THE RISE AND FALL OF THE UNIVERSITY OF TORONTO’S INNOVATIONS FOUNDATION: LESSONS FROM CANADIAN TECHNOLOGY TRANSFER

by

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Abstract

This study explains the rise and fall of the Innovations Foundation, the University of Toronto’s first office dedicated to the transfer of university-developed technologies to industry. Drawing on extensive archival research, ten interviews with key informants, and other sources, the case study traces the evolution of the Foundation from its launch in 1980 to its closure in 2006. The study delineates three distinct business models under which the Foundation operated from 1980 to 1990, 1990 to 1999, and 1999 to 2006. The reasons for the adoption and failure of each model are explored and a historically grounded, context-sensitive explanation of the university’s decision to dismantle the Foundation in 2006 is provided. This explanation emphasizes the importance of managing unrealistic expectations for Canadian university technology transfer, and adds weight to a growing consensus on the importance of historical path-dependence as a conceptual tool for understanding the persistence of differentials in technology transfer performance among universities.
Acknowledgments

My path towards completing this project has been long and winding. Now near the culmination, it’s difficult to know where to begin acknowledging all of the exceptional people and places that have made my master’s thesis a reality.

In any version of my acknowledgements, my mom Sue requires special recognition. She raised me to be who I am and gave me so many opportunities to develop as a person and a professional. I owe her more than words can express, and her pride in my work and accomplishments continues to be the elemental driver behind everything I do. My sister Afton, who is about to begin her graduate studies in Chemistry, is another hugely positive influence in my life. She is a sounding board for my ideas, and source of immense pride and inspiration for me.

Over the course of my master’s I became engaged to the most important person I’ve ever met. If anyone deserves high accolades for putting up with my academic obsession, it’s Kailey. She has made everything in my life easier, more joyful and more worthwhile since the day we met. If this project is a stepping-stone, it is one that we will both stride from together.

At the University of Toronto, my greatest appreciation goes to my supervisor Creso Sá. From the day of my arrival, I have benefited spectacularly from his personal and professional mentorship and from our friendship. The trust and responsibility he has allotted me and the opportunities I have been given to research my interests are a testament to his generosity and wisdom as a guide in academia. I must also thank Glen Jones, who introduced me to the many fundamentals of higher education systems and has been a constant source of solid and compassionate advice in the department since I first landed there. Finally, I also owe a debt of gratitude to Andrew Kretz. He helped teach me the ropes as a fellow graduate student and co-author and is responsible for a large chunk of the archival research drawn on for my discussion of the pre-1980 period of the university’s history.

Over the course of this project I have realized some important things about myself, but perhaps none more important than the depth of my passion for research and writing. I came to Toronto with a two-year plan that ended with a return-ticket to Washington DC. Today, I am about to embark on a four-year extension of my foray into academia, and I couldn’t be more satisfied. It is something truly remarkable to wake up in the morning and be genuinely excited about going to work. I owe the discovery of my new path just as much to the city of Toronto and the people I’ve met here, as I do to its premier university. At the same time, I cannot help but remember the friends and family in Washington DC, British Columbia, Alberta and California that have helped to get me here. Thank you.
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Chapter 1: Introduction

The ultimate limits to growth may lie not as much in our ability to generate new ideas, so much as in our ability to process an abundance of potentially new seed ideas into usable forms.

Martin Weitzman (1998, p. 333)

Overview of the Problem

Canadian universities have always contributed to the health of the country’s business environment and to economic growth. Research universities contribute graduates to the labour pool, provide opportunities for businesses to engage academics in consulting or joint research projects, and enrich the technical foundations on which Canadian businesses are built in many other ways including peer-reviewed publication and conference presentations. However, higher education’s industrial linkages have never been so direct as they are today. Over the past 30 years, several technological and economic changes have altered the operating environment of universities in the country such that they have taken on more active roles in driving the expansion, dynamism and competitiveness of the economy. In line with similar trends taking place in the US and around the world, Canadian universities have become particularly valuable as sources of technological development in key emerging industries. In fields such as biotechnology, nanotechnology and information and communication technology, for example, universities are core wellsprings of highly skilled labour, new products, new processes and the ideas that push business forward. Even in more traditional manufacturing and services sectors, universities are more important than ever as sources of improvements to efficiency and innovation (Feldman, 2003). Universities are also seen as promoters of entrepreneurship both by virtue of the opportunities for exploiting new technologies they provide and increasingly also due to their capacity to instil entrepreneurial skills and mindsets among graduates (Audretsch, 2007).

Universities have also been urged towards closer relations with business for financial reasons. As the former Harvard University President Derek Bok remarks,
“universities share one characteristic with compulsive gamblers and exiled royalty: there is never enough money to satisfy their desires” (2003, p. 10). From the 1980s onward, a move towards reduced and more efficient government interactions in the economy has taken place. Also faced with the increasing costs of pensions and healthcare, government agencies in Canada and elsewhere have increasingly left universities to their own devices to fill funding shortfalls. Taken together, financial circumstances and the more technology-intensive demands of industry have impelled Canadian universities to establish more and deeper connections with the business sector.

However, studies over the past two decades have shown that the contributions of university research to the economy are far from automatic and that harvesting science for economic growth is a laborious and highly complex affair (Fisher & Atkinson-Grosjean, 2002; Geiger & Sá, 2008; Siegel, Waldman, & Link, 2003). Even the most entrepreneurial universities do not produce, by default, market-ready creations that can be simply handed off to business managers like the passing of a baton in a relay race. Rather, university inventions are embryonic and their successful commercialization typically requires overcoming several major challenges (Geiger & Sá, 2008). For instance, the successful development of a university invention may depend on the ongoing engagement of the faculty inventor (Agrawal, 2006). However, incentive systems remain weighted towards rewarding faculty for performing the traditional functions of research and teaching and not the commercialization of inventions. The risks of failure in commercializing research are also very high and this undermines demand from potential licensees, or from investors who may be willing to finance university startup ventures.

Data collected by the Association of University Technology Managers (AUTM)\(^1\) seem to confirm that converting research to economy-benefitting innovation is a daunting task. AUTM has collected data on measures of research commercialization in several of the largest Canadian research universities since 1991 and on a majority of the country’s most prominent research producing institutions since 2000.\(^2\) While this data has several

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1 AUTM is a US-based professional organization that has surveyed research commercialization activity among universities in the US and Canada since the early 1990s.
2 Only six of the top 15 Canadian universities (as ranked according to the 2012 RESEARCH Infosource Inc, Top 50 Research Universities, http://www.researchinfosource.com/media/2012Top50List.pdf)
major weaknesses, it nonetheless convincingly demonstrates that, on average, very few university inventions are successfully commercialized. Furthermore, the trend over the past decade appears to be that while higher quantities of embryonic inventions are being disclosed to these universities upon their discovery, the rates of licensing and startup formation have been relatively stagnant over this same period. Figure 1, generated from best available data collected by AUTM, provides an idea of general trends across commercialization performance metrics over the past 20 years.

Figure 1. Combined average performance of the top 15 Canadian universities on commercialization performance indicators since 1991.

These problems are far from unique to Canada. In Europe, the term “European Paradox” has been used to describe the persistent condition of having universities that

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3 One major weakness is that despite reaching most major Canadian universities by the early 2000s, not all of these institutions have completed the survey consistently in every year since. Sometimes an entire year may be skipped, or data may not have been provided for specific questions. Other important limitations of the survey as an evaluation device have been identified by the US General Accounting Office, including that respondents report data according to their own fiscal year and that no independent verification or validation of the data is undertaken (General Accounting Office, 1998). Langford, Hall, Josty, Matos and Jacobson (2006, p. 1594) found there to be a “startling discrepancy” between patenting figures reported to the AUTM and what is actually taking place on campus in at least one major Canadian university.
excel in terms of indicators of research quality, but underperform (relative to the US) when it comes to producing patents, licenses and startups (Conti & Gaule, 2011; Crespi, Geuna, & Verspagen, 2006). While the paradox argument has been strongly critiqued, it has nonetheless been used as a justification for several high-profile European Commission reports calling for major changes to the governance of Europe’s universities in order to improve research commercialization outcomes (e.g. European Commission, 1995, 2003, 2007).

Even in the US, where research commercialization is perceived as most successful, the evidence suggests that its impact may be overstated. University licensing revenues equated to little more than three percent of all academic research expenditure in the US in 2006 (Sampat, 2009). This small fraction of university revenue is also highly concentrated among a miniscule group of high performing institutions and within these institutions, owing to an even smaller subset of exceptionally valuable inventions (Mowery & Sampat, 2001). Moreover, when legal and other costs of patenting and licensing, or of incubating startups are taken into account, the net returns to most US universities are modest, and a majority of these institutions struggle just to break even on their commercialization activities (Bulut & Moschini, 2009; Nelsen, 1998).

Despite the fact that upon closer inspection, Canada is not the only country in which the successful commercialization of research has proven difficult, a national policy discourse has emerged that frames Canadian universities’ contributions to economic development and innovation as sub par and in need of significant improvement. In Canada, federal and provincial governments have emphasized the need to enhance this form of university-industry interaction since the 1990s (Fisher & Rubenson, 2010; Sá, 2010). More recent reports and studies have added weight to such criticism by continuing to contrast the country’s world-class scientific infrastructure with perceived weaknesses in its ability to commercialize (e.g. Council of Canadian Academies, 2009, 2013; Science, Technology, and Innovation Council, 2009, 2011). For their part, Canadian

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4 Major critiques of the European Paradox argument have challenged the validity of the data on which the argument is most often based. For instance, Crespi et al. (2006) and Lissoni, Llerena, McKelvey and Sanditov (2008) find that commercialization performance as measured by patents of European universities is commonly underreported because of a focus on counting university-owned patents rather than university-invented patents. In a related vein of criticism, Arundel and Bordoy (2006) point out that there are few internationally comparable indicators of research commercialization, which would be important to determining if European countries are actually underperforming relative to the US or other countries.
universities have leveraged public perceptions of Canada’s innovation deficit in arguments for increased levels of government funding for research, claiming that they will be better able to make important contributions to the economy only if adequate resources are at their disposal (Association of Universities and Colleges of Canada, 2002, 2006). Despite increases in research funding from government sources, analysts and policymakers continue to point to performance indicators that suggest Canadian universities are not doing enough to more directly contribute to national innovation and economic growth (OECD, 2012; Owens, 2013) and particularly as compared to their US peers (Agrawal, 2008; Howitt, 2013).

The negative judgment that has been passed on Canadian research commercialization efforts relies heavily on the use of aggregate indicators and in particular on the statistics collected annually by the AUTM. However, the use of such indicators bares an increasing weight of criticism (e.g. Bubela & Caulfield, 2010; Grimaldi, Kenney, Siegel, & Wright, 2011; Joly, Livingstone, & Dove, 2011; Rasmussen, 2008). Langford et al. (2006) assert that the core of the problem is that “the aggregate nature of currently available indicators ‘blurs out’ the idiosyncrasies and unique path dependencies” of the commercialization process (p.1588). Thus, a reliance on de-contextualized aggregate indicators such as invention disclosure and patent counts, or quantities of startups formed, obscures a more detailed picture of Canadian university innovation that is coloured by substantial diversity in approaches and results among individual institutions. Researchers have increasingly come to suggest that in current government policymaking and university approaches to research commercialization, recognition of this variegated reality is important (Grimaldi et al., 2011).

Few studies have investigated, in detail, the historical trajectories of research commercialization efforts among individual Canadian universities. Such investigations are a valuable complement to the use of aggregate indicators to promote a better understanding of institutional performance. The lack of research on historical paths and the evolution of organizational culture among specific Canadian institutions is particularly problematic because research commercialization is known to be highly path-dependent (Feldman & Desrochers, 2003). Kay (2005) relates that:
A process is path dependent if initial moves in one direction elicit further moves in that same direction; in other words the order in which things happen affects how they happen; the trajectory of change up to a certain point constrains the trajectory after that point. (p. 553)

Thus, performance depends not only on the specificities of each university’s structure, context and resources available today, but also on its historical trajectory marked by past experiences with commercial activity which may have influenced the institution’s culture (Bercovitz, Feldman, Feller, & Burton, 2001; O’Shea, Allen, Chevalier, & Roche, 2005; Phan & Siegel, 2006). How universities are able to bring about “shifts in their path dependencies”, specifically related to academic entrepreneurship, is today a major issue. However, “the processes by which these shifts may occur are not trivial yet remain little understood and warrant further research” (Grimaldi et al., 2011, p. 1054).

The rare studies that have focused in on specific Canadian university commercialization experiences tend to a) focus on present practices and policies while paying little attention to historical antecedents; and b) investigate the few institutions that are seen as having achieved the greatest success in commercialization, such as the University of Waterloo (e.g. Bramwell & Wolfe, 2008), and the University of British Columbia (e.g. Rasmussen, 2008). Studies such as these may well serve as valuable counterpoints to criticism of the country’s academic-industry interface as a whole, and offer some alternative models of commercialization for less successful universities to attempt to follow. However, the usefulness of these accounts can only be augmented by the in-depth, context-sensitive study of those cases that fall on the other side of the spectrum. In other words, research into the commercialization experiences of major Canadian universities that have been cast as failures is an important missing piece of the puzzle for understanding Canadian underperformance as a whole. Looking at the

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5 Geissler, Jahn and Haefner (2010) refer to the present conditions for entrepreneurship in a university as ‘entrepreneurial climate,’ and distinguish this from the more deep-rooted ‘entrepreneurial culture’ of which climate is largely a manifestation. Accordingly, they argue that while climate may best be assessed through quantitatively measured ‘ahistorical snapshots,’ a university’s entrepreneurial culture is better approached through analysis of the ‘historical evolution’ of the university’s social environment, which benefits most from qualitative methods.
evolution of practices and policies in a university that, despite strong performance in traditional measures of academic productivity, has lagged in measures of research commercialization may help to generate a more nuanced understanding of the topic.

