INDUSTRY-ACADEMIA COLLABORATIONS: IMPLICATIONS FOR TRINIDAD

AND TOBAGO

by

Zameer Mohammed

Copyright 2014

A Dissertation Presented in Partial Fulfillment
of the Requirements for the Degree
Doctor of Education in Educational Leadership

University of Phoenix

UMI Number: 3648299

UMI

Dissertation Publishing

UMI 3648299

ProQuest®

The Dissertation Committee for Zameer Mohammed certifies that this is the approved version of the following dissertation:

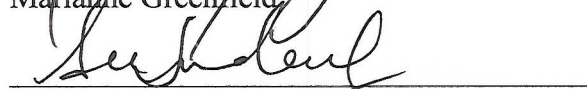INDUSTRY-ACADEMIA COLLABORATIONS: IMPLICATIONS FOR TRINIDAD AND TOBAGO

Committee:

Marianne Greenfield, PhD., Chair

Sushil Jindal, PhD., Committee Member

Rosann Downing, PhD., Committee Member

Marianne Greenfield

Sushil Jindal

Rosann Downing

Jeremy Moreland, PhD
Dean, School of Advanced Studies
University of Phoenix
Date Approved: August 19, 2014

ABSTRACT

Practices of collaborative relationships between industry and academia have a long-standing history traced to the time when prototypes of modern universities emerged in the medieval period. The purpose of this quantitative study was to identify the extent of agreements in stakeholder perceptions on the benefits of industry-academia collaborations for sustainable growth in Trinidad and Tobago. One hundred and thirty three persons participated in 13-item survey instrument over the Internet from industry and academia in Trinidad and Tobago to measure perceptions. The measurements were in goal achievement, benefits, satisfaction levels, influences, barriers, and key success factors. The unit of analysis was individuals from industry and academia. Analysis of the data revealed that perceptions to goal achievement from both industry and academia towards collaborative relations ranged from important to very important. Benefits to industry and academia ranged from important to very important while the perceived influences from Government were indifferent. The main barriers to collaborative relations were communications, leadership, and cultural awareness. The key findings were significant differences between industry and academia perceptions on additional income for universities as a goal of collaborative relations; joint representation on technical committees as a means of information; lack of entrepreneurial culture and communication as a barrier to collaborative relations. The recommendations include the need for entrepreneurial development and improved communications among the stakeholders as a pre-requisite to success in collaborative partnerships.

DEDICATION

This dissertation is dedicated to my wife Ashriffa and son, Ansari Abas Al Ferisi Mohammed. Ansari, you continue to be the brightest spot in my life. I know you have had to undertake several challenges soon after birth but your courage, love and willingness to participate in this world continues to provide the inspiration to me for the rest of my life. To my mom and Dad, Halima and Shaheed Mohammed, thank you for all you have done for me. I wish you could have lived to share in this accomplishment.

ACKNOWLEDGEMENTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter 1

Introduction

The purpose of this quantitative study was to identify the extent of agreements in stakeholder perceptions about the benefits of industry-academia collaborations. The study specifically analyzed the current state of industry-academia collaborative relationships in Trinidad and Tobago and identified critical success factors for future industry- academia collaborations. Chapter 1 provides information regarding the background to the problem before stating the problem in specific terms. This chapter also stated the purpose of the study and provided the theoretical framework as the foundation used in the study. The chapter ended with a brief overview of the assumptions and limitations used in this study.

Several factors characterize human development. The development of society and a nation link closely to societal behavior, motivation, the environment, and the availability of educational opportunities within that society (Örtenblad & Koris, 2014). Although educational opportunities do influence human behavior, it is also important to understand the context of educational opportunities in relation to a country's current and long-term goals. The perception of the value of educational opportunities is different in many countries. In several western countries, the perception of industrial and commercial work has a higher value than those in eastern countries. In several eastern countries, valuing individuality and the development of individual talent for its own sake has a perception as good value (Catana, Pucko, & Krzykala-Schaefer, 2013).

In Trinidad and Tobago, higher education links closely to sustainable development and the achievement of developed country status by 2020 (Lam, 2011). Trinidad and Tobago has a population of 1.3 million people with two established universities - the University of

the West Indies (UWI) that has a Caribbean focus and the University of Trinidad and Tobago (UTT) that is the indigenous national university in the twin-island republic. The UTT's mandate is to increase access to higher education in Trinidad and Tobago through the provision of relevant programs aligned to national priorities.

Recent research (Bauer & Cohen, 2012; D'Este, Mahdi, Neely, & Rentocchini, 2011; Hall, 2010; Orecchini, Valitutti, & Vitali, 2012) in industry-university relationships suggest that university centers do provide industry with new ideas and technology. As universities identify participation in industrial projects as a source of information for research an expectation is that there will be a continual increase in industry-university collaboration in forthcoming years. O'Rafferty, Curtis, and O'Connor (2014) contended that where universities make direct contributions to industry it can be through a framework of academic entrepreneurship. The university's direct contribution involves the creation of new business and industrial ventures by universities and faculty that make connections across disciplines. This direct contribution by universities provides a basis for sustainability and entrepreneurship (Meyer, 2011). In the Trinidad and Tobago context, the level of Trinidad and Tobago nationals accessing higher education is 9% of its population while the North American average is 24% (Thomas & Soares, 2009). Comparing the North American average with the Trinidad and Tobago average a negative variance exists with access to higher education in Trinidad and Tobago. The shortfall has created challenges for Trinidad and Tobago policy makers in education. The challenges range from a decreasing stock of local intellectual capital, as highly qualified individuals have opted to migrate from developing countries to the more developed ones. Other individuals, while university-trained, have lacked the skill-set appropriate to the requirements of industry, a result of poor higher

education policy planning. The final challenge comes from the lack of a coordinated approach to industry-academia linkages in Trinidad and Tobago.

Background

Trinidad and Tobago's economy has relied substantially on its oil and gas reserves. The contribution of the energy sector to gross domestic product (GDP) was significant, ranging from 38% in 2000 to 46.1% in 2010. Local and multinational organizations have participated in the economic upstream, midstream, and downstream activities of the energy sector. The multinational organizations have installed new and innovative technologies in their operations. Because of these technological installations, several organizations require specific and specialized skills and competencies to sustain themselves. The sustainability of an economy links closely to a thriving business and industrial sector in the modern world. In this context, Nelles and Vorley (2010) and others (Szolár, 2011) contended that relevant higher education policy and increased institutional capacity can transform an economic and social environment to meet the demands of the changing technological environment.

The intellectual capital that is necessary for such a transformation to a sustainable economy relates to the type of Trinidad and Tobago higher education polices. To this end, a variety of alliance activities occurs among the University of Trinidad and Tobago, University of the West Indies, business, and industry in Trinidad and Tobago. These include the delivery of higher education at the technician, advanced, and professional levels. Part-time instruction, guest lectures, laboratory sharing, business incubation, and consulting services also have the potential for academia-industry collaborative activities.

Problem Statement

Despite the efforts of successive governments in Trinidad and Tobago, the higher education sector continues to endure troubling structural challenges resulting in loss of educational opportunities for nationals. The loss of educational opportunities has left many nationals of Trinidad and Tobago without the necessary knowledge, skills, and competencies. The result of this shortfall in skills and competencies disallowed many nationals of Trinidad and Tobago from participating actively in key decisions in business and industry. Historically, foreign expatriate workers filled the gap by occupying leadership positions in the major industries in Trinidad and Tobago and the developing world (Al-Adwani, 2014).

The thriving oil and gas sectors of Trinidad and Tobago attract investments and new technologies from global multinational corporations. The growth in these sectors contributed to 46% of gross domestic product. Sustainable growth is critical to the economy of Trinidad and Tobago. To maintain economic sustainability the sale of natural resources (oil and gas) is important. Equally important is the acquisition of appropriate skills, competencies, and new knowledge that is necessary to lead organizations in the extraction of natural resources. Failure to adequately address any shortfall in the appropriate skill-set can lead to increasing levels of expatriate employment, denial of opportunities for nationals of Trinidad and Tobago (Ahmed, 2010), and shortfalls in revenue because of weakening negotiating powers in important foreign direct investment decisions. This situation has led multinational corporations to rely on non-nationals to operate and lead their organizations in Trinidad and Tobago. The reliance on non-nationals, a result of the shortfall in local intellectual capital stock coupled with the gap between the requirements of industry and outputs from the higher

4

education sector have created the need to reexamine the relationship between industry and academia in Trinidad and Tobago.

To develop meaningful recommendations to the specific challenges, this quantitative descriptive study of industry – academia relationships examined perceptions of industry and academic leaders about current higher education policy as a strategy to build local intellectual capital and sustainable development in Trinidad and Tobago. The data gathered in this study provides higher education policy makers with information relating to how policy may address the factors contributing to lower levels of intellectual capital and sustainable national development. This study also provides the pre-requisite baseline data for future studies on specific collaborative activities between industry and academia.

The methodology of this quantitative study incorporated a survey to collect data from a selected sample of industry and academic leaders. A survey instrument was developed and pilot tested using 12 participants from the sample to ensure reliability and validity of the instrument. Chapter 3 provides a detailed description of the pilot test results. The analysis of the data was quantitative and descriptive with adequate description of culture, context, and situation. The methodology also incorporated analysis of the survey data with descriptive statistics and independent samples t-test analysis.

Purpose of the Study

Trinidad and Tobago is in a process of major transformative changes in its economic and education polices. The basis for the new thrust is on the seven pillars (Ministry of Planning and the Economy, 2012). The pillars include:

1. People-centered development;
2. Ensuring national and personal security;

3. Entrenching good governance;

4. Development of a knowledge intensive economy;

5. Poverty eradication;

6. Accommodating foreign policy; and

7. Availability of information and communications technology. (p. 8)

This study was consistent with the pillar of developing a knowledge intensive economy. The intent of this study was to identify the requirements for collaborative relations between the two major universities in Trinidad and Tobago and industry in a manner that can enhance economic sustainability. The purpose of this quantitative ex post facto study was to:

1. Identify agreements/disagreements in stakeholder perceptions about the benefits of industry-academia collaborations;

2. Analyze the current state of industry-academia collaborative relationships in Trinidad and Tobago; and

3. Identify critical success factors for future industry-academia collaborations

Using a quantitative ex post facto design, the dependent variable was perceptions and the independent variables were industry and academia personnel. A G*Power post hoc power analysis confirmed a statistical power of 0.99 for a two-group independent samples t-test. The basis for the power analysis was on a two-tailed test, effect size of 0.08, alpha value of 0.05, and group sample sizes of 66 and 67. Given the power analysis $(1 - \beta)$, this ex post facto design resulted in a relatively small beta value and indicate reduced effect of Type II errors.

This quantitative design enables this researcher to identify the agreements /disagreements in stakeholder perceptions about the benefits of industry-academia

collaborations. It also allowed this researcher to analyze the current state of industry-academia relationships in Trinidad and Tobago and to determine the critical success factors for future collaborations. Finally this study used a larger number of participants ($N = 133$) than is normally associated with a qualitative one.

While much research was available about the subject of industry-academia collaborations, very little research existed regarding collaborations in developing countries including Trinidad and Tobago on this subject. While this study is a context-specific one, this study could provide wider applications to developing countries as these countries formulate policies on higher education for sustainable development.

The key variables in this study include industry-academia perceptions between industry professionals in Trinidad and Tobago and academic leaders at the University of Trinidad and Tobago and the University of the West Indies. The key areas under study include - (a) requirements for collaboration (b) benefits to industry and university (c) satisfaction needs (d) supporting strategies (e) current practices (f) influences, and (g) barriers. This study focused on organization and policies for industry-academia alliances with UTT and UWI, the importance of collaborative alliances and the benefits and obstacles of operating industry-academia alliances.

The population under investigation included those business and industry sectors aligned to the centers of learning at UTT and UWI. The population included representatives from (a) energy (b) maritime (c) manufacturing (d) information and communications technology (e) process and utilities, and (f) academia.

Significance of the Study

This study has two levels of significance. The first significance related to higher education policy initiatives at the governmental level. The policy considerations range from higher education funding, broadening access to higher education, relevance of curricula to industry and society, entrepreneurship and technology transfers, and employment opportunities for graduates. The second significance of this research was its contribution to scholarship and leadership through the provision of baseline data.

The direct significance of this study relates to pertinent issues in educational policy formulation in developing countries. Developing countries with similar characteristics (oil and gas), and higher education challenges can benefit from this study. The countries identified include those in Asia and Africa rich in natural resources but lack the educational infrastructure at the higher education level to produce the skills and knowledge. This study provided greater insights between government's policy options in higher education and industrial planning in nation states where natural resources exploitation has not produced sustainable development.

The indirect significance of this research is its contribution to scholarship and learning. This contribution is particularly suited for educational leadership. The focus of this research was applications of synergistic models for improving the relationships between corporate entities and higher education institutions. Several leadership models in practice show how the strengths of these models have contributed to meaningful outcomes in countries that have implemented them (Kile, 2012). The research in this study also examined leadership models in industry-academia relations that have presented challenges to host

countries and have led to unfavorable outcomes between the foreign investing clients and host nation states.

Nature of the Study

This quantitative study focused on industry-academia perceptions between industry leaders and academic professionals. The focus of this study is in six key areas (a) requirements for collaboration (b) benefits to industry and university (c) satisfaction needs (d) supporting strategies (e) current practices (f) influences, and (g) barriers. The design also incorporated the local Trinidad and Tobago environment, culture, and context with a formal quantitative descriptive survey methodology.

The documentation on the of subject of industry-academia relationships existed, yet little transpired regarding those collaborations in developing countries. To date few scientific studies existed regarding industry-academia collaborations in Trinidad and Tobago (Dawe, Wilson, & Rajpaulsingh, 2007). A point of importance is that while this is a context-specific study, it might provide wider applications to the developing world as developing nations aspire to formulate policies on higher education for sustainable development.

Research Questions

The following research questions address the stated problem:

RQ1: How do senior administrators in academics perceive industry-academia collaborations in Trinidad and Tobago with respect to potential mutual benefits, its current collaborative status, and potential for future strengthening?

RQ2: How do senior administrators in industry perceive industry-academia collaborations in Trinidad and Tobago with respect to potential mutual benefits, its current collaborative status, and potential for future strengthening?

RQ3: What are the issues of current collaborative practices in Trinidad and Tobago as perceived by university and industry senior administrators?

RQ4: To what extent is there agreement/disagreement between perceptions toward industry-academia collaborations between senior industry personnel and academics?

Theoretical Framework

Several theories informed this study. This study incorporated the theoretical issues in comparative education. The economics of education and the disbursement of resources by the developing countries form an integral part of the theoretical framework of this study. The expenditure on education as a percentage of gross domestic product (GDP) was part of the data analysis. The researcher compared the findings from the results of the expenditure with other countries in the developed world. The social construct of developing societies including Trinidad and Tobago and the relationship to higher education and society were part of the findings. The theoretical framework also incorporated higher education policies in the developing world. This study included various approaches to organizational structure and infrastructure for higher education. Additionally, curriculum content and best practices in educational law, economics, philosophy, and political science informed the theoretical framework of this study. Other epistemological perspectives in this study include the cultural phenomena as related to industry and academia in developing countries.

The literature provided an overview in comparative industry-academia relationships, the historical context, and issues that foster higher learning in the pre-modern Trinidad and Tobago era. Consistent with the triple helix model (Halilem, 2010) perceptions in industry, academia, and government revealed the changing nature of collaborative relationships. The literature also highlighted the economic development role of research universities. This study

included an analysis of the perceptions from major stakeholders in industry and academia. In academia, these perceptions included curricular and pedagogical practices across different jurisdictions, and reactions from academics to industry involvement. An analysis of the perceptions to applied research and use of university's facilities in industrial problem solving occurred.

Over the past 15 years, many research universities in the United States and Europe moved toward an entrepreneurial position in their governance model. The entrepreneurial trend has enhanced the pursuit of corporate relationships with industry. The entrepreneurial trend was against a background of the restructuring of higher education systems to make it consistent with the realities of the changing economic climate worldwide. Evidence to date suggested that the trend would influence many aspects of higher education institutions, including instructional delivery platforms, research, governance, and policy formulation (Felder, Brent, & Prince, 2011; Xu, 2011). Other critical issues in this study involved the examination, effect, and consequences of academic entrepreneurship in relation to the legitimacy of education as a fundamental human right.

Educational policy theory informed this study by the nature of the policy initiatives host governments implement in national budgets for higher education. The policy initiatives underscore the nations' philosophical approach to research and development within the national higher education agenda. In many national systems, policy theory forms the basis of how to raise, allocate, and justify resources economically. Policy theory informed this study by establishing the connections between educational investments and other national priorities. Policy theory also provided greater insights into revenue generating investments in

the short term and the long-term investments in higher education, research, science, and technology.

Educational leadership theory and strategy were important considerations in establishing any industry-academia relationships. This study obtained information from reports on the best practices among educational leaders and those in the corporate echelons of industry. Several instructional designs and leadership models including the boundary-breaking leadership development model (Edwards, 2010) informed this research study. Other themes have also emerged that informed this study. Some of these included the global perspectives of educational leadership in small nation states, and its effect on learning, development, and leadership in higher education. Leadership theories and strategies also assisted in the support and establishment of educational planning, infrastructure, and policy formulation in developing countries.

Definitions

This study used the following terms:

Denominational school: A school or institution funded partly by the Government of the Republic of Trinidad and Tobago and a religious organization (Kodelja, 2012).

Higher education institution: An institution providing academic and professional programs at the university level. These include institutions offering programs at the Bachelor, Master, and Doctoral levels. The institution is also engaged in research and development activities (Su & Chang, 2010).

Assumptions

There were three assumptions in this study. The first assumption was candidates selected from the population responded openly and honestly. The second was candidates

responded to the survey and do so within the specified periods. Finally, participants in the survey had access to a computer and the Internet.

Limitations

Given that the basis of the study was on participants' perceptions of the nature and structure of the relationships between industry and academia, one of the limitations was the honesty of the participants' responses during the survey. The second limitation was the amount of time to complete the data collection. The data collection period was two months however several participants did indicate their work commitments and business travel presented a challenge to completing the survey within the specified period.

Delimitations

A delimitation of this study was to surveying industry professionals and academics from five sectors. These include energy, maritime, information technology, manufacturing, process, and utilities. The focus of this study was on the analysis of perceptions from senior university personnel and industry stakeholders in key areas of education and training, industry alliance initiatives, sustainable intellectual capital, higher education policies, technology transfer, and collaborative research. The selection of participants was from only the six sectors identified in this research. This condition was necessary to allow consistency in the data analysis between industry perceptions and Trinidad and Tobago's university fields of study. Furthermore, because universities and industry play a critical role in a country's development, the expectation was that the perceptions of these stakeholders would be instrumental in analyzing the status of Industry-Academia collaborations.

The findings from the analysis of the data (Research Question 1) indicated that academic personnel perceived employment opportunities for students and relevance of

instructional programs as goals that require industry-academia collaborations. Academic personnel also perceived there was a high possibility for improving institutional mission and entrepreneurial skills through collaborative relations with industry. Practical hands-on experience for students is a high benefit perceived by academics and industry participants.

Analysis of data from Research Question 2 concluded that industry personnel perceived improved institutional reputation for universities through collaborative relations with industry. Personnel from industry also felt that industry could benefit by "gaining competitive advantage" through collaborative relations. The results from Research Question 2 also concluded that industry benefited from access to a broader recruitment pool from university graduates.

Research Question 3 addressed the current practices/issues in industry-academia collaborations. The results for this question indicated that participants consulted moderately with professional publications as a source of information on collaborations. There was a moderate level of satisfaction among participants for government support, planning, and commitment toward collaborative practices. On leadership matters, the results of this study concluded a lack of commitment by participants was the major barrier to collaborative relations.

The analysis of the data from Research Question 4 concluded that there was a significant difference in perceptions between industry and academia on entrepreneurial culture within the university. The establishment of significant differences in perceptions related to the issue of additional income for universities as a primary goal of collaborative relations with industry.

Summary

Chapter 1 examined the background to the issues involving industry-academia relationships. The chapter revealed the definition of the problem statement and articulated the major research questions. The definition of the problem was a discontinuous alignment between industry requirements for skills and competencies and the graduate output from universities. To address this problem the use of a quantitative ex post facto design methodology captured and analyzed perception data from senior personnel from industry and academia. Analysis of the data provided valuable inputs to policy formulation on industry-academia collaborative relations.

Chapter 2 will highlight the contribution of major research conducted in industry-academia relationships. This research provides the theoretical framework by citing global cases, including the historical perspective that give rise to industry-academia collaborations. Chapter 2 will also identify current benefits and barriers in formulating industry-academia relationships.

Chapter 2

Review of the Literature

The purpose of this chapter is to provide the theoretical framework to this study. This chapter highlights the origins of university-industry relationships, its structure, organization, and management. The exploration of several theories and models in higher education were part of the review with particular reference to university-industry relationships. This chapter also highlights the legal framework of education in Trinidad and Tobago. The role of government, industry, and academia as enabling factors for the sustainability of small nation states is also part of the literature reviewed for this study.

In recent years, universities and colleges around the world enhanced their relationships with other parts of their societies. This increased collaboration was transforming the traditional nature of academic institutions from an ivory tower of knowledge production and dissemination to one of producing and transferring technology. A second academic revolution (Etzkowitz & Goktepe-Hulten, 2010) connotes a knowledge capitalization process that broadens the university's mission to include the capacity to generate revenues. The third stream contributes directly to economic growth by producing marketable goods and services (Abeles, 2014). Capitalization means to become an entrepreneurial institution capable of responding to emerging needs. Consequently, universities need to collaborate with potential partners who can contribute to building their competitive strength (Gildersleeve, 2010).

The forces that drive increased collaborative ties between industry and academia are rooted externally and internally in the search for alternative revenue sources and the need to provide learning and development opportunities for nationals of Trinidad and Tobago. The

external forces are the expectations of major stakeholders such as the government, local community, and the society for increased contribution of universities to economic development. Internal forces include the university's need for new sources of revenue that may supplement diminishing public funding (McKeown-Moak, 2013). This need to increase revenue and apparent shortfall in traditional funding for universities can make it difficult for universities to accomplish multiple missions of knowledge generation and entrepreneurial spin-offs (De Geest et al., 2010). Based on the pressures of these external and internal forces, universities in industrialized economies are evolving into an increasingly entrepreneurial age. In this entrepreneurial age, the perception of knowledge is a commercial capital and traditional public institutions may be seen (including universities) as business entities (Heinzl, Kor, Orange, & Kaufmann, 2013).

The challenges that enforce increased partnership relationships are particularly influential to institutions in transitional economies where the extent of state control, state regulation, and state funding was diminishing (Schensul, 2010). For universities in those countries, transition has bought new mandates in ideology, philosophy, and new opportunities in partnership building (Örtenblad & Koris, 2014). The ideological perspective of higher education as a government investment and the citizens' inherent right to access higher education become an integral part of higher education policy in small nation states. Regardless of the ideological perspective, the issue of economic sustainability relates inherently to a nation's ability to manage and lead its own affairs.

Examinations of the major forces that drive universities to collaborate with industry represent the extent to which universities can benefit from these relationships. The challenge for the parties (university and industry) is on the managerial aspects of the relationship and in

the formalization of collaborative agreements. These agreements attempt to answer the following questions: Why do universities collaborate with industry? What are the potential benefits and concerns of collaborations? How university-industry collaborative activities are organized and managed? What are the success factors that make the collaboration work?

This chapter attempts to answer these leading questions in four sections. The first section reveals environmental factors that affect collaborative relationships. This section outlines the general framework and historical development of university-industry relations with an emphasis on the United States experiences and other international trends. The second section describes current practices in terms of their importance as characterized by benefits gained by collaborating parties.

The third section explores critical success factors that are, or may be applicable to higher education institutional settings. The focus in this section is in formalizing the relationships through institutional strategic visioning rather than with individual engagements of faculty and staff in industry-sponsored or funded projects and programs. However, individual collaborative activities require support because these collaborations lay the foundations for wider organizational relationships between industry and academia. The final section elaborates on university-industry relationship in the context of Trinidad and Tobago. The chapter concludes with a summary of the information learned from the literature.

Overview of University-Industry Relationships

The division of the factors that drive collaborative relationships between universities and industry can be external and internal factors. The external factors highlight the changes occurring in the surrounding environment such as government policies, international, regional relations, economic, political, demographic, and technology developments (Salter &

Faulkner, 2011). The internal factors include the changing missions and roles of the parties (Mohrman & Baker, 2008) as a response to external changes and the need to survive in competition with other providers of similar knowledge products and services.

Forces Driving University-Industry Relationships

External factors influence the increase interactions between social institutions, the global market, and increased interconnectivity (Qureshi, Shaukat, & Hijazi, 2010). Other external factors that drive industry-university relationships include demographic shifts, the explosions of information, and the acceleration in which contemporary universities operate. The most influential factor that characterizes the environment surrounding universities is an international movement toward increased democracy and globalization (Wang, Muhos, & Kess, 2011). Globalization is the product of the liberalizing policy of extended interaction of nations characterized by the global economic phenomenon. This phenomenon accelerated, enlarged, and promoted a corporate culture of competition and wealth maximization (Bratianu, & Stanciu, 2010). This culture of competition includes cost reduction, efficiency, and bottom-line profit (Krimsky, 2010).

With the fall of the communist nations, principles of liberty and democracy are becoming widely accepted values. The popularity of these values in former totalitarian regimes reshaped relationships between institutions free from imposition from top-down, ideological oppression and rigid administrative controls. Social institutions in those newly liberalized environments are in the process of building mutually beneficial relationships based on trust and equality. Today institutional relationships between markets and organizations have shifted with the loss of trust, dedicated time, and attention to each other (Kishel, 2011). Following the common trends toward decentralization and privatization at all

levels, governments in traditional economies are delegating more authority to institutions of higher education, allowing them to allocate resources freely in pursuit of their institution's missions (Lea, 2010).

Meanwhile, governments must contend with a broad range of traditional and new tasks in serving their aging populations, providing increased social welfare, and combating global environment and health. Altogether, these challenges require an increase in public spending, leading to increased competition among traditionally public supported institutions. A popular measure practiced by governments to reduce their authority over public institutions such as universities and colleges – is granting them greater autonomy to manage their institutions. The autonomy produced a reduction of public funding and an increased need for alternative sources initiated the relaxation of government control of revenue (Nelson, 2011). This need for alternative revenue sources can include tuition-paying students, the sale of faculty research and training capabilities, and an increase in commercial activities. These alternatives help to reduce dependence on sources of government revenue. These resources reflect the effect of external environmental factors, which led to academic capitalism (Zheng, 2010), a new phenomenon in higher education. Academic capitalism is characterized by the capitalization of knowledge (Zheng, 2010) that makes institutions more entrepreneurial (Krimsky, 2010). The result of this is universities are presumably able to exercise greater autonomy over resource flows and contribute directly to sustainable development (Sirat, 2010). As such, universities challenged for access to resources perform better than do universities with guaranteed sources of income (Boronico & Boronico, 2010). Thus, external factors drive universities to become more competitive and capable. These alternative resources could be accessible through collaboration.

Internal factors also contribute to collaborative efforts. Within the higher education sector exists a proliferation of the different types of institutions. Many of these institutions come as a direct response to the increasing demand for enrollment (Roberts, Chou, & Ching, 2010). The increase demand for higher academic and professional education has resulted from an acceleration of technological innovations and a liberalization of educational delivery services (Yean, 2010). This demand has brought new platforms to higher education, such as corporate and entrepreneurial universities, virtual institutions, and proprietary schools into the higher education market (Brown & Brandt, 2014).

The advancement in information technology enables universities to become key agents for the enhancement of scientific and technological strengths of nations. There is also a need for continuous improvement and upgrading to keep pace with competing peers. In this complex environment, universities have not been able to accomplish their mission alone. Therefore, effective and mutually beneficial cooperation and partnership with the traditional and non-traditional partners have become an imperative issue.

In industry, the need for continuous improvement through organizational learning and development is necessary because of new and innovative technological changes (Lillis & Lynch, 2014). These changes add to corporate competition and forces universities to become more responsive to the provision of a competent workforce (Barnes & Harris, 2010). In this regard, universities are most suitable allies for industry because of the ability to share and consume physical resources. Universities are also not in direct competition with industry. Inter-organizational relationships supplement and complement the symbiotic nature of the collaboration between industry and academia. Inter-organizational relationships also facilitate the flow of knowledge between partners (Howard & Wilson, 2014).

