al., 2013).
- There has been a surge in policy development to assess the performance and outcomes of research activity and technology transfer supported by public funding (Curi, Daraio, & Llerena, 2012; Palomares-Montero & García-Arcil, 2011; Sá, Kretz, & Sigurdson, 2013; Stone & Lane, 2012).
- Logic Model Evaluation (LME) is a useful tool for designing and supervising program evaluations, specifically, when evaluating research and knowledge transfer activity (Lawton et al., 2014; Stone & Lane, 2012).

- Factors that assess economic impact of universities and universities' entrepreneurial capacities are entrepreneur generation, applied research, knowledge and technology transfer, contribution to socio-economic development, developing an entrepreneurial culture, and collaborative actions between triple helix (university-private sector-public sector) networks and partners (Lawton Smith & Bagchi-Sen, 2012; Svensson, Klofsten, & Etzkowitz, 2012; Yadollahi Farsi et al., 2012).
- Policymakers around the world are interested in entrepreneurship education as a mean to generate jobs and economic development. Therefore, technology transfer centers at universities may support the acceleration of entrepreneurship education in university students (Kretz & Sá, 2013).
- There are more universities educating in entrepreneurship, and there is a deficiency in entrepreneurship learning evaluation (Kretz & Sá, 2013, Welsch & Tullar, 2014).
- Concepts like goal setting, need for achievement, moderate risk taking, responsibility, intentions, and success motivation scored higher in a pre-test, post-test application when a group of students received entrepreneurship education (Welsch & Tullar, 2014).
- It is essential to focus assessment not only on the outcomes of research and technology/knowledge transfer, but also in the teaching and learning process (Kennedy, 2011).

- Evaluation indexes for technology parks found to be most important are development vision, innovation culture, development strategy, team cohesion, team management ability, service culture, ratio of personnel with higher education, and consulting and training system (Fuyang et al., 2014).
- There is a positive relationship between company growth and availability of private financing (Jimenez-Zarco et al., 2013).
- Technology transfer offices (TTOs) in science and engineering universities have a better performance. One reason is that science and engineering TTOs have a more applied knowledge and better market chances. In addition, university TTOs' efficiency is enhanced through faculty collaboration and the support of spending from private companies (Curi et al., 2012).
- Some indicators to measure the capacity of technology parks in supporting technology transfer and spin-off creation are number of spin-offs created or located in the technology park, university personnel involved in companies, number of contracts and collaboration projects with companies, number of patents and products developed with companies, number of licensed technologies to companies, number of companies attracted, created or installed in the technology park, number of internationalized companies, companies' survival, employment

development, and revenue development (Palomares-Montero & García-Aracil, 2011; Rodeiro-Pazos & Calvo-Babio, 2012).

- Some relevant success factors for assessment in technology park's services include sales increase during the first year after company installation in the park, level of park management support, level of cooperation with universities and research centers, level of access to international networks and marketing, quality of park's facilities for informal and formal meetings, relaxation, and eating, level of prestige of the park, and level of networking between companies in the park (Brčić et al., 2010).
- Four financial indicators to measure spin-offs performance are sales increase, employment increase, revenue increase, and net cash flow (Bigliardi et al., 2013).
- Outcomes assessment in technology and knowledge transfer should deliver beyond simple output measures like number of patents or number of publications. Outcomes assessment should provide evidence-based results to stakeholders on the socio-economic effects (Stone & Lane, 2012).

### **Policy Recommendation**

This section proposes six new policy standards for the outcomes assessment of the TKTP at one of TIU's campus. These recommendations are based on the research findings and literature review from this research study. The purpose of these assessment

policies, if implemented, is to provide evidence-based information about the outcomes of the TKTP. Following implementation, these data would be available for accountability purposes and provide decision-making support for TIU leaders and TKTP administrators.

### **Implement an Assessment Plan**

It is recommended that TIU leaders and TKTP administrators design and implement an outcomes assessment plan for TKTPs. This plan could be informed by the research and literature findings of this study. The appointment of a TKTP assessment leader is highly recommended. This assessment leader would work full time in the design, implementation, monitoring, and reporting of the assessment plan.

Stakeholders of the TKTP require information on the results and outcomes of the TKTP. The implementation of this recommendation would deliver the much-needed information for stakeholders. With this information, stakeholders would have support for decision-making on the administration and strategic planning of the TKTP initiative. In addition, the assessment information would support the accountability of the TKTP initiative.

### **Use a Logic Model Evaluation (LME) Structure**

It is recommended that the assessment plan follows a Logic Model Evaluation (LME) structure. Inputs, activities, results, and outcomes would be evaluated.

**Recommended inputs for assessment.** The following inputs or resources for the TKTP are recommended for assessment

- The existence of a vision and a strategic and innovation plan for the TKTP.