This study is about the University of Toronto’s efforts to establish and promote a unit dedicated to the commercialization of research from 1980 to 2006. It is a historical case study that follows the development trajectory of the not-for-profit organization established by the university in 1980 to be the focal point and official channel for research commercialization and academic entrepreneurship on campus. In a sense, this study documents the opposite of a success story. It is more accurately described as a post-mortem. The organization, named the University of Toronto Innovations Foundation, was closed in 2006 with the following justification:

Over the past 25 years, there have been a variety of business models, the most recent being approved in 2002. That plan called for the Foundation to become economically successful and provided a line of credit to carry the organization through the initial investment period. This plan has not been successful and the University now wishes to refocus on the mission of transferring knowledge without taking the risks associated with investing in start-up technologies. (Riggall, 2006, p. 1)

While the closure of the Foundation did not in any way result in the wholesale abandonment of research commercialization at the university, it was a powerful symbolic punctuation signalling the end of an era of commercialization at Canada’s most prestigious research institution. On the surface, the university’s position as the most heavily funded and largest Canadian research university, its affiliation with numerous research hospitals, and its location within a major international hub for business and finance all suggest it might have advantages in commercialization. The city of Toronto has long been considered a vibrant and innovative metropolis. However, as indicated by the university’s then Vice-President of Business Affairs in the statement above, the commercialization record of the Foundation was a disappointment to the university leadership. The purpose of this study is to identify and explain the reasons for the failure
of the Innovations Foundation. To achieve its aims, the study pursues the following research questions.

**Research Questions**

Why did the Innovations Foundation fail?

• How did the University of Toronto employ the Innovations Foundation to commercialize research?
• Did the strategies or approaches change over time? What caused these shifts?
• What were the impetuses and actors driving the adoption of the strategy or strategies?
• What internal or external factors shaped these strategies?

Finally, and most generally, the study asks:

• What does the case of the Innovations Foundation tell us about research commercialization in Canada?

**Organization of the Study**

The final section of Chapter One details the methodological approach and data sources used to answer the study’s research questions. Chapter Two then provides a review of literature relevant to the case and an overview of the historical context for research commercialization in Canada. After a discussion of the range of possible university-industry linkages, the focus narrows to an in-depth view of the types of research commercialization undertaken by entities such as the Innovations Foundation. The final section of the chapter assesses some of the general attributes of the processes of research commercialization through licensing and startup formation, as well as research findings on the obstacles and success factors relevant to such processes.

Chapter Three explores the case of the Innovations Foundation. It provides a detailed account of the rise and fall of the Foundation between 1980 and 2006, divided
into three historical periods that correspond to the three distinct business models under which the Foundation operated. The chapter closes with an assessment of the conditions under which the Foundation ultimately failed including a brief discussion of its eventual replacement, which is the prevailing model in place as of August, 2013.

Chapter Four provides a summary of the findings, crafts an explanation for the Foundation’s failure and discusses the implications of the case with regard to existing research. A table is also presented with a condensed view of the Foundation’s three phases and a run-down of the distinguishing characteristics of each.

Methods & Data

The case (unit of analysis) that this study seeks to explore is the Innovations Foundation. Most central to the study is the construction of a descriptive socio-historical narrative and analysis of the conditions that led to the closure of the Foundation in 2006. As such, the study reaches back to the Foundation’s launch in 1980 and even earlier to provide necessary context for the institutional, cultural, political and economic bases on which the Foundation was launched, operated for 26 years, and ultimately closed.

In order to understand the Foundation, the case study method is employed as the most appropriate of available alternatives. Case studies are a richly endowed approach to understanding complex dynamic phenomena within their context. Case studies are often employed to provide a holistic description and intensive analysis of individuals, programs, policies or institutions (Merriam, 1998). This method is of particular value when the boundaries between the phenomenon and its context are not evident (Yin, 2009). Case studies also “often tackle subjects about which little is previously known or about which existing knowledge is fundamentally flawed” (Gerring, 2004, p. 345). Indeed, two central premises for the present study are that knowledge of cases of Canadian universities failing to successfully commercialize research is lacking and that what little knowledge does exist on the topic more generally may be flawed because of its rooting in a relatively narrow base of potentially skewed quantitative evidence.6

6 The quantitative evidence referred to is that generated by the annual surveys of the AUTM.
In the specific case of the University of Toronto, which has been previously subjected to assessments of its performance through the usual quantitative means (e.g. Agrawal, 2008; Howitt, 2013), the present study is an attempt to build a stronger understanding of how the university got to where it presently stands. While the Foundation’s failure is the central bounded-phenomenon under investigation, the case study research design breaks down this primary unit into subunits, which are then subjected to covariational analysis both synchronically and diachronically (Gerring, 2004). Thus, while the overarching intention is to understand how the Foundation evolved and why it failed as a whole, this larger narrative is constructed to a large extent by following and comparing critical lower-level strands of the story such as the evolution of Foundation leadership, the university administration’s relationship with the Foundation, the operating models employed, and even certain key commercialization projects. Taken together, these subunits of analysis are interwoven to construct a case study that illuminates the central issues pertinent to the overall performance and status of the Foundation.

In analysing conditions and occurrences that eventually lead to the Foundation’s demise, this investigation takes an interdisciplinary approach. This perspective allows for a phenomenon-centred investigation that benefits from the rich theoretical traditions of multiple disciplines such as economics, sociology and history, as well as research fields comprising the study of higher education and entrepreneurship. Shane (2003) argues that the interdisciplinary approach is ideal for the study of academic entrepreneurship because while multiple disciplines each illuminate part of the picture of research commercialization, none succeed in providing the conceptual breadth for explaining all aspects in a holistic manner.

This study draws on multiple, complementary sources of evidence (Yin, 2009). It relies predominantly on two main pillars of evidence, archival sources and interviews with key informants. Complementing these sources are Canadian policy documents, news articles, university reports and publications, and relevant peer-reviewed articles and dissertations. Archival research took place over several months during the summer of 2012 and in the summer of 2013. The University of Toronto’s Archives and Records Management Services (UTARMS) holds materials that address the institution’s research
commercialization activity. Key document types considered during the course of data collection included invention files, meeting minutes of various institutional bodies and committees, reports, correspondence and other material linked to research commercialization activities. Archived invention files were a critical source of information for this study. These often contained: invention disclosure forms; patent filing documents; correspondence among university administrators, Foundation staff, inventors and licensees; meeting minutes; press clippings; a variety of legal documents and other relevant materials. In total, archival research spanned seven different UTARMS archived collections\(^7\) including some 240 boxes of files linked to the offices of the Vice-President Research, the Board of Governors, and the Innovations Foundation. Of these 240, 51 boxes in the two main collections associated with the Innovations Foundation\(^8\) were most thoroughly scrutinized.

While archived documents were plentiful and highly valuable for exploring relevant events prior to the 1990s, the most recent decades of the university’s dealings with research commercialization were more effectively analyzed through personal interviews with key informants.\(^9\) These semi-structured interviews were valuable for contextualizing and confirming findings and patterns that emerged from archival research and from the analysis of news articles, university reports and other documents available in the public domain. They also allowed for the development of a nuanced understanding of the most recent history of the Foundation and the multiple interconnected themes underlying its closure. In all, ten one-hour long interviews were tape-recorded, transcribed and analyzed. The interviews took place during the summer of 2012. Interviewees include two former Foundation directors, three former Foundation project managers, one former member of the Foundation’s Board of Directors, a high ranking administrator in the university’s Faculty of Medicine, and three faculty inventors each

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\(^7\) Accession numbers: A1973-0025; A1975-0004; A1979-0012; A1979-0025; A1980-0023; A2004-0007; A2008-0021.

\(^8\) The collections under accession number A2004-0007 (13 boxes, ca. 1965-1989) and A2008-0021 (38 boxes, 1982-2005) contained boxes with a majority of files directly relating to the operations of the Innovations Foundation and as well as the conditions and commercialization activities that immediately preceded its launch in 1980.

\(^9\) University of Toronto Research Ethics Board approval for the inclusion of human participants in this study was obtained as part of a broader research protocol submission entitled “The Institutionalization of University Technology Transfer in Canada,” reference #27591.
with over 20 years of research experience in the university’s faculties of engineering, chemistry and medicine.\textsuperscript{10}

Documentary and interview data were subjected to content analysis (Krippendorf, 1980; Weber, 1996). This part of the research design allowed for the study’s large volume and variety of collected data to be condensed into broad descriptions of the phenomenon under investigation and its most important sub-components. It facilitated the identification of themes central to the development and evolution of the Foundation as well key internal and external factors undermining its sustainability and contributing to its false starts and ultimate failure. Exploring these categories is the focus of this study.

\textsuperscript{10}In accordance with the stipulations of this project’s Research Ethics Board approval, the identities of individual interviewees are not published herein. However, to the extent possible, limited information is provided as to professional roles of interviewees.
Chapter 2: Conceptual Framework & Literature Review

This study is about the Innovations Foundation, the first technology transfer office (TTO) of the University of Toronto. University TTOs, sometimes also labelled ‘industrial liaison offices’ (ILOs), are organizational units in universities that are responsible for patenting, licensing, and other activities associated with the management of university-generated intellectual property (IP), including the creation and incubation of startup companies (Geiger & Sá, 2008). TTOs are the formal gateways for channelling inventions to the economy. They are considered to perform important brokering and boundary-spanning functions between the often antithetical cultural and attitudinal predispositions of university academics and the business managers of the corporate world (Fisher & Atkinson-Grosjean, 2002; Markman, Siegel, & Wright, 2008).

The literature review to follow is made up of two main pillars intended to ground the case study of the Foundation. First, the historical and institutional context of the emergence of TTOs in Canadian universities will be assessed. This section will position the initiation of TTOs at individual universities such as the University of Toronto as part of a broader experience in Canada and the US. Second, university TTOs will be introduced as an important sub-component of the broad set of activities known as university-industry relations, the core processes of the TTO will be summarized, and several key issues concerning TTO performance will be introduced.

The Emergence of the Technology Transfer Office

In the last two decades of the 20th century, university TTOs went from relative obscurity to become virtually ubiquitous on campuses in Canada, the US, Europe, and elsewhere (Fisher & Atkinson-Grosjean, 2002; Wright, Clarysse, Mustar, & Lockett, 2007). The proliferation of these unique organizational units in the 1980s and 1990s ran parallel to major observed increases in the numbers of inventions disclosed to universities, patents applied for and issued, licenses executed and start-up companies formed (Atkinson-Grosjean, 2002; Siegel, Veugelers, & Wright, 2007). The history of
increased patenting, licensing and startup formation among the universities of Western economies is irrefutably linked to the rise of university TTOs. These units began to provide a dedicated set of resources for linking faculty members and their inventions to business managers with the capital, expertise and ambition required to commercialize them.

The emergence of TTOs in Canada followed a trend that began in the US. It was south of the border that TTOs and research commercialization efforts first began to appear with the greatest intensity, and a major impetus for this proliferation was the enactment of the Bayh-Dole Act in 1980. This piece of federal legislation was a watershed for US university-industry relations because it standardized the rules by which university IP generated as a result of federal research funds could be owned, marketed and sold by universities (Owen-Smith, 2003). It gave universities the right to commercialize and profit from this IP, but also put in place stipulations intended to legally require these institutions to make serious efforts to exploit this IP and to report on these efforts to government (Atkinson-Grosjean, 2002). The Act also forced researchers working on federally funded projects to disclose any inventions to their university administration by way of the TTO (Mowery, Nelson, Sampat, & Ziedonis, 2004). The Act was an important symbol of the US Congress’ support for the commercialization of publicly funded research (Popp Berman, 2008). It helped to engineer an environment within universities in which stakeholders would be more inclined to pursue related activities.

There is ongoing debate regarding just how positive Bayh-Dole’s impact has been on university technology transfer (Verspagen, 2006). For instance, Mowery and Sampat (2005) claim that the Act was “as much an effect as a cause of expanded patenting and licensing by US universities during the post-1960 period” (p. 119). However, it is undeniable that the legislation was among the leading causes of major changes in the way that universities commercialize and diffuse the results of research to the economy (Grimaldi et al., 2011). Particularly owing to the reporting requirements the Act installed, and the government endorsement it represented, the signing into law of Bayh-Dole contributed to the widespread establishment of TTOs in the US. However, in terms of its impact on promoting research commercialization more generally, it was actually one of
several important factors at play in 1970s and 1980s, some of which were not specific to the US context. Together, these factors resulted in the elevation of new commercialization-friendly scientific fields and the easing of obstacles that would prevent these from being tapped (Geiger & Sá, 2008). As a result of US success in commercialization, and the perceived importance of the Bayh-Dole Act therein, many nations have debated emulating the legislation, including most European countries (Verspagen, 2006), and Canada (Atkinson-Grosjean, 2002).

According to Atkinson-Grosjean (2002), legislation modeled on the Bayh-Dole Act was seriously considered in Canada in the late 1990s and early 2000s, with strong backing from the federal government’s Advisory Council on Science and Technology (ACST). Composed of eminent Canadian leaders in science, industry, business and economics, the ACST had established an Expert Panel on the Commercialization of University Research in 1998 and by the end of 1999 it seemed that a uniform national IP policy covering all universities was on the immediate horizon. However by early 2000, groups such as the Canadian Association of University Teachers were mobilizing in opposition to the Panel’s recommendations. The country’s universities eventually also rebelled against the plan to install a Canadian version of the Act in 2001, and no Canadian Bayh-Dole Act was ever enacted (Rasmussen, 2008).