21

Authors defined the term collaboration in various ways, each emphasizing different characteristics (Jin, Wu, & Chen, 2011). To explore institutional implications of collaborative relations, preference aligns with characteristics that reveal features of formal and institutionalized forms of relationships linked to institutional missions and strategic goals. In this respect, Mattessich and Mansey (1992, as cited in Alexander, 1997) provide a specific description of collaboration as a long-term commitment of parties:

> …collaboration connotes a more durable and pervasive relationship. Collaborations bring previously separated organizations into a new structure with full commitment to a common mission. Such relationships require comprehensive planning and well-defined communication channels operating on many levels. Collaboration structure determined authority. Risk is much greater because each member of the collaboration contributes its own resources and reputation. Resources are pooled or jointly secured, and products are shaped. (p. 39)

This definition incorporates the major features of contemporary collaborative relationships (Lehtimäki & Peltonen, 2013) that partners in university-industry relations must forge. Parties that become more engaged in collaborative relationships share many commonalities in organizational, cultural, economic, and personal dimensions. In this manner, collaboration denotes the meaning of higher-level involvement of participants in longer-term relations that assume some supporting structure.

Historical Development of University-Industry Relationships

Practices of collaborative relationships between university and industry have a long-standing history traced to the time when prototypes of modern universities emerged in the medieval period. The development of universities is notable through the dynamic nature of

these institutions with rich examples of changes and adaptations to new circumstances that occur over centuries (Altbach, Reisberg, & Rumbley, 2010). However, researchers are cautious to identify few substantial changes named as academic revolutions because of their complex implications.

The first academic revolution took placed when the professional character of higher education became prevalent in the late nineteenth century as the world moved into the industrial era (Zheng, 2010). University and industry recorded significant relationship activities during this period. Universities began increasingly to offer professional-oriented programs in the fields of engineering and agriculture (Saltz, Serva, & Heckman, 2013). In the United Kingdom, Cambridge University emerged as one of the first scientific research centers that were active in generating new knowledge and promoting a new brand of intellectual property. The strategy implemented was through increased registration of patents and start-up companies. In 1870, the Cavendish endowment produced the first company from Cambridge – the Cambridge Scientific Instrument Company. Its purpose was to develop instruments and machinery for the research laboratories.

At the same time, other European universities started their collaboration with industry, emphasizing an increase of open types of interaction (Lind, Styhre, & Aaboen, 2013). During the mid-nineteenth century, the German government allocated significant resources to universities promoting research, and sustainable national development. This signaled a new public mission for academia. German universities used an enhanced academic approach to industrialization and sustainable national development through the provision of increased access to graduate education and doctoral degrees. These graduate programs aligned to national priorities. This approach integrated research at German universities as a

critical part of the offering in the university portfolio and led to a new governance model in the management of scientific disciplines.

The American model in higher education was different. This model added greater democracy to the German one. In the American model, there were greater linkages between university and society especially in service industries and agriculture. This governance model led to the emergence of academic departments in the American context. The German model used the land-grant concept for both high-level research and expanded access to higher education (Altbach, Reisberg, & Rumbley, 2010). The Land-Grant College Act of 1862 (Morrill Act) gave a start to professional land grant universities in the United States providing an endowment for

> …at least one college where the leading object shall be, without excluding other
> scientific and classical studies and including military tactics, to teach such branches
> of learning as are related to agriculture and the mechanic arts in such manner as the
> legislatures of the states may respectively prescribe, to promote the liberal and
> practical education of the industrial classes in the several pursuits and professions in
> life. (Sec. 4)

Thus, the Morrill Act of 1862 was a major boost to the establishment of institutions and provided the legitimacy to further educational access to nationals in agriculture, home economics, and mechanical arts. The supplementation of educational access also included theoretical, practical, and field exercises. Some forms of collaborative activities, such as industrial research grants supporting applied research centers within universities, (Leslie, Slaughter, Taylor, & Zhang , 2012) were also used in that time. Personnel for both industry and academia also collaborated through industrial associates programs, and consultancy

services provided by faculty members. Higher education expanded further after World War II. This expansion was characterized as a transition from elite to mass (Parhizgar, 2010; Rossi, 2010) and to universal higher education for newly industrialized nations. This period also witnessed extensive growth in universities' involvement in collaborative relations. Universities added to their mission a new component of technical expertise to government and industry.

The period of World War II marked the emergence of faculty-formed firms, and interdisciplinary research centers (Etzkowitz & Goktepe-Hulten, 2010) that indicated a shift from informal, subtle individual contract initiatives to longer-term, strategic, multimillion-dollar collaborations. For example, in the United States, during the decades of the 1940s and 1950s, Massachusetts Institute of Technology (MIT) became the leading research university. The impetus for this shift came because of grant funding and commercial agreements from the federal government and from private commercial interests (Kim & Urpelainen, 2014). The proliferation of research centers in the United States after World War II shifted the agenda toward sustainable futures and technologies (Wagner, McGuinness, Yonck, & Roberts, 2010).

The 1950s and 1960s were significant in that they signaled a shift in traditional university administration toward increased adoption of modern management techniques. Industry became increasingly interested in Research and Development (R&D) to access new and innovative technologies as a potential competitive advantage over other firms. In this respect, universities demonstrated their ability to be major partners in creating this potential advantage.

In the 1970s and 1980s, post-secondary educational institutions became involved in various types of collaborative relations. In the United States, in the late 1970s hundreds of linkages between universities and industry were initiated, formalized, and expanded as a reflection of social forces (Chia, 2014) connected with technology advancement. For example, the electronics sector experienced a rapid increase of small and medium sized enterprises, which became flexible and responsive to the customers' demand (Bhukuvhani et al., 2013).

In the early 1980s, technology transfer to industry became a priority in western universities (Cherwitz, 2010). This resulted in an increased number of newly established transfer-oriented support units, such as technology transfer offices at universities, technology centers, science parks, and university-affiliated institutes. Trinity College, United Kingdom, established the first Cambridge science park in the 1970s with the focus to attract science-based industries (Smith & Beasley, 2011). The advantage of this initiative was to create a nursery site for new companies with shared administration and management support. Evidence of the success of this initiative is through the formation of more than 65 companies, 4,500 professionals and researchers employed, and potential for additional expansion based on demand (Jeung, Yoon, Park, & Jo, 2011).

In the United States, research universities began increasingly to create new mechanisms of technology transfer, such as technology business incubators (Al-Mubaraki & Busler, 2013) technology licensing offices (Kirkman, 2013) and technology parks (Abd, Mohd, & Jalaluddin, 2013). To facilitate the transfer of technological innovations, the number of organized research units and university-based research centers increased dramatically. Dumi, Sinaj, and Kociu (2014) argued there was a growing acceptance

especially in the European Commission that academia and industry do benefit from working together. Collaborations stimulated the transfer and sharing of knowledge, and helped create long-term partnerships and profitable opportunities, as well as boosting students' future employment prospects.

In the 1990s, nations regardless of their developmental histories have formulated innovation strategies based upon the intentional expansion of university-relations (Nyerere & Friso, 2013). In Latin America, this pattern became evident with a region-wide movement toward the formalization of university-industry relationships and the generalization of the state funds to foster innovation at firm level (Howard & Laird, 2013). This situation made joint research and development projects between firms and academia a priority.

Governments of developing countries are encouraging their higher education institutions to develop strategies with emphasis on research and development. The research and development thrust came into focus at the K-12 level. The Organization for Economic Cooperation and Development (OECD) member countries purported an intensified formative assessment initiative with a research and development focus at the K-12 level (Clark, 2010). The widespread measures taken internationally to foster relationship activities between universities and industry are as follows (Kahn, Petichakis, & Walsh, 2012):

1. Allow universities and public research centers to use the results of research commercially;

2. Create scientific and technical networks between businesses and universities;

3. Redefine the status of researchers to make it easier for them to become more entrepreneurial; and

4. Create institutions and various forms of assistance to promote the emergence of innovative projects (incubators, seed funding).

These developments were highlighted in recent studies on the changes taking place in university systems globally, such as in the North America (Stacey, 2014), Latin America (Gacel-Ávila, 2012), and the former socialist countries. These studies evidence the common course of governments across nations to strengthened ties between their universities and industrial sectors.

Stakeholder Communities in University-Industry Relations

The major forces that effect changes in today's universities resulted from economic shifts in the world economy and the internationalization of social and cultural values within a nation. Other forces that affect the university-industry relationships include greater access to higher education, and increased competition among other social institutions for limited resources, including state funding (Dougherty, Natow, Bork, Jones, & Vega, 2013). Consequently, establishment of mutually beneficial collaborative relationships with strategic partners and engagement in more entrepreneurial and research activities are perceived to be popular measures that function adequately in these circumstances. As a reflection of these changes that occurred in the environment, the roles of each stakeholder – governments, industry, universities, and the public have changed.

The determination of the necessity to restructure institutional relations is from the knowledge-intensity of the economic development. A transformation in the functions of the triad, as termed by Lee and Ngo (2012), the triple helix is taking place as each stakeholder in the relationship increasingly assumes the role of the other. Arrangements and networks

among the four stakeholders provide inputs to the nature and sustainability of these relationships.

Additionally to its traditional role as a provider of trained personnel and knowledge, universities can play an industrial role as a source of firm-formation, technological, and regional development (Lind, Styhre, & Aaboen, 2013). In this regard, the university acts not only as a supplier of knowledge and human capital, but also acts as another industrial actor creating intellectual property and co-shaping new firms. Under certain circumstances, governments assume the role of entrepreneurs both directly and indirectly. Governments supply the resources (including venture capital) to the other stakeholder (McLendon & Hearn, 2013), and regulate their relations with each other. In this regard, governments act as instigator of organizational innovations and structural adjustments. This can form the basis of knowledge and technology creation, and applications. Industry can take the role of the university in developing training and research, often at a level comparable to universities (Zahra & Pavia, 2012). The next section highlights the role of government as a critical stakeholder.

Government as Stakeholder

Researchers often emphasize diminishing public funding as an indication of reduced government support for social issues (Dervarics, 2010; Jones, 2010; Krimsky, 2010). However, one could argue that governments increased their influence by means other than direct funding. Through policies and legislation that encourage partnerships, entrepreneurial, and other innovative initiatives, governments encourage universities to strengthen themselves even more than they were under generous public funding. Moreover, some universities perceive the decrease in government funding as an increase of their freedom and autonomy.

In the 1980s, a number of industrialized countries introduced public policies for commercializing research (Kretz & Sá, 2013). This formed the new thrust during the 1980s as governments' policy for increasing a market orientation strategy. A prime example is the Bayh – Dole Act of 1980. Under the Act, United States universities patented the results of research allowing these universities to generate additional revenues through royalties from private industry.

In the United Kingdom, a 1987 Government White Paper entitled *Higher Education: Meeting the Challenge* indicated its policy to encourage closer collaborations between universities, and commercial enterprises. In this regard, the government and other funding agencies are obliged to support and promote any approaches by universities to work more closely with the international business community. In France, as in other industrialized countries, the government, through the 1999 Innovation and Research Act, sought to promote extensive ties between universities and private enterprises to stimulate creativity and growth (Link & Scott, 2012). Based on 12 in-depth national case studies conducted in association with the Organization for Economic Cooperation and Development (OECD), the Council of Europe (1990) drew the following conclusion:

> The main finding… is the growing diversity of higher education and its funding mechanisms in most OECD countries. The university has too many missions for the means available and, by decreasing their contributions, governments are hoping that diversification of financial sources will become the solution to the problems they themselves have allowed to develop. (p. 14**)**

The Council of Europe (1990) made the recommendation to its member states to foster the university relationship geared toward research for dollars; hence, the application of

this type of research has become the focus of some states. This means a closer involvement

of scientific researchers, who more readily link the production of knowledge to the

realization of profits through relations with industry (Heinzl, Kor, Orange, & Kaufmann,

2013). Leslie, Slaughter, Taylor, and Zhang (2012) showed that although the direct public

funding to universities reduced drastically, governments still are very influential stakeholders

in these relationships. Governments play an active role by encouraging multinational

corporations to generate relationships with higher education institutions. Through

government policy, formulation industrial stakeholders receive incentives to collaborate with

universities in the development of new knowledge-products and processes. This initiative

enables industrial firms to reduce the time from prototype to commercial market

participation.

As governments reduce their direct funding to universities, they (governments)

removed obstacles to higher education institutions to commercial benefits from research.

Governments have also promoted value added initiatives from relationships between

universities with industry, thus leading the way for active engagement in more general and

commercialized initiatives. In Trinidad and Tobago, the government policy was the

allocation of 1% of the capital cost of Foreign Direct Investment (FDI) is for a training and

development fund to support nationals of Trinidad and Tobago.

Industry as Stakeholder

The result from increased competitiveness in a globalized and internationalized

marketplace has made processes and production highly innovative requiring constant

improvements (Barrientos, Gereffi, & Rossi, 2011). The increased demand for re-training

and knowledge inputs reflects the need for industry to engage universities in professional

development and research programs (Jeffrey, Hide, & Legg, 2010). Other skills and competencies, especially information technology and new management skills become critical in an interconnected world of better-educated and informed consumers. As a result, industries are becoming knowledge-intensive learning organizations (Etzkowitz, 2010). In this regard, universities can possess the unique potential to provide industry with both knowledge and competencies through graduates and researchers serving as employees and advisors. In this context, industry-university collaborations are consistent with the evolving trend for generating new knowledge and technologies (Boggs, 2010; Igun, 2011; Sá 2011).

Öcal (2013) contend that private commercial enterprises can generate meaningful collaborative relationships with research universities within government policy incentives. These relationships have a greater probability of yielding new commercial products in relatively shorter time to market. Additionally industrial entities can benefit from access to new processes that may allow greater competitive advantages in the global market spaces (Hegarty, Kelly, & Walsh, 2011). The benefits to larger enterprises in these collaborative relationships include access to university facilities, research personnel, and professional training opportunities for industry employees (Oleforo, Oko, & Akpan, 2013).

Smaller enterprises can use relationships with universities to strengthen skills, knowledge, and gain access to university facilities to advance core technologies that also support the entity's central mission. Cooperative research and technology transfer relationships are especially appropriate for helping small and medium sized enterprises to advance their core technologies. These relationships involve targeted activities useful for addressing immediate deficiencies in specific areas where market opportunities are greater for smaller enterprises.

University as Stakeholder

The emphasis on partnerships and external outreach is a reflection of a new mission of higher education (Altbach, 2010; Pfotenhauer, Jacobs, Pertuze, Newman, & Roos, 2013). Nejad, Abbaszadeh, Hassani, and Bernousi (2012) contended that universities increasingly institutionalize their relationships with industry, establishing entrepreneurial sub-units. Related university initiatives are part of the increased number of institutional offices set up to facilitate cooperative ventures with business and industry. The establishment of research and technological parks in juxtaposition with university campuses can foster effective collaboration.

With greater emphasis on entrepreneurialism, universities are undergoing substantial structural changes as an organization. Jiang and Carpenter (2013) reported that in United Kingdom, the management structures adopted are consistent with the idea of the university as corporate enterprise, as against collegiums of academics or a professional bureaucracy. Vice Chancellors effectively became chief executives, supported by teams of senior academic managers, regarded often as a distinct management interest group. Matrix structures established for the implementation of policies driven from the center of the institution impinge directly on academic practice. A similar trend observed in other nations in Asia, particularly among large development, builds upon its previous mandate of teaching, research, and practice.

Importance of University-Industry Relationships

The importance of university-industry relationships are important in terms of benefits and advantages expected from collaborative activities. These benefits and advantages may be different from each beneficiary's perspective. Within this study, an emphasis was on the

perspectives of direct university and industry beneficiaries. Table 1 illustrates the categories of the dimensions of tangible/intangible results and outcomes of university-industry relations.

Table 1

Benefits from University-Industry Relations

Benefits to Universities	Benefits to Industry
Tangibles	
Additional funding / revenue	Financial gains / profits
Equipment	Access to advanced facilities
Publication opportunities and knowledge advancement	Translation of research into products for commercial gains
Subsidizes / replaces Government funding	Creates new industries and new jobs
Brings patents to the university	
Increases university – community engagement	
Increases university fundraising opportunities	
Intangibles	
Brings research ideas into the university	Competitive advantage
Provides "real world" grounding for the university	Enhanced reputation
Provides an alternative reward to journal publication for faculty	Access to Technology
Fulfillment of institutional mission	Professional Expertise and "Thought Leadership"
Improves reputation	Professional development
Serves as a source of information	
Practical hands-on experience	
Student job placement	

While industry and academia may have different missions, the possibility exists to find innovative approaches to collaborate for mutual benefit. By establishing collaborative relations, parties naturally desire certain benefits as a pay-off of their investment in

interactive activities. As the literature indicates, participants in university-industry collaborations intend a broad spectrum of outcomes.

Benefits expected from any activity require a definition with regard to intended goals and purposes. For example, a study undertaken to evaluate outcomes of well-established partnerships in the software engineering field reports the following ranking of purposes for forming university-industry collaboration to fulfill institutional mission:

1. Address business growth;

2. Obtain access to education and training resources; and

3. Provide a staffing source (Sandberg, Pareto, & Arts, 2011).

The ranking purposes for building partnerships with industry clearly indicate institutional emphasis consistent with their primary mission. In general, universities of any size are interested in exposing their students and faculty to practical problems and industrial challenges, creating employment opportunities for their graduates, and gaining access to applied technological sectors.

Large universities engage industry for securing additional funds, particularly for research. Additionally, higher education institutions can expect significant incomes from licenses, patents, and consultancies because of their engagement with industry. Consequently, the selection criteria for universities can include access to venture capital, services, industrial site access, and infrastructural support. The local entrepreneurial environment as an enabler for commercializing products from collaborative activities also forms part of the selection criteria for universities in search of potential partners (Krimsky, 2010). The benefits of collaborative activities vary depending upon the primary purpose of

building relationships. Table 1 shows the benefits that universities and industry may expect when undertaking collaborative relations with each other.

Based on the literature and on interviews with faculty and administrators (Metcalfe, 2010) involved in 'academic capitalism' conducted at two Australian universities, Hilliard (2012) constructed a cost-benefit taxonomy to assess the benefits of university-industry relationships while subsequent researchers (Gera, 2012; Greitzer, Pertuze, Calder & Lucas, 2010; Yang & Li, 2012) found the following particular advantages of university-industry relationships:

1. Improved relations with stakeholder communities;

2. Improved credibility with success;

3. Identification of priority research, and teaching;

4. New business opportunities for faculty and employment of graduates;

5. Opportunities for postgraduate students in industrial problem solving;

6. Professional development opportunities for the university-industry collaborative project; and

7. Equipment contribution and utilization from industry and academia.

Based on the above findings, there was expectancy by the university that a significant number of benefits are obtainable from the interaction with industry. These include fulfillment of its mission, generating revenues and intangible advantages such as enhanced reputation. In the case of university researchers, the engagements with industry can provide greater insights to practical applications and industrial trends. This can assists in the development of faculty, equipment acquisition, and in setting an applied research agenda consistent with the priorities of industry.

Additionally, faculty personnel involved in collaborative research activities with industry can gain an ability to work on new applied technologies in their profession. This brings with it enhanced reputation and prestige, an access to life applications. The effort of this engagement allows university personnel to present professional papers and publications, jobs for university graduates, and provision of research funding as potential benefits for universities.

Of note is that benefits to participants are relative and dependent upon many factors, including cultures, traditions, and the environment in which these universities function. For instance, in contrast to the United States and Europe (Spraggins, 2010), German universities cannot apply for patents. The primary reason is the lack of the necessary legal, financial, and regulatory framework to enable this undertaking. Furthermore, in a cross-sectional study in Germany and Portugal (Franco, Haase, & Lautenschläger, 2010) contended that university students scored extremely low on entrepreneurial intent on graduation. Hence, German universities cannot expect financial gains through entrepreneurial student activity from commercialization of collaborative research. Wright (2010) named financial constraints as the most influential force for promoting collaboration. Others contend that university leaders emphasize fulfillment of institution mission (rather than financial gains) as the major benefit gleaned from the collaboration.

Benefits to Industry

Given the rapid pace of technological and managerial changes in industry, the requirement to match tasks with competencies has become increasingly important (Larbi-Apau & Moseley 2010; Larbi-Apau & Sarpong, 2010). Smith and Beasley (2011) argue that such benefits to a firm include access to research facilities, competent graduates, and

researchers. Specific examples of these benefits are identifiable in several fields. New technologies resulting from collaborative efforts include those in biotechnology, manufacturing (Kumar & Ganesh, 2011) and aviation (Yates, 2010). Collaboration enables industry to obtain the means for technological advancement at lower cost and reduce the associated risk with new product development. Collaboration also provides a synergistic approach to new technologies and processes without which the cost and risk would be much higher. For industry employees, industry can benefit from new and enhanced forms of instructional delivery (Stein, Shephard, & Harris, 2011) resulting in reduced employee time away from jobs (Smyth, 2011).

The exploration of collaborative practices allows industry to obtain cost-effective education for employees on timely topics designed to specification, and delivered locally. This is often difficult for an organization but when organizations share and pool resources, the unit cost is considerably less. Many industries access the professional development programs offered by several universities to enhance employee technical and leadership competencies further through shorter non-degree seminars and workshops. Other benefits include stronger market positioning and positive branding of both universities and industry the result of which can enable greater opportunities in generating new business. Thus, collaborative relationships between universities and industry have a greater synergy than the individual efforts of either partner. Collectively the synergistic relationship between industry and academia provides benefits to both parties through the potential for enhanced revenue, the reduced time between concept development and commercialization of products and services, and through enhanced leadership, and managerial competencies.

Potential Disadvantages

Studies have examined university-industry relations in different national jurisdictions and historical contexts (Yang & Welch, 2012). The result of these studies indicated that the social construct that make up the university could be vastly different to those found in commercial enterprises (Ryan, Tilbury, Peter, Abe, & Nomura, 2010). Stakeholder culture and organizational context can play a significant role in the success or failure of university-industry relationships. Consequently, possible conflicts and disadvantages associated with these differences are likely to emerge in these relationships.

In the early 1990s, the Council of Europe (1990) recommended:

...universities, whenever they have the choice should give priority to linkages that strengthen, not weaken, their traditional mission of knowledge generation and transmission, basic and applied. (p. 151)

Accordingly, economic gains should not be the first priority. This debate over the primary mission of the university continues today (Washburn, 2011) and although economic gains are important they should not become the goal itself. Universities should be aware of the implications of any interactions with other constituencies, including entrepreneurial collaborations because they may intervene with the universities' primary mission.

The major concerns in undertaking collaborations with external partners are associated mainly with research activities. The negatives associated with the entrepreneurial university phenomena (Nino, 2011) or what Kauppinen (2012) referenced as academic capitalism have also received considerable coverage in the literature (Kleinman, 2010; Moneta, 2010; Zheng, 2010).

39

The disadvantages identified by Bozeman, Fay, and Slade 2013 represented the issues associated with accountability, follow-ups, and channels of communication. Another potential disadvantage include the specificity of any trade-offs associated with new venture formation (Bozeman, Fay, & Slade, 2013). These include the following:

1. Resources consumed but not covered by contract;

2. Loss of time for basic research;

3. Loss of time for administration;

4. Revenue substitution (loss of government funding as private funding increases); and

5. Wear and tear.

Trends in promoting entrepreneurial behaviors may also lead to greater disparities between active and non-active researchers in collaborative activities. These disparities may emerge based on researchers' income, academic duties, and prestige. Engagement of active faculty in entrepreneurial university-industry initiatives may lead to an increased need for the recruitment of temporary teaching personnel. This may create a situation in which active faculty continues to author increased scholarly publications, gain additional autonomy over the collaborative effort, increase personal revenue, and prestige, whereas the non-active faculty become occupied with increased traditional academic duties (e.g. teaching). In some cases, such differentiation escalates to where some faculty members may feel a sense of loss in identity and prestige associated with meaningful engagement with industry (Flipse, van der Sanden, Maarten, & Osseweijer, 2014).

Management of University-Industry Relationships

During the 1980s, there was a proliferation in collaborations between industry and academia. This trend has continued into the 21ˢᵗ Century with shifts from manufacturing-

based economies to information and knowledge based economies (Lin, Hsieh, Hsieh, & Lai, 2012). The changes in the structure and management of industry academia relationships have affected on the entire stakeholder community namely, industry, academia, and government. Some of the changes include cooperative research between industry itself and between industry and universities. Other changes include industry-sponsored research in universities. The effect has given rise to more competition in the corporate world to reduce the knowledge gap and within the university community for research funding. In the 21st century, the trend toward increased collaborations between industry and academia will place greater emphasis on managing and sustaining these collaborations.

Critical Factors in University-Industry Relationships

By determining the critical factors that shape industry-university relationships, Yang and Li (2012) suggested four major determinants - research support, cooperative research, knowledge transfer, and technology transfer. In a later study, Fernández-Esquinas and Ramos-vielba (2012) added other determinants such as trust, flexible university policies for intellectual property rights, effective communication, and the presence of champions.

Industry support for university research is well documented (Brandt, 2010; Cosh & Hughes, 2010). The majority of the support from industry was financial and equipment contributions (Cosh & Hughes, 2010). This should not negate the cooperative research between industry and individual faculty members to solve specific industry problems.

Other critical factors that shape industry-university relationships are knowledge and technology transfers (Fernández-esquinas & Ramos-vielba, 2012). Perhaps the most important issue in sustainable development of a developing nation such as Trinidad and Tobago is its ability to transfer technology to the productive sector. Teng (2010) contended

41

that university-enterprise technology transfer form an integral part of the socio-economic development of nations and this activity added revenues to universities. In Brazil, the transfer of technology in industry-university relationships takes place through a two-way transfer of tacit knowledge between industry and university. These examples support the view not only of the benefits of industry-university collaborations but also the management of such collaboration.

Success Factors In University- Industry Relationships

In the late eighties, Yang and Li (2012) traced the key success factors to industry-university relationships. This study identified involvement of faculty in the initial stages of relationship, a clear channel of communication between the stakeholders, wide reporting of results, and the implementation of an evaluation process as critical success factors. A model proposed by Saltz, Serva, and Heckman (2013) emphasized the importance of commitment to the relationship, training, and management of the stakeholder community during the relationship.

The roles of governments are a critical success factor in industry-university relationships. Federal science policy and research and development incentives add to the success of the industry-university relationships. As the knowledge generation continues to change, industry and universities aspire to manage their relationship. The management of this relationship reflects the increasing complexity of the university profession and the requirements of industry. In this context, governments' role as enablers of industry-academia success cannot be overemphasized (Lee & Ngo, 2012).

Industry – University Relationships in the Trinidad and Tobago Context

This section reveals the current experiences of university-industry relationships in Trinidad and Tobago. A review of the economic and social context in Trinidad and Tobago is notable, with reference to the current reforms in higher education. Additionally, the section provides a review of the current policy framework for higher education and its relationships to industry and economic sustainability.

An overview of the economy of Trinidad and Tobago reveals that this twin-island state provides an excellent investment site for international investors. Trinidad and Tobago has one of the highest growth rates and per capita incomes in Latin America (Central Intelligence Agency, 2011). The economic growth rate between 2000 and 2007 averaged eight percent above the Caribbean average of 3.7% for that period. However, during 2009 the economy slowed and contracted 3.5% and has risen in 2010 by 2%. The Trinidad and Tobago growth is largely because of investments in Liquefied Natural Gas (LNG), petrochemicals, and steel.

Trinidad and Tobago is the leading producer of oil and gas in the Caribbean region and is largely dependent on these commodities for economic sustainability. Manufacturing of food products and beverages also contributes to a lesser extent to the economy. Oil and gas contributes approximately 40% of GDP and 80% of exports of Trinidad and Tobago (CIA, 2011), however, this sector only contributes to five percent of employment.

Trinidad and Tobago is also a regional financial center. Tourism is also a growing sector although not as important to the Trinidad and Tobago economy as in the other Caribbean islands. This country benefits from a trade surplus, but declining oil and gas prices have decreased the revenues to the government and no doubt bring about new challenges in

sustaining public investment in Trinidad and Tobago. According to the World Fact Book

(CIA World Fact Book, 2011) Trinidad and Tobago ranked 102 in terms of expenditure on

education as a percentage of Gross Domestic Product (GDP) with 4.2 %. Table 2 below

shows the ranking of public expenditure on education as a percentage of GDP.