- How well the TKTP personnel function as a team.
- How well the TKTP personnel focus on a service culture.
- Percentage of TKTP and firms personnel with a higher education degree.
- The existence of a training system for all TKTP personnel.
- Total amount of financial support from private sector received by the TKTP. This amount includes support given to TKTP's firms, start-ups, research projects, technology transfer projects, and operation.
- Total amount of financial support from public sector received by the TKTP. This amount includes support given to TKTP's firms, start-ups, research projects, technology transfer projects, and operation.
- Total amount of financial support from the University received by the TKTP. This amount includes support given to TKTP's firms, start-ups, research projects, technology transfer projects, and operation.
- Number of faculty involved with TKTP's projects and activities.
- Number of students involved with TKTP's projects and activities.
- Number of talented/high skilled workers involved with TKTP's projects and activities.
- A comprehensive listing of written policies and guidelines related to TKTP governing and managing.
- Number of persons from the private sector involved in TKTP's governance.

- Number of persons from the public sector involved in TKTP's governance.

**Recommended activities for assessment.** The following activities or aspects of implementation for the TKTP are recommended for assessment

- Number of new technology start-ups in the process of incubation.
- Number of firms in the process of acceleration.
- Number of existing technology firms attracted to the TKTP.
- Number of technology transfer projects in the TKTP.
- Number of commercialization of technology transfer projects.
- Number of new jobs created by TKTP's firms.
- Number of projects executed by firms, students, and professors.
- Number of angel or venture capital supported TKTP's start-ups.

**Recommended outputs for assessment.** The following outputs or observable products for the TKTP are recommended for assessment

- Number of new jobs created by TKTP's firms, start-ups, and accelerated companies.
- Number of new firms or start-ups incubated at the TKTP that are operating outside the TKTP.
- Number of students that participated in TKTP projects that created their start-up.
- Number of new publications (research papers, case studies, etc.) on the work done at the TKTP.

- Number of new patents (from research and development).
- Amount of financial support from the university for TKTP's operation expenses. (Aims at assessing self-sufficient operation by the TKTP)
- Amount of financial resources received by the TKTP for the commercialization of technology transfer projects
- Amount of angel or venture capital received by TKTP's start-ups.
- Number of start-ups created by personnel from the University (faculty, students, staff, administrators, etc.)

**Recommended outcomes for assessment.** The following outcomes or observed changes in time induced by the TKTP are recommended for assessment

- How close are the relations between TKTP and industry.
- How the TKTP contributed to improving the prestige of the University.
- How the physical presence of the TKTP in the University campus contributed to make the local community (city/region) more attractive to new economic investment from outside sources (international firms, global institutions, federal government, etc.).
- How the TKTP initiative improved faculty's creation of new knowledge and technology.
- Number of firms incubated or accelerated at the TKTP that operate internationally.



**Evaluate for Entrepreneurship Education**

It is recommended to develop an evaluation program for entrepreneurship education and the development of an ecosystem that fosters and promotes ideas, innovation, and entrepreneurship at the university. Evaluate how the TKTP serves as an instrument for supporting the generation of an entrepreneurial university, entrepreneurial faculty, and entrepreneurial students.

**Outcomes Assessment Report**

It is recommended to generate an outcomes assessment report (OAR) twice a year at the end of the months of June and December. This OAR would include all the assessment information. This OAR would be distributed among all TKTP's stakeholders. The OAR would be available for use in TKTP planning and decision-making. The OAR could help to confirm the following perceptions from TKTP stakeholders:

- The implementation of the TKTP initiative has been successful up to now.
- Faculty creation of new knowledge and technology has been improved by the TKTP initiative.
- The university entrepreneurial ecosystem has been improved by the TKTP initiative.
- The support of investment by the university for additional resources to expand its TKTP initiative.

**Leadership Involvement**

It is recommended that there exist a stronger involvement and engagement of TIU leaders in the TKTP initiative. It is important to define and communicate to all

stakeholders of how the TKTP initiative fits within and supports TIU's current vision and strategic plan. In addition, it is further recommended that TIU leaders when making decisions on the future of the TKTP initiative use the OAR.

### **TKTP Information Campaign**

It is recommended to design and execute an information campaign for students. This information campaign would inform students about the TKTP. It is important that students better understand the TKTP. Inform the students about the inputs, activities, outputs, and outcomes of the TKTP on a regular basis.