In the absence of national IP legislation, Canadian TTOs and the research commercialization efforts of Canadian universities have emerged due to different impulses in Canada than in the US. Instead of relying on legislative instruments, successive Canadian governments have employed supportive policies and programs to generate incentives for research commercialization and the creation of TTOs (Atkinson-Grosjean, 2002; Rasmussen, 2008). Rather than legislating TTOs into existence, as was effectively the case in the US, Canadian governments in the 1980s established programs to sponsor the creation of such offices (Fisher & Atkinson-Grosjean, 2002). One such initiative was the Industrial Research Development Agency (IRDA) program, which made available funds for Canadian universities to help establish TTOs in the 1980s (Fisher & Atkinson-Grosjean, 2002). Provincial governments and grants available from federal research funding agencies such as the Natural Sciences and Engineering Research
Council of Canada (NSERC) also helped to promote the establishment and early sustainability of these units.

Complementing the effects of government policy instruments was the less tangible but still very important influence of pressure on Canadian universities to emulate the highly conspicuous commercialization successes taking place south of the border. As the 1980s progressed, not only were most US research universities establishing dedicated technology transfer programs, but a highly publicized few were also succeeding with such programs to bring in major revenue. The success of revenue-generating inventions such as the Boyer-Cohen patent on the process for ‘gene-splicing’, internet search engines Google and Lycos, diagnostic tests for cancer detection, a variety of green technologies and others (Siegel, 2011), made ignoring the US trend towards establishing TTOs harder to do. The TTOs at institutions such as Stanford, MIT and the University of Wisconsin were already reaping millions of dollars in royalties, hiring expensive in-house patent lawyers and commercialization experts and having a tangible impact on the economic outlook of the regional economies they were linked to. Policy borrowing by one institution based on the perceived success of its peers is a common occurrence among universities (Powell, Owen-Smith, & Colyvas, 2007).

Yet, as much as individual Canadian universities may have wanted to spur their own version of the Stanford supported Silicon Valley or MIT’s Route 128, they faced unique obstacles that slowed their efforts to do so. Aside from the different governmental approach to promoting commercialization, there were obstacles in Canada that were not present to the same degree in the US. To begin with, Canadian universities have not historically been subject to the same competitive forces as are US institutions (Skolnik & Jones, 1992), leaving them less apt to take the same risks in efforts to innovate. Furthermore, Canada has long been viewed as a relatively weak protector of IP rights (Atkinson-Grosjean, 2002). Decisions of the Canadian judiciary have caused the country to diverge sometimes markedly from the IP protection models in place in the US and Europe. For instance, the legal frameworks used in these other countries have typically allowed for strong protection of IP related to genetically modified organisms (GMOs), which is an important prerequisite for biotechnology commercialization (Prudham, 2007). In 2002, the Supreme Court of Canada refused to allow Harvard to patent a
genetically modified mouse engineered to be vulnerable to cancer and intended for use in cancer research. News of the decision reverberated worldwide due to the fact that Harvard had been granted the same patent without significant challenge in the US, Europe and Japan. However, the ruling was perceived as less of a setback for Harvard’s commercialization efforts than for Canada’s (Abraham, 2002; Check, 2002)\(^\text{11}\).

Similar challenges have afflicted those seeking to obtain and protect IP related to pharmaceutical products in Canada (Grey, 2012). Over the past decade in particular, this has contributed to the country being panned both domestically (McKenna, 2011) and internationally (Falconi, 2013; Koring, 2009) for its poor record of IP protection and weak regulatory framework. It is pertinent to note that a strong national IP protection framework is not necessarily a prerequisite for the successful commercialization of research. For one, there are many channels by which research is transferred to industry and effectively commercialized that do not directly involve IP (Perkmann & Walsh, 2007). Furthermore, persuasive arguments as to the negative effects of strong IP protection on industrial innovation, and particularly on innovation spurred by public sector research, have long existed (Mazzoleni & Nelson, 1998). These arguments posit that allowing broad patents on embryonic inventions and research tools may actually stifle innovation by limiting the availability of ideas in the public domain, which has been a key fountain from which companies develop useful and patentable products and services.\(^\text{12}\)

In the context of this ongoing debate over the appropriateness of strong IP protection, Canada’s atypical approach may seem more justified. However, with other advanced economies refusing to follow suit, the effect has been to make Canada appear as a relatively unfriendly climate for high-technology investment, leading to fears of an exodus of both researchers and private investment in research commercialization (Abraham, 2002).

\(^\text{11}\) The decision was not perceived as a major setback for Harvard because Canada was a relatively small part of the global market for the mouse. However, observers from the biotechnology industry and from within a Canadian university TTO expected it to have significant ramifications for life-sciences research and biotechnology in the country.

\(^\text{12}\) Mazzoleni and Nelson (1998) go so far as to claim that the basic rationale behind the Bayh-Dole Act, which is that exclusive licenses on embryonic inventions will best lead to private sector investment in development and commercialization, is empirically wrong.
Table 1. Establishment dates of TTOs among top Canadian universities

<table>
<thead>
<tr>
<th>University</th>
<th>Date</th>
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<tbody>
<tr>
<td>University of Toronto</td>
<td>1980</td>
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<tr>
<td>University of Manitoba</td>
<td>1983</td>
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<tr>
<td>University of British Columbia</td>
<td>1984</td>
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<tr>
<td>Queen's University</td>
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<td>University of Alberta</td>
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<td>University of Guelph</td>
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<td>McMaster University</td>
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<td>University of Ottawa</td>
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<td>University of Montreal</td>
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<td>McGill University</td>
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<td>University of Saskatchewan</td>
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<td>University of Waterloo</td>
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<tr>
<td>Western University</td>
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</table>

The differing context for the emergence of TTOs on Canadian campuses described above led to these units being established somewhat slowly throughout the 1980s and early 1990s. Table 1 shows the establishment dates of TTOs among Canada’s top research universities. Fisher and Atkinson-Grosjean (2002) note that despite their late start, the rate of expansion of these offices among Canadian universities was significant. By 1989, ten of the top 15 research universities had established TTOs, and by 1995, all 15 had joined the trend (Association of University Technology Managers, 2013). While these offices were not large, averaging less than five full-time equivalent (FTE) staff by 1995, they were becoming widespread fixtures on Canadian campuses. A major impetus for the commercialization of university research came in the early 1990s when a recession put an end to growth in federal funding for research (Atkinson-Grosjean, 2002). By the end of the 1990s, all but the smallest universities and university colleges housed active TTOs (Fisher & Atkinson-Grosjean, 2002).

University-Industry Linkages

As noted earlier, university science has an impact on industry through a variety of channels. One commonly referenced typology is provided by Cohen, Nelson, and Walsh
who identify the following forms of university-industry engagement: informal information exchange, publications and reports, public meetings and conferences, recently hired graduates, temporary personnel exchanges, joint or co-operative research ventures, contract research, consulting, patents, and licenses. Perkmann and Walsh (2007) offer a more generic set of categories that they refer to as ‘university-industry links’: research partnerships, research services, academic entrepreneurship (startup firm creation), human resource transfer, informal interaction, commercialization of IP (licensing patents), and scientific publications.

Perkmann and Walsh emphasize the importance of the level of relational involvement of each type of linkage as a distinguishing aspect. Thus, they separate research partnerships and research services (which includes contract research and consulting) as the two types of links with the highest relational involvement. Activities within either of these two groups are the only types of links that they consider to be true university-industry ‘relationships’. Links of intermediate relational involvement include human resource transfer and academic entrepreneurship. Connections in this second group are considered to be “based on ‘mobility’ whereby individuals move between academic and industrial contexts” (Perkmann & Walsh, 2007, p. 263). The commercialization of IP, in which university-generated patents are licensed to existing firms, ranks lowest on the relational involvement scale. The other two classes of links - informal interaction and scientific publications - are considered to be accompaniments to the other types, but are not constituteive of meaningful relationship on their own.

Another way that university-industry links have been distinguished is by their level of formality (Debackere & Veugelers, 2005). Here, personal contacts, networks of scientists and industry personnel, and networking at conferences and other events are distinguished from formalized linkages such as joint research projects, licensing, or the hiring of graduates. On the other hand, Poyago-Theotoky, Beath and Siegel (2002) situate university-industry links on a spectrum based on which side of the link initiates the engagement. In this formulation, industry-pull, in which a firm seeks out a university to conduct research on its behalf, is on one end of the spectrum. At the other extreme are instances of university-push, such as when a scientist has an idea for commercializing her work and engages with an industrial partner to make this a reality. Examples of
university-push can involve low relational involvement activities such as licensing a patent to an existing firm that will take over responsibility for further commercialization activity. However, licensing can also encompass high relational involvement, such as when the inventor maintains a relationship with the licensee in order to support the successful commercialization of the invention (Agrawal, 2006). The other major example of university-push is when it is decided to commercialize a university invention by creating a new startup firm. In this case, engagement with industry takes the form of securing venture capital, hiring individuals with business experience, or finding surrogate entrepreneurs to accomplish these tasks.

Finally, and of particular relevance for assessing the channelling of university-industry interaction through TTOs, is the distinction made between university-industry interaction taking place inside and outside of the IP systems overseen by university administrators (Fini, Lacetera, & Shane, 2010). When inventions arising from research are formally disclosed to the university administration to be considered for possible patenting and either licensing to existing firms, or for use as seeds to sprout startup companies, this activity is considered to take place within the university’s IP system. This group of activities falls nearly exclusively within the domain of TTOs. Other university-industry activities are typically not the responsibility of university TTOs, however TTOs may sometimes play a role in managing or promoting links such as research contracts or interpersonal networking between academics and industry. Their core tasks have typically been to manage IP through licensing and startup creation, two processes that will be described in greater detail below.

**Commercializing Research through the TTO**

In abstract terms, TTOs have been described as ‘brokers’ that mediate between the worlds of business and science (Fisher & Atkinson-Grosjean, 2002). They have been viewed as ‘translators’ who convert academic capital into economic return (Kaghan, 1998), and as ‘focal points’ for university interaction with the commercial realm (Feldman, 2003). Siegel (2011) uses the term ‘intermediaries’ to describe these offices and their work connecting the academic scientists that supply inventions with the various
agents of business who assist in commercializing them: firms, entrepreneurs, and venture capitalists. Such conceptualizations underscore the uniqueness of the niches TTOs fill in a sort of no man’s land that exists between the academic and the industrial.

In a more practical sense, TTOs are in many ways like various other university offices. They oversee a number of interrelated processes important to the university’s operations and serve their institution under the guidance of the university’s central administration, which sets objectives and milestones and tries to ensure these are met. However, the processes that TTOs oversee tend to be highly complex and unpredictable. As referenced above, the role of the TTO demands a certain flexibility to work closely with different groups of collaborators that come from different worlds and are beholden to markedly different incentive structures. The existence of TTOs is justified by “their contribution to local economic development, their service to the faculty, and the need to generate income for the university and inventors” (Geiger & Sá, 2008, p. 119). These objectives do not always pull TTO staff in the same direction. For instance, serving faculty and generating income for the institution are rarely perfectly synonymous. Even contributing to local economic development and also university revenue may be contradictory. This would be the case if, for instance, a university is torn between licensing an invention to a local firm that will create employment in the local community, or to a powerful foreign-based multinational enterprise that will pay a higher premium but contribute relatively less to local development.

The work of the TTO is also often controversial and the rise to prominence of these structures over the past several decades has fed into politically charged debates about whether and to what degree universities and faculty should be engaging with the private sector (Bok, 2003; Slaughter & Rhoades, 2004; Washburn, 2005). Criticism of the commercialization of science draws from the notion that the scientific community’s value to society is fundamentally dependent on norms such as universalism, communalism, disinterestedness and organized scepticism (Merton, 1973) and that these norms are eroded as the scientist is driven towards closer participation in the market. However, such

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13 Some TTOs, such as the Wisconsin Alumni Research Foundation (WARF) of the University of Wisconsin-Madison, appear to have gained a greater degree of independence and influence in the university power structure by virtue of their longevity and early financial success (Geiger & Sá, 2008; George, 2005; Jain & George, 2007). However, most TTOs are dependent on the institution for funding and for maintaining the stream of inventions that constitute the inputs to their operations to a much greater degree.
criticism has also often been based on anecdotal evidence and failed to appreciate the ongoing capacity of most institutions to be mindful of and manage the risks of their more active participation in commercial activity (Geiger & Sá, 2008). While continued debate about public science’s turn towards the market is critical to ensuring the health of our science systems, this study purposefully skirts this level of discussion. As noted by Feldman (2003) “we may question the desirability of university-based entrepreneurship, but a wide variety of resources are devoted to it” (p. 93). This study focuses primarily on understanding the strategies for how these resources are employed, and the context-dependent outcomes thereof.

The Research Commercialization Process

The complex and unpredictable commercialization process over which university TTOs preside generally begins with an individual faculty member or research team making an invention disclosure. Invention disclosures are submitted by way of a faculty member completing an invention disclosure form that describes an invention that has been made as a result of university-supported research. These forms often also request information on potential commercial applications, the stage of development of the technology and other pertinent information.

Inventions do not take place with great frequency on most university campuses and tend to come primarily from a select group of university areas: biotechnology, pharmacy, chemistry and chemical engineering, electrical engineering and computer science, materials science, surgery, optics and several others (Geiger & Sá, 2008). A TTO in a major US university may today receive as many as 500 invention disclosures in a year (Association of University Technology Managers, 2013). Data from the period 1991 to 2010 suggests that a more realistic range for a large Canadian university is between 40 and 130 disclosures per year (Howitt, 2013). One reason that disclosures are relatively rare is that many of the researchers conducting the most innovative research are prone to avoid the commercialization process altogether, despite their high potential for producing commercially viable inventions. Highly productive faculty, as measured by publication outputs, may be less likely to want to devote the time to disclosing an invention, much
less to work on further development (Jensen, Thursby, & Thursby, 2003). Another reason is that requirements for faculty to disclose inventions are often only enforceable when it comes to patentable technologies. Thus in certain fields such as engineering and the social sciences where “patents are less important appropriability mechanisms,” many inventions are never disclosed to the university and are commercialized outside of the formal IP system by the inventor instead (Fini et al., 2010, p. 1061).