Table 2

Ranking of Public Expenditure on Education as a Percentage of GDP

Rank	Country	Percent of GDP
1	Kiribati	17.8
2	Cuba	13.8
6	St. Kitts & Nevis	9.9
27	St. Vincent & Grenadines	7
32	St. Lucia	6.3
34	Jamaica	6.2
37	Guyana	6.1
46	United States	5.5
62	Belize	5.1
79	Dominica	4.8
102	Trinidad and Tobago	4.2
108	Antigua & Barbuda	3.9

Note. Caribbean countries selected. Adapted from CIA World Fact Book (2011). Retrieved from
https://www.cia.gov/library/publications/the-world-factbook/geos/td.html

With the exception of the United States, the Caribbean countries ranked in Table 2

with the exception of Trinidad and Tobago have educational infrastructural challenges both

in quality of facilities and quantity of facilities. Consequently, the relatively higher

percentage of expenditure by other Caribbean countries is largely for the provision of basic

infrastructure into the education sector.

Trinidad and Tobago has a universal policy on primary and secondary education for all its citizens. Under this policy, citizens of Trinidad and Tobago have 100% access to both primary and secondary education. Trinidad and Tobago also has a free-tuition policy for university education as higher education institutions receive reimbursement from the Government of the Republic of Trinidad and Tobago (GORTT) under an entitlement program, Graduate Assistance for Tertiary Expenses (GATE).

Legal Framework

The legal framework for the education system in Trinidad and Tobago follows the law enacted by the Education Act of 1966 with subsequent amendments. The legislation is wide ranging encompassing responsibilities between denominational schools and state schools. The Act also provides legislative guidelines for registration and operation of private schools including the terms and conditions of service of teachers (United Nations Education, Scientific, and Cultural Organization, 2010). The Parliament Act No. of 2004 established the Accreditation Council of Trinidad and Tobago (ACTT). This Act provided the framework for higher education institutions in Trinidad and Tobago with the mandated requirements, criteria, and standards for the establishment of higher education institutions.

The University of Trinidad and Tobago (UTT) and the University of the West Indies (UWI) are the two major higher education institutions in Trinidad and Tobago. UTT is the indigenous university with emphasis on national priorities and alignment to national goals while UWI is the regional university of the Caribbean with a wider focus on Caribbean economies. The enrollment at UWI, St Augustine, Trinidad, is 15,890 students while UTT is 6,000 students (The University of the West Indies, 2009).

45

Some collaboration exists between UWI, UTT, and industry. UTT has several programs with major oil and gas companies in Trinidad and Tobago. These companies include British Petroleum (BP), Petroleum Company of Trinidad and Tobago (Petrotrin), Atlantic LNG, and Power Generation Company of Trinidad and Tobago (Powergen). The extent of these collaborations is through the provision of professional development programs to bridge the competency gaps that exist in the respective companies. UWI has a similar program of professional development albeit to a lesser extent than UTT. However, UWI has an elaborate Geosciences program in collaboration with industry that is a collaborative initiative between the Geological Society of Trinidad and Tobago (GSTT), several industrial operators in Trinidad and Tobago, and UWI (Dawe, Wilson, & Rajpaulsingh, 2007). The program design provides a cadre of competent nationals to serve in the energy sector of Trinidad and Tobago. Other collaborative relationships between UTT, UWI, and industry include sponsorship of a Chair in Petroleum Engineering at UWI and a Chair in Process and Utilities Engineering at UTT.

Summary

This chapter provided the theoretical background to the origin, structure, organization, and management of university-industry collaborations. Chapter 2 provided the literature review of published works on the subject of industry –academia collaborations. The historical evolution of these collaborations was cited in the three academic revolutions (Etzkowitz & Goktepe-Hulten, 2010) followed by the emergence of the entrepreneurial university (Osiri, McCarty, & Jessup, 2013). The forces identified that drive contemporary collaborative relationships are globalization and inter connectivity (Qureshi, Shaukat, &

Hijazi, 2010). Cost, culture, efficiency, and competition are key drivers for collaboration (Bratianu & Stanciu, 2010).

The legal framework adopted in United States (Bayh-Dole Act of 1980) was a measure cited to increase patent registrations to universities under federal funding, followed by highlights of the higher education legislation in Trinidad and Tobago (Valdivia, 2011). Chapter 2 concluded with a description of the success factors in industry-academia collaborations. Chapter 3 will provide the methodological approach to this quantitative descriptive study.

Chapter 3

Method

The purpose of this quantitative ex post facto study was to examine perceptions of industry professionals in Trinidad and Tobago and academic leaders at the two major universities in Trinidad and Tobago, the University of Trinidad and Tobago (UTT) and the University of the West Indies (UWI) with permission (see Appendix A). The definition of the leadership initiatives were from a higher education perspective and focused on three areas, perceptions of (a) potential benefits of industry – academia collaborations (b) barriers to industry-academia relationships and (c) key factors conducive to future strengthening of industry-academia collaborations. The following sections highlight the appropriateness of the research method and design, the population and sample frame used in this study, the data collection procedures, data analysis techniques, and measures used to increased internal and external validity.

Design Methodology

A quantitative ex post facto design was the method and design used in this study. The dependent variable was perceptions and the independent variables were industry and academia personnel. A G*Power post hoc power analysis confirmed a statistical power of 0.99 for a two-group independent samples t-test. The basis of the power analysis was on a two-tailed test, effect size of 0.08, alpha value of 0.05, and group sample sizes of 66 and 67. Given the power analysis $(1 - \beta)$, this ex post facto design resulted in a relatively small beta value and indicate reduced effect of Type II errors.

This study included surveys of perceptions from individuals in business and industry on industry-academia collaborative activities. The benefits derived from this study may

provide wider applications to the developing world when developing countries desire to formulate policies on higher education for sustainable development. The results of this study may also provide baseline data for future comparative studies in industry-academia collaborations. The next section highlights the rationale and for the appropriateness of the research design

Appropriateness of Design

The ex post facto design used in this study was a non-experimental research technique in which preexisting groups (industry and academia) were compared on a dependent variable (perceptions). The assignment of participants to the levels of the independent variable included the situations that occurred in the past. These situations consisted of participants' job title, number of years in industry and academia, leadership and responsibility in participants' respective organizations. In this design, a comparison of two groups of individuals occurred and their perceptions analyzed to determine if significant differences existed.

This design is appropriate to the study because of the specificity of the stated problem in set terms, the minimizing of subjectivity in judgment, and the relatively large number of participants required in data collection. Therefore, this quantitative design approach was preferred over a qualitative design. The researcher is also mindful of the need to incorporate culture, context, and communication issues into the design methodology. Many of these issues were part of the information covered in the literature review.

The estimated population was 201 individuals and the sample size of 133, the details of the population and sample are provided later in this chapter. The survey approach using this sample size allowed for greater quantitative analysis of the relevant issues in industry-

academia collaborations. Literature was available about the subject of industry-academia collaborations in the developed world; however, very little research documentation existed regarding industry-academia collaborations in developing countries. At the time of this research, no scientific research was available about industry-academia collaborations in Trinidad and Tobago. In this regard, this quantitative study will not only provide specific benefits to higher education policy makers in Trinidad and Tobago but also to other developing countries and in particular small nation states.

The advantage of this methodology provided a better approach to measuring individual perceptions from a large number of individuals (n>30) through the survey method while allowing for subject-matter opinions through a small number of open-ended questions. In the Trinidad and Tobago context, the number of Subject-Matter Experts (SMEs) in oil and gas, manufacturing, maritime, ICT, process, and utilities is quite extensive. Given this number of SMEs in these sectors, a quantitative survey method was best suited for data collection and analysis.

The methodological approach helped to achieve the study goals through data capture from a wider cross section within the population sample. The quantitative design also contributed to the achievement of the study goals through the capture and analysis of data from subject matter experts in the five selected sectors within the study. The findings from this study might provide wider applications to the developing world as developing countries aspire to formulate policies on higher education for sustainable development. The next section highlights the population, sampling, and data collection methods for this study.

Population

The population under investigation included individuals from business and industry sectors aligned to the centers of learning at the University of Trinidad and Tobago and the University of the West Indies. The population included participants from the following industries in Trinidad and Tobago: (a) energy (b) maritime (c) manufacturing (d) information and communications technology (e) process and utilities, and (f) academia. This industry selection represented the organizations and companies operating in Trinidad and Tobago.

In Trinidad and Tobago, the number of industrial plants operating in these sectors include, one natural gas liquids processing facility, four liquefied natural gas trains, ten ammonia plants, seven methanol plants, four power generation plants, and one petroleum refinery (Furlonge & Kaiser, 2010). The estimated number of individuals from these plants inclusive of senior academic personnel was 1,827. The demographic breakdown of these individuals included 201 (11%) management and professional. Technical, administrative, and support staff made up 1,626 or 89% of personnel. Because this study focused on leadership and policy issues in industry-academia collaborations, the population for this study included the management and professional (201) personnel only. The next section describes the nature and composition of the sample from this population.

Sampling Frame

The sampling frame included a representative sample from business and academia. An approximate sample size of 133 was estimated using a sample size calculator (Dawson & Lavori, 2010), (n>30), or 66% of the population made up of 66 individuals from academia and 67 from industry. The population of 201 individuals included two groups divided into 101 participants from industry and 100 participants from academia. The RAND formula in

Microsoft Excel was helpful for generating a simple random sample from each sub-group. The simple random sample represented individuals from industry and academia and included personnel from leadership and policy formulation, management, operations, and senior supervisory staff. The educational background of each participant included the minimum qualification of a bachelor's degree and involvement in research, teaching, or industrial practice. Age, gender, and ethnicity did not influence the sample.

A survey method included using a web-administered survey instrument. Participants indicated their perceptions regarding the following:

1. The importance of collaborations between universities and industries;

2. The current collaborative activities between universities and industries; and

3. The factors contributing to the future success of industry/university collaborations.

Participants indicated their perceptions on the survey instrument to several questions under the three broad headings listed above. The questions included several statements and used a response format at the interval measurement level. Participants indicated their response on an interval scale on issues of importance of university - industry collaborations, current collaborative activities, and future success factors in industry - university collaborations.

The basis for the data collected was on individual perceptions and the collection of proprietary information did not occur. The data collection procedure involved the administration of a survey instrument to participants via www.surveymonkey.com and participants completed the survey. There were no items in the survey instrument, and in the entire study, in which the participants encountered the possibility of stress, psychological,

social, physical, or legal risks. The research method did not use any visual or auditory

stimuli, chemical substances or other measures that may have created a risk to participants.

Other data collection methods replicated subject matter experts using a convenience

and judgment sampling technique. The selection criteria for these individuals included

significant contribution to business, industry, and academia. Individuals included the

Permanent Secretaries in Government ministries, President, and Chief Executive Officers of

major organizations in the sectors identified in this study. Published authors on policy issues

in industry and academia also formed part of the survey.

Informed Consent

Several areas of this study required the use of literature and other material whose

intellectual property rights did not belong to this researcher. The first of these was the use of

several works cited in chapter two that formed part of the theoretical framework for this

study. With respect to instrumentation, this researcher developed a survey instrument

administered to both academic and industry personnel. The highlights and details of

instrument validation are part of the findings presented later in this chapter.

All participants received information regarding the procedures involved in their

participation through an Informed Consent form (see Appendix B), sent prior to the

administration of the survey. This procedure allowed any prospective participant the option

to withdraw before participating in the survey. For participants who consented to the survey,

a cover letter (see Appendix C) was available for review at the beginning of the survey

instrument. The procedure reminded the participants of the intent of the study, the benefits of

the study, the selection process, and the assurance of no potential risks to participants. This

measure allowed participants to withdraw their participation during the survey even if they

provided prior consent. The action for withdrawal by the participants during the survey was simply to press delete on the web-enabled survey. For participants who wished to withdraw from the study after the data collected process ended, the participant would contact this researcher. Thereafter, the researcher would expunge the information from the data set.

The cover letter accompanying the survey clearly stated that participation in this survey was voluntary and that the participant was free at any time before or during the survey to withdraw from participation. In the process of withdrawing, the participant can close or exit the survey at any time without submission. Participants were given a telephone and e-mail contact with the Informed Consent form prior to the survey and again with the cover letter that accompanied the survey instrument. This measure was to ensure that all participants had access to the researcher to address any potential concerns related to the survey.

Geographic Location

Individuals consenting to participate in this study were limited to a specified geographical area within the borders of Trinidad and Tobago. The geographic location of this study was limited to nationals and non-nationals of Trinidad and Tobago residing in the country. The industries in Trinidad and Tobago listed in the five business areas of this study formed part of the sample frame. These organizations include one natural gas liquids processing facility, four liquefied natural gas trains, ten ammonia plants, seven methanol plants, four power generation plants, and one petroleum refinery (Furlonge & Kaiser, 2010). These organizations included the sectors of energy, maritime, ICT, manufacturing, process, and utilities. This frame also includes senior academics from the two universities in Trinidad and Tobago.

Confidentiality

Prospective participants in the survey received assurance of confidentiality throughout the study. A simple random sampling technique was useful for helping to identify prospective participants from industry and academic institutions. The purpose of this random sampling technique was for the tracking, submission, and recording of the information. The generation of random numbers required using the RAND formula in Microsoft Excel. Once generated, using the F9 function locked the process, to prevent any random number changes when opening the spreadsheet to add or revise the data.

The researcher made provisions for storage of information on a computer hard drive located at UTT Chaguanas Campus, Lot No. 1, Monroe Road, Charlieville, Trinidad and Tobago. Hard copies of notes relevant to the research are in a locked cabinet at the researcher's office. The researcher's office is a single occupant office with electronic locks and central surveillance capabilities.

The researcher will keep the data for a period of 3 years. At the end of this period, the researcher will delete all electronic records from the researcher's computer. Hard copy notes related to the research will be shredded and discarded for recycling.

Pilot Test

Prior to the survey, the pilot testing of the survey instrument commenced using 12 graduate students from the Arthur Lok Jack Graduate School of Business (ALJGSB) of the University of the West Indies. The ALJGSB is the premiere graduate management school in Trinidad and Tobago and its graduates occupy senior positions in industry and academia. The 12 graduate students selected for the pilot test were from both industry and academia. Those

from industry include representation from manufacturing, maritime, energy, information, and communications, process, and utilities.

The administering of the pilot test involved 12 participants completing the questionnaire without interruption or request for clarification and an interview commenced following the completion of the survey. In the first instance, the pilot test examined general issues in instrument design such as question flow, usefulness of instruction, and readability. Second, feedback from the interview provided guidelines to question content, question form, clutter, the creation of appropriate frames of reference, and questionnaire length. Responses from the pilot test informed this researcher on issues of clarity, reduction of ambiguity, readability, formatting, neutrality, relevance, scaling options, and mode of administration. All participants in the pilot test were required to sign the informed consent form (see Appendix B).

Data Collection

The data capture for this study was through a survey instrument (see Appendix D). The administration of the survey instrument was through a web-enabled third party. The third party was the Survey Monkey online website. Participants were required to complete the web-based questionnaire and return it to www.surveymonkey.com. This researcher retrieved the data from Survey Monkey for data analysis.

Part One of the survey instrument captured demographic information about the collaborative relations between industry and universities, the importance of collaborative relations between the stakeholders. The data capture items included the university and industry profiles, goals that may require industry input and vice versa and potential benefits

derived between universities and industry. Responses to these items allowed this researcher to answer Research Questions 1 and 2.

Part Two of the survey instrument captured data regarding current collaborative practices between universities and industry and included items of information sources between industry and academia. In addition, this section of the survey instrument captured responses to the university's current engagements with industry, the strategies to support collaborative practices, and barriers to collaborative relationships. These questionnaire items included the policy issues in formulating the relationships by both industry and academia. Responses from this section allowed the researcher to answer Research Question 3 in this study.

Part Three of the survey instrument included data capture items focused on the future of collaborative relations between industry and academia. The data items included a series of questions focused on strengthening the collaborative relations between industry and academia. This section of the instrument also included items on the critical factors to success, the relationships, and the role of government in enabling such relationships in developing countries. Responses from this section of the survey allow the researcher to answer Research Question 4 in this study.

Instrumentation

The researcher used one survey instrument in this study. The development of this instrument was based on similar studies conducted in Finland, Taiwan, Africa (Bahgat, 2012), and Singapore. These selected countries share some commonalities with Trinidad and Tobago. Finland, Taiwan, and Singapore also have similarities in economic development, country, and population size. The selection of Africa, and in particular Mongolia, Ghana,

(Tahiru, 2014) and Angola were because of the developing country status and similarity to Trinidad and Tobago in terms of its oil and gas resources.

Validity and Reliability

The measurements in this study have validity if they measure what they are supposed to measure (Vogt, 2007). Clear definitions of the study goals and objectives inclusive of operationalized definitions enhanced the face validity. Pilot testing of the instrument enhanced content validity by having independent experts rate the instrument separately. Only items that rated as strongly relevant were included in the final instrument (Christensen, Johnson, & Turner, 2014).

The internal consistency of the instrument scored high on the reliability tests. The Cronbach's alpha was 0.94. Moskal and Leydens (2000) contended that Cronbach's alpha values greater than 0.7 are acceptable measures on internal consistency of an instrument.

Data Analysis

The analysis of the data captured from the survey instrument included using Statistical Package for Social Sciences (SPSS) software. This analysis included descriptive and inferential statistics. The results of the survey inform the recommendation and conclusions of the study.

The unit of analysis was individuals from industry and academia. While different areas of industry and academia weigh differently on sustainable issues the perceptions of individuals that constitute the primary analytical units to inform sustainability measures in higher education in Trinidad and Tobago. These individuals were those participants to the survey.

Descriptive statistics were helpful for determining the answer to Research Question 1. Responses from academia to survey questions 3, 4, and 5 were analyzed using means and standard deviation. To answer Research Question 2, responses from industry to survey questions 3, 4, and 5 were analyzed using means and standard deviation. Similarly for Research Question 3, responses from survey questions 7, 8, 9, 10, and 11 were analyzed using means and standard deviation.

An independent samples *t*-test was useful for determining the answer to Research Question 4. The independent *t*-test is one type of inferential statistics used to determine whether there is a significant difference between the means of two groups (Christensen & Turner, 2014). Responses from survey questions 3 through 13 were analyzed using independent samples *t*-test. There was one outcome variable (perception) and one predictor variable per group in this study. The predictor variable had two groups (industry and academia). The groups were independent and different for each group. Furthermore, the data met the assumptions for parametric tests. The Shapiro-Wilks test determined normality in distribution, and the Levene's test established homogeneity of variance. If $\alpha > 0.05$, the Levene's test met the assumption of homogeneity (Vogt, 2007) and equal variances.

Summary

This chapter outlined the methodology of this study and focused on the roadmap used to administer the study and analyze the data. The information revealed included the design of the study, the appropriateness of the design, the population, and sample frames and the measures to increase reliability and validity of the study. The quantitative survey option was the most appropriate for this study because of the large number of participants, the specificity of the research questions and mode of analysis. This analysis of the data included the use of

descriptive statistics and data reduction techniques to describe the relevant issues in industry-academia collaborations. The next section in Chapter 4 highlights the results of the survey. A thorough analysis follows these results.

Chapter 4

Results

The previous chapters highlighted the critical elements of this study. These included the background to the study, the relevant literature, and the methodology used in this study. The purpose of this chapter is to present the results of the data collected from the survey. The collection of the data necessitated conducting a quantitative survey. The results presented in this chapter include illustrations supported by tables, figures, and charts. The purpose of this quantitative descriptive research study was to examine perceptions of senior personnel from industry and academia with respect to industry-academia collaborations. The independent variables were senior academic officials and industry leaders. The academic officials are representatives from the University of Trinidad and Tobago (UTT) and the University of the West Indies (UWI). These two universities represented the two major academic institutions in Trinidad and Tobago. The sample selected were industry officials from the Chamber of Commerce of Trinidad and Tobago, the major industrial organizations operating in the country, and senior officials of the ministries of Trade and Energy. The dependent variables were the perceptions received through the survey instrument from senior industry and academic personnel.

Presentation of Data

This chapter begins with an overview of the data collection process and the results of the data analysis. The research questions are as follows:

1. How do senior administrators in academics perceive industry-academia collaborations in Trinidad and Tobago with respect to potential mutual benefits, its current collaborative status, and potential for future strengthening?

2. How do senior administrators in industry perceive industry-academia collaborations in Trinidad and Tobago with respect to potential mutual benefits, its current collaborative status, and potential for future strengthening?

3. What are the issues of current collaborative practices in Trinidad and Tobago as perceived by university and industry senior administrators?

4. To what extent is there agreement/disagreement between perceptions toward industry-academia collaborations between senior industry personnel and academics?

The survey findings presented for Research Questions 1, 2, and 3 entailed using descriptive statistics (frequency, mean, standard deviation). For Research Question 4 a *t*-test analysis compared the means of the perceptions between industry and academia. To answer Research Question 4, survey questions 3 through 13 were analyzed using *t*-tests to determine if significant differences existed between the means from the two groups. The software, Statistical Package for Social Sciences (SPSS) was useful for analyzing the data. This chapter also reveals the information regarding the population description, geographical location issues, and observations related to participants' responses. A section of the chapter presents the results from the survey and statistical interpretation of the descriptive and inferential statistics used in the data analysis. The chapter concludes with a presentation of the key findings and relationships identified during the research study and data analysis.

Data Collection

The data collection process used included prior approval process of each participant through a signed informed consent letter (see Appendix B) issued to all participants prior to the survey instrument. Upon receipt of consent to participate each participant was administered the web-enabled survey instrument. The instrument used in this study was

developed and pilot- tested to ensure reliability and validity. Feedback from the instrument

pilot test resulted in the elimination of several items that were redundant. The feedback from

the pilot test also resulted in a shorter duration time for completion by participants. The

administration of the survey required using Survey Monkey. Survey Monkey is a third party

service specially designed to conduct surveys via the Internet. Only individuals who accepted

and signed the informed consent form obtained access to the survey instrument and

participated in this study. The Survey Monkey application generated a unique URL location

for participants to access the instrument. This researcher provided the URL via e-mail to

individuals who signed the informed consent form.

The data collection process began following the receipt of signed informed consent

forms. Two hundred and one individuals returned signed informed consent forms made up of

101 individuals from industry and 100 from academia. The generation of random numbers

for the two subgroups used the RAND formula in Microsoft Excel. Each participant received

an e-mail containing the URL location to access the survey instrument. For industry

participants, 67 individuals received the e-mailed survey instrument using the simple random

selection. These participants needed to complete the survey during the period October 01,

2013 to December 31, 2013. The period of data collected commenced after formal approval

of this dissertation proposal. The researcher dropped individuals who did not respond to the

survey during the specified period and added new industry individuals from the population

list to achieve a sample size of 67.

A similar process commenced to collect data from the 66 individuals from academia.

The total sample size was 133 persons. The data collection ended on January 30, 2014. This

researcher retrieved the data from Survey Monkey for analysis.

Population and Sample

In Trinidad and Tobago, the number of physical plants operating in the sectors selected for this study included, one natural gas liquids processing facility, four liquefied natural gas trains, ten ammonia plants, seven methanol plants, four power generation plants, and one petroleum refinery (Furlonge & Kaiser, 2010). The number of individuals from these plants inclusive of senior academic personnel from the two universities was 1827. The demographic breakdowns of these individuals included 201 (11%) management and professional. Technical, administrative, and support staff make up 1626 or 89% of personnel. Because the basis of focus for many of the issues in this study were on policy formulation, leadership, and higher applied research, the population for this study included the management and professional (201) personnel only. The next section describes the nature and composition of the sample from this population.

The methodology used to draw the sample was a simple random sample method and taken from a population of 201 individuals. The use of a sample calculator (Dawson & Lavori, 2010) determined the sample size. Based on the desired 95% confidence level and a confidence interval of 0.05 the desired sample size was 133. An approximate sample size of 133 (n >30), made up of 66 individuals from academia and 67 from industry were surveyed. The population of 201 individuals was subdivided into two groups of 101 and100 representing those from industry (101) and academia (100). Using the RAND formula in Microsoft Excel the researcher selected a simple random sample for each sub-group. The sample represented those within industry and academia and included personnel from leadership and policy formulation, management, operations, and senior supervisory staff. The educational background of each participant included a minimum of a bachelor's degree and

involved in either, research, teaching, or industrial practice. Age, gender, and ethnicity did not influence the sample.

One hundred thirty-three participants took part in this survey. All participants were either industry (67, 50.4%), or academic (66, 49.6%). Table 3 shows the frequencies and percentages for the sample including industry sample breakdown.

Table 3

Sample Composition and Affiliated Industries

	N	%
<u>Industries</u>		
Maritime	12	9.0%
Process and Utilities	14	10.0%
Manufacturing	15	11.3%
Energy	13	9.8%
ICT	13	9.8%
<u>Academic</u>		
	66	49.6%
Total (all participants)	133	100%

Note: Participants chose one response

The process of data collection began after formal approval of this dissertation proposal. The total number of participants for this survey was 133 individuals.

Data Analysis

Statistical Package for Social Sciences (SPSS) version 14.0 for Windows was useful for analyzing the data. The use of descriptive statistics provided details of sample characteristics. Frequencies and percentages represent categorical or nominal data. For interval/ratio data, means and standard deviations were calculated (Howell, 2010).

Participants who consented to participate in the survey indicated their perception to 13 questions in the survey. The measurement level used for each question (including sub questions) was at the interval level. A response option of "1", indicated the lowest level perception for usage, importance, agreement, or satisfaction and a response option "5" indicated the highest in the respective characteristics. Table 4 shows the classification of mean values.

Table 4

Classification of Mean Values

Range of M	Rating
1.00 – 1.79	Very Low
1.80 – 2.59	Low
2.60 – 3.39	Moderate
3.40 – 4.19	High
4.20 – 5.00	Very High

Research Question 1 was: How do senior administrators in academic public universities in Trinidad and Tobago perceive collaborative relations with industry with regard to the following?

1. The achievement of university goals through collaborative activities.

2. The potential benefits to universities.

3. The potential benefits to industry.

To examine Research Question 1, descriptive statistics using means and standard deviation are used. For this analysis, responses from academia to survey question 3 (requirements for collaborative goals), survey question 4 (benefits to universities), and survey question 5 (benefits to industry) were analyzed using means and standard deviations.

Research Question 2 was: How do senior administrators in industry perceive collaborative relations with universities with regard to the following?

1. The achievement of university goals through collaborative activities.

2. The potential benefits to universities.

3. The potential benefits to industry.

Descriptive statistics using means and standard deviations were useful for examining Research Question 2. For this analysis, responses from industry to survey question 3 (requirements for collaborative goals), survey question 4 (benefits to universities), and survey question 5 (benefits to industry) were analyze using means and standard deviations.

Research Question 3 was: What are the issues in current collaborative practices in Trinidad and Tobago as perceived by university and industry senior administrators?