## Appendix B: TKTP-AT Instrument

**Questionnaire for a Technology-Knowledge Transfer Park Assessment Test****Instructions:**

**Please select the number of stakeholder type that you belong.**

*Please note, if you have various roles as a stakeholder, please select the role with which you have the strongest relation to the TKTP.*

**A. Stakeholder type:**

1. University Leader or University Administrator
2. Faculty
3. Student (undergraduate last year)
4. Student (graduate last year)
5. Alumni
6. Board of trustee member
7. TKTP administrator
8. TKTP firm employee
9. Industry leader
10. Government leader

**Instructions:**

**TKTP means Technology-Knowledge Transfer Park**

**Answer the following close-ended items according to the following scale:**

Answer Option	Value	Meaning
Strongly disagree	-2	Full/total/significant opposition to the item's statement
Disagree	-1	Regular/medium opposition to the item's statement
Neither agree or disagree	0	There is a neutral position about the item's statement
Agree	+1	Regular/medium accordance with the item's statement
Strongly agree	+2	Full/total/significant accordance with the item's statement
Not enough information or context background to answer the item	5	There is not enough information or context background to answer the item
No Response	6	Choose not to answer the item

**You may skip any item if you decide to do so. Nevertheless, this research will be more complete with all of your answers from the survey. Your effort to answer all the survey items will be greatly appreciated.**

**B. TKTP Inputs (These refer to the study's research question R2)**

B1. Private financial resources are a fundamental input for successful TKTP operation. For example, this resources could be money, grants for research or projects, capital funds, or lab equipment.

B2. Public financial resources are a fundamental input for successful TKTP operation. For example, this resources could be money, grants for research or projects, capital funds, or lab equipment.

B3. University financial resources are a fundamental input for successful TKTP operation.

B4. The location of the TKTP at the university campus is fundamental for the TKTP's success.

B5. University faculty involvement with the TKTP is fundamental for the TKTP's success.

B6. University students' involvement with the TKTP is fundamental for the TKTP's success.

B7. The involvement of talented/high skilled workers in the TKTP is fundamental for TKTP's success.

B8. University definition of TKTP's governing/managing policies is fundamental for TKTP's success.

B9. The involvement in TKTP's governance of members from the university's Board of trustees is fundamental for TKTP's success.

B10. The involvement in TKTP's governance of members from the private sector is fundamental for TKTP's success.

B11. The involvement in TKTP's governance of members from the public sector is fundamental for TKTP's success.

B12. The involvement in TKTP's governance of university's alumni is fundamental for TKTP's success.

**C. TKTP Activities (These refer to the study's central question, activities are part of the process)**

C1. The support for creation/incubation of new technology firms/start-ups is a fundamental TKTP activity.

C2. The support for acceleration success of existing firms is a fundamental TKTP activity.

C3. The attraction to the TKTP of existing technology firms is a fundamental TKTP activity.

C4. Faculty participation on projects from TKTP's firms/start-ups is a fundamental TKTP activity.

C5. Students' participation on projects from TKTP's firms/start-ups is a fundamental TKTP activity.

C6. The transference of knowledge and technology from the university to the TKTP's firms/start-ups is a fundamental activity.

C7. The transference of knowledge and technology from the firms/start-ups to the university is a fundamental activity.

C8. The commercialization or selling of research, knowledge, and technology from the university to the TKTP's firms/start-ups is a fundamental activity.

C9. The creation of new jobs through technology-based firms is a fundamental TKTP activity.

C10. The constant generation of innovation in technology and services for firms/start-ups to take advantage is a fundamental TKTP activity.

\*C11. The fostering of links between businesses, students, and professors is a fundamental TKTP activity.

\*C12. The generation of opportunities for students to do professional service hours and/or internships is a fundamental TKTP activity.

\*C13. The generation of innovation and ideas for creating technology-based start-ups is a fundamental activity of the TKTP.

\*C14. The connection between start-ups and angel/venture capital funds is a fundamental activity of the TKTP.

\*C15. The development of an ecosystem that fosters and promotes ideas, innovation, research, development, entrepreneurship, and angel/venture capital is a fundamental TKTP activity.

**D. Specific Issues to Assess in a TKTP (These refer to the study's research questions R3 and R4, outputs and outcomes)**

D.1 The creation of new jobs should be a fundamental TKTP result.

D.2 The creation of new firms or start-ups should be a fundamental TKTP result.

D.3 The creation of entrepreneurial students should be a fundamental TKTP result.

D.4 Innovation on technology and knowledge for firms or companies to exploit should be a fundamental TKTP result.

D.5 Close relations between TKTP and industry should be a fundamental TKTP result.

D.6 Close relations between TKTP and government should be a fundamental TKTP result.

D.7 The generation of new publications (research papers, case studies, etc.) on the work done at the TKTP should be a fundamental result.

D.8 The generation of new patents (from research and development) should be a fundamental TKTP result.

D.9 The TKTP financial operation should be self-sufficient without support from the university.

D.10 The TKTP should be a profit center for the university.

D.11 The TKTP should be a fundamental instrument for research, development, and transfer of technology from the university to the business/industry sector.

D.12 The TKTP should be a fundamental instrument for the commercialization of research, knowledge, technology, or innovation from the university to the productive sectors.

D.13 The TKTP should strongly contribute to improve the prestige of the university.

D.14 The physical presence of the TKTP at the university campus strongly contributes to improve transfer of knowledge and technology to businesses and industry.



D.15 The physical presence of TKTP at the university campus strongly contributes to improve the number of new firms created by people from the university.