When an invention disclosure is made to the TTO, an assessment must be made as to the merits of the invention and whether it makes sense to either a) find an existing firm to license it to, b) seek further sources of development funding or venture capital, as well as the expertise necessary to build a startup company around the invention, or c) return the invention to the inventor. Regarding the third option, when the TTO determines that it has no interest in commercializing a discovery it may assign invention IP rights back to the inventor. However, in some cases the inventor may be sent back to the lab to conduct further research and asked to disclose again at a later stage in development.

Determining whether to pursue the commercialization of an invention, and if so, how to go about it, are both formidable tasks. These decisions involve the consideration of various factors and conditions related to the characteristics of the invention itself, of the university, TTO, and inventor (the university-push side), and of the industrial partners and potential market required to support further development and accept the final product (industry-pull side). Evaluating the invention itself and whether it can or should be patented is often an onerous task for TTO staff who will most often lack expertise specific to the inventor’s subject area. While early interest from industry partners may provide sufficient justification for taking on the project and filing a patent, the TTO will often be forced to make these decisions before any outside interest in the invention has been expressed (Siegel et al., 2003).

A great deal of the potential for success of a commercialization project depends not just on the invention itself, but also on the personality, experience and disposition of the inventor. Whether an invention is licensed to an existing firm or used as the basis for launching a new firm, the ongoing active involvement of the inventor can be a powerful determinant of success (Agrawal, 2006; Jensen & Thursby, 2001). However, not all inventors will be easily convinced to dedicate their energies to a process with highly
unpredictable results and over a potentially multi-year timeline. Even those inventors who do stay actively involved may have a negative effect on commercialization success if they insist on being in control of parts of the process for which other individuals may be better suited, such those related to business or law. Only very rarely will an inventor possess the financial or managerial skills to perform as effectively in business as in science (Auerswald & Branscomb, 2003).

Research suggests that successful TTOs must also be realistic about their own capacities to support the commercialization process for the inventions that are taken on. Existing workload of TTO staff, their familiarity with the subject matter, and funds available for patenting, legal and other costs associated with negotiating licenses or launching startups must be weighed when considering the TTOs approach to each potential project. Common findings of studies investigating the productivity of TTOs are that staffing levels, resources available, and the experience and capabilities of staff are critical determinants to success in commercialization (George, 2005; Rothaermel, Agung, & Jiang, 2007). Further complicating the situation is that aside from considerations related to commercial potential, many TTOs (Canadian TTOs in particular) are also saddled with broader, non-revenue related knowledge mobilization mandates (Bubela & Caulfield, 2010). This further clouds the decision-making process for these offices as they weigh which potential projects to take on and how to allocate scarce resources without always having a clear indication of how their performance will be judged by the university, governments or the general public.

TTOs will also often find themselves on unsure footing when attempting to predict how an invention will fare in the market for which it is intended. For instance, companies, and even other universities, may be developing competing technologies. Some large firms may even seek out exclusive licenses on TTO patents and then for a variety of reasons use this to prevent further development of the technology. Kenney and Patton (2011) argue that patented inventions may be licensed and then never commercialized due to “changing R&D goals, ‘banking’ the patent for other motives, or a simple lack of motivation” (p. 1101). The point is that even when a great invention makes it to the desk of TTO staff member, and the inventor possesses the right skills and attitude
to enhance the probability of commercial success, a range of factors largely beyond the control of the university may intervene to cause failure.

When the determination is made by the TTO to proceed with a commercialization project, the development process that follows can be highly erratic and is usually unsuccessful. Long development horizons are coupled with the general fast pace and unpredictability of technological change, the possible appearance of new competing products, changes to market demand potential for the invention, the sudden withdrawal of a licensee or venture investor, or even the disintegration of the inventor’s interest. Indeed, in a vast majority of cases the time and resources invested by a TTO are never recuperated. Feldman (2003) notes that “the rule of thumb in university technology transfer is that for every one hundred invention disclosures, ten patents and one commercially successful product result” (p. 99). Thus, while TTOs are recognized to be positive influences on the chances of science-based inventions becoming commercial innovations by allowing the pooling of resources dedicated towards such activity (Siegel et al., 2007), the odds of success are still heavily stacked against them.

As mentioned above, licensing and startup formation are two primary paths by which inventions disclosed to the TTO may be commercialized. Traditionally, US university TTOs gave preference to licensing inventions to established firms (Siegel et al., 2003). A license is a contractual agreement in which the TTO grants the rights to use IP to a firm. These agreements typically involve a) an upfront payment by the licensee once the agreement is signed, b) a commitment to make periodic payments when certain milestones in development are reached, such as the clearing of technical or regulatory hurdles, and c) provisions for royalty payments based on product sales in cases where the invention makes it to the market (Feldman, 2003). Sometimes the licensee will enter into an agreement with the TTO prior to the IP being codified and take responsibility not only for the cost of further development, but also for the legal costs of patenting. Licensees may even agree to provide additional funding for the inventor’s research in addition to compensating the university if the invention becomes a commercial success (Jensen, 2011). Indeed, Jensen and Thursby (2001) find that faculty members may consider the possibility of future sponsored research to be the one of the most important potential outcomes of licensing.
Locating potential licensees is the main problem faced by licensing officers in the TTO. TTOs may pursue a variety of strategies to find a licensee including: passively advertising their IP online; hosting events to lure industry representatives to campus; networking with company contacts at trade shows and conferences; and tapping the inventor’s knowledge about companies that may be receptive to their discoveries, among others (Geiger & Sá, 2008). While finding one or more licensees for the highest profile discoveries such as an innovative cancer treatment may pose less of a challenge to TTOs, these high profile inventions are few and far between. For the majority of inventions disclosed to a TTO and then marketed to potential licensees, companies are hesitant to sign a license agreement for a variety of reasons. Furthermore, in most cases even after an agreement is in place, the TTO will be required to “devote substantial resources to maintenance and renegotiation” (Siegel et al., 2003, p. 30). This is due to the embryonic nature of most inventions and the fledgling state of the typical companies willing to risk licensing early stage technologies.

Siegel, Veugelers and Wright (2007) note that university TTOs are increasingly faced with the strategic choice between licensing inventions to established firms, or establishing startup firms as a means of commercialization. Increasingly, university TTOs have chosen the latter path, either by taking equity in and licensing IP to small firms, or more directly by launching startups and pursuing funding from communities of investors. There are a variety of reasons why TTOs may be shifting towards establishing startups in lieu of licensing to larger established firms. For starters, these ventures typically provide greater motivation for closer cooperation and sustained engagement of the inventor. Relatedly, the difficulty of evaluating the economic potential of a university invention often leaves the researcher that made the discovery in the best position to know how or whether to drive the commercialization work forward (Feldman, 2003). The increased availability of public funds to support the creation of new businesses and to overcome a

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14 In a survey of industry licensing executives from 300 US business units conducted in 2000, Thursby and Thursby (as cited in Feldman, 2003) found that one third had never licensed IP from a university for a number of reasons: Forty-nine percent of those who had never worked with a university claimed that it was because the university research was too early in its development stage; 37.4 percent felt that available IP was disconnected from actual business needs; 31 percent were frustrated with common refusals to transfer ownership of the IP; 20 percent felt that university policies aimed to prevent excessive delay of publication were too strict; and 16 percent were dismayed at the difficulty of obtaining future faculty cooperation necessary to further development.
funding gap faced by early stage technologies is another major cause for the increase of university startups (Auerswald & Branscomb, 2003; Clarysse, Wright, Lockett, Mustar, & Knockaert, 2007). Programs such as the Small Business Innovation Research (SBIR) fund in the US, and similar initiatives in Europe have encouraged startup creation largely by lessening the risks associated with launching a new business based on embryonic technology (Bramwell, Hepbrun, & Wolfe, 2012).

Universities and their TTOs have responded not only to the perceived advantages of startups over licensing owing to increased inventor engagement and available funding. Perhaps just as salient as a justification for surging interest in faculty entrepreneurship over the past two decades has been the rise of what economist David Audretsch (2007) describes as the “Entrepreneurial Society,” which encompasses a broad societal infatuation with entrepreneurship and the popularity of policies that promote it. In this context, universities have become evermore determined to focus resources on the creation of new firms, rather than solely focusing on negotiating licenses with existing enterprises.

Rothermael et al. (2007) suggest that research on how to best manage the creation of new firms based on university research has developed along two independent streams. One approach has been to investigate the factors that obstruct the formation and growth of startups. These factors include informational gaps and unrealistic expectations about potential success. Another key impediment is lack of competency in founding teams as well as insufficiency of funding and structural support, (Chiesa & Piccaluga, 2000; Kinsella & McBrierty, 1997). Cultural problems including unsupportive university culture, and clashes between academic and industrial mindsets during the startup formation process are other important obstacles (Franklin, Wright, & Lockett, 2001).

The other approach has been to look at the success factors critical to startup formation, which are encompassed within one of four main themes: “intellectual property, networking activities of university spin-offs, resources, and overall university involvement” (Rothaermel et al., 2007, p. 762). Higher spending on IP protection and university policies that encourage equity investment correlate with higher startup formation rates (Di Gregorio & Shane, 2003; Lockett, Wright, & Franklin, 2003; Lockett & Wright, 2005). Research by Shane and Stuart (2002) indicates that better ties with venture capitalists will increase a startup’s propensity to secure funding and decrease the
probability of failure. Networking within the parent university is important too, as stronger ties here will lead to greater access to infrastructure and expertise (Grandi & Grimaldi, 2003; Johansson, Jacob, & Hellstrom, 2005). Availability of resources for venture creation and incubation is also extremely important. Successful university startups are shown to have greater access to high-quality faculty, founding teams and TTO staff, to richer technological endowments, and to better funding from the university, industry partners and venture capital providers (Link & Scott, 2005; Lockett & Wright, 2005; O’Shea et al., 2005; Powers & McDougall, 2005; Shane & Stuart, 2002).\(^\text{15}\)

As with the licensing process, the efforts employed by TTOs to form startups rarely progress in a simple or linear fashion (Siegel et al., 2003). However, some general characteristics of the process may be outlined. In general, the costs of startup creation, as compared with licensing processes, are less dominated by legal fees. Instead, TTO funds and financing leveraged from government programs or angel investors are used in the early stages to pay for the hiring of staff and other initial business operation expenses (Gibbons, 2007). The central task is for TTO staff to create the right team to build the firm and then help find the funding to keep the development process moving, which is usually accomplished “through hard work, repeated presentations, and much negotiation” (Gibbons, 2007, p. 8).\(^\text{16}\)

\(^{15}\) Complementing these specific areas of study, a large body of work focuses on the entire university system in seeking to determine the extent to which a university’s policies, incubation mechanisms and research environments are supportive of startup creation. Some research in this stream has argued that more active university involvement in this area can lead to dependency, a negative reputation for the institution, and delayed graduation from incubators (Johansson, Jacob, & Hellstrom, 2005; Rothaermel & Thursby, 2005). However, a much stronger consensus exists around the notion that university systems that are more active in support of startup creation enjoy higher startups survival rates, better startup performance and improvements to university reputation (Rothaermel, Agung, & Jiang, 2007).

\(^{16}\) Composing a competent management team is a critical task of the TTO when setting out to establish or help establish a new firm. University startup management teams are an important and understudied aspect of research commercialization (Rothaermel et al., 2007). The research on this topic has found that capable teams need to be heterogeneous in their composition, bringing multiple skillsets and experiences to the table (Ensley & Hmieleski, 2005). Less clear is whether startups launched with the support of TTOs benefit more from the use of surrogate entrepreneurs (e.g. Franklin, Wright, & Lockett, 2001) or from keeping the inventor closely integrated but providing coaching to fill gaps in capability (e.g. Clarysse & Moray, 2004).
Chapter 3: The Rise and Fall of the Innovations Foundation

Setting the Stage

Research commercialization at the University of Toronto did not begin in 1980 with the launch of the Innovations Foundation. The roots of the university’s experience in transferring invention to innovation lay much deeper. A useful starting point in the discussion of research commercialization’s emergence at the university can be found in two separate but interrelated events taking place in the late 1910s and early 1920s (Sá, Kretz, & Sigurðsson, in press). First is the establishment of Connaught Laboratories in 1914. The Lab was founded in order to produce diphtheria antitoxin based on the research of John FitzGerald and soon thereafter also began producing tetanus antitoxin and smallpox and typhoid vaccines. Its objective was not to commercialize university discoveries, but to “combine the promotion of health policies, through the production of low-cost vaccines for free distribution, with the development of research” (Cassier & Sinding, 2008, p. 154). Initially, Connaught was envisioned as a means of providing vaccines and antitoxins to Canadian military personnel. However, when the First World War ended, its mission shifted to providing for the civilian population. It remained a pharmaceutical producer kept by the university at arms length until its sale to the Canadian Development Corporation in 1972 (“Brief history of Connaught,” 1991).

The other major event was the invention of insulin in the early 1920s and the decision in 1922 to file patents on this revolutionary therapeutic and the process for isolating and refining it. According to the sub-committee of the university’s Board of Governors charged with handling the discovery, called the Insulin Committee, this treatment for diabetics was patented not to allow the university to bring in revenue, or to support the local or regional economy as might be more dominant rationales today, but “for the purpose of preventing [its] commercial exploitation and uncontrolled manufactur[ing]” (Insulin Committee, 1923, p. 485).