Descriptive statistics using frequencies, means, and standard deviations was useful for examining Research Question 3. The researcher divided survey questions 7, 9, 10 and 11 into sub-issues for detailed analysis. Items from survey question seven are grouped into three dimensions these included government issues, planning issues, and commitment issues. National priorities, learning and development, and governance issues formed three dimensions using items for survey question nine. Similarly, the dimensions formed for survey question 10 were governance, national priorities, and learning and development. For survey question 11, the dimensions were communications, leadership, and management and culture. Figure 1 outlined the details of each question, the key issue, and the dimensions.
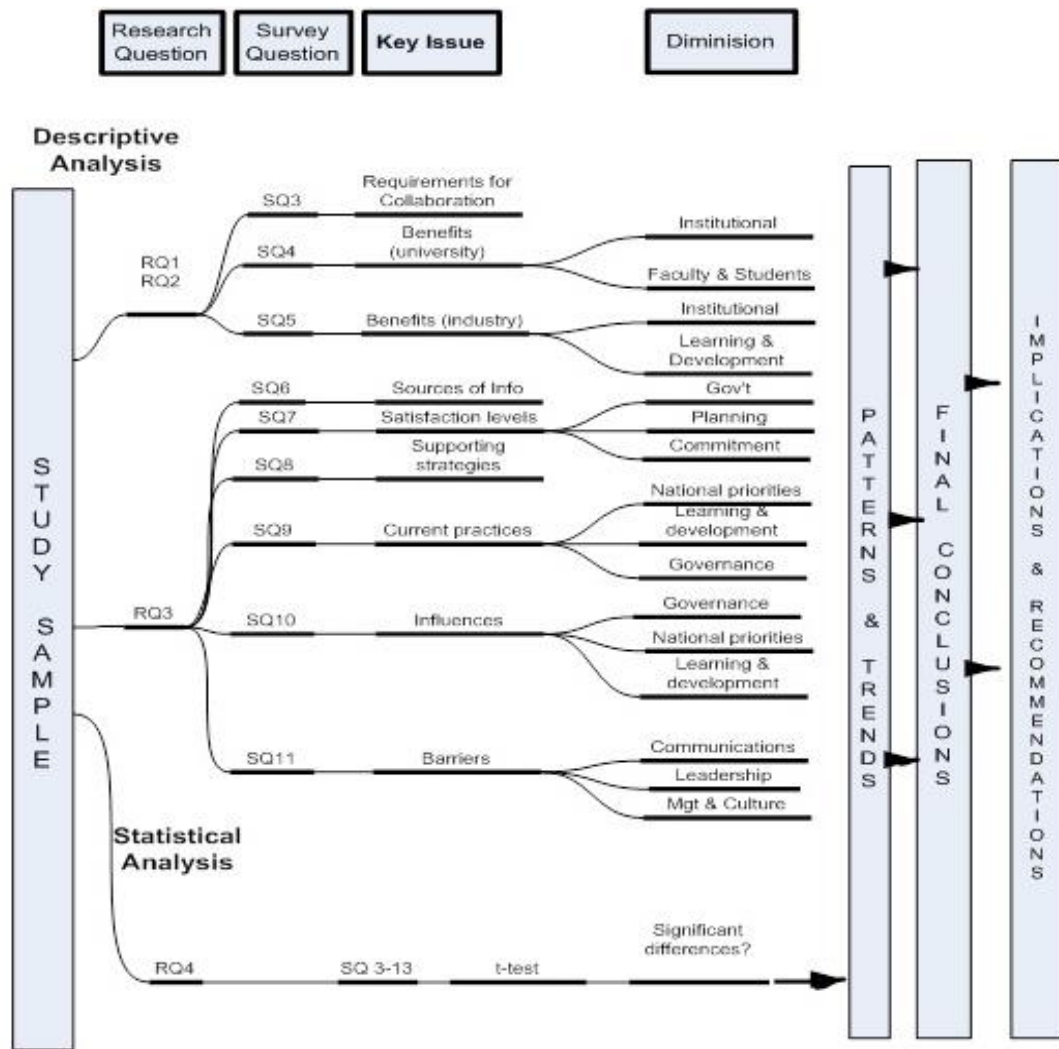
Figure 1. Data Analysis Process

This section presents the results related to Research Question 4. To what extent is there agreement between industry and academia leaders in their perceptions of collaborative relations with each other? The hypothesis for Research Question 4 was:

H₀: There are no significant differences in perceptions between industry and

academia personnel toward industry-academia collaborations.

Hₐ: There are significant differences in perceptions between industry and academia

personnel toward industry-academia collaborations.

To examine Research Question 4, survey questions 1 through 13 were analyzed using *t*-tests.

Analysis Justification

The following section justifies the use of the *t*-test in this analysis. The comparison and analysis of means can be measured using *t*-test, *z*-test, and ANOVA statistical techniques. The preferences of the t-test were as follows:

1. The *t*-test is a statistical measure for comparison between two independent samples;

2. This study compared two independent groups and hence the use of ANOVA was not appropriate as the preferred statistical measure. The ANOVA technique involved comparing the means of three or more groups. Furthermore, only differences between the two groups were analyzed as differences within groups were outside the scope of this study;

3. The population standard deviation was not known and this provided additional justification for use of the *t*-test over the *z*-test; and

4. The sample size in this study was greater than 30 and the *t*-test is typically identical at N > 30. Several studies (Douglass, 2011; Rodriquez, 2011.) used the *t*-test for samples greater than 30.

Given an alpha set at 0.05, significant finding is rendered when a calculated *t*-value is larger than the critical *t*-value after considering degrees of freedom (*df*) for independent samples (*N* - 2) the null (H_0) will be rejected, hence the acceptance of alternative hypothesis (H_a). The *t*-test is a suitable statistical analysis when the extent of a research question is to assess if significant differences exist between the means of two groups. The *t*-test was two tailed, with alpha levels, or the probability of rejecting the null hypothesis when true, set at *p* < 0.05 and will ensure a 95% confidence that differences did not occur by lone chance. Given an alpha set at 0.05, significant finding revealed when a calculated *t*-value is larger than the

critical *t*-value after taking into account degrees of freedom (*df*) for one sample (*N* - 1).

Figure 1 outlines the data analysis process linking the research questions to the survey

questions and outlines the key issue and dimensions analyzed in the survey.

Independent Sample *t*-test

The independent sample *t*-test was the appropriate statistical analysis, as the scope of

the research question was to assess if differences exist on a continuous dependent variable by

a dichotomous grouping independent variable (Christensen, Johnson, & Turner, 2014). The *t*-

test is two tailed, with alpha levels, or the probability of rejecting the null hypothesis when

true, set at $p < 0.05$ and ensures a 95% confidence that differences does not occur by lone

chance.

To answer Research Question 4 the researcher analyzed responses from survey

questions 3 through 13 using independent samples *t*-test. There was one outcome variable

(perception) and one predictor variable per group in this study. The predictor variable had

two groups (industry and academia). The groups were independent and different for each

group. Furthermore, the data met the assumptions for parametric tests. The Shapiro-Wilks

test determined normality in distribution, and the Levene's test established homogeneity of

variance. If $\alpha > 0.05$ the assumption homogeneity and equal variance was met (Vogt, 2007).

The *t*-test analysis identified whether the responses to the sub-questions are different between

the groups and overall differences. Intra group differences were not the subject of this study.

Research Question 1

RQ 1: How do senior administrators and academics perceive industry-academia

collaborations in Trinidad and Tobago with respect to requirements for achieving

institutional goals and potential mutual benefits to their respective organizations?

Descriptive statistics (frequencies, means, and standard deviations) were useful in the analysis to examine Research Question 1. Institutional, faculty and student matters formed the basis for the grouping responses to survey question 4. Similarly, the groupings for survey question 5 were institutional matters, learning and development matters. The division was helpful for examining perceptions related to the dimensions of the key issues. Appendix E highlighted the frequencies and percentages for survey questions 3, 4, and 5 related to Research Question 1.

Of the six items for question 3, the item with the highest mean was "employment opportunities for students." University personnel felt employment opportunities for students through collaborative efforts are very important in achieving university goals. The item with the lowest mean was "additional income for the university." Table 5 highlighted means and standard deviations for question 3 items for academic participants.

Table 5

Means and Standard Deviations for Question 3 Items for Academic Participants

Q3: Indicate the level of importance for each of the goals that may require collaborative effort between industry and academia	*M*	*SD*
Employment opportunities for students	4.61	0.61
Relevance of instructional programs to industrial need	4.51	0.56
Enhancement of applied research (technology development)	4.46	0.56
Increased access to state of the art facilities	4.37	0.67
Enhancement of basic research (knowledge production)	4.32	0.69
Additional income for the university	4.03	0.81

Survey question 4 included nine items related to the possibility of potential benefits to universities. Appendix E provides details of the frequencies and percentages for survey questions 3, 4, and 5. Based on means and standard deviations for the nine items for survey

71

question 4 (possibility for potential benefits), responses for one out of the nine items (improved institutional entrepreneurial skills; ($\bar{x}$ =4.15) indicated a high possibility for potential benefits for universities.

Table 6

Means and Standard Deviations for Question 4 Items for Academic Participants

Q4: Indicate the possibility for potential benefits to universities if they (universities) collaborate with industries in Trinidad and Tobago	M	SD
Institutional		
Assists in fulfilling the institutional mission	4.26	0.73
Improved institutional reputation	4.24	0.84
Improved institutional entrepreneurial skills	4.15	0.78
Faculty and Students		
Increase faculty awareness of industry needs	4.68	0.47
Practical hands on experience for students	4.66	0.57
Improved employment prospects for students	4.55	0.61
Improved instructional programs	4.44	0.64
Source of part-time faculty from industry	4.14	0.65
Consulting opportunities for faculty	4.06	0.93

All other eight items suggested a very high ($\bar{x}$ >4.20) possibility for potential benefits. Academic participants felt there was a very high ($\bar{x}$ = 4.68) possibility for universities to benefit from increase faculty awareness of industry needs and this can be enhanced through collaborative relations with industry. From an institutional perspective, academic participants felt there was a very high ($\bar{x}$=4.26) possibility that collaborations with industry will assists in fulfilling their institutional mission. Table 6 highlighted the means and standard deviations for question 4 items for academic participants.

Survey question five included 10 items related to potential benefits to industry. There were two dimensions for survey question five. Appendix E provides details of frequencies and percentages for survey question five.

As shown in Table 7, of the ten items for survey question 5, responses from academics to four items indicate high possibility ($3.40 < \bar{x} < 4.20$) for benefits to industry while responses from six items suggest very high ($\bar{x} > 4.20$) potential for benefits to industry. For institutional matters, academics felt there was a very high ($\bar{x} = 4.53$) possibility for industry benefits through access to professional expertise from universities.

Table 7

Means and Standard Deviations for Question 5 for Academic Participants

Q5: Indicate the possibility for potential benefits to industries if they (industries) collaborate with universities in Trinidad and Tobago	M	SD
Institutional		
Access to professional expertise	4.53	0.59
Enhanced reputation	4.23	0.78
Access to specialized facilities	4.21	0.81
Gain and / or sustain competitive advantage	4.15	0.75
Solution to technical problems	4.14	0.7
Reduced time between innovation and commercialization	3.94	0.86
Learning and Development		
Access to broader recruitment pool	4.52	0.59
Customized education / training programs	4.44	0.56
Improved opportunity for in-service training	4.35	0.57
Reduced in-service training costs per employee	3.85	0.85

For matters related to learning and development academics felt that industry has a very high ($\bar{x} = 4.52$) possibility of potential benefits through access to a broader recruitment pool from

the university. Table 7 highlighted the means and standard deviations for question 5 items for academic participants.

Research Question 2

Research Question 2 is: How do senior administrators in industry perceive industry-academia collaborations in Trinidad and Tobago with respect to requirements for achieving institutional goals and potential mutual benefits to their respective organizations?

Descriptive statistics (frequencies, means, and standard deviations) were useful for the analysis of Research Question 2. Survey question 4 (potential benefits to universities) was divided into two dimensions institutional matters and faculty and student matters. Survey question 5 (potential benefits to industry) were grouped into two dimensions, institutional matters and learning and development matters. This division examined perceptions related to the dimensions of the key issues. Appendix F highlighted the frequencies and percentages for survey questions related to Research Question 2.

For each of the six items pertaining to survey question 3, most industry participants felt it was very important ($\bar{x}$=4.52) for students to have employment opportunities in industry. Perceptions from industry participants also indicated a very high ($\bar{x}$=4.52) level of importance to employment opportunities for students. These items are important to fulfilling industry goals through collaborative relations with universities. Table 8 highlighted the means and standard deviations for question 3 items for industry participants.

Table 8

Means and Standards Deviations for Question 3 Items for Industry Participants

Q3: Indicate the level of importance for each of the goals that may require collaborative effort between industry and academia	*M*	*SD*
Employment opportunities for students	4.52	0.59
Relevance of instructional programs to industrial need	4.44	0.59
Enhancement of applied research (technology development)	4.42	0.68
Enhancement of basic research (knowledge production)	4.27	0.71
Increased access to state of the art facilities	4.25	0.72
Additional income for the university	3.73	0.85

For industry responses to Research Question 2, there were two dimensions in the analysis of responses from survey question four. Survey question 4 included items related to potential benefits to universities and faculty and student matters. Appendix F provided the details of frequencies and percentages.

On matters related to faculty and students, industry opinions suggested there were very high ($\bar{x}$=4.66) possibility of potential benefit to universities through practical hands on experience for students. On institutional matters, industry participants felt that universities can benefit from improved institutional reputation ($\bar{x}$=4.42) and entrepreneurial skills ($\bar{x}$=4.28) from collaborations with industry. Table 9 highlighted the means and standard deviations for question four items for non-academic participants.

Table 9

Means and Standard Deviations for Question 4 Items for Industry Participants

Q4: Indicate the possibility for potential benefits to universities if they (universities) collaborate with industries in Trinidad and Tobago	M	S
Institutional		
Improved institutional reputation	4.42	0.79
Improved institutional entrepreneurial skills	4.28	0.69
Assists in fulfilling the institutional mission	4.24	0.68
Faculty and Students		
Practical hands on experience for students	4.66	0.48
Increase faculty awareness of industry needs	4.58	0.66
Improved employment prospects for students	4.39	0.72
Consulting opportunities for faculty	4.28	0.6
Improved instructional programs	4.19	0.84
Source of part-time faculty from industry	4.15	0.56

Survey question five included 10 items related to benefits to industries. To analyze survey question five, the 10 items in question five were grouped institutional issues (four items) and employee learning and development issues (six items). Appendix F highlighted the frequencies and percentages for survey question five.

Of the 10 items for question 5, Table 10 highlighted the mean for each of the ten items. Industry opinions suggested that there was a very high ($\bar{x}$=4.45) possibility for industry to benefit from access to a broader recruitment pool form universities. This can enhance the learning and development of employees and students. From an industrial organizational perspective the potential benefits to organization was very high ($\bar{x}$=4.36) through sustaining competitive advantage. Table 10 provided details of means and standard deviations for survey question five items for industry participants.

76

Table 10

Means and Standard Deviations for Question 5 for Industry Participants

Q5: Indicate the possibility for potential benefits to industries if they (industries) collaborate with universities in Trinidad and Tobago	M	SD
Institutional		
Gain and / or sustain competitive advantage	4.36	0.83
Access to professional expertise	4.33	0.66
Enhanced reputation	4.15	0.72
Access to specialized facilities	4.09	0.73
Reduced time between innovation and commercialization	4.09	0.83
Solution to technical problems	3.98	0.83
Learning and Development		
Access to broader recruitment pool	4.45	0.66
Improved opportunity for in-service training	4.37	0.57
Customized education / training programs	4.37	0.69
Reduced in-service training costs per employee	4.04	0.84

Research Question 3

Research Question 3 was: What are the issues in current collaborative practices in Trinidad and Tobago as perceived by university and industry senior administrators?

To examine Research Question 3, the researcher analyzed survey questions 6, 7, 8, 9, 10, and 11 using frequencies, means, and standard deviations. Research Question 3 addressed the current practices/issues in industry-academia collaborations. These practices reflected the frequency with which personnel consulted with relant information sources (survey question 6) and other forum to identify current issues. Other categories surveyed included levels of satisfaction (survey question 7), supporting strategies (survey question 8), current practices (survey question 9), levels of influence (survey question 10), and barriers to collaborative practices (survey question 11).

Survey question six had eight items related to the frequency with which individuals consulted with information sources about collaborative relations. Of the eight items for survey question six, both industry and academia responses indicated moderate ($\overline{x}$=2.92) consultations with professional publications ($\overline{x}$=2.92) for collaborative opportunities. The other two items with moderate consultations were collaborative opportunities through professional organization ($\overline{x}$=2.67) and government initiatives ($\overline{x}$=2.65). As shown in Table 11 below the other five items suggest there were low ($\overline{x}$<2.60) consultations on these items as a source of information on collaborative activities. Table 11 highlighted the means and standard deviations for question 6 items for all participants.

Table 11

Means and Standard Deviations for Question 6 for All Participants

Q6: How often do you consult the following sources of information about collaborative opportunities between industry and academia	M	SD
Professional publications	2.92	0.12
Joining professional organizations	2.67	1.12
Government initiatives	2.65	1.21
Individual faculty initiatives	2.33	0.99
Special services from universities	2.33	0.98
Meetings with university representatives	2.19	0.95
Joint technical committees	2.08	1.01
Representatives on university governing boards	1.88	0.9

For the 10 items pertaining to question seven, three dimensions which relate to government, planning, and commitment respectively. Appendix G provided details of frequencies and percentages for all participants to survey question seven.

Survey question seven included 10 items related to satisfaction levels in collaborative efforts (as shown in Table 12).

Table 12

Means and Standard Deviations for Question 7 for All Participants

Q7: What is your level of satisfaction between industry and academia for each of the following features	M	SD
Government		
Support of the Government in university – industry relations	2.86	1.05
Planning		
Role of professional associations in supporting collaborative programs	2.95	0.94
Role of individual faculty members in collaborative agreements and development	2.8	0.91
University's emphasis on supporting small business organizations	2.75	1.03
Specifications of planning of relationship activities with universities	2.58	0.94
Commitment		
Willingness of your company's leaders to collaborate with universities	3.11	1.12
University's focus in supporting your company's needs	2.82	1
Performance of university personnel responsible for facilitating collaborative programs with industry	2.73	0.9
Enforcement of procedures regulating collaborative activities	2.52	0.9

Of the ten items in survey question seven, Government support for collaborative activities was moderate ($\bar{x}$=2.86), satisfaction was moderate ($\bar{x}$=2.95) for the planning role professional associations played in collaborative development, and willingness by organizational leaders to commit to collaborative relations was also moderate ($\bar{x}$=3.11). As shown in Table 12, four out of the ten items suggested low ($\bar{x}$<2.59) levels of satisfaction on the respective collaborative activities. Table 12 highlighted the means and standard deviations for survey question seven items for all participants.

Survey question 8 captured data on the current issues related to supporting strategies for collaborative relations. The means and standard deviation of each of the eight items were calculated and presented in Table 13.

As shown in Table 13, participants had high ($\bar{x}$=3.60) support for involving senior administrators in the early stages of collaborative activities. High support ($\bar{x}$>3.40) for collaborative activities were recorded from strategies related to communication and mediation ($\bar{x}$=3.57), employment of project management techniques ($\bar{x}$=3.58), reported results ($\bar{x}$=3.47), and the designation of a partnership coordinator ($\bar{x}$=3.48).

Table 13

Means and Standard Deviations for Question 8 for All Participants

Q8: To what extent do each of the following strategies support collaborative practices between industry and university in Trinidad and Tobago	*M*	*SD*
Involving senior administrators from the initial stages of collaborative activities	3.60	0.99
Employment of project management techniques	3.58	1.05
Developing a network for reporting communication and mediation	3.57	1.01
Designating a partnership coordinator	3.48	1.15
Reporting the results widely	3.47	1.14

Survey question 9 captured data related to the current collaborative practices that exist in Trinidad and Tobago. Appendix G provided details pertaining to the three dimensions from survey question 9. These dimensions were national priorities, learning and development, and governance.

Table 14 provided details of the means and standard deviation for survey question 9. As a national priority the existence of recruitment of recent university graduates by industry was moderate ($\bar{x}$= 3.15), for learning and development the existence of cooperative education programs was low to moderate ($\bar{x}$=2.67), and for governance issues there was low ($\bar{x}$=2.40) levels of existence for financial grants to universities. As shown in Table 14, the existence of all other collaborative activities was low ($\bar{x}$<2.60) with the exception of training

programs for employees which was moderate ($\bar{x}$=2.96). Table 14 highlighted the means and

standard deviations for survey question nine.

Table 14

Means and Standard Deviations for Question 9 for All Participants

Q9: Indicate the extent to which the following types of collaborative activities between university and industry exist in Trinidad and Tobago	M	SD
National Priorities		
Recruitment of recent university graduates	3.15	1.15
Your company's employment of student interns	3.03	1.26
Joint participation in exhibitions and fairs	2.51	1.14
Contract research	2.3	1.04
Joint research and consortia	2.15	1.03
Learning and Development		
Cooperative education programs	2.67	1.19
Fellowships to university students	2.48	1.09
University employment of your specialists as adjuncts	2.44	1.08
Technological consulting arrangements	2.31	1
Equipment contributions to university	2.28	1.12
Joint revision and assessment of curriculum	2.25	1.05
Management consulting by university faculty	2.22	1
Joint publications	2.13	1.02

Table 14

Means and Standard Deviations for Question 9 for All Participants (cont.)

Q9: Indicate the extent to which the following types of collaborative activities between university and industry exist in Trinidad and Tobago	M	SD
Governance		
Training programs for your employees	2.96	1.11
Joint organized meetings, conferences and seminars	2.47	1.06
Financial grants to university	2.4	1.19
Joint committees	2.38	1
Regular mutual visits	2.25	1.11
Technology business incubators	2.11	0.99
Your company's representation on university governing boards	2.09	1.05
Technology parks	2.07	0.99
Jointly owned and operated ventures	2.06	0.98
Technology licensing offices	2.02	0.94
Establishing spinoff companies	1.09	0.93

Survey question 10 captured data on the degree of influence on collaborative practices. For the eight items in survey question 10, the degree of influence on university-industry practices were divided into three dimensions, governance, national priorities, and learning and development. Appendix G provided details of frequencies and percentages for all participants to question 10. Table 15 highlighted the means and standard deviations for question 10.

On governance issues, there was a high degree ($\overline{x}$=3.78) of influence related to government policies toward collaborative practices. On national priorities, the degree of influence was high ($\overline{x}$=3.76) for technology development and adaption in collaborative practices, and high influence ($\overline{x}$=3.82) on learning and development for staff development.

As shown in Table 15, all other influential factors on collaborative practices were high

($\bar{x}$>3.40).

Table 15

Means and Standard Deviations for Question 10 for All Participants

Q10: Indicate the degree of influence of each of the following factors on university-industry collaborative practices	M	SD
Governance		
Government policies or programs stimulating relations	3.78	0.9
Traditional interaction between university and industry	3.48	0.99
Reward system and incentives for university staff to collaborate	3.43	1.06
National priorities		
Company's need for technology development and / or adaptation	3.76	0.9
Entrepreneurial culture within university	3.68	1.04
Local entrepreneurial climate	3.51	1
Learning and Development		
Company's need for staff development	3.82	0.92
Teaching capacity of universities	3.81	0.89

Survey question 11 captured data related to barriers to collaborative practices. From the 19 items in survey question 11, there were three dimensions. These included barriers related to communication, leadership, and management and culture. Appendix G provided details of frequencies and percentages for all participants to question 11.

Table 16 provided details of means and standard deviations for all responses in question 11.

Table 16

Means and Standard Deviations for Question 11 for all Participants

Q11: To what extent does each of the following present a barrier to collaborative practices between industry and university	M	SD
Communications		
Lack of communication	4.29	0.76
Lack of clear understanding of the project	4.07	0.89
University unawareness of problems encountered in industry	3.84	0.99
Unavailability of information about university services	3.71	1.05
Leadership		
Lack of commitment	4.26	0.83
Lack of consistency in program management	4.05	0.83
Lack of leadership	4.02	0.95
Inefficient reward systems	3.67	0.9
Loss of university's control over academic work	3.55	1.04
Loss of Government funding	3.54	1.06
Management and Culture		
Bureaucratic procedures in the university	4.09	0.9
Differences between institutional, academic and industrial culture and values	4.05	0.85
Inefficient evaluation and monitoring mechanisms	3.91	0.88
Insufficient facilities	3.82	1
Overemphasis of universities on teaching	3.79	0.99
Insufficient equipment	3.78	1
Lack of qualified personnel to manage relationship activities	3.77	1.04
Nonexistence of intermediary bodies	3.71	0.87
Equipment depreciation	3.45	0.97

Lack of communication was a very high barrier ($\bar{x}$=4.29) to collaborative practices,

on leadership issues lack of commitment was very high ($\bar{x}$=4.26), and on management and

cultural issues bureaucratic procedures within the university was a very barrier ($\bar{x}$=4.09).

This section presents the results for Research Question 4. Research Question 4 was: To what extent is there agreement between industry and academia leaders in their perceptions of collaborative relations with each other?

Comparison of Perceptions

To examine Research Question 4, the statistical technique was independent t-test analysis. The researcher analyzed survey questions 3 through 13 using the t-test to determine if significant differences in perceptions existed between industry and academia personnel. For the analysis of each survey question the Levene's test for equality of variances was not significant, $p>0.05$, indicating the assumption of homogeneity of variances.

Importance and Benefits in Collaborative Relations

Table 17 represents the descriptive data (mean and standard deviation) in response to the importance of collaborative relations and benefits. Table 16 also presents the results of the t-test. As shown in Table 17, there were no significant differences in perceptions between the two groups with respect to the importance of collaborative goals to institutions' mission. The p-values ($p>0.05$) for instructional programs, enhancement of basic research, facilities, and applied research indicated no significant difference in perceptions from industry and academia. Both industry and academia personnel perceived the importance of collaborative goals to institutions' mission as very high. Individuals in academia placed a very high level of importance on additional income for university as opposed to high level of importance from industry individuals. There was a significant difference in perceptions for industry (3.37, 0.84) and academia (4.03, 0.80) toward additional income for universities: $t\,(130) = 2.077, p = 0.04$.

Table 17

Comparison of University and Industry Participants as to Importance of Collaborative Goals to Institutions' Mission

Q3: Collaborative Goals	Group	N	M	SD	T	df	p
Relevance of instructional programs to industrial need	Industry	66	4.44	0.585	0.681	129	0.497
	Academia	65	4.51	0.562			
Enhancement of basic research (knowledge production)	Industry	67	4.27	0.709	448	130	0.655
	Academia	65	4.32	0.687			
Increased access to state of the art facilities	Industry	67	4.25	0.725	947	130	0.345
	Academia	65	4.37	0.675			
Enhancement of applied research (technology development)	Industry	66	4.42	0.681	0.342	129	0.733
	Academia	65	4.46	0.561			
Employment opportunities for students	Industry	67	4.52	0.587	0.834	129	0.406
	Academia	64	4.61	0.607			
Additional income for the university	Industry	67	3.37	0.845	2.077	130	0.04
	Academia	65	4.03	0.809			

Table 18 represents the results of the comparison of university and industry responses regarding benefits to universities. As shown in Table 18, there were no significant differences ($p > 0.05$) between the perceptions of industry and academia with respect to benefits derived from universities. Benefits to the university from seven out of the nine items in Table 18 rated very high while two items (consulting opportunities and part time faculty from industry) rated as high.

Table 18

Comparison of University and Industry Participant Responses as to Benefits to Universities

Q4: Benefits for Universities	Group	N	M	SD	T	df	p
Assists in fulfilling the institutional mission	Industry	67	4.19	0.657	0.528	131	0.598
	Academia	66	4.26	0.73			
Improved instructional programs	Industry	67	4.27	0.709	1.462	131	0.146
	Academia	66	4.44	0.636			
Improved employment prospects for students	Industry	67	4.36	0.69	1.655	131	0.1
	Academia	66	4.55	0.612			
Practical hands on experience for students	Industry	67	4.66	0.478	0.053	130	0.958
	Academia	65	4.66	0.567			
Increase faculty awareness of Industry needs	Industry	66	4.53	0.613	1.594	130	0.113
	Academia	66	4.68	0.469			
Consulting opportunities for faculty	Industry	67	4.13	0.757	0.503	131	0.616
	Academia	66	4.06	0.926			
Improved institutional entrepreneurial skills	Industry	67	4.24	0.698	0.662	130	0.509
	Academia	65	4.15	0.775			
Source of part time faculty from Industry	Industry	67	4.06	0.694	0.656	131	0.513
	Academia	66	4.14	0.654			
Improved institutional reputation	Industry	66	4.29	0.78	0.322	130	0.748
	Academia	66	4.24	0.842			

Table 19 represents the findings of the comparison between perceptions of industry and academia with respect to the benefits for industry. There were no significant differences (p > 0.05) in perceptions between the groups. Of the 10 items in Table 19, reduced time between innovation and commercialization, reduced training costs, and solution to technical problems rated as high potential benefits to industry while the other seven items in Table 18 rated as very high potential benefits to industry.

Table 19

Comparison of University and Industry Participant Responses as to Benefits to Industry

Q5: Benefits to Industry	Group	N	M	SD	T	df	p
Access to professional expertise	Industry	67	4.33	0.66	1.862	131	0.065
	Academia	66	4.53	0.588			
Access to specialized facilities	Industry	67	4.09	0.733	0.913	131	0.363
	Academia	66	4.21	0.814			
Access to broader recruitment pool	Industry	67	4.45	0.658	0.622	131	0.535
	Academia	66	4.52	0.588			
Improved opportunity for in-service training	Industry	67	4.37	0.573	0.194	130	0.847
	Academia	65	4.35	0.571			
Customized education/training programs	Industry	67	4.37	0.693	0.607	131	0.545
	Academia	66	4.44	0.558			
Enhanced reputation	Industry	67	4.15	0.723	0.598	131	0.551
	Academia	66	4.23	0.78			
Gain and/ or sustain competitive advantage	Industry	67	4.36	0.829	1.479	130	0.142
	Academia	65	4.15	0.755			
Reduced time between innovation and commercialization	Industry	67	4.09	0.83	1.026	131	0.307
	Academia	66	3.94	0.857			
Reduced in-service training costs per employee	Industry	67	4.04	0.843	1.346	130	0.18
	Academia	65	3.85	0.852			
Solution to technical problems	Industry	66	3.98	0.832	1.133	130	0.259
	Academia	66	4.14	0.699			

The Current Status of Collaborations in Trinidad and Tobago

This section presents the status of collaborative relations in Trinidad and Tobago.