D.16 The physical presence of the TKTP at the university campus strongly contributes to make the local community (city/region) more attractive to new economic investment from outside sources (international firms, global institutions, federal government, etc.).

D.17 The TKTP should serve as an instrument to strongly support the generation of an entrepreneurial university, entrepreneurial faculty, and entrepreneurial students.

\*D.18 The TKTP is a preferred option for businesses setting up their operation over other industrial parks or sites in the region.

**E. Other considerations (These refer to the study's research questions R3 and R4, outputs and outcomes)**

E.1 The implementation of the TKTP initiative has been successful up to now.

E.2 Student learning and skills development has been improved through the TKTP initiative.

E.3 Faculty creation of new knowledge and technology has been improved by the TKTP initiative.

E.4 The university entrepreneurial ecosystem has been improved by the TKTP initiative.

E.5 Faculty is more entrepreneurial because of the TKTP initiative.

E.6 Students are more entrepreneurial because of the TKTP initiative.

E.7 The university is more in touch with the outside world's needs because of the TKTP initiative.

E.8 The university and faculty have improved their programs' curricula from better understanding firms' needs through the TKTP initiative.

E.9 The success of the TKTP initiative highly depends on the involvement and engagement of university leaders.

E.10 The TKTP initiative should be expanded to other university's campus.

E.11 The university should invest additional resources to expand its TKTP initiative.

E.12 The TKTP initiative has not delivered the intended objectives and goals, therefore it should be revised.

E.13 The university should eliminate the TKTP initiative.

E.14 The TKTP initiative has no place in the current university's vision and strategic plans.

\* Items that were added from group of experts recommendations.

## Appendix C: Expert Feedback on TKTP-AT Instrument

### Summary of the Six Experts' Feedback on the Content Validity of the Instrument

#### **Expert 1**

Validation: Yes

Main Comments:

1. How easy is to generate links between TKTP's businesses and students and professors?
2. How much emphasis do TKTP businesses leaders give to setting their firms inside or outside the TKTP?
3. How many hours of volunteer professional service and internships are done by students in TKTP's businesses?
4. What percentage of people participating in the TKTP on a daily basis are
  - a. Students
  - b. Professors
  - c. Businesses' employees
  - d. University's employees

How Comments were Addressed:

1. This new item was added to the instrument: The fostering of links between businesses, students, and professors is a fundamental TKTP activity. The answers are in Likert scale format.

2. This new item was added to the instrument: The TKTP is a preferred option for businesses setting up their operation over other industrial parks or sites in the region. The answers are in Likert scale format.
3. This new item was added to the instrument: The generation of opportunities for students to do professional service hours and/or internships is a fundamental TKTP activity. The answers are in Likert scale format.
4. The instrument cannot measure this recommendation because the instrument uses a Likert scale. This recommendation will be considered at the project study definition stage. This recommendation may inform an assessment plan.

## **Expert 2**

Validation: Yes

Main Comments:

All the members of the university community know the context of the TKTP and can have more information to answer the questions. Members from outside the university community (government and industry leaders) may not have the full context from the TKTP, therefore they may need more context before answering the questions.

How Comments were Addressed:

Rationale for this issue is that if members from outside the university community do not have the full context, then the TKTP has not done a good job in keeping them close and informed about the TKTP. Therefore, a new answer option was added. A “Not

enough information or context background to answer the item”. With this answer option, the data collection may yield information about how informed are stakeholders from industry and government about the TKTP.

### **Expert 3**

Validation: Yes

Main Comments:

1. In the first section where the participants respond to the type of stakeholder he or she is, the participant may have several roles, for example, alumni and industry leader. Therefore, this issue should be addressed in the instrument design.
2. The survey does not allow skipping questions. Recommendation to allow people to skip questions if they wish to do it.

How Comments were Addressed:

1. The study aims at stakeholders to select the role that he or she sees is the most active role in his or her relation with the TKTP. For example, if the stakeholder is a university administrator and an alumnus, the prevalent role is university administrator. The study wants to identify fundamental issues for assessing a TKTP from the perspective of the main role the stakeholder is performing.
2. The option “skip” was added on each of the survey’s items.

### **Expert 4**

Validation: Yes

Main Comments:

1. It would be convenient to define what are private and public financial resources.
2. In general, the instrument is effective and responds clearly to the context of technology parks at the university, this may not be the case for other universities.
3. The questions are clear and should be easy to answer them for someone involved with the TKTP. This may not be the case for someone who is totally unaware of the TKTP.

How Comments were Addressed:

1. On this issue, information was added about what are private and public financial resources in the instrument's item.
2. This research focuses on the study of one TKTP at one university's campus.
3. Rationale is that in the target population there are people involved with the TKTP with different levels of involvement, if there are some stakeholders that do not have any context on the TKTP then, it is important to identify this issue and this may be part of an assessment plan or recommendation from the project study.