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17 It was founded in 1914 as the Antitoxin Laboratory and later renamed to Connaught Laboratory (Cassier & Sinding, 2008)
At this early stage, the university was concerned not with how to benefit financially from either Connaught Labs or from its revolutionary diabetes treatment. Rather, focus was placed on maintaining the institution’s reputation as a place of research and on protecting the public against any agents in the marketplace that may seek to restrict access to the products of university. The use of the insulin patents as a means of protecting the public interest was controversial from the beginning (Cassier & Sinding, 2008). On one hand, there were those who saw it as legitimate that a university might use patents to control the quality and availability of such a valuable invention, essentially taking into its own hands the responsibility for protecting the public good and for disciplining industry. On the other hand, there were those who saw it as wholly inconsistent with a university’s purpose in society that such an institution would regulate control of a discovery like insulin and in the process receive royalties from those approved to produce or otherwise work with it.

The discovery of insulin was followed closely by observers around the globe, not just due to its scientific or medical importance but also for the way in which the university chose to handle the IP associated with the invention. Researchers and administrators at universities in the US, such as the University of Wisconsin, would soon after use the experience, and the ‘public good’ justification for patenting, as a model for their own treatment of important medical discoveries (Apple, 1989). Following the insulin experience, from the 1920s to the 1960s, the university maintained a fairly consistent approach to processing opportunities for commercialization of research. The approach teetered between avoidance and ambivalence. The Insulin Committee had been maintained as the de facto authority on discoveries with commercial potential, and would sometimes recommend investing university funds to patent or license. However, inventions brought to the committee’s attention were always handled, first and foremost, with the interest of the reputation of the university as a protector of the public good in mind (Sá et al., in press).

From 1961 to 1980 the university’s approach began to shift as an increasing number of inventions were made and trends in science and industry drew universities around the world into closer interaction with business. In 1961, the university put in place
the Policy on Discoveries and Inventions.\textsuperscript{18} The policy continued to reaffirm, in no uncertain terms, that inventions were to be disclosed, and patented if necessary, only to ensure that their benefits would be made most widely available to the public.\textsuperscript{19} However, it was an important moment signifying an increased institutionalization of practices related to disclosing inventions and set out the process and responsibilities for inventors and the university when it came to patenting them.

Throughout the 1960s, possibilities for research commercialization kept creeping up onto the agendas of administrators. This occurred despite their lack of enthusiasm toward the topic, which seemed to raise the potential for conflict with the core functions of teaching, research and publication. These more traditional academic functions were given first consideration by any subcommittee of the Board of Governors dealing with patenting and licensing.\textsuperscript{20} Yet, as the 1960s came to a close, inventors among the faculty ranks continued to come forward, often pointing to American universities using commercialization partnerships with industry to expand their research budgets\textsuperscript{21} and even suggesting that the university explore the possibility of working with the US-based Research Corporation, a private entity devoted to administering the patents of many US universities since 1912.\textsuperscript{22} A new Patent Policy in 1966, while still emphasizing the primary importance of protecting the public good, included a subtle shift towards greater acceptance of commercialization in that it “also sought to ensure that the university capture any revenue generated from the exploitation of licensed inventions” (Sá et al., in press, p. 8).

In the 1970s, the pace of change quickened as the university was no longer just facing pressure from the odd entrepreneurially minded faculty-member looking for support, but now too from a federal government intent on fostering greater university-industry engagement. In 1966 the federal government had created the Science Council, an organization intended to advise the government on science and technology policy.

\textsuperscript{18} Meeting minutes, University of Toronto Scientific Development Committee, 1964, in UT Archives, A1973-0025, box 040, file Board Committees – SDC – meetings 1964-1965/University patent policy.
\textsuperscript{20} Ibid.
\textsuperscript{21} Letter, Guillet to Fisher, 11 November 1964, in UT Archives, A1975-0004, box 006, file Dr. Guillet.
\textsuperscript{22} Letter, T. C. Clark to O. Ga, 22 November 1979, in UT Archives A2004-0007, box 010, file Ozin Ga et al Organo-metal.
Among its most influential contributions was the report titled *Towards a National Science Policy in Canada* (1968), which, among other things, called for greater university-industry-government partnerships (Grove, 1989). Also important were the reports of the Senate Special Committee on Science Policy (The Lamontagne Committee), which was established in 1967 and issued recommendations regarding necessary improvements to university-industry collaboration until well into the 1970s (Fisher et al., 2006).

The university continued to maintain its distance from responsibility for decisions about whether or not to pursue commercialization in specific cases, and because the Patent Policy was not formally built into faculty contracts, ultimate decisions about patenting lay with the inventor.\(^{23}\) However, by the early 1970s concerns were being raised that the reputation of the university would be at risk if public perceptions arose that the university was not ensuring the capture of revenue from discoveries.\(^{24}\) These concerns were undoubtedly buttressed by the numerous government reports that were at the time presenting Canada’s universities to politicians and the general public as disengaged from the economic and industrial challenges the country was facing.

As the 1970s progressed, a number of changes, when considered together, demonstrated the institutionalization of fundamental features of the process of research commercialization in the university (Sá et al., in press). Whereas commercialization decisions were once the domain of a sub-committee of the Board of Governors, a committee directly linked to the Office of Research Administration and the Research Board now had this authority. Commercialization activity was therefore normalized as part of the regular affairs of research administration. Despite not believing it was in the university’s interest to force faculty members to disclose their inventions or much less to patent and commercialize them, university leadership considered it a moral obligation to disclose inventions with economic potential.\(^{25}\)

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\(^{24}\) Meeting minutes, University of Toronto Patent Committee, 27 September 1972, in UT Archives, A2004-0007, box 012, file Dr. Milles Townsend.

When inventors did come forward, the Patent Committee would provide guidance on commercial potential if possible and in some cases provide the funds necessary to secure a patent. Initially, the general approach was to pursue non-exclusive licenses, which was thought to be the best way of defending the public good and provide the broadest access. However, this strategy appeared to falter because of licensee reluctance to invest in further development under this condition, and so the stance was softened so that companies could be offered exclusivity (Sá et al., in press).

The revenue sharing system by which licensing income was divided among the university, its departments and the inventor also became more standardized in 1970. Revenue from licensed inventions was thereafter apportioned according to a variety of schemes depending on the nature of the invention, and the university-resources that went into it. The policy in place ensured that the inventor would receive at least some compensation but that “the bulk of the proceeds of any invention [were] returned to the area of research of the university in which the invention was originally developed.” Overall, the 1970s were a time of transformation in how the university administration conceived of the outputs of the academic research enterprise over which it presided. After decades of dealing with commercialization opportunities on an ad hoc basis, an increased prevalence of such opportunities, and new pressure both from a small but growing minority of inventors within the university, and from the federal government, led to the regularization of practices and routines such as disclosing, patenting, licensing, revenue sharing and others.

The Launch of the Innovations Foundation

In an environment increasingly favourable to research commercialization activity in the latter half of the 1970s, the university administration began to position itself to be more active in supporting patenting, and licensing of inventions. Back in 1967, the

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28 Ibid.
The university had entered into an agreement with the Canadian Patents and Development Limited (CPDL), the federal government’s technology transfer arm, “to secure patents on inventions and to bring these inventions into use, to derive a reasonable income therefrom and to protect these inventions from misuse.” The partnership with CPDL, an organization that commercialized inventions arising from government funded research and government operated research labs throughout the country, had allowed the university to outsource key commercialization activities that it was not initially interested in directly undertaking. However, as the 1970s came to a close, there was a growing sentiment that this partnership was not effective enough in supporting the transfer of the university’s technology. At the same time, many institutions in the US had launched their own technology transfer offices. Doing so would allow the University of Toronto to gain an additional measure of control over the transfer of its inventions to market.

In 1976 the Research Board appointed a Patent Committee Review Task Force to provide recommendations for how the university should respond to growing expectations that university research lead to practical applications and to consider possible changes to the Patent Policy. The result of the task force’s labours was a report in 1977 that recommended that “the university encourage researchers to find practical applications for their inventions and that the university provide assistance, where practicable, in the development of inventions.” The report suggested a shift from passive acceptance of commercialization towards active encouragement and support for commercialization. Included was the recommendation that the university create a new structure dedicated to developing university inventions, and that it enhance the incentives for scientists to commercialize by increasing their shares of related revenue.

As a result of the report, the Patent Policy was reconstituted as the Inventions Policy, a change that was mirrored by a similar renaming of the Patent Committee to the Inventions Committee. The new policy guaranteed inventors a share of any revenues resulting from their inventions, but it also stipulated that ownership and therefore control of the commercialization process for any campus invention was vested firmly in the

hands of the university. Once disclosed to the university, an inventor’s responsibility was to sit back and watch the university commercialize it.

The panel also undertook an environmental scanning process by investigating the university TTOs of institutions such as Stanford, MIT and Wisconsin, which were seen as highly successful models in research commercialization. A committee established by the Vice-President, Research and Planning to assess commercialization efforts at Canadian and US universities was dismissive of the potential for any existing Canadian university structures to serve as models as these were deemed ineffective. The TTOs of this select group of US universities were viewed as much more successful, due to their “ability to bring together inventor, venture capital, and entrepreneur.” Drawing from the examples of those successful TTOs as well as from other non-university organizations operating in the technology transfer field such as the Arthur D. Little Corporation, the Research Corporation and the Battelle Institute, the Patent Committee Review Task Force recommended the creation of an Invention Development Corporation.

Gordon Slemon, who had been appointed Dean of Engineering in 1979, was a key player who spurred the university to launch this new structure both as a member of the Inventions Committee and for his leadership role in one of the university’s most application-oriented faculties. Slemon’s support of the university establishing its first TTO was part of a broader initiative he had begun after ascending to the position of Dean to offset declining government funds for engineering, by looking to partnerships with industry (White, 2000). Overall, it was increasingly clear to Slemon and the members of the task force that the onus for improving research commercialization outcomes had landed on universities: “there seems [to be] little question that both the public and the public bodies which support university research expect that a greater emphasis be placed on such practical solutions in the future.” The university responded to such demands by

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32 Ibid.
following the lead of US institutions. Interaction between the university and the sources of entrepreneurial expertise and business capital was seen as lacking, and the creation of an invention development corporation was proposed to foster it.37

**The Invention Marketing Model: 1980 to 1990**

The latter half of the 1970s witnessed important shifts in the university towards support of research commercialization that culminated in the launch of the University of Toronto Innovations Foundation in 1980. It was launched at a time when perceptions of the legitimacy of disclosing, patenting and licensing of inventions had reached an important tipping point at the university. This legitimation resulted from internal factors such as an increasing propensity of academics to see and pursue commercial applications for their work, and external factors such as pressure from government bodies and from the perception that many US schools were pulling ahead in what had become an important university function. However, while university leaders had determined that the institution was expected to support and even promote commercialization, they still had to decide what kind of structure would be created to accomplish this mission, and how it would function.

The university established the Foundation as a non-profit organization, located just outside, but on the very edge of the university’s campus. There were, at the time, a range of models to choose from with regard to just how separate the university’s new TTO should be from the institutional core. For instance, Stanford’s highly successful TTO was a department within the university’s formal structure, while Wisconsin’s was a separately incorporated, off-campus foundation. At the University of Toronto, it was decided that the new TTO would be physically separate from the university, but that it would remain accountable to the university through a close relationship with the Inventions Committee, which became the Foundation’s de facto Board of Directors.38

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37 Meeting minutes, University of Toronto Research Board, 30 March 1976, in UT Archives, A1979-0025, box 019, file Research Board ’75-6.
38 Interview with former Innovations Foundation Board of Directors member, Toronto, 28 August 2012.
The Committee members who determined the nature of the new entity’s relationship with the university were aware of the challenges of commercialization through their work on the Patent Committee up to 1977 and the Inventions Committee that replaced it thereafter. They had seen first hand some of the obstacles to bringing university discoveries to the market throughout the 1970s. In their view, it was clear that a unit commercializing research at the university would benefit from being distanced from the regular operations of the institution. Becoming more prevalent at the time was the notion among the business community that university bureaucracy was destabilizing to successful commercial activity. Committee members felt that an off-campus location would allow the Foundation to more adequately interact with business partners who were weary of university bureaucracy when engaging in academic partnerships. However, while the Foundation was given physical separation, its operations were still strongly controlled by the university through the Inventions Committee.

In its incipient form, the Foundation was positioned primarily as a mechanism for marketing university inventions to industry, not necessarily as a vehicle for the further or joint development of such inventions. The purpose of the Foundation, as it was presented to the public through media outlets such as the Globe and Mail, was “to market U of T inventions, products and processes” (Lancashire, 1980). Slemon, then Dean of Engineering and the chair of the Inventions Committee upon the launch of the Foundation, framed the Foundation’s role as that of an active vendor, stating that “industry should come to universities for ideas, but it doesn’t, so we are going to them” (Lancashire, 1980). One article wrote of the Foundation as a “marketing boost for university inventors” (Richardson, 1983). Another, similarly framed the Foundation’s role as a communicator rather than a developer: “although the university’s researchers had been developing 25 commercially valuable ideas a year, they had no system for communicating those ideas to the business community” (“Export or Perish,” 1980).