This section compared the perceptions between industry and academia concerning uses of

specific sources of information in communications, levels of satisfaction among specific

88

collaborative practices, support levels for collaborative strategies, and specific features of current collaborations.

Table 20 represents the results of the comparison between industry and academia with respect to sources of information used in informing the stakeholder community about collaborative activities. Perceptions on three out of the eight items in Table 20 were significantly different ($p >0.05$). The significant differences in perceptions between the groups were meetings with university representatives, t (125) = 1.94, $p = 0.05$, industry representatives on university boards, t (126) = 2.71, $p = 0.01$, and representation on joint technical committees t (127) = 2.7, $p = 0.01$. The frequency with which industry personnel relied on from university meetings for information were moderate compared with a low reliance by university personnel from the same channel. Perceptions were significantly different on reliance on industry representation of university boards and representation on technical committees ($p >0.05$). Academics relied more on representation on governing boards as a source of information than did industry personnel.

Table 20 also presents the *t*-test results indicating that five items show no significant difference ($p > 0.05$) in perceptions to reliance on sources of information. Individual faculty initiatives, university special services, and professional organizations all recorded low levels of usage while professional publications and government initiatives recorded moderate usage as information sources on collaborative activities.

Table 20

Comparison of University and Industry Responses as to Usage of Sources of Information

Q6: Sources of Information	Group	N	M	SD	t	df	p
Individual faculty initiatives	Industry	65	2.18	0.967	1.648	127	0.102
	Academia	64	2.47	0.992			
Special services from universities	Industry	65	2.28	0.96	0.658	127	0.512
	Academia	64	2.39	1.002			
Professional publications	Industry	675	2.74	1.035	1.908	127	0.59
	Academia	64	3.11	1.17			
Meetings with university representatives	Industry	65	2.03	0.901	1.945	125	0.054
	Academia	62	2.35	0.977			
Representatives on university governing boards	Industry	64	1.67	0.798	2.712	126	0.008
	Academia	64	2.09	0.955			
Joint technical committees	Industry	65	1.85	0.922	2.7	127	0.008
	Academia	64	2.31	1.037			
Joining professional organizations	Industry	65	2.54	1.076	1.378	126	0.171
	Academia	63	2.81	1.148			
Government initiatives	Industry	65	2.48	1.161	1.66	127	0.099
	Academia	64	2.83	1.242			

Table 21 highlights the level of satisfaction to specific features in current collaborative relations. There were no significant differences ($p > 0.05$) in perceived satisfaction levels between industry and academia personnel. Industry personnel had low levels of satisfaction ($\bar{x} = 2.48$) in the planning of collaborative relations. Academia had moderate levels of satisfaction ($\bar{x} = 2.69$) for the same feature. The differences were not significant. Satisfaction levels with current university-industry relations were between low to moderate for all 10 features listed in Table 21 and there were no significant differences between industry and personnel from academia.

90

Table 21

Comparison of University and Industry Participant Satisfaction with Specific Features of Current University-Industry Relations

Q7: Collaborative Goals	*Group*	*N*	*M*	*SD*	*T*	*df*	*p*
University's emphasis on collaborative relations with your company	Industry	66	2.44	1.01	0.902	128	0.369
	Academia	64	2.59	0.938			
Specifications of planning of relationship activities with universities	Industry	66	2.48	0.881	1.234	128	0.22
	Academia	64	2.69	0.99			
Enforcement of procedures regulating collaborative activities	Industry	66	2.48	0.932	0.49	128	0.625
	Academia	64	2.56	0.871			
Performance of university personnel responsible for facilitating collaborative programs with industry	Industry	66	2.64	0.835	1.222	128	0.224
	Academia	64	2.83	0.952			
Support of the Government in university industry relations	Industry	65	2.85	1.019	0.144	126	0.885
	Academia	63	2.87	1.085			
Willingness of your company's leaders to collaborate with universities	Industry	66	2.94	1.122	1.771	127	0.079
	Academia	63	3.29	1.099			
Role of professional associations in supporting collaborative programs	Industry	66	2.88	0.886	0.921	127	0.359
	Academia	63	3.03	0.999			

Table 21

Comparison of University and Industry Participant Satisfaction with Specific Features of Current University-Industry Relations (cont.)

Q7: Collaborative Goals	*Group*	*N*	*M*	*SD*	*T*	*df*	*p*
University's focus in supporting your company's needs	Industry	66	2.91	0.956			
					1.02	127	0.309
	Academia	63	2.73	1.035			
University's emphasis on supporting small business organizations	Industry	65	2.75	0.985			
					0.021	127	0.983
	Academia	64	2.75	1.084			
Role of individual faculty members in collaborative agreements and development	Industry	66	2.82	0.763			
					0.231	128	0.818
	Academia	64	2.78	1.046			

Table 22 represents the results of the *t*-test for perceptions of university and industry individuals in relation to usage of specific strategies in current practices. Of the five specific strategies listed in Table 22, perceptions in two specific strategies were significantly different. Perceptions on the involvement of senior administrators in early stages of collaborative activities were significantly different, $t(127) = 2.28$, $p = 0.02$, followed by issues in designating a partnership coordinator for collaborative activities, $t(127) = 2.06$, $p = 0.04$. There were no significant differences ($p > 0.05$) in opinions with respect the need to develop a network for reporting and mediation, employment of management techniques, and the reporting of collaborative results widely.

Table 22

Comparison of University and Industry Participant Responses as to Collaboration Management Strategies

Q8: Strategies	*Group*	*N*	*M*	*SD*	*T*	*df*	*p*
Involving senior administrators from the initial stages of collaborative activities	Industry	66	3.79	0.903	2.283	127	0.024
	Academia	63	3.4	1.04			
Developing a network for reporting communication and mediation	Industry	66	3.71	0.989	1.598	127	0.113
	Academia	63	3.43	1.027			
Employment of project management techniques	Industry	66	3.71	0.873	1.452	127	0.149
	Academia	63	3.44	1.202			
Reporting the results widely	Industry	66	3.62	1.064	1.576	126	0.118
	Academia	62	3.31	1.195			
Designating a partnership coordinator	Industry	66	3.68	1.084	2.066	127	0.041
	Academia	63	3.27	1.181			

Table 23 represents the findings and results of the *t*-test for perceptions on the levels of collaborative activities that exist in Trinidad and Tobago. There were no significant differences ($p > 0.05$) in perceptions for the 24 items listed Table 23. Perceptions on 21 of the 24 items indicated low levels ($1.0 < \bar{x} < 2.59$) of existence for collaborative practices while employment of student interns and recruitment of university graduates recorded high levels ($3.39 < \bar{x} < 4.19$) of existence. Table 23 represented a list of collaborative activities.

Table 23

Comparison of University and Industry Participant Responses as to Types of Collaborative Activities

Q9: Collaborative Activities	*Group*	*N*	*M*	*SD*	*T*	*df*	*p*
Your company's representation on university governing boards	Industry	65	1.95	1.052	1.507	128	0.134
	Academia	65	2.23	1.042			
Joint committees	Industry	65	2.23	1.012	1.77	128	0.079
	Academia	65	2.54	0.969			
Joint revision and assessment of curriculum	Industry	65	2.26	1.035	0.083	128	0.934
	Academia	65	2.25	1.076			
Cooperative education programs	Industry	65	2.66	1.203	0.073	128	0.942
	Academia	65	2.68	1.187			
Your company's employment of student interns	Industry	66	3.03	1.403	0.002	129	0.998
	Academia	65	3.03	1.104			
Recruitment of recent university graduates	Industry	66	3.09	1.286	0.616	129	0.539
	Academia	65	3.22	1.008			
Fellowships to university students	Industry	65	2.4	1.101	0.881	128	0.38
	Academia	65	2.57	1.089			
Training programs for your employees	Industry	66	2.89	1.097	0.704	128	0.483
	Academia	64	3.03	1.126			
University employment of your specialists as adjuncts	Industry	66	2.3	1.136	1.413	129	0.16
	Academia	65	2.57	1.015			
Regular mutual visits	Industry	66	2.11	1.097	1.552	128	0.123
	Academia	64	2.41	1.109			
Contract research	Industry	66	2.29	1.106	0.108	129	0.914
	Academia	65	2.31	0.983			

Table 23

Comparison of University and Industry Participant Responses as to Types of Collaborative Activities (cont.)

Q9: Collaborative Activities	Group	N	M	SD	T	df	p
Management consulting by university faculty	Industry	66	2.11	0.979	1.341	129	0.182
	Academia	65	2.34	1.004			
Technological consulting arrangements	Industry	65	2.29	1.011	0.176	128	0.861
	Academia	65	2.32	0.986			
Jointly organized meetings, conferences, and seminars	Industry	66	2.48	1.099	0.208	129	0.836
	Academia	65	2.45	1.031			
Joint publications	Industry	65	2.09	1.042	0.431	128	0.667
	Academia	65	2.17	0.993			
Joint participation in exhibitions and fairs	Industry	65	2.46	1.16	0.462	128	0.645
	Academia	65	2.55	1.118			
Joint research and consortia	Industry	65	2.12	1.053	0.255	128	0.799
	Academia	65	2.17	1.009			
Technology business incubators	Industry	65	2.06	0.95	0.53	128	0.597
	Academia	65	2.15	1.034			
Technology licensing offices	Industry	65	2	0.919	0.28	128	0.78
	Academia	65	2.05	0.959			
Technology parks	Industry	65	2.08	1.02	0.082	127	0.935
	Academia	64	2.06	0.974			
Establishing spinoff companies	Industry	64	1.83	0.901	0.865	127	0.389
	Academia	65	1.97	0.951			
Jointly owned and operated ventures	Industry	62	1.97	0.923	0.983	125	0.328
	Academia	65	2.14	1.029			
Equipment contributions to university	Industry	64	2.2	1.057	0.764	127	0.446
	Academia	65	2.35	1.178			
Financial grants to university	Industry	63	2.41	1.24	0.133	126	0.895
	Academia	65	2.38	1.155			

Barriers and Influences to Collaborative Relations

The following section highlights the summary findings and results of the *t*-test for the responses related to influential factors in collaborative relations. This section also presents

the results of the opinions on barriers and obstacles to collaborative practices in Trinidad and Tobago. Table 23 and 24 provided details of the *t*-test results.

As shown in Table 23, there were significant differences ($p < 0.05$) between the two groups on matters related to the entrepreneurial culture within universities. Industry opinions indicated a higher level ($\bar{x} = 3.86$) of influence on entrepreneurial culture than academic opinions ($\bar{x} = 3.50$) in enabling collaborative practices. This difference was significant, $t (126) = 1.97$, $p = 0.05$. There were no significant differences ($p > 0.05$) in levels of influence for the other seven items listed in Table 24.

Table 24

Comparison of University and Industry Participant Perceptions of Influence on Specific Factors

Q10: Influential Factors	*Group*	*N*	*M*	*SD*	*T*	*df*	*p*
Government policies or programs stimulating relations	Industry	64	3.89	0.875	1.387	126	0.168
	Academia	64	3.67	0.909			
Company's need for technology development and/or adaptation	Industry	64	3.91	0.921	1.879	126	0.063
	Academia	64	3.61	0.866			
Company's need for staff development	Industry	63	3.84	0.954	0.271	125	0.787
	Academia	64	3.8	0.894			
Local entrepreneurial climate	Industry	64	3.56	1.067	0.62	126	0.537
	Academia	64	3.45	0.925			
Teaching capacity of universities	Industry	63	3.9	0.928	1.201	124	0.232
	Academia	63	3.71	0.851			

Table 24

Comparison of University and Industry Participant Perceptions of Influence on Specific Factors (cont.)

Q10: Influential Factors	*Group*	*N*	*M*	*SD*	*T*	*df*	*p*
Entrepreneurial culture within university	Industry	64	3.86	1.082	1.973	126	0.051
	Academia	64	3.5	0.976			
Reward system and incentives for university staff to collaborate	Industry	63	3.43	0.962	0.036	125	0.972
	Academia	64	3.42	1.152			
Traditional interaction between university and industry	Industry	64	3.61	0.953	1.437	126	0.153
	Academia	64	3.36	1.014			

Table 25 highlights the findings and results of the *t*-test for responses to barriers in collaborative practices. There were significant differences ($p < 0.05$) between the two groups on matters of communications. Lack of communications was a significant barrier to collaborative practices between industry and academia $t (127) = 2.2, p = 0.02$. Industry opinions indicate that lack of communication ($\bar{x}$=4.44) presented a greater barrier to collaborative practices than do opinions from academia ($\bar{x}$=4.14). There were no significant differences ($p > 0.05$) in opinions for the other 18 items listed in Table 25.

Table 25

Comparison of University and Industry Participant Responses as to Obstacles and Barriers Encountered

Q11: Barriers	*Group*	*N*	*M*	*SD*	*T*	*df*	*p*
Lack of communication	Industry	64	4.44	0.614	2.263	127	0.025
	Academia	65	4.14	0.864			
Lack of Leadership	Industry	64	4	1.008	0.276	127	0.783
	Academia	65	4.05	0.891			
Lack of commitment	Industry	64	4.25	0.797	0.107	126	0.915
	Academia	64	4.27	0.859			
Lack of clear understanding of the project	Industry	64	4.17	0.865	1.303	127	0.195
	Academia	65	3.97	0.901			
Lack of consistency in program management	Industry	64	3.95	0.862	1.375	127	0.172
	Academia	65	4.15	0.795			
Differences between institutional, Academia, and Industry culture and values	Industry	64	4.14	0.814	1.256	127	0.211
	Academia	65	3.95	0.874			
Unavailability of information about university services	Industry	64	3.78	0.983	0.731	127	0.466
	Academia	65	3.65	1.11			
University unawareness of problems encountered in industry	Industry	64	3.84	0.996	0.074	127	0.941
	Academia	65	3.83	0.993			
Bureaucratic procedures in the university	Industry	64	4.05	0.95	0.588	126	0.558
	Academia	64	4.14	0.852			

Table 25

Comparison of University and Industry Participant Responses as to Obstacles and Barriers Encountered (cont.)

Q11: Barriers	Group	N	M	SD	T	df	p
Inefficient reward systems	Industry	64	3.55	0.872	1.515	127	0.132
	Academia	65	3.78	0.91			
Overemphasis of universities on teaching	Industry	63	3.78	0.958	0.127	126	0.899
	Academia	65	3.8	1.019			
Loss of government funding	Industry	64	3.53	1.083	0.121	127	0.904
	Academia	65	3.55	1.046			
Lack of qualified personnel to manage relationship activities	Industry	64	3.83	1.062	0.66	127	0.511
	Academia	65	3.71	1.011			
Nonexistence of intermediary bodies	Industry	64	3.69	0.924	0.303	126	0.762
	Academia	64	3.73	0.821			
Inefficient evaluation and monitoring mechanisms	Industry	64	3.92	0.803	0.092	127	0.927
	Academia	65	3.91	0.947			
Insufficient equipment	Industry	64	3.78	0.934	0.068	127	0.946
	Academia	65	3.77	1.072			
Insufficient facilities	Industry	62	3.84	0.944	0.217	125	0.829
	Academia	65	3.8	1.064			
Equipment depreciation	Industry	63	3.46	0.93	0.082	126	0.935
	Academia	65	3.45	1.016			
Loss of university's control over Academia work	Industry	63	3.57	0.979	0.216	125	0.829
	Academia	64	3.53	1.112			

Institutional Strengthening and Success factors

Table 25 and Table 26 compare the responses of industry and academia to specific

issues of institutional strengthening and key success factors to collaborative practices. There

were no significant differences ($p > 0.05$) in opinions between the two groups on the eight

items listed in Table 26. Both industry and academia strongly agreed on matters of

institutional strengthening. The specific issue on institutional strengthening was the

university's development of entrepreneurial skills and the development of specific policies to

manage industry-academia collaborations. There was no significance difference in this

finding between industry and academia personnel. Table 26 highlighted the list of these

items.

Table 26

Comparison of University and Industry Participant Responses as to Areas for Strengthening University-Industry Relationships

Q12: Areas of Strengthening	*Group*	*N*	*M*	*SD*	*t*	*df*	*p*
Universities should improve their entrepreneurial skills	Industry	65	4.38	0.678	0.931	128	0.353
	Academia	65	4.49	0.64			
Industry leaders should serve on university governing boards	Industry	65	4.03	0.951	0.481	128	0.631
	Academia	65	4.11	0.868			
Universities should establish special policies in the domain of relationships with industry	Industry	65	4.38	0.604	0.302	128	0.763
	Academia	65	4.42	0.556			
Universities should build a capacity to manage collaborative relationships	Industry	65	4.34	0.567	0.936	128	0.351
	Academia	65	4.43	0.558			

Table 26

Comparison of University and Industry Participant Responses as to Areas for Strengthening
University-Industry Relationships (cont.)

Q12: Areas of Strengthening	*Group*	*N*	*M*	*SD*	*t*	*df*	*p*
Faculty members should periodically visit industry as part of their professional development	Industry	65	4.52	0.562	0.146	128	0.884
	Academia	65	4.54	0.639			
Universities should offer customized training programs for industry employees	Industry	65	4.29	0.701	1.308	128	0.193
	Academia	65	4.45	0.638			
The government should adopt a favorable policy to support collaborative relationships	Industry	65	4.48	0.562	0.964	128	0.337
	Academia	65	4.57	0.529			
The government should subsidize specific programs to stimulate collaborative relationships	Industry	65	3.89	0.937	0.887	128	0.377
	Academia	65	4.05	1.037			

As shown in Table 27, there were no significant differences ($p > 0.05$) between the two groups on matters related to success factors necessary for collaborative practices. Both industry and academia responses to the eight items listed in Table 26 indicated these items contributed a very high level ($4.20 < \bar{x} < 5.0$) to the success of collaborative practices between industry and academia.

Table 27

Comparison of University and Industry Participant Responses as to Success Factors in University - Industry Collaborative Programs

Q13: Success Factors	*Group*	*N*	*M*	*SD*	*t*	*df*	*p*
Strength of each partner having something of value to contribute	Industry	65	4.45	0.56	0.824	128	0.412
	Academia	65	4.52	0.503			
Fitness of collaborative activities in partners' strategic objectives and long term	Industry	65	4.34	0.668	0.178	126	0.859
	Academia	63	4.32	0.668			
Existence of complimentary assets and skills in partners	Industry	64	4.2	0.717	0.212	127	0.833
	Academia	65	4.23	0.766			
Investment of partners in each other proving their long term commitment	Industry	65	4.25	0.73	0.791	128	0.043
	Academia	65	4.34	0.594			
Open flow of communication between partners	Industry	65	4.55	0.613	0.583	128	0.561
	Academia	65	4.49	0.59			
Establishment of broad connections linking many organizational levels in shared ways of operating	Industry	65	4	0.75	1.839	128	0.068
	Academia	65	4.23	0.679			
Formalization of status of relationship programs	Industry	65	4.06	0.768	1.468	128	0.145
	Academia	65	4.25	0.662			
Partners' honorable behavior and trust building	Industry	65	4.49	0.664	0.132	126	0.895
	Academia	63	4.48	0.715			

Summary

Chapter 4 presented an overview of the data collection process, followed by the detailed presentation of the results from the survey. To answer research questions (RQ1 and RQ2) survey questions 3, 4, and 5 were analyzed to determine the perceptions of senior academic officials and industry professionals toward requirements for collaborative effort (survey question 3), mutual benefits in industry and academia collaborations (survey questions 4 and 5). To answer Research Question 3, the researcher analyzed survey questions 6, 7, 8, 9, 10, and 11 to determine the current practices/issues in industry-academia in Trinidad and Tobago. The method of analysis for research questions 1, 2, and 3 were descriptive statistics using mean and standard deviations. To answer Research Question 4, the researcher analyzed survey questions 1 through 13 to determine if any significant differences in perceptions existed between industry and academia personnel.

Data analysis commenced using Statistical Package for Social Sciences (SPSS) for Windows version 14.0. Descriptive statistics described the sample characteristics and variables. For categorical or nominal data, frequencies are used. For interval data, means and standard deviations are used (Howell, 2010).

Data analysis for Research Question 1 revealed that academic personnel perceived the employment opportunities for students ($\bar{x}$=4.61) and relevance of instructional programs ($\bar{x}$=4.51) as goals that require industry-academia collaborations. For benefits to the university, most academic participants felt there was a high possibility for improving the institutional mission ($\bar{x}$=4.26) and entrepreneurial skills ($\bar{x}$=4.15) followed by improved institutional reputation ($\bar{x}$=4.24). In relation to benefits for faculty and students, academic personnel perceived having increased awareness of industrial needs ($\bar{x}$=4.68) as beneficial to

universities. Practical hands-on experience for students was perceived as a very high benefit ($\bar{x}$=4.66). Academics also perceived benefits to industry as very high with industry access to professional expertise ($\bar{x}$=4.53) followed by industry's access to a broader recruitment pool ($\bar{x}$=4.52).

Analysis of Research Question 2 (survey questions 3, 4, and 5) followed the same methodological approach as for Research Question 1. Perceptions from industry personnel toward benefits to university revealed very high benefits to universities through improved institutional reputation ($\bar{x}$=4.42). Also perceived, were faculty and students benefits from practical hands on exposure for students ($\bar{x}$=4.66). Perceptions from industry toward benefits for industry was "gaining competitive advantage" ($\bar{x}$=4.36) and industries' access to a broader recruitment pool ($\bar{x}$=4.45).

Research Question 3 addressed the current practices/issues in industry-academia collaborations. These practices reflected the frequency with which personnel consulted with relevant information sources (survey question 6) and other forum to identify current issues. Other categories surveyed included levels of satisfaction (survey question 7), supporting strategies (survey question 8), current practices (survey question 9), levels of influence (survey question 10), and barriers to collaborative practices (survey question 11).

Participants consulted moderately ($\bar{x}$=2.92) with professional publications as a source of information on collaborative practices followed by joining professional organizations ($\bar{x}$=2.67) as a means of access to information. There was moderate levels of satisfaction among participants to government support ($\bar{x}$=2.86), planning, and commitment to collaborative practices. Support for current strategies for collaborative practices was also moderate.

Analysis of survey question nine revealed the extent of the existence of the various types of collaborative practices in Trinidad and Tobago. On national priorities the existence of recruitment of university graduates as a collaborative practice between industry and academia was moderate ($\bar{x}$=3.15). On learning and development matters, the existence of cooperative learning programs between industry and academia was moderate, and on governance matters there was moderate existence to training programs for employees ($\bar{x}$=2.96).

Survey question 10, measured the degree of influence several factors had on collaborative practices. The results indicated that on governance issues, the level of influence on government policy to stimulate collaborative practices was high ($\bar{x}$=3.78). As a national priority, the influence of a company's need for technology adaptation in collaborative practice was also high ($\bar{x}$=3.76), and on learning and development initiatives, the influence was high ($\bar{x}$=3.82) for staff development.

Analysis of survey question 11 indicated the barriers to the collaborative practices. The results show that lack of communication was a very high barrier to collaborative practices ($\bar{x}$= 4.29). On leadership matters, lack of commitment by the stakeholders was a very high barrier ($\bar{x}$=4.26) to collaborative practices and on management and culture of the stakeholders, bureaucratic procedures at the universities was a high barrier ($\bar{x}$=4.09) to collaborative practices.

Research Question 4 examined the differences between industry and academia perceptions toward collaborative practices. There was significant differences (p=0.04) between industry and academia perceptions with respect to the importance of additional income for universities as a goal through collaborative practices. There was no significant

differences ($p > 0.05$) in perceptions with respect to the benefits for universities and industry through collaborative practices.

Satisfaction levels for specific features of current collaborative practices range from low to moderate and there were no significant differences in these perceptions between industry and academia. Similarly, there were no significant differences in support between industry and academia for management strategies in collaborative practices; however, the perceptions range from moderate to high levels of support. Industry participants indicated there was a high degree of influence to collaborative practices through an entrepreneurial culture within the university. This was a significant difference in perceptions when compared to participants from academia. Lack of communication was the major barrier to collaborative practices and responses from industry were significantly different from those in academia. Most participants indicated high to very high levels of agreement on areas for strengthening industry-university relationships. There were no significant differences in perceptions to these areas with specific reference to the development of entrepreneurial skills by universities. Similarly, there were no significant differences between industry and academia to the success factors in collaborative practices. Most participants indicated high to very high levels of importance to the specific success factors identified. Based on the results from Research Question 4, there was little support for the null hypothesis ($p < 0.05$) and therefore the results concluded that significant differences in perceptions between industry and academia personnel toward collaborative activities.

Chapter 5 provides an interpretation of the data results presented in this chapter. The chapter provides an overview of the implications of the current study to leadership

knowledge, stakeholder relationships, and policy considerations. Chapter 5 ends with

conclusions and recommendations for future research.

Chapter 5

Conclusions and Recommendations

In recent years, universities and colleges around the world have enhanced their relationships with other parts of their stakeholder communities. Three academic revolutions characterized the emerging trends in academia. Research regarding the involvement of higher education institutions, universities in particular, in the innovation processes, dates back to the late 20th century. Etzkowitz and Leydesdorff (2001) interpret changes of universities through the prism of institutional interaction. Wu, Chen, and Chen (2012) analyzed the involvement of universities in innovation-based economy through the approach of knowledge creation and dissemination. These theories explain how higher education emerges in a national innovation system and interact with other stakeholder entities. The first revolution saw increased collaboration as a transformative agent from an ivory tower of knowledge production and dissemination to one of producing and transferring technology (Yusof & Jain, 2010). A second academic revolution (Etzkowitz & Goktepe-Hulten, 2010) connoted a knowledge capitalization process that broadens the university's mission to include the capacity to generate revenues. The third stream contributed directly to economic growth by producing marketable goods and services (Abeles, 2014). Capitalization provided one way to become an entrepreneurial institution capable of responding to emerging needs. Consequently, universities should collaborate with potential partners who may contribute to their competitive strength (Gildersleeve, 2010).

Examinations of the major forces that drive universities to collaborate with industry partners represent the extent to which universities can benefit from these relationships. The challenge for the parties (university and industry) is on the managerial aspects of the

relationship and in the formalization of agreements between the entities. These agreements attempt to answer the following questions: why do universities collaborate with industry? What are the potential benefits and concerns of collaborations? How university-industry collaborative activities are organized and managed? What are the success factors that make the collaboration work?

The purpose of this quantitative study was to (a) examine the perceptions of industry and academia personnel with respect to collaborations between their respective organizations (b) identify the current practices/issues in industry-academia collaborations in Trinidad and Tobago, and (c) examine the extent of the agreement in stakeholder perceptions about collaborative strengthening and key success factors. The independent variables were senior academic officials and industry leaders. The dependent variables were the perceptions received through the survey instrument from senior industry and academic personnel.

The data collection method used was a web-enabled survey through a third party (Survey Monkey) to all pre-selected participants. The data analysis process identified in Figure 1 required using the Statistical Package for Social Sciences (SPSS) followed by descriptive and inferential statistical evaluations. Based on the perceptions analyzed the study concluded that several areas of mutual benefits for industry and academia through collaborative relationships. These include the following

1. Employment opportunities for students
2. Improved relevance to instructional programs
3. Improved entrepreneurial skills
4. Enhanced practical hands on experience for students
5. Enhanced industry access to professional expertise

6. Broader recruitment pool for industry

The results also showed that significant differences between industry and academia perceptions with respect to the importance of additional income for universities. Significant differences in perceptions with respect to communications existed. The findings revealed that a lack of communications was a major barrier to collaborative practices.

This chapter provides a comparison of the study results to the literature in Chapter 2, followed by a summary of the methodology used for this study as detailed in Chapter 3. Chapter 4 provided an overview of the data analysis and findings. This chapter concludes with implications to Trinidad and Tobago and recommendations for future research.