**Expert 5**

Validation: Yes

Main Comments:

The expert suggests measuring issues like:

- Number of students participating in the TKTP per semester
- Number of professors participating in the TKTP per semester
- Level of TKTP's occupancy
- Annual budget for the TKTP
- Cost of services given by the TKTP
- Number of events per semester with different stakeholders

How Comments were Addressed:

The answers to the instrument's items are in a Likert scale format. Therefore, the instrument cannot measure these issues. If the outcome of the project study is an assessment plan model for a TKTP, this recommendation may inform the assessment plan.

### **Expert 6**

Validation: Yes

Main Comments:

1. It is suggested not only to ask if generation of employment is important but also the generation of value, startups generate a little number of employment but a lot of value through innovation and new ideas.
2. It is suggested to ask for the ecosystem mix of ideas+innovation+research+development+entrepreneurship+angel/venture capital

How Comments were Addressed:

1. This new item was added to the instrument: The generation of innovation and ideas for creating technology-based start-ups is a fundamental activity of the TKTP. The answers are in Likert scale format.
2. These new items were added to the instrument:
  - a. The connection between start-ups and angel/venture capital funds is a fundamental activity of the TKTP.
  - b. The development of an ecosystem that fosters and promotes ideas, innovation, research, development, entrepreneurship, and angel/venture capital is a fundamental TKTP activity.

The answers are in a Likert scale format.



## Appendix D: Data Analysis of Stakeholder Groups with Response Rate Over 35%

The next set of tables includes the data analysis for stakeholder group 1. This group represents university leaders and administrators.

Table D1

### *Median, Mode, and Interquartile Range (IQR) for Stakeholder Group 1, Section B Items*

	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12
Number	14	14	14	14	14	14	14	14	14	14	14	14
Missing	0	0	0	0	0	0	0	0	0	0	0	0
Median	2.00	1.00	1.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00
Mode	2	1	1	2	2	2	2	2	1	1	1	1
IQR	1	1	1	1	0	0	1	1	2	2	1	1

Table D1 shows the opinions from leaders and administrators at the university about research question R2. The data analysis indicates that there is a tendency to agree with all the items except B9 and B10 where there is a high variability equal to 2. For all of these items the median and mode are equal to 1 or 2.

Table D2

### *Median, Mode, and Interquartile Range (IQR) for Stakeholder Group 1, Section C Items*

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
Number	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
Missing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Median	2.00	2.00	2.00	2.00	2.00	2.00	2.00	1.50	2.00	2.00	1.50	1.00	1.00	1.00	2.00
Mode	2	2	2	2	2	2	2	1,2	2	2	1,2	2	2	1	2
IQR	0	0	1	1	0	1	1	1	0	1	1	2	1	1	0

Table D2 shows the opinions from university leaders and administrators about research question R1. The data analysis indicates that there is a tendency to agree with

all the items except C12. The median and mode are 1, 1.5, or 2. In this stakeholder group, there is accordance on all the issues except for C12, where the IQR is equal to 2.

Table D3

*Median, Mode, and Interquartile Range (IQR) for Stakeholder Group 1, Section D Items*

	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
Number	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
Missing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Median	1.50	2.00	2.00	1.00	1.00	.50	1.00	1.00	1.50	1.00	1.00	1.00	2.00	2.00	1.00	1.00	1.50	1.00
Mode	1,2	2	2	1	1	0,1	1	1	2	0,1	1	1	2	2	2	1	1,2	5
IQR	1	1	1	0	1	1	1	1	1	2	1	1	0	1	1	1	1	5

Table D3 shows the opinions from university leaders and administrators about research questions R3 and R4. The data analysis indicates that there is a tendency to agree with all the items except for D6, the median and mode are between 1 and 2. There is neither agreement nor disagreement with D6, the median is 0.5 and the mode is 0 and 1. D10 and D18 do not show accordance among this stakeholder group, their IQR is 2 and 5.

Table D4

*Median, Mode, and Interquartile Range (IQR) for Stakeholder Group 1, Section E Items*

	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14
Number	14	14	14	14	14	14	14	14	14	14	14	14	14	14
Missing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Median	1.00	1.00	1.00	1.00	.50	1.00	1.00	1.00	2.00	2.00	1.00	1.00	-2.00	-2.00
Mode	1	1	1	2	1	2	1	1	2	2	1	5	-2	-2
IQR	1	1	2	2	2	3	1	6	1	2	1	6	1	1

Table D4 shows the opinions from leaders and administrators at the university's Campus about research questions R3 and R4, and other issues. There is a tendency to



Table D6 shows the opinions from the faculty about research question R1. The data analysis indicates that there is a tendency to agree with all the items. The median and mode are 1, or 2. In this stakeholder group, there is accordance on all the issues; the IQR equals 1 for all the items.