The Foundation was launched as a passive recipient of university inventions. Once an invention was disclosed, decisions regarding the appropriateness of commercializing it, given the characteristics of the technology itself and the resources of

39 Ibid.
the Foundation, were made by the university through its Inventions Committee. It was only after the technical and commercial potential of an invention had been assessed that the Foundation stepped in. The Foundation is framed in early documents and media reports as playing a specific, and consistent role in a relatively fixed process:

Invention disclosures were made to an Inventions Committee at the university. If the Inventions Committee determined that the invention had some value, the committee would direct the inventors to assign the invention to the university and the university would assign the invention to the University of Toronto Innovations Foundation…in practice, all invention disclosures were accepted by the committee and hence assigned to the Innovations Foundation. (Hoye, 2006, p. 64)

The Foundation’s key responsibilities lay in taking the steps necessary to protect the IP of any discovery that reached it, and then marketing the protected discoveries to businesses predisposed to acquire them. The nature of the arrangement meant that the university was the client of the Foundation more than the inventor was. It “was expected to patent whatever the university deemed worthy of protection” (Lucas, 2005, p. 133), which according to interviews with former Foundation staff conducted by Hoye (2006), was almost everything that was disclosed. The lack of a filter on inventions being presented to the Foundation may have resulted from the relatively weak initial flow of inventions.41 However, the quantity of disclosures increased significantly in the early 1980s, and this increase was not matched by greater resources for the Foundation (Hoye, 2006). In the context of a relatively fixed Foundation budget, receiving too many inventions to commercialize was a problem when there were not enough resources to devote adequately to each invention.

Underlying the lack of measures taken to ensure that the Foundation would be able to handle ever-increasing numbers of inventions was the assumption that the Foundation would be able to quickly profit from the inventions it was asked to commercialize. Initially, the university covered the Foundation’s operating costs,

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41 In 1980, the university received only 15 invention disclosures. However, 24 were received in 1981 and 1982, 26 in 1983 and 38 in 1984 (Hoye, 2006).
however this situation was intended to last for only five years. By 1985, the Foundation was “expected to be self-supporting through royalties from the developments it is able to market” (Westell, 1980, p. B2). Not only was it to become self-sufficient within five years, but highly publicized projections were also made that within those same five years, the Foundation would supply inventions leading to annual product sales of more than $10 million (Lancashire, 1980; Westell, 1980). The plan was presented to the media as follows:

With a royalty rate of 1 per cent, the foundation’s budget would be unchanged with $10-million in sales. If the royalty payments produced a “profit,” some of the money would be kept in the foundation to invest in new developments and any surplus amount would be returned to the university for further research. (Westell, 1980, p. B2)

However, the optimistic projections announced in the early 1980s never materialized. Funding was a problem from the very beginning. Early budgets were small and dominated by unpredictable legal costs associated with hiring lawyers for patenting. The costs of patenting an invention could easily run into the tens of thousands (Deverell, 1989), and the Foundation was often faced with difficult decisions regarding seeking international patents. In practice, US and Canadian patents were sought for most inventions. However, some patents were also pursued in other countries such as Japan and in Europe, depending on the perceived importance of the invention. Decisions to patent in multiple countries were risky and the returns were even more uncertain than the decision to patent in Canada and the US. Patenting complex research discoveries also involves extensive ‘prior art’ searches to determine whether components of the IP to be protected have already been patented elsewhere. In addition, the Foundation was frequently required to make adjustments and clarifications before a patent would be issued, requiring expensive and time-consuming input from patent lawyers, Foundation staff and the inventors as well. Even in the relatively rare cases where a successfully
obtained patent had been licensed and the company began making sales, Foundation revenues could be “eaten away” by the costs of fighting patent infringement.42

Adding to high patent-related costs were the salaries of a modest staff of three. Initially, the Foundation was made up of an executive director, a university legal counsel and one support staff member. Expectations of the Foundation soon outgrew its staffing and patent budget, and returns on its early work did not materialize nearly as quickly as was envisioned by the Inventions Committee. The Foundation was marketing its wares, which reportedly included at least 20 inventions ready to be licensed upon its launch, including energy-saving fluorescent lights, improved intravenous fluid and a new type of reinforced plastic (“Export or Perish,” 1980). However, revenues were elusive and the Foundation was not able to capitalize on its early stock of inventions. Patent costs continued to rise from the steady stream of 20 to 40 new discoveries funnelled to the Foundation each year (Hoye, 2006), but licensing revenues were microscopic by comparison.

By the mid-1980s, the university administration began to see the Foundation as an unwanted drain on its resources, and it was only kept alive thanks to the introduction of a provincial government funding program for TTOs. The new program provided some $200,000 a year for the Foundation, representing about a third of the total budget at the halfway point of the decade (Story, 1988). A new executive director was hired in 1985 and owing to the provincial funds, staffing increased to three professionals, which included the director, and two managers, as well as two support staff (Lucas, 2005).

The second half of the 1980s was a critical time for the Foundation. Despite a less successful than anticipated first five years, provincial support and continued subsidization by the university had kept the Foundation alive. However, staff were still overwhelmed by the volume and diversity of inventions they were asked to expertly handle. The Foundation was expected to commercialize a wide range of IP, from trademarks to computer programs, and in fields as diverse as engineering, medicine, physics and chemistry (Westell, 1980). Yet, it lacked the scale, expertise and business contacts to perform effectively in all areas. Interviews with experienced technology licensing

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professionals indicate that a rule of thumb is for each manager to be in charge of no more than 5-10 inventions at a time in order to give each one sufficient care and attention. With only the director and one or two managers\textsuperscript{43} to lead licensing efforts for any given invention, the 40 licenses, 55 patents and 85 pending patent applications controlled by the Foundation as of 1987 (Dotto, 1987) were an enormous burden. Commercialization proved more laborious than the mere marketing activity outlined by the Foundation’s early planners on the Inventions Committee.

The Challenges of Marketing Inventions

Archived invention files provide important insights into the types of problems faced by the Foundation in its formative years. For one, successful commercialization almost always depended on the continued involvement of the inventors. However, because the university took control of all that was disclosed and passed it immediately to the Foundation, the system in place provided little incentive for inventors to continue to develop their work. Licensing agreements that included funding for ongoing research and development of the invention at the university were often signed with companies, which provided some incentive for the inventors. However, the Foundation sometimes encountered problems in convincing researchers to continue working in a manner that would lead to successful commercialization and revenue for the Foundation.

Such was the case when the Foundation had licensed a promising compound to be used in sleeping pills and arranged for further research funding for the two inventors. When the inventors, after having accepted the funding, decided to switch course and investigate a related compound that was already in the public domain and thus not patentable, the Foundation was put in a difficult position. After receiving a typed legal opinion indicating that the best the Foundation could do was encourage the inventors to look for new potentially patentable discoveries in their new line of investigation, a

\textsuperscript{43} Lucas (2005) reports from an interview conducted in 2001 that the Foundation was staffed in the latter half of the 1980s by three managers and two support staff. Analysis of numerous invention files from the period indicate that the three professionals correspond to the executive director, a lawyer, and a single project manager with a technical background to manager the commercialization process for individual projects.
Foundation staff member noted on the letter: “They should be encouraged to work on the [original project] and not waste time which could be put into the [original project], on activities which according to their agreement with us, they shouldn’t even think of doing with our prior written consent!”

Even when inventors did take an active role in the development of an invention that had been disclosed to the Foundation, their understandable lack of knowledge of the commercialization process, its risks, and patience for its outcomes, was a major distraction to the work of the TTO. Inventors were often unaware of the different research funding agencies and institutions with claims on the ownership of their discoveries, which forced the Foundation to act as a detective at the early stages of commercialization to determine whom they would have to share revenues with and how much they would have to share. In 1989, one inventor who felt he had disclosed a “discovery of extraordinary interest” in the mid-1980s related to a new method of preserving animal tissue (embalming), expressed his frustration by mailing a newspaper clipping and a letter to the Foundation that read:

I have waited patiently for assistance from your office, and the authorization to proceed with publication. From this article in the Star I recognize that I am not the only one who is frustrated after making a discovery and permitting it to become a financial boon to the employer, in this case the University.

From the inventor’s standpoint, a sacrifice had been made to withhold from publishing in order to preserve patentability, and also to agree to spend time working with the Foundation and give the university access to his idea. However, from the perspective of the Foundation staff, the inventor had years earlier been informed that the project was a dead end, and that spending any further time or resources, including in any attempt to file a patent would be unproductive. According to the Foundation manager

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responsible for the file, the invention was not patentable because the faculty member had not conducted the necessary research to determine the underlying chemical processes by which it actually worked.\footnote{47 Memorandum, R. Rethoret to P. Walsh, 18 January 1989, in the UT Archives, A2008-0021, box 006, file A Method of Embalming.}

The Foundation also often found itself in the position of mediator, embroiled in complicated disagreements between inventors. An invention disclosure out of the geography department in 1983 appeared to be at least partially an attempt to pre-empt the commercialization of another invention disclosed by a former research collaborator from the chemical engineering department. This collaborator was portrayed as having made unauthorized use of geography department data.\footnote{48 Invention Disclosure, “Ionization Electrode, (IE), Geo-Surveying”, F. Beales and P. Sivenas, 18 January 1983, in the UT Archives, A2008-0021, box 004.} In another case, an engineering discovery disclosed by a master’s student became contested as one of his supervisors, who owned a company in a related industry, sought to be added to the patent filing as a co-inventor in the middle of the patenting process. Foundation staff perceived the supervisor’s actions as an attempt to avoid paying future royalties to use the invention, since according to the patent lawyer hired to process the filing, his involvement was not such to justify being named a co-inventor. Being added to the patent filing would have allowed the faculty member to transfer the right to practice the invention to his company without being responsible for payment to the Foundation even though it was the Foundation assuming the entirety of the patenting costs.\footnote{49 Letter, A. Mallin to G. Adamson, 17 July 1984, in the UT Archives, A2008-0021, box 022, file Carlew Chemicals Ltd. - Woodhams Misc. Literature (Not Lic.AGMT).}

In a particularly surprising case, two groups of inventors from the Faculty of Dentistry disclosed two dental implant inventions at the same time, both of which boasted the same key patentable feature, a tapered design.\footnote{50 Letter, R.H. Rethoret to R. Pilliar, 27 July 1984, in the UT Archives, A2008-0021, box 008.} The Foundation considered the inventions to be near “head-to-head competitors,” as the only major difference was in the proposed quality and cost of each model.\footnote{51 Memorandum, R.H. Rethoret to P. Walsh, 18 December 1987, in the UT Archives, A2008-0021, box 008, file Symington/Listrom.} The Foundation did not have the freedom to select one invention over the other and this led to an exceedingly complicated patenting process. Another consequence was that a major conflict of interest developed for the
Foundation manager forced to commercialize both implant models, a situation that was unavoidable due to understaffing, despite his repeated warnings to the director that he was uncomfortable with the situation.\textsuperscript{52}

The university’s affiliation with numerous Toronto-area hospitals, each of which had a significant measure of autonomy to devise its own invention policy, also led to frequent disputes regarding ownership of IP arising in medicine. In one particularly complicated case, a group of inventions that had been jointly supported by the university, the Toronto General Hospital and the CPDL were disclosed and assigned to the Foundation. All of the parties had contributed to the research and had varying claims over some or all of the resulting IP. Moreover, it was later learned that the inventor had forgotten that he had also assigned some rights to the Queen Elizabeth Hospital as part of an agreement to use its facilities. The frustration of the Foundation staff in being forced to lead the commercialization of this particular project is evident in an internal memo from the executive director to the Foundation’s lawyer. The memo notes that the Inventions Committee “did not follow the University’s Inventions Policy and negotiate a sharing agreement with the inventor’s cross appointment institutions. As a result a ‘Sunnybrook Letter’ is a real possibility.”\textsuperscript{53} The term ‘Sunnybrook Letter’ referred to another situation in which the Sunnybrook Hospital had itself run into conflict with the Foundation for not having acknowledged its share of a different invention’s ownership.

Aside from showing the difficulties of commercializing inventions jointly owned with hospitals, cases like these show that there was also a growing sense of frustration towards the Inventions Committee from the Foundation, and particularly its director, in the late 1980s. The unfiltered nature by which the committee passed inventions on to the Foundation was becoming a sore point for Foundation staff. While it is quite possible that the Committee was itself under-prepared to play a more effective role in helping the Foundation to succeed, there was sentiment in the Foundation that the committee members were not fulfilling their responsibilities.

Dealing with companies that would license university inventions was another challenging aspect of the Foundation’s work. Licensees in Canada were often too small

\textsuperscript{52} Ibid.
\textsuperscript{53} Memorandum, “The Tam Invention”, A. Mallin to P. Walsh, 2 October 1986, in the UT Archives, A2008-0021, box 010, file Anti-Parathyroid Monoclonal Antibodies.
or not well enough endowed technologically to take on university inventions. Despite the priority given to finding Canadian licensees, their capacity to make substantial sales and thus royalties and licensing income for the Foundation was frequently in doubt. A great deal of the early motivation for the creation of the Innovations Foundation was actually to help funnel technologies to Canadian industry specifically (Sá et al., in press). However, in practice this was difficult and the Foundation quickly ran out of domestic options for many of its inventions, despite making strong efforts to commercialize locally. Working with foreign licensees in the US or elsewhere also presented problems that drained the resources of the Foundation and limited its revenues. One lucrative patent licensed to a Japanese firm for the production of reinforced plastics resulted in far less than anticipated revenues due to Foundation lacking foreign tax exempt status. Several US companies working with Foundation patents would periodically become delinquent in their payments and needed to be repeatedly pressured to produce development milestone and sales reports as stipulated in licensing agreements. Many patents were licensed after laborious negotiations, in one case lasting 18 months, only to result in minimal royalties unlikely to cover patenting costs. Some companies were even suspected of using licenses from the Foundation as a means of preventing the development of the invention for competitive reasons.