Comparison of Results to the Literature

The literature review presented in Chapter 2 highlighted the historical perspectives of university-industry relationships, its structure, organization, and management. The literature is abundant on the university's broadening role to generate revenues (Etzkowitz, 2010) and its direct contribution to economic growth through marketable goods and services (Haq, 2012). The literature presented in chapter two also highlights the development of the university's entrepreneurial capability to manage in the new competitive environment (Gildersleeve, 2010).

The literature suggests that the participants involved in industry-academia collaborations intended a broad spectrum of outcomes. Krimsky (2010) outlined several benefits to the university regarded as institutional matters while others relate to faculty and students. On institutional matters, the literature suggests (Bratianu & Stanciu, 2010) that entrepreneurial activity at universities are on the rise. The results of the perceptions analyzed

in this study (Research Question 1) support this view as participants answered favorably high ($\bar{x}$=4.15) to improved institutional entrepreneurial capabilities.

Chapter 2 also highlights the benefits to industry in collaborative relationships. The requirements for industry training and the matching of industrial tasks with competency development (Larbi-Apau & Moseley 2010; Larbi-Apau & Sarpong, 2010) reflect the managerial changes in industry. There was an increase in the establishment of specialist personnel to Learning and Development activities in industry. Industry perceptions analyzed in this study (Research Question 2) concluded that industry benefited through industrial personnel as part time faculty. This measure assists in improving the relevance of instructional programs to industry needs.

The literature suggested several current issues in industry-academia relationships. New sources of revenue to supplement the diminishing public funding (McKeown-Moak, 2013) and the difficulty which universities have in accomplishing their mission based on these funding shortfalls (De Geest, Marx, Rich, Spichiger, Schwendimann, Spirig, & van Malderen, 2010) contribute to major issues in collaborative relationships. Other critical issues identified in the literature include industry support for research (Brandt, 2010; Cosh & Hughes, 2010), and equipment contributions (Yang & Li, 2012). Notwithstanding the United States perspective the results of this study (Research Question 3) concluded that participants are indifferent (neither high nor low) to government support in enabling collaborative relationships. This study concluded that the barriers to collaborative relations are lack of communication, and lack of consistency in program management of the relationship.

The literature is abundant on contributory success factors to industry-academia collaborations. Technology transfer is a critical success factor (Gera, 2012). The contribution

of technology transfer to sustainable development has also been well documented (Teng, 2010). To what extent do industry and academia personnel agree on key success factors? The results of this study (Research Question 4) indicate that industry and academia personnel do have significant differences in perceptions toward strengthening collaborations. The lack of communication among stakeholders is a critical barrier to collaborative success.

Implications

There was a rapid rise in commercial knowledge transfers from universities to practitioners through university – industry collaborations (Boyle, McDonnell, Mitchell, & Nicholas, 2012). The benefits to both industry and academia have come through licensing, research joint ventures, and start-ups. This study analyzed the perceptions of senior industry and academia personnel in Trinidad and Tobago. In the Trinidad and Tobago context, the view of academia is that employment opportunities for students and institutional reputation are of high importance for collaborative relations. These findings suggested benefits that included the improvement of entrepreneurial skills of students and administrators. The implications of this finding is consistent with the literature as in chapter two in which a reduction of state resources to universities. This implication is also consistent with the growth of entrepreneurial universities in their attempt to become net revenue generators.

In Trinidad and Tobago, s tuition fees for university students are free through the Government Assistance for Tuition Expenses (GATE) program. The only qualifier to access the GATE funds is acceptance to a tertiary level institution. The fundamental issue remains the sustainability of such levels of state support for higher education in Trinidad and Tobago. While globally state support for university and higher education decreased, the strategic

advantage for Trinidad and Tobago must be to initiate collaborative alliances with industry to guard against any eventual shortfall in state funding.

While the orientation of Trinidad and Tobago universities needs realigned realignment toward stronger entrepreneurial outcomes, the provision of a graduate with entrepreneurial competencies can provide the increased possibilities of economic sustainability. The economic growth is limited given the current infrastructure in Trinidad and Tobago. To this end, the implications of this study suggest that building a competitive, innovation-driven economy are an imperative for sustainability and prosperity and that investing in research and development can provide a strong platform for building a vibrant knowledge industry.

If entrepreneurship needs be the driving force in generating higher levels of constant growth perceptions in satisfaction levels (survey question seven) in government, planning, and commitment by the stakeholder community must move from its current perception level (moderate) to higher positive levels. The role of the government as an enabler in enhancing collaborative relationship between industry and academia becomes very critical, especially in small nation states Trinidad and Tobago.

The data shows that new and emerging relationships between university and industry in Trinidad and Tobago must not only continue to be a center of knowledge production but must include liaison consultations with industry, technology transfer offices, intellectual property, and patent licenses. The role of government is not excluded from this stakeholder model as (Etzkowitz & Goktepe-Hulten, 2010) advocated in the triple helix model of university, industry, and government.

The data shows that the government of the Republic of Trinidad and Tobago need to focus on providing the supporting infrastructure. Satisfaction levels for government support for collaborative relations were moderate ($\overline{x}$= 2.86), adopt favorable policy was very high ($\overline{x}$=4.57), and government's provision of a stimulus to collaborative relations ($\overline{x}$= 4.05) was high. Given the low levels of satisfaction from industry and academia, the high levels of favorable policy and high requirement for stimuli in collaborative enterprise development, the implications from the results suggest the need for a comprehensive policy framework that facilitates ideas and product development to feasibility, enterprise creation, and incubation. The data also show the removal of barriers (survey question eleven) to communications ($\overline{x}$= 4.44), leadership ($\overline{x}$=4.05), and cultural awareness ($\overline{x}$=4.14) by the creation of new growth centers, the mapping of value chains and the building of production clusters can create the environment for economic sustainability and for enhancing international competitiveness.

Institutional Entrepreneurship

While there was agreement on the development of entrepreneurial skills at an institutional level by both industry and academia the implication of this finding lies in the transformation of the higher education sector with a focus on sustainable economic development in Trinidad and Tobago. Key implication resulting from this finding is the establishment of institutional entrepreneurship within industry and academia with the intent of making the entrepreneur the catalyst for economic change.

The role of industry, academia, and government is critical to the creation of a cadre of entrepreneurs. A redefinition of the current higher education system in Trinidad and Tobago must be a pre-requisite to the creation of this cadre. In the new economic paradigm, labor is internationally mobile, existing jobs are becoming obsolete, and new occupations require

greater knowledge, skills, and adaptability from graduates and the workforce. The new global system rewards knowledge, enterprise, creativity, and adaptability and no singular entity is adequately equipped to achieve this outcome. The outcomes of knowledge, enterprise, creativity, and adaptability are attainable through collective triple helix collaborations.

In the Trinidad and Tobago context, given its small size and high unit costs, this country is unlikely to compete with entrepreneurs from mass-producing countries such as in India, China, and Brazil. Instead, the collaborative efforts from industry, academia, and government must focus to produce a higher value output based on value creation, and competing based on quality and innovation. Achieving this trait is difficult within the education system alone. This trait cannot be must be encouraged with the education system. A better option may be the adoption of collective entrepreneurship between industry and academia.

Benefits of Entrepreneurial Institutions

The benefits of entrepreneurial transformation in higher education and industry should not be measured solely on the acquisition of entrepreneurial skills ($\bar{x}$=4.49), but also on increased motivation, contribution to learning, development of creativity, and self-confidence in different aspects of their peoples' lives. An important note is that stimulating entrepreneurship in education is about not only business and making a profit; but it is also about the connections to community well-being, poverty reduction, and sustainable development in Trinidad and Tobago. Institutional entrepreneurship is therefore not limited to business but incorporates a holistic approach involving industry, academia, government, and community (Cantaragiu, 2012).

Curriculum Reform and Institutional Delivery through Collaborations

Curriculum reform is an integral part of the collaborative strengthening between industry and academia. The findings of the study reveal agreement of improved relevance of instructional programs by universities and students practical hands-on experiments through industrial attachments. Curriculum alignment to improve relevance and entrepreneurial thought is imperative to collaborative strengthening. Although no universal model of entrepreneurship education, many programs were successful because of their flexible delivery methods that take into account students' and administrators' preferences. Moreover, underlying nearly all programs is the need for principles of action and experiential learning with learners as active generators of knowledge, rather than passive receivers.

New pedagogical and learning approaches have emerged that connect education and skills more directly to the life situation of young and adult learners. The entrepreneurial reform can assist to modernize the curricula by making more explicit the connections and relevance to life situations and providing greater definition to what the learning should be. Improvements in critical thinking curricula and pattern recognition phenomenon can also assist the reform program.

Partnerships in Stimulating Entrepreneurship and Collaborations

The development of meaningful partnerships is important to engender collaborative relationships. These partnerships must extend beyond industry and academia and must include government, enterprise promotion agencies, chambers of commerce, Chambers of Commerce, local business communities, and community based organizations. Figure 2 illustrates the new partnership model for collaboration modified from triple helix model (Etzkowitz & Goktepe-Hulten, 2010).

116

Figure 2. Institutional strengthening for collaborative relationships.

Local businesses can directly sponsor courses relevant to their area of operation, while local entrepreneurs can act as classroom speakers, serve on advisory boards and curriculum committees, or work placement employers. In some industries, the private sector firms can supply curriculum guidelines and materials.

In Trinidad and Tobago, several programs exist in isolation that can be coordinated to address the needs on industry and academia to assist in sustainable development. The National Entrepreneurship Development Company (NEDCO), established in 2002, is the implementing agency for the government's policy on small and micro enterprise development. This agency can collaborate with the university to offer specialized training programs developed to build entrepreneurial competencies.

ICT as a Pre-requisite to Collaboration

While there was little agreement between industry and academia on the dimensions of strengthening collaborative relations and key success factors, the enabling strategies must include a coordinated plan to increase the national capacity to develop, acquire, and commercialize knowledge and technology. In this regard, information, communications, and

117

technology (ICT) can be the catalyst for reengineering traditional business enterprises and the creation of new knowledge industries.

Based on the findings of this study and the literature tremendous benefits are available to industry. This study identified that such benefits to industry included the university's enhancement of applied research. The increase in applied research can create a learning community between industry and academia that focused on application, new products and processes, solution to industrial problems, and a shorter time from patents to commercialization.

The findings revealed barriers to industry-academia collaborations in Trinidad and Tobago. In this study, the low rate of spin-off companies from research was one of the barriers related to governance of the collaborative relationship. The implications of this low spin-off rate reflect the lack of alignment toward an entrepreneurial focus in business and academia. Equally, the low rate of licenses from universities was attributable to the current governance model. The implications of these findings relate to several issues in leadership. Differences in culture, stakeholder relations, and management styles between industry and academia may contribute to the imbalances in perceptions between industry and academia.

Based on the findings of this study several implications for improvements of industry-university collaborations exist. The implications for university-industry based improvements can include the following:

1. The need for universities to improve their understanding of the needs of the true "customers," – Firms that pay to commercialize potential technologies,

2. The adoption of a more flexible position in negotiating university-industry agreements with systems and procedures that clearly articulate the process of how the relationship will be managed,

3. The recognition of the value of personal relationships involving scientists, graduate students, industry liaisons and alumni,

4. Industry needs to become more proactive in its efforts to bridge the cultural gap with academia and that universities need to rethink their cultural orientation to become more market –oriented,

5. Industry-academia personnel need to commit additional resources to business incubation models to accelerate spin-offs.

The significance of these implications outlined above provides a new focus based on sustainability economic development based on new knowledge generation and research commercialization. The implications indicate that considerable room exists for enhancing the effectiveness of industry-academia collaborations in several dimensions – governance, learning and development, management and culture, and leadership. The next section will highlight the recommendations for future research.

Recommendations and Suggestions for Future Research

Recommendations to key stakeholders leading university-industry collaborations will include review of institutional goals and priorities. The priority list must include the key issues identified in this study. These dimensions must address the specific benefits to industry and academia, the learning and development opportunities for students, faculty and industry, and the contribution to sustainable development. On the issue of sustainable development the researcher recommends the greater engagement with the stakeholder

community as outlined in Figure 2; the development of cadre of entrepreneurs as graduates from the higher education system and a complete review of the curricula with a focus on entrepreneurial competencies. This review must entail cross-fertilization in science, technology, and creativity in an experimental delivery format. This study further recommends the following:

1. Use of the findings of this study as baseline data for future studies in industry-academia collaborations in Trinidad and Tobago;

2. Enable a clearer identification of the links between sustainable technological innovation and structural changes needed for sustainable development in different sectors of Trinidad and Tobago;

3. Promote a broader perspective of certain crucial questions about employment, changing employment trends with a view to enhancing the relevance of the higher education curricula;

4. Promote an enabling environment to influence government policy to stimulate partnerships between industry and academia;

5. Establish curricula advisory boards with input from industry;

6. Use industry expertise as guest lecturers to bridge the gap between academia and industry;

7. Use industry industrial equipment in universities to enable hands on experience by students prior to industrial engagement;

8. Provide industry attachments, site visits, and study tours to university faculty to enrich their classroom delivery; and

9. Develop a comprehensive communications plan, inclusive of social networks to build the cultural barriers that may exist among members of the stakeholder community.

Future researchers may consider replicating this study with a greater focus on specific dimensions identified in the study. Causal relationships pertaining to specific dimensions in industry-academia relationships between culture issues in industry and academia, management styles and governance models warrant future research. Future researchers may consider the following:

1. What is the relationship between government policy and high performance collaborative relationships between industry and academia?

2. How does academic entrepreneurship contribute to collaborative relations with industry?

3. Is there a cultural divide between industry and academia? What are the implications to learning and development from both stakeholders?

Summary

This study examined the perceptions of senior industry and academia personnel. Chapter one of this study include the background to the problem before highlighting the problem in specific terms. The purpose of the study was to examine the perceptions of industry and academia personnel toward collaborations. Chapter 1 concluded with a brief description of the limitations and delimitations of the study.

Chapter 2 provided a literature review of published works on the subject of industry – academia collaborations. The historical evolution of these collaborations was cited in the three academic revolutions (Etzkowitz, 2010) followed by the emergence of the entrepreneurial university (Abeles, 2014). The forces that drove contemporary collaborative

relationships were globalization and interconnectivity (Qureshi, Shaukat, & Hijazi, 2010). Cost, culture, efficiency, and competition were also key driver for collaboration (Bratianu & Stanciu, 2010).

The legal framework adopted in United States (Bayh-Dole Act of 1980) was as a measure to increase patent registrations to universities under federal funding (Valdivia, 2011). This followed by highlights of the higher education legislation in Trinidad and Tobago. Chapter 2 concluded with a description of the success factors in industry-academia collaborations.

Chapter 3 provided the methodological approach to this study. This quantitative descriptive study used a web-enabled survey. The instrument required revision following a pilot test using 12 graduate students from the Arthur Lok Jack Graduate School of Business (ALJGSB). The sample size of 133 was determined via a sample calculator for a confidence level of 95% and $p = 0.05$.

Chapter 4 presented the results this study. There were four research questions. Research questions one and two provided the answers on industry-academia perceptions from industry and academia respectively. Research Question 3 provided the answers to current issues in industry-academia collaborations and Research Question 4 examined the extent of agreement on collaborative strengthening and key success factors between industry and academia. The results for Research Question 4 indicated no support for the null hypothesis and ($p<0.05$), and concluded that significant differences in perceptions between industry and academia toward collaborative activities.

The view of this researcher is that industry, academia collaboration, represents not what to think but how to think, not what to learn but how to learn, how to correct, how to

apply knowledge. Critical thinking, pattern recognition, reverse assumption, case studies, simulations, and life experiences stimulate the human imagination, problem identification, solution, and logic to think things through and to think differently. The collaborative efforts of this stakeholder community in Trinidad and Tobago may provide the pathway to sustainable development.

References

Abd, H. A., Mohd, Y. H., & Jalaluddin, A. M. (2013). Knowledge transfer and the role of local absorptive capability at science and technology parks. *The Learning Organization, 20*(4), 291-307. doi:http://dx.doi.org/10.1108/TLO-12-2011-0059

Abeles, T. P. (2014). The university - the shifting past. *On the Horizon*, *22*(2), 101-110. doi:http://dx.doi.org/10.1108/OTH-02-2014-0003

Ahmed, M. (2010). Economic dimensions of sustainable development, the fight against poverty and educational responses. *International Review of Education, 56*(2-3), 235-253. doi:http://dx.doi.org/10.1007/s11159-010-9166-8

Al-Adwani, A. (2014). Effects of implementing strategic human resource management on organizational success: Case study of (Kuwait Finance House-KFH). *International Business* Research*, 7*(3), 149-158. Retrieved from http://search.proquest.com/docview/1510283484?accountid=458

Alexander, A. E. (1997). *Perceived critical success factors in triad partnerships between a community college and business and industry*. (Order No. 9802814, The University of Texas at Austin*). ProQuest Dissertations and Theses, *, 219-219 p. Retrieved from http://search.proquest.com/docview/304373515?accountid=458. (304373515).

Al-Mubaraki, H., & Busler, M. (2013). Business incubation as an economic development strategy: A literature review. *International Journal of Management, 30*(1), 362-372. Retrieved from http://search.proquest.com/docview/1315212878?accountid=458

Altbach, P. G., Reisberg, L., & Rumbley, L. E. (2010, Mar). Tracking: A global academic revolution. *Change, 42*, 30-39. Retrieved from http://search.proquest.com/docview/250827693?accountid=458

Bahgat, G. (2012, Jan 09). Preliminary assessment of Arab spring's impact on oil and gas in

    Egypt, Libya. *Oil & Gas Journal, 110,* 58-63. Retrieved from

    http://search.proquest.com/docview/923151812?accountid=458

Barnes, B., & Harris, M. (2010). Privatization Influences and Strategic Enrollment

    Management Decisions in Public Research Universities. *College and University,*

    85(4), 2-9. Retrieved April 1, 2011, from ProQuest Education Journals. (Document

    ID: 2148808391).

Barrientos, S., Gereffi, G., & Rossi, A. (2011). Economic and social upgrading in global

    production networks: A new paradigm for a changing world. *International Labour*

    Review, *150*(3), 319-340. Retrieved from

    http://search.proquest.com/docview/933126623?accountid=458

Bauer, E. A., & Cohen, D. E. (2012). The changing roles of industry and academia. *The*

    Journal of Investigative Dermatology, 132(3), 1033-6.

    doi:http://dx.doi.org/10.1038/jid.2011.368

Bhukuvhani, C., Tigere, A., Sana, A., Mhishi, M., Sunzuma, G., & Mupa, P. (2013). Science

    and technology education curriculum reforms for the nanoscience and

    nanotechnology revolution. *Journal of Education, 3*(1), 44-47. Retrieved from

    http://search.proquest.com/docview/1506758687?accountid=458

Boggs, G. R. (2010). Growing roles for science education in community

    colleges. *Science, 329*(5996), 1151-1152.

    doi:http://dx.doi.org/10.1126/science.1194214

Boronico, C., & Boronico, J. (2010). Study abroad perspectives on institutional

    operations. *Contemporary Issues in Education Research, 3*(4), 13-20. Retrieved from

    http://search.proquest.com/docview/196355127?accountid=458

Boyle, B., McDonnell, A., Mitchell, R., & Nicholas, S. (2012). Managing knowledge in

    internationalizing universities through foreign assignments. *The International Journal*

    of Educational Management, 26(3), 303-312.

    doi:http://dx.doi.org/10.1108/09513541211213363

Bozeman, B., Fay, D., & Slade, C. P. (2013). Research collaboration in universities and

    academic entrepreneurship: The-state-of-the-art. *Journal of Technology Transfer,*

    38(1), 1-67. doi:http://dx.doi.org/10.1007/s10961-012-9281-8

Brandt, A. M. (2010). A not-so-slippery slope. *Academe, 96*(6), 25-27, 3. Retrieved from

    http://search.proquest.com/docview/816430654?accountid=458

Bratianu, C., & Stanciu, S. (2010). An overview of present research related to entrepreneurial

    university. *Management & Marketing, 5*(2), 117-134. Retrieved from

    http://search.proquest.com/docview/749213164?accountid=458

Brown, T., & Brandt, D. (2014). How high growth economies impact global information

    technology departments. *AI & Society, 29*(2), 241-247.

    doi:http://dx.doi.org/10.1007/s00146-013-0478-7

Catana, D., Pucko, D., & Krzykala-Schaefer, R. (2013). How future managers view societal

    culture: A comparison across seven CEE countries. *Journal for East European*

    Management Studies, 18(4), 463-481. Retrieved from

    http://search.proquest.com/docview/1465244459?accountid=458

Cantaragiu, R. (2012). Towards a conceptual delimitation of academic

    entrepreneurship. *Management & Marketing, 7*(4), 683-700. Retrieved from

    http://search.proquest.com/docview/1270850426?accountid=458

Cherwitz, R. (2010). Viewpoint: The challenge of creating engaged public research

    universities. *Planning for Higher Education, 38*(4), 61-64. Retrieved from

    http://search.proquest.com/docview/520194804?accountid=458

Chia, R. (2014). From relevance to relevate. *The Journal of Management*

    Development, 33(5), 443-455. doi:http://dx.doi.org/10.1108/JMD-02-2014-0013

Christensen, L., Johnson, B. & Turner, L. (2014). *Research methods, design, and analysis.*

    Boston: Pearson.

Central Intelligence Agency. (2011). World Fact Book. Economy-Overview. Retrieved from

    https://www.cia.gov/library/publications/the-world-factbook/geos/td.html

Clark, I. (2010). Formative assessment: 'there is nothing so practical as a good

    theory'. *Australian Journal of Education, 54*(3), 341-352. Retrieved from

    http://search.proquest.com/docview/819183192?accountid=458

Cosh, A., & Hughes, A. (2010). Never mind the quality feel the width: University-industry

    links and government financial support for innovation in small high-technology

    businesses in the UK and the USA. *Journal of Technology Transfer, 35*(1), 66-91.

    doi:http://dx.doi.org/10.1007/s10961-009-9110-x

da Costa, R. L., & António, N. S. (2011). The "outsourcing" as an instrument of

    competitiveness in the business consulting industry. *Journal of Management*

    Research, 3(1), 1-13. Retrieved from

    http://search.proquest.com/docview/845798219?accountid=458

Dawe, R. A., Wilson, B., & Rajpaulsingh, W. (2007). A professional engineering degree in petroleum geoscience to satisfy Caribbean industry. *Journal of Geoscience Education, 55*(2), 181-190. Retrieved from http://search.proquest.com/docview/202779961?accountid=458

Dawson, R., & Lavori, P. W. (2010). Sample size calculations for evaluating treatment policies in multi-stage designs. *Clinical Trials, 7*(6), 643-52. doi:http://dx.doi.org/10.1177/1740774510376418

De Geest, S., Marx, E., Rich, V., Spichiger, E., Schwendimann, R., Spirig, R., & Van Malderen, G. (2010). Developing a financial framework for academic service partnerships: Models of the United States and Europe. *Journal of Nursing Scholarship, 42*(3), 295-304. Retrieved from http://search.proquest.com/docview/755431393?accountid=458

Dervarics, C. (2010). With high demand, pell grant program faces challenges. *Diverse Issues in Higher Education, 27*(23), 6. Retrieved from http://search.proquest.com/docview/822169472?accountid=458

D'Este, P., Mahdi, S., Neely, A. D., & Rentocchini, F. (2011). *Inventors and entrepreneurs in academia: What types of skills and experience matter?* Rochester: Social Science Research Network. doi: http://dx.doi.org/10.2139/ssrn.1951845

Dougherty, K. J., Natow, R. S., Bork, R. H., Jones, S. M., & Vega, B. E. (2013). Accounting for higher education accountability: Political origins of state performance funding for higher education. *Teachers College Record, 115*(1), 1. Retrieved from http://search.proquest.com/docview/1266433874?accountid=458

Douglass, R. H. (2011). The effectiveness of web-based homework for developmental

    mathematics students at a New England community college. *University of Phoenix).*

    ProQuest Dissertations and Theses, 141. Retrieved from

    http://search.proquest.com/docview/992999382?accountid=35812. (992999382).

Dumi, A. R., Sinaj, M. Z., & Kociu, M. B. (2014). The collaboration of higher education

    schools and SME's institutional structure development. *Journal of Educational and*

    Social Research, 4(1), 11-18. Retrieved from

    http://search.proquest.com/docview/1530634149?accountid=458

Edwards, A. (2010). Applying learning organizations to the classroom. *Academy of*

    Educational Leadership Journal, 14(4), 1-20. Retrieved from

    http://search.proquest.com/docview/763256529?accountid=458

Etzkowitz, H., & Goktepe-Hulten, D. (2010). Maybe they can? University technology

    transfer offices as regional growth engines. *International Journal of Technology*

    Transfer & Commercialization, 9(1), 166. Retrieved from

    http://search.proquest.com/docview/219305313?accountid=458

Etzkowitz, H., & Leydesdorff, L. (2001). The transformation of university-industry-

    government relations. *Electronic Journal of Sociology*, *5*(4), 0. Retrieved from

    http://search.proquest.com/docview/196314785?accountid=458

Felder, R. M., Brent, R., & Prince, M. J. (2011). Engineering instructional development:

    Programs, best practices, and recommendations. *Journal of Engineering*

    Education, 100(1), 89-122. Retrieved from

    http://search.proquest.com/docview/857255394?accountid=458

Fernández-esquinas, M., & Ramos-vielba, I. (2012). Beneath the tip of the iceberg: Exploring
the multiple forms of university-industry linkages. *Higher Education*, *64*(2), 237-265.
doi:http://dx.doi.org/10.1007/s10734-011-9491-2

Flipse, S. M., van der Sanden, Maarten C. A., & Osseweijer, P. (2014). Setting up spaces for
collaboration in industry between researchers from the natural and social
sciences. *Science and Engineering Ethics, 20*(1), 7-22.
doi:http://dx.doi.org/10.1007/s11948-013-9434-7

Franco, M., Haase, H., & Lautenschläger, A. (2010). Students' entrepreneurial intentions: An
inter-regional comparison. *Education & Training, 52*(4), 260-275.
doi:http://dx.doi.org/10.1108/00400911011050945

Furlonge, H., & Kaiser, M. (2010). Overview of natural gas sector developments in Trinidad
and Tobago. *International Journal of Energy Sector Management*, *4*(4), 535-554.
doi:http://dx.doi.org/10.1108/17506221011092779

Gacel-Ávila, J. (2012). Comprehensive internationalization in Latin America. *Higher
Education Policy, 25*(4), 493-510. doi:
http://dx.doi.org/10.1057/hep.2012.9

Gera, R. (2012). Bridging the gap in knowledge transfer between academia and practitioners.
The International Journal of Educational Management, 26(3), 252-273. doi:
http://dx.doi.org/10.1108/09513541211213336

Gildersleeve, R. E. (2010). A primer on capitalist practice for a modern research
university. *Academe, 96*(6), 59-60, 3. Retrieved from
http://search.proquest.com/docview/816423449?accountid=458

Greitzer, E. M., Pertuze, J. A., Calder, E. S., & Lucas, W. A. (2010). Best practices for

industry-university collaboration. *MIT Sloan Management Review, 51*(4), 83-90.

Retrieved from http://search.proquest.com/docview/633322645?accountid=458

Halilem, N. (2010). Inside the triple helix: An integrative conceptual framework of the

academic researcher's activities, a systematic review. *Journal of Research*

Administration, 41(3), 23-50, 5. Retrieved from

http://search.proquest.com/docview/1013881527?accountid=458

Hall, D. (2010, Feb 09). Industry meets academia; plotting the future of manufacturing. *The*

Windsor Star Retrieved from

http://search.proquest.com/docview/253576450?accountid=458

Haq, S. M. A. (2012). Knowledge-based development and its relation to economic prosperity

in developing countries. *Asian Social Science, 8*(12), 36-47. Retrieved from

http://search.proquest.com/docview/1081341923?accountid=458

Hegarty, P. M., Kelly, H. A., & Walsh, A. (2011). Reflection in a workplace qualification:

Challenges and benefits. *Journal of Workplace Learning*, 23(8), 531-540. doi:

http://dx.doi.org/10.1108/13665621111174889

Heinzl, J., Kor, A., Orange, G., & Kaufmann, H. R. (2013). Technology transfer model for

Austrian higher education institutions. *Journal of Technology Transfer, 38*(5), 607-

640. doi:http://dx.doi.org/10.1007/s10961-012-9258-7

Hilliard, A. (2012). Sharing resources: Benefits of university partnerships to improve

teaching, learning and research. *Journal of International Education Research*, 8(1),

63-n/a. Retrieved from

http://search.proquest.com/docview/1433377902?accountid=458

Howard, D. J., & Laird, F. N. (2013). The new normal in funding university science. *Issues in Science and Technology*, *30*(1), 71-76. Retrieved from

http://search.proquest.com/docview/1508507428?accountid=458

Howard, T., Lee, M., & Wilson, A. (2014). Future scenarios for management education. *The Journal of Management Development, 33*(5), 503-519.

doi:http://dx.doi.org/10.1108/JMD-02-2014-0018

Howell, D. C. (2010). *Statistical methods for psychology* (7th ed.). Belmont CA: Wadsworth Cengage Learning.