Table D7

*Median, Mode, and Interquartile Range (IQR) for Stakeholder Group 2, Section D Items*

	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
Number	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
Missing	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Median	2.00	2.00	2.00	2.00	2.00	1.00	2.00	2.00	1.00	.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	1.00
Mode	2	2	2	2	2	1	2	2	1	0,1	2	2	2	2	2	2	2	0,1
IQR	2	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	0	1

Table D7 shows the opinions from the faculty about research questions R3 and R4. The data analysis indicates that there is a tendency to agree with all the items except for D1, D10. The median and mode are between 1 and 2. For D1 and D10, the IQR equals 2 showing low accordance from the faculty.

Table D8

*Median, Mode, and Interquartile Range (IQR) for Stakeholder Group 2, Section E Items*

	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14
Number	15	15	15	15	15	15	15	15	15	15	15	15	15	15
Missing	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Median	1.00	1.00	1.00	1.00	.00	1.00	2.00	1.00	1.00	2.00	1.00	1.00	-2.00	-2.00
Mode	1	0,1	0	1	0	1	5	5	1,2	2	1	5	-2	-2
IQR	1	1	2	1	5	5	4	6	1	1	1	6	1	1

Table D8 shows the opinions from the faculty at the university's Campus about research questions R3 and R4, and other issues. There is a tendency to agree with items E1, E2, E4, E9, E10, and E11. The median and mode are 1 or 2, and the variability is low with IQR equals 1 for these items. E13 and E14 show a disagreement tendency with median and mode equal to -2 and IQR equals 1. There is high variability or low level of accordance with items E3, E5, E6, E7, E8, and E12.

The following tables present the information for stakeholder group 4. This group represents the graduate students of the Campus in their last year of studies.

Table D9

*Median, Mode, and Interquartile Range (IQR) for Stakeholder Group 4, Section B Items*

	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12
Number	29	29	29	29	29	29	29	29	29	29	29	29
Missing	0	0	0	0	0	0	0	0	0	0	0	0
Median	2.00	2.00	1.00	1.00	1.00	1.00	2.00	2.00	1.00	1.00	1.00	1.00
Mode	2	2	2	1,2	2	2	2	2	2	1	1	1
IQR	1	1	1	2	1	1	1	1	2	1	1	2

Table D9 shows the opinions from the graduate students at the university about research question R2. The data analysis indicates that there is a tendency to agree with all the items except B4, B9, and B12 where there is a high variability equal to 2. For all of these items the median and mode are equal to 1 or 2.

Table D10 shows the opinions from the graduate students about research question R1. The data analysis indicates that there is a tendency to agree with all the items except C4 and C12. The median and mode are 1, or 2. In this stakeholder group, there is accordance on all the issues except for C4 and C12 where the IQR equals 2.

Table D10

*Median, Mode, and Interquartile Range (IQR) for Stakeholder Group 4, Section C Items*

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
Number	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28
Missing	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Median	2.00	2.00	2.00	1.00	1.50	2.00	2.00	1.00	2.00	2.00	2.00	1.00	1.00	2.00	2.00
Mode	2	2	2	1	2	2	2	1	2	2	2	2	2	2	2
IQR	1	1	1	2	1	1	1	1	1	1	1	2	1	1	1

Table D11

*Median, Mode, and Interquartile Range (IQR) for Stakeholder Group 4, Section D Items*

	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
Number	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28
Missing	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Median	2.00	2.00	2.00	2.00	2.00	1.00	1.00	2.00	1.00	1.00	2.00	1.50	2.00	1.50	2.00	1.00	2.00	1.00
Mode	2	2	2	2	2	1,2	2	2	2	2	2	1,2	2	2	2	2	2	1
IQR	1	1	1	1	1	2	2	1	1	3	1	1	1	1	1	1	1	2

Table D11 shows the opinions from graduate students about research questions R3 and R4. The data analysis indicates that there is a tendency to agree with all the items except for D6, D7, D10, and D18. The median and mode are between 1 and 2. For D6, D7, D10, and D18, the IQR equals 2 or 3 showing low accordance from graduate students.

Table D12 shows the opinions from graduate students at the university's Campus about research questions R3 and R4, and other issues. There is a tendency to agree with items E2, E9, E10, and E11. The median and mode are 1 or 2, and the variability is low with IQR equals 1 for these items. E13 shows a disagreement tendency with median and

mode equal to -2 and IQR equals 1. There is high variability or low level of accordance with items E1, E3, E4, E5, E6, E7, E8, E12, and E14.

Table D12

*Median, Mode, and Interquartile Range (IQR) for Stakeholder Group 4, Section E Items*

	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14
Number	28	28	28	28	28	28	28	28	28	28	28	28	28	28
Missing	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Median	1.00	1.00	1.00	1.00	.00	1.00	1.00	1.00	1.00	1.50	1.00	1.00	-2.00	-1.50
Mode	1	1	1	1	0	1	1	-1,2	1,2	2	1,2	2	-2	-2
IQR	2	1	2	2	2	2	2	3	1	1	1	3	1	2

Stakeholder group 6 represents the Campus' Board of Trustees.