The Foundation was often caught between the competing interests of inventors, firms, and the TTO’s own survival. Inventors sometimes requested that improvement or modifications to their licensed invention be approved by them in writing or that strict performance commitments be included in agreements to ensure that the licensee take commercialization seriously. Licensees, on the other hand, motivated by financial bottom lines, sought to minimize the royalties they were forced to provide to the

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54 Several invention files in the UT Archives indicate attempts made at licensing to Canadian companies but that were contingent on the receipt of R&D funding from provincial government programs such as the IDEA corporation. These domestic arrangements were more labor intensive for the Foundation and were often unsuccessful.
57 Ibid.
Foundation and the inventors and maximize their control over the development trajectories of the inventions they licensed. In one case, a promising pharmaceutical discovery was licensed to a California biotechnology company in an agreement that included ongoing research funding for the inventors. Not long after beginning the arrangement, however, the company abruptly terminated the research funding and sublicensed the patent to two different companies neither of which appeared particularly interested in developing a product that would use the patent in a way that would result in royalties for the Foundation. An internal memo is indicative of the reality of the situation for the Foundation and the stress involved in adjusting the expectations of the inventor:

We don’t control their business. They can sell to Dupont or anyone else they please, or make it in China if they wish. I don’t propose to question their business practices, unless it is clear that they are in violation of the agreement. The only problem I see at present is how to explain this to [the inventor].

In its first decade of operation, the Foundation also experimented minimally with forming or taking equity in companies. However, similar to its experience in licensing, this approach resulted in very few successes. One of the earliest mentions of the Foundation in 1979, while the TTO was still in the planning stage, related to the new structure’s potential role in supporting a university-based enterprise called General Comunition Incorporated (GCI), which developed milling machines and was run by a prominent professor in the engineering department. The first executive director of the Foundation, who was in fact also the president of a management and electronics company (Westell, 1980) served on the board of GCI prior to taking his position with the Foundation. GCI struggled to make ends meet in the first half of the 1980s, and as the first leadership change at the Foundation took place in 1985 and a new executive director was installed, one of her first tasks was to try to rescue the embattled company that had managed to accumulate substantial debt, in part to the university through unpaid research.

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60 Memorandum, R.H. Rethoret to P. Walsh, 15 November 1988, in the UT Archives, A2008-0021, box 017, file California Biotechnology Inc. No. 1059.
contracts. The only viable option, according to the new director was to allow the company to convert some $48,000 of debt into equity in the company. While the company continued to survive, the new director of the Foundation resigned from her position on the board in 1988, citing the risk to the foundation of her continued involvement, and the Foundation gradually reduced its involvement in the venture’s management.

In 1985, the Vice-President, Research made a special request of the Foundation to take on the task of starting a computer software company in cooperation with the university’s Computer Systems Research Institute. The Foundation was charged with hiring a new manager in the computer software area, who would also be a “Chief Executive Officer-type with good technical strength in computer software and direct business experience encompassing responsibility for [patenting and licensing] budgets, and marketing in the software field.” The Foundation would also provide office space, bookkeeping, accounting, legal services and other services required by the company in its start-up phase. The deal between inventors and the Foundation fell apart nine months later as the inventors came to see the originally negotiated terms for equity and royalty sharing as weighing too heavily in the Foundation’s favour. The Foundation’s director was not well disposed toward revising the terms of the deal for business reasons. However, she also held that it was not the Foundation’s role to negotiate with inventors, but to implement the wishes of the administration. In a letter to the Dean of Engineering, who had brokered the original agreement, the director of the Foundation remarked that “the role of the Foundation is to implement the agreement, as it implements (and does not re-negotiate) the University’s Inventions Policy.” While involvement with the software startup would have allowed the Foundation to gain a new manager, the Foundation’s self-

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65 Memorandum, P. Walsh to G. Slemon, 10 April 1986, in UT Archives, A2008-0021, box 015, file Turing Management Committee Meetings.
acknowledged lack of experience in starting companies\textsuperscript{66} threatened to drain it of its limited resources, and involvement in the company went no further than planning.

In other cases, the option to launch a company was not so much a premeditated act based on calculations of the merits of this commercialization approach relative to the lower risk and lower profit approach of licensing, but rather a last resort option proposed to placate frustrated inventors. An internal memo concerning one such proposed company exemplifies this ‘last resort’ commercialization effort: “we don’t really have too much to lose…We have no other licensees at the door…Besides, the inventors can’t complain to us if things drag.”\textsuperscript{67} Overall, starting and running companies was attempted rarely and without success at the Foundation in its first decade. That the Foundation was, at least in the case of the software company, coerced by the Inventions Committee to support the launch of a startup despite its protestations, also helped deteriorate the relationship between the Foundation and the university administration.\textsuperscript{68}

Despite below expected revenues and the multitude of obstacles to effective commercialization listed above, there were some bright spots in the Foundation’s first decade of operation. In the mid-1980s, the Foundation helped commercialize a university-developed technology to extract food-grade protein from an inedible by-product of the Canola oil manufacturing process. The Foundation and the two scientists who made the invention were awarded a Bronze medal award in the invention category by the 1987 Canada Awards for Business Excellence.\textsuperscript{69} However, despite the novelty of the invention, it appeared to have little promise in Canada, the US or other advanced economy markets, due to a plentiful existing supply of protein sources. Thus, while the

\textsuperscript{66} Ibid.
\textsuperscript{67} Memorandum, R.H. Rethoret to P. Walsh, 8 October 1987, in the UT Archives, A2008-0021, box 008.
\textsuperscript{68} After the deterioration of the Foundation director’s relationship with the company’s faculty founders, she informed the Dean of Engineering who had initially requested the Foundation’s involvement, that she would no longer be attending the company’s meetings. In an attached background document she stresses that “the Foundation has never successfully started a company, so there are no operating models of equity-sharing and licensing” (Memorandum, P. Walsh to G. Slemon, 10 April 1986, in the UT Archives, box 015, file Turing Management Committee Meetings). In an earlier company planning document, it was also emphasized by Foundation staff that “the incorporation of new companies or the reorganization of companies of which the Foundation is a sole shareholder is a matter which is not ‘routine’ business for the Foundation’s management and, absent a general authorization by the [Board of Directors] delegating decisions in such matters to the [Foundation’s] executive director, such matters must be approved by the [Board of Directors]” (Memorandum, P. Walsh to G Slemon & C. Hamacher, 24 March 1986, in the UT Archives, box 015, file Turing Management Committee Meetings).
invention was considered a potential boon for developing countries, it never materialized into an economically successful invention for the Foundation.

A newspaper article in 1986 noted that the Foundation “has had some significant short-run successes, and appears to be gaining acceptance within the university and in industry” (Anderson, 1986, p. B6). By 1989, the Foundation had amassed 61 patents, had 106 pending patent applications and 55 active licenses from the first nine years of its operation (Deverell, 1989). As recently as 1987 it had brought in some $3.5 million in revenue for the university (Dotto, 1987). However, a large (unspecified) portion of this was for faculty research contracts, which largely bypassed the Foundation’s coffers. While not inconsequential, these accomplishments were a far cry from the expectations levied some seven years earlier.

The Globe and Mail Affair

Despite some optimism that new leadership and an influx of provincial funds would get the Foundation back on track to self-sufficiency, several events during the final years of the 1980s took a severe toll on the Foundation and its staff. Even though it won a second consecutive Canada Award for Business Excellence in 1988, the perception of the Foundation among many faculty, university administrators and even the general public began to turn toxic in 1988 and 1989. One particular incident, archived within the Foundation files as “The Globe and Mail Affair” provides useful insight into just how dire the situation was that the Foundation found itself in as the 1990s approached.

The Globe and Mail Affair began as a result of a May 25, 1989 article by Geoffrey Rowan, a Toronto business journalist. The article dealt with the Foundation’s handling of the commercialization of a dental varnish called Chlorzoin, purported to prevent tooth decay. It included text from interviews with one of the co-inventors, Tom Balanyk of the Faculty of Dentistry, and with the recently appointed Assistant Vice-President Technology Transfer (hereafter AVP Tech Transfer). The article presented

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71 The position of Assistant Vice-President Technology Transfer was created in the mid-1980s and served
the efforts of the Foundation in a poor light, noting that the inventors had been left with “a bad taste in their mouths” from the process. Balanyk was quoted as saying that the university did a poor job of marketing his invention and that the way it was handled represented a “strong disincentive to inventors” (Rowan, 1989, p. B9). Juxtaposing the Toronto invention with the commercialization success of the University of Florida’s sports drink Gatorade, the article implied erroneously that all rights to the dental varnish had been licensed to a generic drug company for a paltry $10,000. It stated that after patenting costs were paid, the university took $200 as its share and each inventor was left with only $100. In reality, the $10,000 was an advance on anticipated future royalties, not the entire licensing fee as presented in the article. No additional upfront fee was charged, according to the Foundation manager overseeing the project, because of substantial research and development still required from the licensee to make the product commercially viable.

The article painted a damning picture of the Foundation’s capacity to support university-based innovation. This was particularly the case because Chlorzoin had been just the invention that less than a year earlier won the Foundation its second consecutive Canada Award for Business Excellence. The article portrayed the Foundation as virtually giving away a prized result of Canada taxpayer money and the hard work of its top scientists.

The Foundation staff, none of whom had been asked for interviews or consulted about any of the information in the story, went into crisis mode, trying to repair the damage. The story had not only misconstrued the terms of the licensing agreement, but also made it appear that the invention was market ready at the time it was licensed. The article’s author had only interviewed one of the inventors, and unfortunately for the

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72 According to the article, the licensing of Gatorade had netted the research team that invented it $36 million (US), and $9 million for the University of Florida at the time of writing.

73 An internal memo provides additional detail with regard to the nature and extent of the licensee’s true contribution to commercialization: “it should be noted that in addition to the $10,000, they have spent several hundreds of thousands assisting in research, assisting in patent costs, in market preparation, preparing and submitting Canadian and U.S. approval submissions, and so on. To even imply that they bought it for $10,000 is ridiculous. It is still costing APO and the Foundation lots of money. More will be spent before any profit is seen, and the researchers don’t have to contribute one Loonie towards it.” Memorandum, R.H. Rethoret to A. Mallin, 26 May 1989, in the UT Archives, A2008-0021, box 004, file The Globe and Mail Affair.
Foundation, it was not the one who had been closely involved in negotiations with the licensee. Shortly after the article was published, the other inventor, James Sandham, made an apologetic call to the Foundation manager in charge of the project and acknowledged his share of the blame for not providing more information to Balanyk so that he would be better informed as to the status of the project and the terms of the license. Eventually Sandham also wrote a letter to the editor of the Globe and Mail in defence of the Foundation.74

The Foundation director’s reaction was to immediately draft two letters to the Globe and Mail to demand corrections to the information presented in the Rowan article. One was a shorter version that sought only to correct the inaccuracies of the report. Namely, it addressed that the $10,000 was anticipated to be only the tip of the iceberg in terms of university and inventor revenues from the invention. Furthermore, it made the case that this instance of technology transfer to a Canadian company exemplified “exactly the successful university-to-industry technology transfer which Canada should be strongly promoting for the benefit of Canadian industry and the Canadian economy, not the failure implied in the article.”75 This was the version that was ultimately sent, and it resulted in a correction issued a week later but that dealt only with the facts of the article, such as the nature of the $10,000 received from the licensee, and the technicality that the Foundation, and not the university itself, had managed and licensed the invention. The correction made no serious effort to undermine the overarching premise of the article, which was that the University of Toronto was failing to commercialize inventions compared to other universities.

The second, much longer draft to the Globe and Mail was ultimately never sent, but much of its content is telling of the condition of the Foundation at the time of writing:

Mr. Rowan’s comment on the low up-front fee paid for the Chlorzoin license raises the general matter of support for university-industry technology transfer in

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74 The letter from Jim Sandham was published several weeks later. It carefully separated the case of Chlorzoin with that of Gatorade and listed several of the expensive and time-consuming trials that the drug still had to go through before it would bring any financial returns, thus justifying the lack of more substantial payments from the licensee up to that point (Sandham, 1989).
Canada. With more money, greater foreign patent coverage could have been acquired. With more money clinical trials of the invention could have been carried out prior to licensing. With more money, the invention would have been several years closer to the market place before it was licensed and the license might have been marketed for a much larger up-front fee.  

The long version went on to provide an extensive description of the challenges facing not only the Foundation, but also all Ontario and Canadian TTOs. A particular sore point was the government’s cancellation in 1988 of the program of direct funding to university TTOs, which had been providing about $200,000 annually to the Foundation and had helped keep it alive since 1985. The director highlighted the university’s lack of funds to replace this important resource, a point that she had also raised in an interview published as part of a 1988 Toronto Star article.  

In a related internal memo, Foundation staff discussed the possibility of writing a letter to the editor on the theme of “how harmful such inaccurate articles are to the whole university-industry technology transfer effort”. However, it was never followed through.

The Globe and Mail article was a problem for the Foundation not just because of how negatively it portrayed its role in commercializing University of Toronto inventions, but also because of information it quoted from an interview with the new AVP Tech Transfer. In the article, the AVPs comments were presented as validation of the author’s prognosis about the university’s ability to commercialize. He was quoted as saying that the university was “not doing as well in this area as it could” and that “we’re still fairly new at it, still trying to learn the rules of the game” (Rowan, 1989, p. B9). Foundation staff wondered why the new AVP had not insisted that Rowan call the Foundation to check the facts and provide more context. Even more troubling was the AVP Tech

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77 In the article, the head of the Foundation was quoted as lamenting the loss of $200,000 per year of its $600,000 annual budget due to the closure of an assistance program for Ontario TTOs. When contacted for comment, the minister responsible noted that “the University of Toronto has no cause to complain because they have been the chief beneficiary of the ($7.5 million) Centres of Excellence program” (Story, 1988).


Transfer being cited as mentioning that the university was considering revising its Inventions Policy towards the type of inventor ownership model in place at the University of Waterloo. The director of the Foundation was concerned that any hint that the university was in the process of reviewing its mechanism for handling inventions would harm several existing and potential private sector donations that were being sought to compensate for the provincial government’s withdrawal of funds the year previous.  