Igun, S. E. (2011). Bridging of digital divide in Africa. *International Journal of Information and Communication Technology Education, 7*(1), 11. Retrieved from

http://search.proquest.com/docview/837357677?accountid=458

Jeffrey, L. M., Hide, S., & Legg, S. (2010). Learning characteristics of small business managers: Principles for training. *Journal of Workplace Learning, 22*(3), 146-165.

doi:http://dx.doi.org/10.1108/13665621011028602

Jeung, C., Yoon, H. J., Park, S., & Jo, S. J. (2011). The contributions of human resource development research across disciplines: A citation and content analysis. *Human Resource Development Quarterly, 22*(1), 87. Retrieved from

http://search.proquest.com/docview/858319522?accountid=458

Jiang, N., & Carpenter, V. (2013). A case study of issues of strategy implementation in internationalization of higher education. *The International Journal of Educational Management*, *27*(1), 4-18. doi:

http://dx.doi.org/10.1108/09513541311289792

Jin, J., Wu, S., & Chen, J. (2011). International university-industry collaboration to bridge

    R&D globalization and national innovation system in China9130. *Journal of*

    Knowledge Based Innovation in China, 3(1), 5-14.

    doi:http://dx.doi.org/10.1108/17561411111120837

Jones, J. (2010). How will education funding and policy fare in a republican

    congress? *Diverse Issues in Higher Education, 27*(21), 6-7. Retrieved from

    http://search.proquest.com/docview/815307910?accountid=458

Kahn, P., Petichakis, C., & Walsh, L. (2012). Developing the capacity of researchers for

    collaborative working. *International Journal for Researcher Development*, *3*(1), 49-

    63. doi:

    http://dx.doi.org/10.1108/17597511211278643

Kauppinen, I. (2012). Towards transnational academic capitalism. *Higher Education*, *64*(4),

    543-556. doi:

    http://dx.doi.org/10.1007/s10734-012-9511-x

Kile, J. (2012). *Exploring industry perceptions of the development and sustainability of*

    academia-industry advanced technological education partnerships. (3524362, Baylor

    University). *ProQuest Dissertations and Theses,* 306. Retrieved from

    http://search.proquest.com/docview/1080789588?accountid=458. (1080789588).

Kim, S. E., & Urpelainen, J. (2014). Technology competition and international co-operation:

    Friends or foes? *British Journal of Political Science, 44*(3), 545-574.

    doi:http://dx.doi.org/10.1017/S0007123412000762

Kirkman, D. M. (2013). Survival and growth motivations as predictors of university-
biotechnology technology transfer activities. *Journal of Entrepreneurship
Education, 16*, 33-57. Retrieved from
http://search.proquest.com/docview/1464981657?accountid=458

Kishel, P. G. (2011). Wikibrands: Reinventing your company in a customer-driven
marketplace. *Choice, 48*(10), 1966. Retrieved from
http://search.proquest.com/docview/870629097?accountid=458

Kleinman, I. (2010). *Academic capitalism and the community college.* (Order No. 3409029,
The University of Alabama). *ProQuest Dissertations and Theses, ,* 148. Retrieved
from http://search.proquest.com/docview/610145047?accountid=458. (610145047).

Kodelja, Z. (2012). Religious education and the teaching about religions. *Solsko Polje*, *23*(1),
253-261,279-280,296. Retrieved from
http://search.proquest.com/docview/1352856946?accountid=458

Kretz, A., & Sá, C. (2013). Third stream, fourth mission: Perspectives on university
engagement with economic relevance. *Higher Education Policy*, *26*(4), 497-506. doi:
http://dx.doi.org/10.1057/hep.2013.32

Krimsky, S. (2010). The entrepreneurial university. *Academe, 96*(6), 2-3. Retrieved from
http://search.proquest.com/docview/816430690?accountid=458

Kumar, A., & Ganesh, L. S. (2011). Inter-individual knowledge transfer and performance in
product development. *The Learning Organization, 18*(3), 224-238. doi:
http://dx.doi.org/10.1108/09696471111123270

Lam, E. (2011). Sharing best practices in Barbados and Trinidad and Tobago: Patterns of

    policy implementation and resistance. *Compare, 41*(1), 25. Retrieved from

    http://search.proquest.com/docview/848012593?accountid=458

Larbi-Apau, J., & Moseley, James L. (2010). Performance-based measurement: Action for

    organizations and accountability. *Performance Improvement, 49*(1), 7. Retrieved

    from http://search.proquest.com/docview/237243052?accountid=458

Larbi-Apau, J., & Sarpong, D. (2010). Performance measurement: Does education impact

    productivity? *Performance Improvement Quarterly, 22*(4), 81. Retrieved from

    http://search.proquest.com/docview/218560350?accountid=458

Lea, R. (2010). BP, corporate R&D, and the university. *Academe, 96*(6), 20-21, 3. Retrieved

    from http://search.proquest.com/docview/816430695?accountid=458

Lee, S. J., & Ngo, T. H. (2012). Riccardo Viale and Henry Etzkowitz (eds): The

    capitalization of knowledge: A triple helix of university-industry-government. *Higher*

    Education, 63(1), 161-163. doi:http://dx.doi.org/10.1007/s10734-011-9427-x

Lehtimäki, H., & Peltonen, T. (2013). Relations of power and knowledge: University-

    industry relations in business studies in Finland. *Higher Education*, *66*(2), 203-216.

    doi:http://dx.doi.org/10.1007/s10734-012-9599-z

Leslie, L. L., Slaughter, S., Taylor, B. J., & Zhang, L. (2012). How do revenue variations

    affect expenditures within U.S. research universities? *Research in Higher*

    Education, *53*(6), 614-639. doi:http://dx.doi.org/10.1007/s11162-011-9248-x

Lillis, D., & Lynch, M. (2014). New challenges for strategy development in Irish higher

    education institutions. *Higher Education Policy, 27*(2), 279-300.

    doi:http://dx.doi.org/10.1057/hep.2013.23

Lin, D., Hsieh, Y., Hsieh, Y., & Lai, W. (2012). Technical manpower training strategies for small and medium enterprises through innovation and incubation centers-Taiwanese experience. *The Journal of Human Resource and Adult Learning*, *8*(1), 119-127. Retrieved from

http://search.proquest.com/docview/1285154767?accountid=458

Lind, F., Styhre, A., & Aaboen, L. (2013). Exploring university-industry collaboration in research centres. *European Journal of Innovation Management, 16*(1), 70-91. doi:http://dx.doi.org/10.1108/14601061311292869

Link, A. N., & Scott, J. T. (2012). The small business innovation research program. *Issues in Science and Technology*, *28*(4), 89-92. Retrieved from

http://search.proquest.com/docview/1035326272?accountid=458

Mattessich, P.N., & Mansey, B.R. (1992*). Collaboration: What makes it work.* Minnesota: Amherst H. Wilder Foundation.

McKeown-Moak, M. P. (2013). The "New" Performance Funding in Higher Education. *Educational Considerations*, *40*(2), 3-12.

McLendon, M. K., & Hearn, J. C. (2013). The resurgent interest in performance-based funding for higher education. *Academe*, *99*(6), 25-30. Retrieved from

http://search.proquest.com/docview/1465267592?accountid=458

Metcalfe, A. S. (2010). Revisiting academic capitalism in Canada: No longer the exception. *The Journal of Higher Education, 81*(4), 489. Retrieved from

http://search.proquest.com/docview/744487673?accountid=458

Meyer, G. D. (2011). The reinvention of academic entrepreneurship. *Journal of Small Business Management, 49*(1), 1-8. Retrieved from http://search.proquest.com/docview/852775102?accountid=458

Ministry of Planning and the Economy (2012). Working for Sustainable development in Trinidad and Tobago. Retrieved from http://www.planning.gov.tt/sites/default/files/content/mediacentre/documents/Working%20for%20Sustainable%20Development%20in%20Trinidad%20and%20Tobago.pdf

Moneta, L. (2010). The entrepreneurial domains of American higher education. *Review of Higher Education, 33*(2), 295-296. Retrieved from http://search.proquest.com/docview/220846571?accountid=458

Nejad, B. A., Abbaszadeh, M. M. S., Hassani, M., & Bernousi, I. (2012). Study of the entrepreneurship in universities as learning organization based on Senge model. *International Education Studies*, *5*(1), 67-77. Retrieved from http://search.proquest.com/docview/1009899588?accountid=458

Nelson, C. (2011). The last chance. *Academe, 97*(1), 48. Retrieved from http://search.proquest.com/docview/847666264?accountid=458

Nino, L. (2011). Ideological and historical challenges in business education. *American Journal of Business Education, 4*(1), 19-27. Retrieved from http://search.proquest.com/docview/851373459?accountid=458

Öcal, S. D. (2013). Problems between universities and educational research and development companies at techno centers. *Journal of Education and Future,* (4), 87-107. Retrieved from http://search.proquest.com/docview/1470365184?accountid=458

137

Oleforo, N. A., Oko, D. E., & Akpan, E. G. (2013). Entrepreneurship training programme in

    universities and graduates' productivity in south-south Nigeria. *International*

    Education Studies, 6(7), 260-266. Retrieved from

    http://search.proquest.com/docview/1448006957?accountid=458

O'Rafferty, S., Curtis, H., & O'Connor, F. (2014). Mainstreaming sustainability in design

    education - a capacity building framework. *International Journal of Sustainability in*

    Higher Education, 15(2), 169-187. Retrieved from

    http://search.proquest.com/docview/1508308651?accountid=458

Orecchini, F., Valitutti, V., & Vitali, G. (2012). Industry and academia for a transition

    towards sustainability: Advancing sustainability science through university-business

    collaborations. *Sustainability Science, 7*, 57-73. doi:

    http://dx.doi.org/10.1007/s11625-011-0151-3

Örtenblad, A., & Koris, R. (2014). Is the learning organization idea relevant to higher

    educational institutions? A literature review and a "multi-stakeholder contingency

    approach". *The International Journal of Educational Management, 28*(2), 173-214.

    doi:http://dx.doi.org/10.1108/IJEM-01-2013-0010

Osiri, J. K., McCarty, M. M., & Jessup, L. (2013). Entrepreneurial Culture in Institutions of

    Higher Education: Impact on Academic Entrepreneurship. *Journal of*

    Entrepreneurship Education, *16*, 1-11. Retrieved from

    http://search.proquest.com/docview/1464981631?accountid=458

Parhizgar, K. D. (2010). Comparative ethical analysis of educational competition in

    academia. *Competitiveness Review, 20*(1), 72-84.

    doi:http://dx.doi.org/10.1108/10595421011019993

Pfotenhauer, S. M., Jacobs, J. S., Pertuze, J. A., Newman, D. J., & Roos, D. T. (2013).
Seeding change through international university partnerships: The MIT-Portugal program as a driver of internationalization, networking, and innovation. Higher Education Policy, *26*(2), 217-242. doi:
http://dx.doi.org/10.1057/hep.2012.28

Qureshi, T. M., Shaukat, M. Z., & Hijazi, S. T. (2010). Service quality SERVQUAL model in higher educational institutions, what factors are to be considered? *Interdisciplinary Journal of Contemporary Research in Business, 2*(5), 281-290. Retrieved from http://search.proquest.com/docview/815310197?accountid=458

Roberts, A., Chou, P., & Ching, G. (2010). Contemporary trends in East Asian higher education: Dispositions of international students in a Taiwan university. *Higher Education, 59*(2), 149-166. doi:http://dx.doi.org/10.1007/s10734-009-9239-4

Rossi, F. (2010). Massification, competition and organizational diversity in higher education: Evidence from italy.*Studies in Higher Education, 35*(3), 277. Retrieved from http://search.proquest.com/docview/219521049?accountid=458

Ryan, A., Tilbury, D., Peter, B. C., Abe, O., & Nomura, K. (2010). Sustainability in higher education in the Asia-pacific: Developments, challenges, and prospects. *International Journal of Sustainability in Higher Education, 11*(2), 106-119. doi:http://dx.doi.org/10.1108/14676371011031838

Sá, C., M. (2011). Redefining university roles in regional economies: A case study of university-industry relations and academic organization in nanotechnology. *Higher Education, 61*(2), 193-208. doi:http://dx.doi.org/10.1007/s10734-010-9332-8

Salter, B., & Faulkner, A. (2011). State strategies of governance in biomedical innovation: Aligning conceptual approaches for understanding 'rising powers' in the global context. *Globalization and Health, 7*, 3. doi:http://dx.doi.org/10.1186/1744-8603-7-3

Saltz, J., Serva, M. A., & Heckman, R. (2013). The GET immersion experience: A new model for leveraging the synergies between industry and academia. *Journal of Information Systems Education*, *24*(2), 121-131. Retrieved from http://search.proquest.com/docview/1462047076?accountid=458

Sandberg, A., Pareto, L., & Arts, T. (2011). Agile collaborative research: Action principles for industry-academia collaboration. *IEEE Software, 28*(4), 74-83. doi:http://dx.doi.org/10.1109/MS.2011.49

Schensul, J. J. (2010). Engaged universities, community based research organizations and third sector science in a global system. *Human Organization, 69*(4), 307-320. Retrieved from http://search.proquest.com/docview/819207704?accountid=458

Sirat, M. B. (2010). Strategic planning directions of Malaysia's higher education: University autonomy in the midst of political uncertainties. *Higher Education, 59*(4), 461-473. doi:http://dx.doi.org/10.1007/s10734-009-9259-0

Smith, K., & Beasley, M. (2011). Graduate entrepreneurs: Intentions, barriers and solutions. *Education & Training*, *53*(8), 722-740. doi: http://dx.doi.org/10.1108/00400911111185044

Spraggins, A. M. (2010). The twenty-first century university: Developing faculty engagement in internationalization. *International Journal of Educational Advancement, 10*(2), 119-122. doi:http://dx.doi.org/10.1057/ijea.2010.12

Stacey, S. W. (2014). Campus sustainability plans in the United States: Where, what, and

    how to evaluate? *International Journal of Sustainability in Higher Education, 15*(2),

    228-241. Retrieved from

    http://search.proquest.com/docview/1508308741?accountid=458

Stein, S. J., Shephard, K., & Harris, I. (2011). Conceptions of e-learning and professional

    development for e-learning held by tertiary educators in New Zealand. *British*

    Journal of Educational Technology, 42(1), 145-165.

    doi:http://dx.doi.org/10.1111/j.1467-8535.2009.00997.x

Smyth, R. (2011). Enhancing learner-learner interaction using video communications in

    higher education: Implications from theorizing about a new model. *British Journal of*

    Educational Technology, 42(1), 113-127. doi:http://dx.doi.org/10.1111/j.1467-

    8535.2009.00990.x

Szolár, É. (2011). The Bologna process: The reform of the European higher education

    systems. *Romanian Journal of European Affairs, 11*(1), 81-99. Retrieved from

    http://search.proquest.com/docview/857720911?accountid=458

Su, H. J., & Chang, T. (2010). Sustainability of higher education institutions in

    Taiwan. *International Journal of Sustainability in Higher Education, 11*(2), 163-172.

    doi:http://dx.doi.org/10.1108/14676371011031883

Tahiru, H. (2014). Ghana's Oil Exploration Quagmire. *The Chronicle,* April 2014.

Teng, H. (2010). University-industry technology transfer: Framework and

    constraints. *Journal of Sustainable Development, 3*(2), 296-300. Retrieved from

    http://search.proquest.com/docview/818852910?accountid=458

The University of the West Indies. (2009). Statistical review academic year 2008-2009.

> Retrieved from http://www.mona.uwi.edu/opair/statistics/2008-
>
> 2009/UWI+2009+Statistics+Review%20(2).pdf

Thomas, M., & Soares, J. (2009). Increasing Public Access to University Qualifications:

> Evolution of the University of the West Indies Open Campus. The International
>
> Review of Research in Open and Distance Learning, 10(1), Article 10.1.3. Retrieved
>
> from http://www.irrodl.org/index.php/irrodl/article/view/537/1184

United Nations Education, Scientific, and Cultural Organization – International Bureau of

> Education (UNESCO-IBE). (2010). *World Data on Education VII Ed. 2010/11.*
>
> Retrieved from
>
> http://www.ibe.unesco.org/fileadmin/user_upload/Publications/WDE/2010/pdf-
>
> versions/Trinidad_and_Tobago.pdf

Valdivia, W. D. (2011). Equity Considerations in the Assessment of the Bayh-Dole

> Act. *ProQuest LLC*.

Vogt, P. (2007). *Quantitative research methods for professionals.* Boston, MA: Pearson.

Wagner, C. G., McGuinness, W., Yonck, R., & Roberts, W. A. (2010). Sustainable futures,

> strategies, and technologies. *The Futurist, 44*(6), 47-55. Retrieved from
>
> http://search.proquest.com/docview/757071175?accountid=458

Wang, L., Muhos, M., & Kess, P. (2011). Exploiting enterprise-university cooperation in the

> internationalization process of SMEs. *Journal of US - China Public*
>
> *Administration, 8*(8) Retrieved from
>
> http://search.proquest.com/docview/1465055997?accountid=458

Washburn, J. (2011). Academic freedom and the corporate university. *Academe, 97*(1), 8-13,3. Retrieved from http://search.proquest.com/docview/847665728?accountid=458

Wright, T. (2010). University presidents' conceptualizations of sustainability in higher education. *International Journal of Sustainability in Higher Education, 11*(1), 61-73. doi:http://dx.doi.org/10.1108/14676371011010057

Wu, H., Chen, J., & Chen, I. -. (2012). Ways to promote valuable innovation: Intellectual capital assessment for higher education system. *Quality and Quantity*, *46*(5), 1377-1391. doi:

http://dx.doi.org/10.1007/s11135-011-9451-z

Xu, H. (2011). Students' perceptions of university education - USA vs. China. *Research in Higher Education Journal, 10*, 1-10. Retrieved from

http://search.proquest.com/docview/847386669?accountid=458

Yang, Q., & Li, B. (2012). Research on the industry-academia-research cooperation mechanism of local university and college-take Changchun University of science and technology as an example. *Higher Education Studies, 2*(3), 88-91. Retrieved from http://search.proquest.com/docview/1045497472?accountid=458

Yang, R., & Welch, A. (2012). A world-class university in China? The case of Tsinghua. *Higher Education*, *63*(5), 645-666. doi:

http://dx.doi.org/10.1007/s10734-011-9465-4

Yates, R. (2010). The South Africa project, aviation educational initiative. *Research in Higher Education Journal, 9*, 1-5. Retrieved from

http://search.proquest.com/docview/760989865?accountid=458

Yean T, S. (2010). Trade in higher education services in Malaysia: Key policy

   challenges. *Higher Education Policy, 23*(1), 99-122.

   doi:http://dx.doi.org/10.1057/hep.2009.22

Yusof, M., & Jain, K. K. (2010). Categories of university-level entrepreneurship: A literature

   survey. *International Entrepreneurship and Management Journal, 6*(1), 81-96. doi:

   http://dx.doi.org/10.1007/s11365-007-0072-x

Zahra, A., & Pavia, C. (2012). A unique approach to work-integrated learning: Meeting

   industry, student and educator needs through academic and experiential elements. The

   ACPET *Journal for Private Higher Education*, *1*(2), 41-49. Retrieved from

   http://search.proquest.com/docview/1272300250?accountid=458

Zheng, P. (2010). The "second academic revolution": Interpretations of academic

   entrepreneurship. *The Canadian Journal of Higher Education, 40*(2), 35-50.

   Retrieved from http://search.proquest.com/docview/814375827?accountid=458

Appendix A

Permission to Use Premises, Name, and Subjects

University of Phoenix®

PREMISES, RECRUITMENT AND NAME (PRN) USE PERMISSION

Professional Education Unit, The University of Trinidad and Tobago.

Please complete the following by check marking any permissions listed here that you approve, and please provide your signature, title, date, and organizational information below. If you have any questions or concerns about this research study, please contact the University of Phoenix Institutional Review Board via email at IRB@phoenix.edu.

☑ I hereby authorize Zameer Mohammed, a student of University of Phoenix, to use the premises (facility identified below) to conduct a study entitled Industry-Academia Collaborations – Implications for Trinidad and Tobago

☑ I hereby authorize Zameer Mohammed, a student of University of Phoenix, to recruit subjects for participation in a conduct a study entitled Industry-Academia Collaborations – Implications for Trinidad and Tobago

☑ I hereby authorize Zameer Mohammed, a student of University of Phoenix, to use the name of the facility, organization, university, institution, or association identified above when publishing results from the study entitled Industry-Academia Collaborations – Implications for Trinidad and Tobago.

Signature

Date 10 July 2013.

Mr. Navin Boodhai

Name   THE UNIVERSITY OF TRINIDAD AND TOBAGO

Vice President: Business Development & Marketing

Title

Address of Facility

UTT-PEU; Lot 1 Off Munroe Road Flyover; Charlieville; Trinidad

1

145

Appendix B

Informed Consent Form

UNIVERSITY OF PHOENIX

Dear (Name),

My name is Zameer Mohammed and I am a student at the University of Phoenix working on my Doctor of Education (Ed.D.) degree. I am conducting a research study entitled Industry-Academia collaborations: Implications for Trinidad and Tobago. The purpose of this quantitative study is to identify agreements/disagreements in stakeholder perceptions about the benefits of Industry-Academia collaborations. This study will specifically analyze the current state of Industry-Academia collaborative relationships in Trinidad and Tobago. The study will seek to

1. Identify agreements/disagreements in stakeholder perceptions about the benefits of Industry-Academia collaborations.

2. Analyze the current state of Industry-Academia collaborative relationships in Trinidad and Tobago, and

3. Identify critical success factors for future Industry-Academia collaborations.

Your participation will involve responding to a web-enabled survey. You will be expected to indicate your perceptions by responding to a series of questions on the survey instrument. The questions include several statements using the Likert format on issues of the importance of university/industry collaborations, current collaborative activities, and future success factors in industry/university collaborations. The data to be collected is purely based

146

on individual perceptions and no proprietary information will be collected. Your participation in this study is voluntary. If you choose not to participate or to withdraw from the study at any time, you can do so without penalty or loss of benefit to yourself. The results of the research study may be published but your identity will remain confidential and your name will not be disclosed to any outside party.

In this research, there are no foreseeable risks to you. There are no items in this instrument and in the entire study in which you will encounter the possibility of stress, psychological, social, physical, or legal risks. This research method does not use any visual or auditory stimuli, chemical substances or other measures that might create a risk to participants.

Although there may be no direct personal benefit to you, a possible benefit of your participation will be to assist senior administrators in higher education on matters of policy formulation with regards to collaborative models with industrial partners. The value of your contribution will add mutual institutional benefits to both industry and academia.

If you have any questions concerning the research study, please call me at 1 868 796 1902 or send me an email at zameermoha@gmail.com.

As a participant in this study, you should understand the following:

1. You may decline to participate or withdraw from participation at any time without consequences.
2. Your identity will be kept confidential.
3. Zameer Mohammed, the researcher, has thoroughly explained the parameters of the research study and all of your questions and concerns have been addressed.

4. If the interviews are recorded, you must grant permission for the researcher, Zameer Mohammed, to digitally record the interview. You understand that the information from the recorded interviews may be transcribed. The researcher will structure a coding process to assure that anonymity of your name is protected.

5. Data will be stored in a secure and locked area. The data will be held for a period of three years, and then destroyed.

6. The research results will be used for publication.

"By signing this form you acknowledge that you understand the nature of the study, the potential risks to you as a participant, and the means by which your identity will be kept confidential. Your signature on this form also indicates that you are 18 years old or older and that you give your permission to voluntarily serve as a participant in the study described."

Signature of the interviewee _____ Date _____

Signature of the researcher _____ Date _____

Appendix C

Instrument Cover Letter

Dear Participant,

My name is Zameer Mohammed and I am a doctoral student at the University of Phoenix. As part of my doctoral dissertation, I am conducting research on stakeholder perceptions in industry-academia relationships in Trinidad and Tobago. You were randomly selected from a list of graduate students who either attended the University of the West Indies or the University of Trinidad and Tobago or hold industry or academic positions at a minimum of supervisory level.

Your responses will be treated with confidentiality and no identifying designations will be associated with any of the responses you make. Your contribution through your participation in this survey will assist educational policy makers and industry leaders in better planning collaborative efforts between industry and academia in Trinidad and Tobago.

Your participation in this survey is purely voluntarily and you may choose to withdraw your participation at any time before or during the survey by closing this web-enabled survey without submission to the researcher. Should you wish to withdraw from the survey after submission of the questionnaire please contact the researcher, Zameer Mohammed at 1 868 796 1902 or email request to azmm@email.phoenix.edu and your responses will be expunged from the survey.

This web-enabled survey will take approximately 15 minutes to complete through the link provided. May I take this opportunity to thank you in advance for your participation.

Sincerely,

Zameer Mohammed
Researcher

Survey Instrument

University-Industry: Stakeholder Perceptions

This questionnaire is designed to analyze perceptions of senior stakeholders of industrial/academic organizations concerning the importance, current status, and potential areas for future enhancement of collaborative relationships between universities and industry in Trinidad and Tobago.

I have read and signed the informed consent letter prior to participating in this survey

1. Name (optional)

----

2. Choose an industry you are affiliated with (you may chose more than one)

O   Maritime   O   Energy

O   Process and Utilities   O   ICT

O   Manufacturing   O   Academic

3. Part One: On a scale of 1 (not very important) to 5 (very important) indicate the level of importance on for each of the goals that may require collaborative effort between industry and academia.