Table D13

*Median, Mode, and Interquartile Range (IQR) for Stakeholder Group 6, Section B Items*

	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12
Number	8	8	8	8	8	8	8	8	8	8	8	8
Missing	0	0	0	0	0	0	0	0	0	0	0	0
Median	2.00	1.00	1.00	2.00	2.00	1.50	2.00	1.50	.50	1.00	.00	.00
Mode	2	1	1	2	2	1,2	2	1,2	0,1	1	0,1	0
IQR	1	2	1	1	0	1	0	2	2	1	2	2

Table D13 shows the opinions from the Board of Trustees at the university about research question R2. The data analysis indicates that there is a tendency to agree with all the items except B2, B8, B9, B11 and B12 where there is a high variability equal to 2. For all of these items the median and mode are equal to 1 or 2.

Table D14

*Median, Mode, and Interquartile Range (IQR) for Stakeholder Group 6, Section C Items*

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
Number	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Missing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Median	2.00	2.00	2.00	2.00	2.00	2.00	1.50	1.00	1.50	2.00	2.00	2.00	2.00	2.00	2.00
Mode	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2
IQR	0	1	1	1	1	1	1	1	1	0	2	1	0	1	1

Table D14 shows the opinions from the Board of Trustees about research question R1. The data analysis indicates that there is a tendency to agree with all the items except C11. The median and mode are 1, or 2. In this stakeholder group, there is accordance on all the issues except for C11 where IQR equals 2.

Table D15

*Median, Mode, and Interquartile Range (IQR) for Stakeholder Group 6, Section D Items*

	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
Number	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Missing	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Median	1.00	2.00	1.50	2.00	1.50	.00	1.00	1.00	.50	.00	2.00	1.00	2.00	2.00	1.50	1.50	2.00	.50
Mode	1	2	1,2	2	1,2	0	1	1	0	-1,0	2	1	2	2	2	1,2	2	0,1
IQR	1	1	1	1	1	1	1	1	1	2	0	1	0	1	1	1	0	2

Table D15 shows the opinions from the Board of Trustees about research questions R3 and R4. The data analysis indicates that there is a tendency to agree with D1, D2, D3, D4, D5, D7, D8, D11, D12, D13, D14, D15, D16, and D17. The median and mode are between 1 and 2. Level of accordance is high because IQR equals 0 or 1. D6 and D9 show a tendency of neither agreement nor disagreement with low variability. D10 and D18 have high variability where IQR equals 2.



Table D16

*Median, Mode, and Interquartile Range (IQR) for Stakeholder Group 6, Section E Items*

	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14
Number	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Missing	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Median	2.00	1.50	1.50	3.50	1.00	2.00	1.00	3.00	2.00	2.00	1.50	.00	-2.00	-1.00
Mode	1,2	1,2	1	5	1	1,2	1	5	2	2	2	-1,5	-2	-2
IQR	4	4	2	4	4	4	2	4	1	1	1	6	0	4

Table D16 shows the opinions from the Board of Trustees at the university's Campus about research questions R3 and R4, and other issues. There is a tendency to agree only with items E9, E10, and E11. The median and mode are 1.5 or 2, and the variability is low with IQR equals 1 for these items. E13 shows a disagreement tendency with median and mode equal to -2 and IQR equals 0. There is high variability or low level of accordance with items E1, E2, E3, E4, E5, E6, E7, E8, E12, and E14.

Group 7 includes TKTP administrators.

Table D17

*Median, Mode, and Interquartile Range (IQR) for Stakeholder Group 7, Section B Items*

	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12
Number	4	4	4	4	4	4	4	4	4	4	4	4
Missing	0	0	0	0	0	0	0	0	0	0	0	0
Median	1.50	1.50	1.00	2.00	2.00	2.00	2.00	1.50	1.00	1.00	1.00	.50
Mode	1,2	2	1	2	2	2	2	2	1	1	1	-2,0,1,2
IQR	*	*	*	*	*	*	*	*	*	*	*	*

\* Not enough data to calculate

Table D17 shows the opinions from TKTP administrators at the university about research question R2. The data analysis indicates that there is a tendency to agree with

all the items except B12. For all of these items the median and mode are equal to 1, 1.5 or 2. There are not enough surveys to calculate IQR. B12 shows no accordance because it has four different modes.

Table D18

*Median, Mode, and Interquartile Range (IQR) for Stakeholder Group 7, Section C Items*

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
Number	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Missing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Median	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Mode	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
IQR	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

\* Not enough data to calculate

Table D18 shows the opinions from TKTP administrators about research question R1. The data analysis indicates that there is a tendency to agree with all the items. The median and mode are equal to 2. There are not enough surveys to measure variability.

Table D19

*Median, Mode, and Interquartile Range (IQR) for Stakeholder Group 7, Section D Items*

	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
Number	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Missing	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Median	1.00	2.00	2.00	2.00	2.00	1.00	1.00	2.00	2.00	-2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Mode	0,1,2	2	2	2	2	0,1,2	1	2	2	-2	2	2	2	2	2	2	2	2
IQR	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

\* Not enough data to calculate

Table D19 shows the opinions from TKTP administrators about research questions R3 and R4. The data analysis indicates that there is a tendency to agree with all

of the items except D1 and D6. The median and mode are between 1 and 2. D1 and D6 have three different modes. There are not enough surveys to measure variability.

Table D20

*Median, Mode, and Interquartile Range (IQR) for Stakeholder Group 7, Section E Items*

	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14
Number	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Missing	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Median	2.00	1.00	2.00	2.00	1.00	2.00	2.00	1.00	2.00	2.00	2.00	-2.00	-2.00	-2.00
Mode	2	1	2	2	0,1,2	1,2,5	2	-1,1,2	2	2	2	-2	-2	-2
IQR	*	*	*	*	*	*	*	*	*	*	*	*	*	*

\* Not enough data to calculate

Table D20 shows the opinions from TKTP administrators at the university's campus about research questions R3 and R4, and other issues. There is a tendency to agree with items E1, E2, E3, E4, E7, E9, E10, and E11. The median and mode are 1 or 2. E5 and E6 have three different modes. E12, E13, and E14 indicate a disagreement tendency with median and mode equal to -2. There are not enough surveys to measure variability.

The last analyzed stakeholder group was number 9 corresponding to industry/private sector leaders.

Table D21

*Median, Mode, and Interquartile Range (IQR) for Stakeholder Group 9, Section B Items*

	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12
Number	11	11	11	11	11	11	11	11	11	11	11	11
Missing	0	0	0	0	0	0	0	0	0	0	0	0
Median	2.00	1.00	2.00	1.00	2.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00
Mode	2	1	2	1,2	2	2	2	2	1	1	1	1
IQR	1	1	1	1	0	0	0	0	0	1	1	1

Table D21 shows the opinions from private sector leaders about research question R2. The data analysis indicates that there is a tendency to agree with all the items. For all of these items the median and mode are equal to 1 or 2. The variability is low with IQR equal to 0 or 1.

Table D22

*Median, Mode, and Interquartile Range (IQR) for Stakeholder Group 9, Section C Items*

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
Number	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Missing	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Median	2.00	2.00	2.00	2.00	2.00	2.00	2.00	1.50	1.50	2.00	1.00	1.50	1.00	2.00	2.00
Mode	2	2	2	2	2	2	2	2	2	2	1	2	1	2	2
IQR	1	1	0	1	1	0	1	1	1	1	1	2	1	1	1

Table D22 shows the opinions from private sector leaders about research question R1. The data analysis indicates that there is a tendency to agree with all the items except C12. The median and mode are 1, 1.5 or 2. In this stakeholder group, there is accordance on all the issues except for C12. IQR equals 0 or 1 for all items excluding C12 where IQR equals 2.

Table D23

*Median, Mode, and Interquartile Range (IQR) for Stakeholder Group 9, Section D Items*

	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
Number	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Missing	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Median	1.50	2.00	2.00	2.00	2.00	1.00	1.50	2.00	1.00	.00	2.00	2.00	2.00	1.50	1.00	2.00	2.00	1.00
Mode	2	2	2	2	2	1	2	2	2	1	2	2	2	1,2	1,2	2	2	0,1
IQR	1	1	1	0	1	1	1	1	2	2	1	1	0	1	1	1	0	2

Table D23 shows the opinions from private sector leaders about research questions R3 and R4. The data analysis indicates that there is a tendency to agree with all items except D9, D10, and D18. The mode is 1, 1.5, and 2. Level of accordance is high because IQR equals 0 or 1. D9, D10, and D18 have high variability where IQR equals 2.

Table D24

*Median, Mode, and Interquartile Range (IQR) for Stakeholder Group 9, Section E Items*

	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14
Number	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Missing	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Median	1.50	1.00	1.00	2.00	5.00	1.50	1.00	3.50	1.50	2.00	1.00	2.00	-2.00	-2.00
Mode	1	1	1	5	5	1	1	5	1,2	2	1	5	-2	-2
IQR	2	1	2	4	4	4	1	5	1	1	1	6	1	7

Table D24 shows the opinions from private sector leaders about research questions R3 and R4, and other issues. There is a tendency to agree with items E2, E7, E9, E10, and E11. The median and mode are 1, 1.5 or 2, and the variability is low with IQR equals 1 for these items. E13 shows a disagreement tendency with median and mode equal to -2 and IQR equals 1. There is high variability or low level of accordance with items E1, E3, E4, E5, E6, E8, E12, and E14.

## Appendix E: Permission for Figure 1

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**Title:** Innovation in Innovation: The Triple Helix of University-Industry-Government Relations:**Author:** Henry Etzkowitz**Publication:** Social Science Information**Publisher:** SAGE Publications**Date:** 09/01/2003

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