Relevance of instructional programs to industrial need	1	2	3	4	5
Employment opportunities for students	1	2	3	4	5
Enhancement of basic research (knowledge production)	1	2	3	4	5
Enhancement of applied research (technology development)	1	2	3	4	5
Increased access to state of the art facilities and equipment	1	2	3	4	5
Additional income for the university	1	2	3	4	5

4. On a scale of 1 (very low) to 5 (very high) indicate the possibility for potential benefits to universities if they (universities) collaborate with Industry in Trinidad and Tobago

Assists in fulfilling the institutional mission	1	2	3	4	5
Improved instructional programs	1	2	3	4	5
Improved employment prospects for students	1	2	3	4	5
Practical hands on experience for students	1	2	3	4	5
Increase faculty awareness of industry needs	1	2	3	4	5
Consulting opportunities for faculty	1	2	3	4	5
Source of part time faculty from industry	1	2	3	4	5
Improved institutional entrepreneurial skills	1	2	3	4	5
Improved institutional reputation	1	2	3	4	5

5. On a scale of 1 (very low) to 5 (very high) indicate the possibility for potential benefits to Industries if they (industries) collaborate with universities in Trinidad and Tobago

Access to professional expertise	1	2	3	4	5
Access to specialized facilities	1	2	3	4	5
Access to broader recruitment pool	1	2	3	4	5
Improved opportunity for in-service training	1	2	3	4	5
Customized education and training programs	1	2	3	4	5
Enhanced reputation	1	2	3	4	5
Gain and/or sustain competitive advantage	1	2	3	4	5
Reduced time between innovation and commercialization	1	2	3	4	5
Reduced in-service training costs per employee	1	2	3	4	5
Solution to technical problems	1	2	3	4	5

6. Part Two: Current Collaborative Activities: On a scale of 1 (not very often) to 5 (very often) how often do you consult the following sources of information about potential collaborative opportunities between industry and university

Individual faculty initiatives	1	2	3	4	5
Special services from universities	1	2	3	4	5
Professional publications	1	2	3	4	5
Meetings with university representatives	1	2	3	4	5
Representatives on university governing boards	1	2	3	4	5
Joint technical committees	1	2	3	4	5
Joining professional organizations	1	2	3	4	5
Government initiatives	1	2	3	4	5

7. On a scale of 1 (very low) to 5 (very high) what is your level of satisfaction between industry and academia for each of the following features

University's emphasis on collaborative relations with your company	1	2	3	4	5
Specifications of planning of relationship activities with universities	1	2	3	4	5
Enforcement of procedures regulating collaborative activities	1	2	3	4	5
Performance of university personnel responsible for facilitating collaborative programs with industry	1	2	3	4	5
Support of the government in university-industry relations	1	2	3	4	5
Willingness of your company's leaders to collaborate with universities	1	2	3	4	5
Role of professional associations in supporting collaborative programs	1	2	3	4	5
University's focus in supporting your company's needs	1	2	3	4	5
University's emphasis on supporting small business organizations	1	2	3	4	5
Role of individual faculty members in collaborative agreements and development	1	2	3	4	5

8. On a scale of 1 (very low) to 5 (very high) to what extent does each of the following strategies support collaborative practices between industry and university in Trinidad and Tobago

Involving senior administrators from the initial stages of collaborative activities	1	2	3	4	5
Developing a network for reporting communication and mediation	1	2	3	4	5
Employment of project management techniques	1	2	3	4	5
Reporting the results widely	1	2	3	4	5
Designating a partnership coordinator	1	2	3	4	5

9. On a scale of 1 (very low) to 5 (very high) indicate the extent to which the following types of collaborative activities between university and industry exist in Trinidad and Tobago

Your company's representation on university governing boards	1	2	3	4	5
Joint committees	1	2	3	4	5
Joint revision and assessment of curriculum	1	2	3	4	5
Cooperative education programs	1	2	3	4	5
Your company's employment of student interns	1	2	3	4	5
Recruitment of recent university graduates	1	2	3	4	5
Fellowships to university students	1	2	3	4	5
Training programs for your employees	1	2	3	4	5
University employment of your specialists as adjuncts	1	2	3	4	5
Regular mutual visits	1	2	3	4	5
Contract research	1	2	3	4	5
Management consulting by university faculty	1	2	3	4	5
Technological consulting arrangements	1	2	3	4	5
Jointly organized meetings, conferences, and seminars	1	2	3	4	5
Joint publications	1	2	3	4	5
Joint participation in exhibitions and fairs	1	2	3	4	5
Joint research and consortia	1	2	3	4	5
Technology business incubators	1	2	3	4	5
Technology licensing offices	1	2	3	4	5
Technology parks	1	2	3	4	5
Establishing spin off companies	1	2	3	4	5
Jointed owned and operated ventures	1	2	3	4	5
Equipment contributions to university	1	2	3	4	5
Financial grants to university	1	2	3	4	5
Your company's representation on university governing boards	1	2	3	4	5

10. On a scale of 1 (very low) to 5 (very high) indicate the degree of influence of each of the following factors on university-industry collaborative practices

Government policies or programs stimulating relations	1	2	3	4	5
Company's need for technology development and/or adaptation	1	2	3	4	5
Company's need for staff development	1	2	3	4	5
Local entrepreneurial climate	1	2	3	4	5
Teaching capacity of universities	1	2	3	4	5
Entrepreneurial culture within university	1	2	3	4	5
Reward system and incentives for university staff to collaborate	1	2	3	4	5
Traditional interaction between university and industry	1	2	3	4	5

11. On a scale of 1 (very low) to 5 (very high) indicate to what extent does each of the following present a barrier to collaborative practices between industry and university

Lack of communication	1	2	3	4	5
Lack of Leadership	1	2	3	4	5
Lack of commitment	1	2	3	4	5
Lack of clear understanding of the project	1	2	3	4	5
Lack of consistency in program management	1	2	3	4	5
Differences between institutional, academic, and industrial culture and values					
Unavailability of information about university services	1	2	3	4	5
University unawareness of problems encountered in industry	1	2	3	4	5
Bureaucratic procedures in the university	1	2	3	4	5
Inefficient reward systems	1	2	3	4	5
Overemphasis of universities on teaching	1	2	3	4	5
Loss of government funding	1	2	3	4	5
Lack of qualified personnel to manage relationship activities	1	2	3	4	5
Non-existence of intermediary bodies	1	2	3	4	5

Inefficient evaluation and monitoring mechanisms	1	2	3	4	5
Insufficient equipment	1	2	3	4	5
Insufficient facilities	1	2	3	4	5
Equipment depreciation	1	2	3	4	5
Loss of university's control	1	2	3	4	5

12. Part Three -The Future: On a scale of 1(strongly disagree) to 5 (strongly agree) indicate to what extent do you agree with the following statements on strengthening university-industry collaboration

Universities should improve their entrepreneurial skills	1	2	3	4	5
Industry leaders should serve on university governing boards	1	2	3	4	5
Universities should establish special policies in the domain of relationships with industry	1	2	3	4	5
Universities should build a capacity to manage collaborative relationships	1	2	3	4	5
Faculty members should periodically visit industry as part of their professional development	1	2	3	4	5
Universities should offer customized training programs for industry employees	1	2	3	4	5
The government should adopt a favorable policy to support collaborative relationships	1	2	3	4	5
The government should subsidize specific programs to stimulate collaborative relationships	1	2	3	4	5

13. On a scale of 1 (very low) to 5 (very high) indicate to what extent do each of the following factors contribute to the success of industry-university collaborations

Strength of each partner having something of value to contribute Fitness of collaborative activities in partners' strategic objectives and long-term goals	1	2	3	4	5
Existence of complimentary assets and skills in partners	1	2	3	4	5
Investment of partners in each other proving their long term commitment	1	2	3	4	5
Open flow of communication between partners	1	2	3	4	5

Establishment of broad connections linking many organizational levels in shared ways of operating	1	2	3	4	5
Formalization of status of relationship programs	1	2	3	4	5
Partners' honorable behavior and trust building	1	2	3	4	5

Thank you very much for your valuable contribution.

Appendix E

Frequency Tables for Research Question 1

Table 28

Frequencies and Percentages for Question 3 Items for Academic Participants

Q3: Indicate the level of importance for each of the goals that may require collaborative effort between industry and academia	*Response*	*N*	*%*
Relevance of instructional programs to industrial needs	3	2	3.1
	4	28	43.1
	5	35	53.8
Employment opportunities for students	3	4	6.3
	4	17	26.6
	5	43	67.2
Enhancement of basic research (knowledge production)	2	1	1.5
	3	5	7.7
	4	31	47.7
	5	28	43.1
Enhancement of applied research (technology development)	3	2	3.4
	4	31	47.7
	5	32	49.2
Increased access to state of the art facilities and equipment	3	7	10.8
	4	27	41.5
	5	31	47.7
Additional income for the university	2	2	3.1
	3	14	21.5
	4	29	44.6
	5	20	30.8

Table 29

Frequencies and Percentages for Question 4 Institutional for Academic Participants

Q4: Indicate the possibility for potential benefits to universities if they (universities) collaborate with industry in Trinidad and Tobago	*Response*	*N*	*%*
	3	11	16.7
Assists in fulfilling the institutional mission	4	27	40.9
	5	28	42.4
	2	2	3.1
	3	9	13.8
Improved institutional entrepreneurial skills	4	31	47.7
	5	23	35.4
	1	1	1.5
	2	1	1.5
Improved institutional reputation	3	8	12.1
	4	27	40.9
	5	29	43.9

Table 30

Frequencies and Percentages for Question 4 Faculty and Students for Academic Participants

Q4: Indicate the possibility for potential benefits to universities if they (universities) collaborate with industry in Trinidad and Tobago	*Response*	*N*	*%*
	3	5	7.6
Improved instructional programs	4	27	40.9
	5	34	51.5
	3	4	6.1
Improved employment prospects for students	4	22	33.3
	5	40	60.6
	2	1	1.5
Practical hands on experience for students	4	19	29.2
	5	45	69.2
	4	21	31.8
Increase faculty awareness of industry needs	5	45	68.2
	1	1	1.5
	2	3	4.5
Consulting opportunities for faculty	3	11	16.7
	4	27	40.9
	5	24	36.4
	3	10	15.2
Source of part time faculty from industry	4	37	56.1
	5	19	28.8

Table 31

Frequencies and Percentages for Question 5 Institutional for Academic Participants

Q5: Indicate the possibility for potential benefits to industries if they (industries) collaborate with universities in Trinidad and Tobago	*Response*	*N*	*%*
Access to professional expertise	3	3	4.5
	4	25	37.9
	5	38	57.6
Access to specialized facilities	2	2	3
	3	10	15.2
	4	26	39.4
	5	28	42.4
Enhanced reputation	2	1	1.5
	3	11	16.7
	4	26	39.4
	5	28	42.4
Gain and/or sustain competitive advantage	2	2	3.1
	3	8	12.3
	4	33	50.8
	5	22	33.8
Reduced time between innovation and commercialization	2	4	6.1
	3	14	21.2
	4	30	45.5
	5	18	27.3
Solution to technical problems	2	1	1.5
	3	9	13.6
	4	36	54.5
	5	20	30.3

Table 32

Frequencies and Percentages for Question 5 Employee Learning and Development for Academic Participants

Q5: Indicate the possibility for potential benefits to industries if they (industries) collaborate with universities in Trinidad and Tobago	*Response*	*N*	*%*
Access to broader recruitment pool			
Neither high nor low	3	3	4.5
High	4	26	39.4
Very high	5	37	56.1
Improved opportunity for in-service training			
Neither high nor low	3	3	4.6
High	4	36	55.4
Very high	5	26	40
Customized education/training programs			
Neither high nor low	3	2	3
High	4	33	50
Very high	5	31	47
Reduced in-service training costs per employee			
Very low	1	1	1.5
Low	2	4	6.2
Neither high nor low	3	11	16.9
High	4	37	56.9
Very high	5	12	18.5

Appendix F

Frequency Tables for Research Question 2

Table 33

Frequencies and Percentages for Question 3 Items for Industry Participants

Q3: Indicate the level of importance for each of the goals that may require collaborative effort between industry and academia	*Response*	*N*	*%*
	3	3	4.5
Relevance of instructional programs to industrial needs	4	31	47
	5	32	48.5
Employment opportunities for students	3	3	4.5
	4	26	38.8
	5	38	56.7
	2	1	1.5
	3	7	10.4
Enhancement of basic research (knowledge production)	4	32	47.8
	5	27	40.3
	2	1	1.5
	3	4	6.1
Enhancement of applied research (technology development)	4	27	40.9
	5	34	51.5
	2	1	1.5
	3	8	11.9
Increased access to state of the art facilities and equipment	4	31	46.3
	5	27	40.3
	2	4	6
	3	23	34.3
Additional income for the university	4	27	40.3
	5	13	19.4

Table 34

Frequencies and Percentages for Question 4 Institutional for Industry Participants

Q4: Indicate the possibility for potential benefits to universities if they (universities) collaborate with industry in Trinidad and Tobago	*Response*	*N*	*%*
	3	9	13.4
Assists in fulfilling the institutional mission	4	33	49.3
	5	25	37.3
	3	9	13.4
Improved institutional entrepreneurial skills	4	30	44.8
	5	28	41.8
	2	2	3.1
Improved institutional reputation	3	6	9.2
	4	20	30.8
	5	37	56.9

Table 35

Frequencies and Percentages for Question 4 Faculty and Students for Industry Participants

Indicate the possibility for potential benefits to universities if they (universities) collaborate with industry in Trinidad and Tobago	*Response*	*N*	*%*
Improved instructional programs			
Low	2	2	3
Neither high nor low	3	12	17.9
High	4	24	35.8
Very High	5	29	43.3
Improved employment prospects for students			
Neither high nor low	3	9	13.4
High	4	23	34.3
Very High	5	35	52.2
Practical hands on experience for students			
High	4	23	34.3
Very high	5	44	65.7
Increase faculty awareness of industry needs			
Low	2	4	6.2
High	4	37	56.9
Very High	5	12	18.5
Consulting opportunities for faculty			
Neither high nor low	3	2	3.1
High	4	21	32.3
Very high	5	42	64.6
Source of part time faculty from industry			
Neither high nor low	3	6	9
High	4	45	67.2
Very high	5	16	23.9

Table 36

Frequencies and Percentages for Question 5 Institutional for Industry Participants

Indicate the possibility for potential benefits to industries if they (industries) collaborate with universities in Trinidad and Tobago	*Response*	*N*	*%*
Access to professional expertise	2	1	1.5
	3	4	6
	4	34	50.7
	5	28	41.8
Access to specialized facilities	2	2	3
	3	9	13.4
	4	37	55.2
	5	19	28.4
Enhanced reputation	2	1	1.5
	3	10	14.9
	4	34	50.7
	5	22	32.8
Gain and/or sustain competitive advantage	2	2	3
	3	9	13.4
	4	19	28.4
	5	37	55.2
Reduced time between innovation and commercialization	2	4	6
	3	8	11.9
	4	33	49.3
	5	22	32.8
Solution to technical problems	2	3	4.5
	3	14	21.2
	4	30	45.5
	5	19	28.8

Table 37

Frequencies and Percentages for Question 5 Employee Learning and Development for Industry Participants

Q5: potential benefits to industries if they (industries) collaborate with universities in Trinidad and Tobago	*Response*	*N*	*%*
Access to broader recruitment pool			
Neither high nor low	3	6	9
High	4	25	37.3
Very High	5	36	53.7
Improved opportunity for in-service training			
Neither high nor low	3	3	4.5
High	4	36	53.7
Very High	5	28	41.8
Customized education/training programs			
Low	2	1	1.5
Neither high nor low	3	5	7.5
High	4	29	43.3
Very high	5	32	47.8
Reduced in-service training costs per employee			
Low	2	2	3
Neither high nor low	3	16	23.9
High	4	26	38.8
Very high	5	23	34.3

Appendix G

Frequency Tables for Research Question 3

Table 38

Frequencies and Percentages for Question 6 Items for all Participants

How often do you consult the following sources of information about potential collaborative opportunities between industry and university	*Response*	*N*	*%*
Individual faculty initiatives	1	27	20.9
	2	51	39.5
	3	36	27.9
	4	12	9.3
	5	3	2.3
Special services from universities	1	28	21.7
	2	47	36.4
	3	39	30.2
	4	13	10.1
	5	2	1.6
Professional publications	1	14	10.9
	2	33	25.6
	3	41	31.8
	4	31	24
	5	10	7.8
Meetings with university representatives	1	31	24.4
	2	55	43.3
	3	29	22.8
	4	10	7.9
	5	2	1.6

Table 38

Frequencies and Percentages for Question 6 Items for all Participants (cont.)

How often do you consult the following sources of information about potential collaborative opportunities between industry and university	*Response*	*N*	*%*
Representatives on university governing boards	1	49	38.3
	2	54	42.2
	3	18	14.1
	4	5	3.9
	5	2	1.6
Joint technical committees	1	43	33.3
	2	48	37.2
	3	25	19.4
	4	11	8.5
	5	2	1.6
Joining professional organizations	1	23	18
	2	32	25
	3	43	33.6
	4	24	18.8
	5	6	4.7
Government initiatives	1	25	19.4
	2	38	29.5
	3	34	26.4
	4	21	16.3
	5	11	8.5

Table 39

Frequencies and Percentages for Question 7 Government Items for All Participants

What is your level of satisfaction between industry and academia for each of the following features	*N*	*%*
Support of the government in university-industry relations		
Very low	14	10.9
Low	33	25.8
Neither high nor low	43	33.6
High	33	25.8
Very high	5	3.9

Table 40

Frequencies and Percentages for Question 7 Planning Items for All Participants

What is your level of satisfaction between industry and academia for each of the following features	Response	N	%
University's emphasis on collaborative relations with company	1	24	18.5
	2	34	26.2
	3	55	42.3
	4	15	11.5
	5	2	1.5
Specifications of planning of relationship activities with universities	1	18	13.8
	2	38	29.2
	3	57	43.8
	4	14	10.8
	5	3	2.3
Role of professional associations in supporting collaborative programs	1	7	5.3
	2	36	27.1
	3	45	33.8
	4	38	28.6
	5	3	2.3
University's emphasis on supporting small business organizations	1	17	13.2
	2	32	24.8
	3	51	39.5
	4	24	18.6
	5	5	3.9

Table 40

Frequencies and Percentages for Question 7 Planning Items for All Participants (cont.)

What is your level of satisfaction between industry and academia for each of the following features	*Response*	*N*	*%*
	1	9	6.9
	2	38	29.2
Role of individual faculty members in collaborative agreement and development	3	57	43.8
	4	22	16.9
	5	4	3.1

Table 41

Frequencies and Percentages for Question 7 Commitment Items for All Participants

What is your level of satisfaction between industry and academia for each of the following features	*Response*	*N*	*%*
Enforcement of procedures regulating collaborative activities	1	18	13.8
	2	42	32.3
	3	56	43.1
	4	12	9.2
	5	2	1.5
Performance of university personnel responsible for facilitating collaborative programs with industry	1	12	9.2
	2	35	26.9
	3	62	47.7
	4	18	13.8
	5	3	2.3
Willingness of your company's leaders to collaborate with universities	1	14	10.9
	2	21	16.3
	3	42	32.6
	4	41	31.8
	5	11	8.5
University's focus in supporting company's needs	1	16	12.4
	2	26	20.2
	3	55	42.6
	4	29	22.5
	5	3	2.3

Table 42

Frequencies and Percentages for Question 8 Items for All Participants

To what extent do each of the following strategies support collaborative practices between industry and university in Trinidad and Tobago	*Response*	*N*	*%*
Involving senior administrators from the initial stages of collaborative activities			
Very low	1	3	2.3
Low	2	18	14
Neither high nor low	3	27	20.9
High	4	61	47.3
Very high	5	20	15.5
Developing a network for reporting communications and mediation			
Very low	1	5	3.9
Low	2	15	11.6
Neither high nor low	3	30	23.3
High	4	59	45.7
Very high	5	20	15.5
Employment of project management techniques			
Very low	1	6	4.7
Low	2	14	10.9
Neither high nor low	3	31	24
High	4	55	42.6
Very high	5	23	17.8
Reporting the results widely			
Very low	1	7	5.5
Low	2	22	17.2
Neither high nor low	3	26	20.3
High	4	55	39.1
Very high	5	23	18

Table 42

Frequencies and Percentages for Question 8 Items for All Participants (cont.)

To what extent do each of the following strategies support collaborative practices between industry and university in Trinidad and Tobago	*Response*	*N*	*%*
Designating a partnership coordinator			
Very low	1	8	6.2
Low	2	20	15.5
Neither high nor low	3	27	20.9
High	4	50	38.8
Very high	5	24	18.6

Table 43

Frequencies and Percentages for Question 9 Governance Items for All Participants

Indicate the extent to which the following types of collaborative activities between university and industry exist in Trinidad and Tobago	*Response*	*N*	*%*
Your company's representation on university governing boards	1	47	36.2
	2	39	30
	3	33	25.4
	4	7	5.4
	5	4	3.1
Joint committees	1	28	21.5
	2	43	33.1
	3	42	32.3
	4	15	11.5
	5	2	1.5
Regular mutual visits	1	42	32.3
	2	33	25.4
	3	40	30.8
	4	10	7.7
	5	5	3.8
Technology business incubators	1	44	33.8
	2	39	30
	3	38	29.2
	4	7	5.4
	5	2	1.5

Table 43

Frequencies and Percentages for Question 9 Governance Items for All Participants (cont.)

Indicate the extent to which the following types of collaborative activities between university and industry exist in Trinidad and Tobago	*Response*	*N*	*%*
Technology licensing offices	1	49	37.7
	2	35	26.9
	3	40	30.8
	4	6	4.6
	5	0	0
Technology parks	1	47	36.4
	2	36	27.9
	3	38	29.5
	4	6	4.7
	5	2	1.6
Establishing spinoff companies	1	55	42.6
	2	38	29.5
	3	31	24
	4	4	3.1
	5	1	0.8
Jointly owned and operated ventures	1	44	34.6
	2	42	33.1
	3	34	26.8
	4	4	3.1
	5	3	2.4

Table 43

Frequencies and Percentages for Question 9 Governance Items for All Participants (cont.)

Indicate the extent to which the following types of collaborative activities between university and industry exist in Trinidad and Tobago	*Response*	*N*	*%*
Financial grants to university	1	37	28.9
	2	33	25.8
	3	36	28.1
	4	15	10.9
	5	8	6.3

Table 44

Frequencies and Percentages for Question 9 Learning and Development Items for All
Participants

Indicate the extent to which the following types of collaborative activities between university and industry exist in Trinidad and Tobago	*Response*	*N*	*%*
Joint revision and assessment of curriculum	1	38	29.2
	2	40	30.8
	3	35	26.9
	4	15	11.5
	5	2	1.5
Cooperative education programs	1	27	20.8
	2	31	23.8
	3	38	29.2
	4	26	20
	5	8	6.2
Fellowships to university students	1	28	21.5
	2	38	29.2
	3	43	33.1
	4	15	11.5
	5	6	4.6
University employment of your specialists as adjuncts	1	36	27.5
	2	26	19.8
	3	45	34.4
	4	24	18.3
	5	0	0

Table 44

Frequencies and Percentages for Question 9 Learning and Development Items for All Participants (cont.)

Indicate the extent to which the following types of collaborative activities between university and industry exist in Trinidad and Tobago	*Response*	*N*	*%*
Management consulting by university faculty	1	39	29.8
	2	37	28.2
	3	43	32.8
	4	11	8.4
	5	1	0.8
Technological consulting arrangements	1	34	26.2
	2	36	27.7
	3	48	36.9
	4	10	7.7
	5	2	1.5
Joint publications	1	43	33.1
	2	40	30.8
	3	37	28.5
	4	7	5.4
	5	3	2.3
Equipment contributions to university	1	39	30.2
	2	38	29.5
	3	34	26.4
	4	13	10.1
	5	5	3.9

Table 45

Frequencies and Percentages for Question 9 National Priorities Items for All Participants

Indicate the extent to which the following types of collaborative activities between university and industry exist in Trinidad and Tobago	*Response*	*N*	*%*
Your company's employment of student interns	1	21	16
	2	23	17.6
	3	33	25.2
	4	39	29.8
	5	15	11.5
Recruitment of recent university graduates	1	14	10.7
	2	22	16.8
	3	39	29.8
	4	42	32.1
	5	14	10.7
Training programs for your employees	1	13	10
	2	35	26.9
	3	34	26.2
	4	40	30.8
	5	8	6.2
Contract research	1	38	29
	2	34	26
	3	42	32.1
	4	16	12.2
	5	1	0.8

Table 45

Frequencies and Percentages for Question 9 National Priorities Items for All Participants (cont.)

Indicate the extent to which the following types of collaborative activities between university and industry exist in Trinidad and Tobago	*Response*	*N*	*%*
Jointly organized meetings, conferences, and seminars	1	29	22.1
	2	36	27.5
	3	46	35.1
	4	16	12.2
	5	4	3.1
Joint participation in exhibitions and fairs	1	29	22.3
	2	38	29.2
	3	37	28.5
	4	20	15.4
	5	6	4.6
Joint research and consortia	1	44	33.8
	2	36	27.7
	3	40	30.8
	4	7	5.4
	5	3	2.3

Table 46

Frequencies and Percentages for Question 10 Governance Items for All Participants

Indicate the degree of influence of each of the following factors on university – industry collaborative practices	*Response*	*N*	*%*
	1	0	0
	2	13	10.2
Government policies or programs stimulating relations	3	29	22.7
	4	59	46.1
	5	27	21.1
	1	8	6.3
	2	14	11
Reward system and incentives for university staff to collaborate	3	38	29.9
	4	50	39.4
	5	17	13.4
	1	4	3.1
	2	17	13.3
Traditional interaction between university and industry	3	37	28.9
	4	53	41.4
	5	17	13.3

Table 47

Frequencies and Percentages for Question 10 National Priorities Items for All Participants

Indicate the degree of influence of each of the following factors on university – industry collaborative practices	*Response*	*N*	*%*
Company's need for technology development and/or adaptation	1	1	0.8
	2	12	9.4
	3	29	22.7
	4	61	47.7
	5	25	19.5
Local entrepreneurial climate	1	5	3.9
	2	12	9.4
	3	44	34.4
	4	47	36.7
	5	20	15.6
Entrepreneurial culture within university	1	4	3.1
	2	14	10.9
	3	30	23.4
	4	51	39.8
	5	29	22.7

Table 48

Frequencies and Percentages for Question 10 Learning and Development Items for All Participants

Indicate the degree of influence of each of the following factors on university – industry collaborative practices	*Response*	*N*	*%*
Company's need for staff development	1	1	0.8
	2	13	10.2
	3	22	17.3
	4	63	49.6
	5	28	22
Teaching capacity of universities	1	1	0.8
	2	9	7.1
	3	31	24.6
	4	57	45.2
	5	28	22.2

Table 49

Frequencies and Percentages for Question 11 Communication Items for All Participants

To what extent does each of the following present a barrier to collaborative practices between industry and academia	*Response*	*N*	*%*
Lack of communication	1	1	0.8
	2	2	1.6
	3	12	9.3
	4	58	45
	5	56	43.4
Lack of clear understanding of the project	1	1	0.8
	2	7	5.4
	3	19	14.7
	4	57	44.2
	5	45	34.9
Unavailability of information about university services	1	2	1.6
	2	17	13.2
	3	31	24
	4	45	34.9
	5	34	26.4
University unawareness of problems encountered in industry	1	3	2.3
	2	10	7.8
	3	27	20.9
	4	54	41.9
	5	35	27.1

Table 50

Frequencies and Percentages for Question 11 Leadership Items for All Participants

To what extent does each of the following present a barrier to collaborative practices between industry and academia	*Response*	*N*	*%*
Lack of Leadership			
Very low	1	3	2.3
Low	2	6	4.7
Neither high nor low	3	20	15.5
High	4	56	43.4
Very high	5	44	34.1
Lack of commitment			
Very low	1	1	0.8
Low	2	5	3.9
Neither high nor low	3	10	7.8
High	4	56	43.8
Very high	5	56	43.8
Lack of consistency in program management			
Very low	1	2	1.6
Low	2	4	3.1
Neither high nor low	3	17	13.2
High	4	68	52.7
Very high	5	38	29.5
Inefficient reward systems			
Very low	1	1	0.8
Low	2	11	8.5
Neither high nor low	3	41	31.8
High	4	53	41.1
Very high	5	23	17.8

Table 50

Frequencies and Percentages for Question 11 Leadership Items for All Participants (cont.)

To what extent does each of the following present a barrier to collaborative practices between industry and academia	*Response*	*N*	*%*
Loss of government funding			
Very low	1	5	3.9
Low	2	14	10.9
Neither high nor low	3	43	33.3
High	4	40	31
Very high	5	27	20.9
Loss of university's control over academic work			
Very low	1	3	2.4
Low	2	16	12.6
Neither high nor low	3	44	34.6
High	4	36	28.3
Very high	5	28	22

Table 51

Frequencies and Percentages for Question 11 Management and Culture Items for All Participants

To what extent does each of the following present a barrier to collaborative practices between industry and academia	*Response*	*N*	*%*
Differences between institutional, academic, and industrial culture and values	1	1	0.8
	2	6	4.7
	3	19	14.7
	4	63	48.8
	5	40	31
Bureaucratic procedures in the university	1	0	0
	2	7	5.5
	3	25	19.5
	4	45	35.2
	5	51	39.8
Overemphasis of universities on teaching	1	3	2.3
	2	11	8.6
	3	27	21.1
	4	56	43.8
	5	31	24.2
Lack of qualified personnel to manage relationship activities	1	3	2.3
	2	16	12.4
	3	21	16.3
	4	57	44.2
	5	32	24.8

Table 51

Frequencies and Percentages for Question 11 Management and Culture Items for All Participants (cont.)

To what extent does each of the following present a barrier to collaborative practices between industry and academia	*Response*	*N*	*%*
Nonexistence of intermediary bodies	1	1	0.8
	2	10	7.8
	3	36	28.1
	4	59	46.1
	5	22	17.2
Inefficient evaluation and monitoring mechanisms	1	2	1.8
	2	6	4.7
	3	25	19.4
	4	64	49.6
	5	32	24.8
Insufficient equipment	1	2	1.6
	2	12	9.3
	3	34	26.4
	4	46	35.7
	5	35	27.1
Insufficient facilities	1	2	1.6
	2	10	7.9
	3	35	27.6
	4	42	33.1
	5	38	29.9

Table 51

Frequencies and Percentages for Question 11 Management and Culture Items for All Participants (cont.)

To what extent does each of the following present a barrier to collaborative practices between industry and academia	*Response*	*N*	*%*
Equipment depreciation	1	2	1.6
	2	16	12.5
	3	54	42.2
	4	34	26.6
	5	22	17.2