When the head of the Foundation took this grievance directly to the Vice-President of Research, bypassing her new formal interface with the AVP Tech Transfer, she was informed that the university was not actively considering withdrawing its right of first refusal over inventions, but that it could not be guaranteed that the right of first refusal would not be withdrawn in two years time. Undermining the existing Inventions Policy was a threat to private sector donations because these were predicated on the current system in which the university, and not the inventor, automatically controlled all inventions. However, it was also a threat to the Foundation’s ability to receive high-quality invention disclosures because inventors might decide to wait until a new more favourable policy was in place to disclose their inventions and thereby end up with greater control and a bigger share of revenue.

By the end of 1989, news was circulating in the university community that a major change was being considered to the Inventions Policy that would take away the university’s, and therefore the Foundation’s, monopoly on control of inventions. This was impeding the work of the Foundation by late 1989. In November, the Foundation was forced to ask the high-profile inventor of a potential cancer and AIDS treatment to sign a letter assuring that if the Inventions Policy did change, that she would nonetheless use the Foundation to continue commercializing her invention, the patent for which was still being applied for. The inventor, acting on the advice of her lawyer, initially refused to sign the letter. However, when the Foundation threatened to refuse to pay further patenting fees on top of the $18,000 to $20,000 it had already invested, the inventor relented and signed the letter, albeit with an important condition:

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81 Ibid.
In the event that the University revises its Inventions Policy, I will take all appropriate action to ensure that ownership of new inventions arising from my present work in the field of anti-cancer and anti-viral substances will be assigned to the Foundation, provided that, in my opinion, the Foundation has reasonable capability to market such inventions.82

Despite the university’s assurances to the contrary, the inventions policy was drastically changed in January 1990, within a year of the Rowan article being published, undermining to a great extent the entire system on which the Foundation’s operating model was based (Hoye, 2006). The director of the Foundation resigned in early 1990.83 The turbulence caused by the Globe and Mail affair not only showcased the rift that had widened between the Foundation and many university inventors, but also a faltering relationship with the university administration. By the end of the 1980s, the limited Foundation staff were inundated by the constant flow of diverse and challenging commercialization projects.84 Without control over which projects they took on, there was little leeway to make strategic business decisions as a means of ensuring the TTO could operate sustainably and look after long-term survival and growth. The indiscrete nature of ongoing deliberations about the important potential Inventions Policy change by 1989 further loosened the Foundation’s tenuous grasp on sustainability by creating a new disincentive for inventors to disclose.

As far as many of the university’s inventors were concerned, a great deal of the blame for the subpar performance in marketing their inventions to industry lay in the lack of capacity of the Foundation. Several high profile faculty members had become displeased with the work of the Foundation by the late 1980s. In one case the director had

83 Project files indicate that the director remained with the Foundation at least until May, but had departed by December (Draft Letter, A. Mallin to C. Ganoza, 19 December 1990, in the UT Archives, A2008-0021, box 019, file Ganoza + Louis #1126 Connaught Laboratories, Gene Location).
84 The exasperation of the Foundation director with the imbalance of the workload compared to resources at her disposal is particularly evident in the long version of the letter drafted to the editor of the Globe and Mail to request a retraction of information published in the Rowan article. Furthermore, at least two other articles published in 1988 and 1989 in which the director is interviewed are focused similarly on the need for additional resources to carry out the Foundation’s mandate, be they from the university, government or elsewhere (Deverell, 1989; Story, 1988).
even been explicitly warned by the Dean of Engineering that her heated interactions with several of his faculty members over the launch of a company was giving them reason to give the Foundation “a very poor press within the University.” The Foundation had become viewed as “ineffective and unresponsive” and the number of invention disclosures being made was in decline (Hoye, 2006, p. 64). And so with its stock of trust from the institution and its most important assets, the faculty members, depleted, a new model was sought for research commercialization at the University of Toronto.

The Licensing Company Model: 1991 to 1999

As the accelerated decline of the Foundation took place in the late 1980s, the university scrambled to limit its financial losses and placate angry inventors. Up to that point, the Foundation had taken default ownership of all campus inventions. It took 50 percent of royalties on commercialization revenues; the inventor’s department would get 25 percent and the inventor would get 25 percent. Revenues were only distributed by the Foundation according to this formula after patenting costs had been deducted. Since a vast majority of inventions never earned more than the costs to patent them, the university and its inventors rarely earned any money. Worse in the minds of many inventors was that they had almost no control over the fate of their inventions once disclosed. The Foundation had won several awards for inventions it was helping to commercialize and, in a few isolated cases, earned royalties or a licensing fee worth more than the cost of commercialization. However, there had been no major licensing successes to boast of, and the Foundation’s limited exposure to university startup companies had been borderline disastrous. The Foundation’s performance left it with few

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85 Numerous references to negative interactions with inventors are present in the archived invention files. One professor expressed “deep dissatisfaction with the way the Foundation and, in particular, [the manager for medical research] has handled the invention.” Letter, A. Mallin to P. Munsche, 16 October 1990, in the UT Archives, A2008-0021, box 016, file Pruzanski/Vadas Rheumatism Treatment Project #1059.4.; As early as 1986, the Foundation director’s negotiations during the attempted launch of the university-supported software company led her to remark in a letter to the dean of engineering “my presence in these meetings, where I have no appropriate or effective role to play, is clearly giving [three engineering faculty members] a very poor impression of the capabilities of the Foundation, and – as you pointed out to me this morning – this may result in Holt giving the Foundation a very poor press within the University.” (Memorandum, P. Walsh to G. Slemon, 10 April 1986, in UT Archives, A2008-0021, box 015, file Turing Management Committee Meetings).
champions among the university faculty, as the scale of public opinion tipped heavily to the side of viewing the entity as a failure.  

New University Policy on Inventions

Within the recently created office of the AVP Tech Transfer an informal investigation had been underway since at least 1989 into the causes of the Foundation’s troubles. While lack of funding and understaffing were certainly identified as key problems, an easier, and possibly just as important fix was to change the Inventions Policy. Under the old policy, only in exceedingly rare cases, where the invention was deemed by the Inventions Committee to be valueless, or when commercialization efforts were made but failed to result in a patent, would a discovery be assigned back to the inventor. In these cases, inventors could invest further time and resources at their own discretion, but would still be required to pay the university 25 percent of any revenues they obtained. Results of the investigation undertaken by the AVP Tech Transfer appeared to reveal both that inventors were eager for greater ownership over their inventions (Hoye, 2006), and that this model had been successful in other institutions, most notably the University of Waterloo (Rowan, 1989).

While federal and provincial governments were around this time increasing other forms of spending on university-industry partnerships, the conditions of this funding precluded its use on enhancing TTOs. The Ontario Centres of Excellence program created in 1987 and the federal government’s Networks of Centres of Excellence program launched in 1989 both aimed to enhance university-industry relationships (Bell, 1996).

86 Lucas (2005) conducted interviews with former university and Foundation staff in 2001 and determined that there was “considerable discontent directed toward the IF in the late 1980s,” which was an impetus for the creation of the AVP Tech Transfer “to create a workable commercialization organization and strategy” (p. 133). Hoye (2006) adds that by the late 1980, “faculty members were complaining” about the ineffectiveness and unresponsiveness of the Foundation (p. 64).

87 While the AVP Tech Transfer’s comments in the Rowan article were that he has “been impressed with the results from universities that have adopted a different policy,” the only such institution named in the article is the University of Waterloo. However, in 1989 Stanford University was another high profile example also operating under an inventor ownership regime and only converted to a university ownership model in 1994 (Kenney & Patton, 2011). According to Kenney and Patton, Waterloo is the only institution in Canada or the US with an “unfettered inventor ownership regime” (p. 1100). Not only do inventors have the right of first refusal over all inventions, should they choose not to use the support of any university structures in the commercialization, they also received 100 percent from the revenues of the invention.
However, these programs targeted a very different type of industry partnership, aimed at very specific disciplines and consistent, long-term, joint research relationships, and therefore were not of direct relevance to the efforts of the TTO (Story, 1988). Coupled with the lack of prospects for improved funding was the toxicity that had developed in the relationships among inventors, the Foundation, and the university administration under the old model. Together these appear to have been the most important factors that led to a new Inventions Policy in 1990. The new policy was devised to allow inventors to develop and market their discoveries independent of university assistance. The right of first refusal was transferred from the Inventions Committee, which was disbanded, to the inventors themselves. While researchers were still required to disclose any invention to the university, it was at their discretion whether to seek the support of the Foundation to help the invention find an industrial home.

The new policy also presented two new revenue sharing formulas. In cases where the inventor took ownership of the invention, 75 percent of revenue went to the inventor and 25 percent to the university. When inventors chose to use the Foundation, the university received 25 percent, the Foundation received 50 percent and the inventor received 25 percent. The changes provided a new ownership route for inventors with improved financial incentives. However, Hoye (2006) asserts that “relative to other Canadian universities, the researcher’s share of the financial returns remained below the norm in both the case where the university develops the technology and the case where the inventor develops the technology” (p. 64). Thus, while the university gave up control, it did not yet appear ready to give up a greater share of the revenue, so as to fall into line with most other Canadian institutions.

Interviews with staff and a board member of the Foundation from the period indicate that the decision to change the Inventions Policy was perceived as primarily motivated by a desire to alleviate an immense pressure on the university from disgruntled inventors. One interviewee noted:

So the long and the short of it is, the university at the time…said, ‘why don’t we put it on their plate. All these researchers are telling us: you guys don’t do anything. If you think it’s so easy, you do it’, right? So in essence, that was the
spirit of what happened and that catalyzed this change whereas ‘you think you can
do this better than we can? You have the option to’. That’s why it was changed.  

Armed with a new Inventions Policy that removed the university’s monopoly over control of inventions, the administration was given some breathing room to reconstitute the Foundation’s operations. The most fundamental change was that the Foundation transformed from a marketing service of the university, to a much more independent licensing business working directly with inventors. This transformation will be returned to below, however, it bears mentioning that while the transition to a new policy, new leadership and a new business model allowed the Foundation a reprieve from its critics, it also presented the problem of effectively carrying-out ongoing commercialization projects. Indeed, ongoing projects were handed off first to the interim leadership in mid-1990 and then to the new permanent head one year later (Rojo, 1991). Each shift represented a new challenge as individuals often unfamiliar with the technology, and lacking a relationship with either the inventor or the licensee attempted to keep the projects moving forward. In more than one instance the Foundation was forced to send letters to licensees asking if these companies may owe royalties or other fees.  

Another problem was presented by the changeover to the new Inventions Policy. For instance, in cases where related inventions spanned both policies, the Foundation was forced to engage in negotiations with the inventor either to consolidate all inventions under one policy (usually the new policy) or to continue licensing and development under both policies, which was a major headache.  

While these problems may have slowed the early success of the Foundation under the new model, it did not stop it. The new entity was in some ways similar to the old. For instance, it retained approximately the same number of staff at equivalent levels: one leader, two or three mid-level professional managers, and a couple of support staff.

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88 Interview with former Innovations Foundation staff member, Toronto, 15 August 2012. Another interviewee remarked similarly that: “Under the new policy, it’s basically, it’s the university’s…well at least in my opinion, kind of clever way of saying, well if you think this is so easy, you do it” (Interview with former Innovations Foundation staff member, Toronto, 21 August 2012).


However, several important shifts took place. The executive director position was transformed to President and Chief Executive Officer. Additionally, a Board of Directors with more substantial industry representation and no direct connection to the university’s Board of Governors replaced the Inventions Committee. The university hired a new president with a background working as a manager for a US firm that was seen as a leader in technology licensing and invention management (Rojo, 1991).

These changes were part of an overall effort to more substantially separate the Foundation and its organizational culture from the university. The new Foundation “was run like a small company because that’s what it was,” remarked one interviewee. The president was still accountable to the university through the AVP Tech Transfer, particularly since the university was continuing to make up the shortfalls in Foundation revenue to cover operating expenses. However, an increasingly strong relationship also developed between the Foundation and one or two key active members of its board. The board numbered between 10 and 15 members, half from academia and half from industry. It was reported to be not very active with the major exception of its Chair from 1994 to 1999 who was a patent lawyer and played a key role in retooling the foundation as a licensing business.

The change of titles and structure accompanied a shift in organizational culture and the approach to licensing. Previously, the Foundation was seen as taking too passive and bureaucratic an approach to licensing negotiations, one that did not work in the world of business. One interviewee reported that under the previous leadership:

The best thing to do was to write a letter, and to put [the invention] on one of these sheets that says ‘the following technologies are available’…if you’ve ever been in the licensing business, my friend, you don’t license technology that way.

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91 Interview with former Innovations Foundation staff member, Toronto, 15 August 2012.
92 Ibid.
93 Interview with former Innovations Foundation staff member, Toronto, 15 August 2012; Interview with former member of the Innovations Foundation Board of Directors, Toronto, 28 August 2012.
94 Interview with former member of the Innovations Foundation Board of Directors, Toronto, 28 August 2012.
The new approach was much more hands-on, with Foundation staff working hard to establish key relationships with businesses in order to successfully license inventions:

We tried to take an industrial approach. So when we had a licensee, we would get on a plane and go visit them, sit in their office, deal with the technology, deal with the license agreement, send drafts back and forth.95

These changes were seen as an important way to get the Foundation on the track to financial self-sufficiency and for it to become the ‘do-or-die’ business that the new Inventions Policy forced it to be. It was also important for reasons relating to the Foundation’s perceived ability to interact with industrial partners:

We had to get it out of the university. There was a stigma attached to companies and to people when [they were] in the university. So the whole idea would be to separate the Innovations Foundation from the university…we were able to approach corporations and with our own letterhead, our own board, we were able to give them the technology they were interested in, away from the university. I mean it was called the Innovations Foundation, it was still affiliated with the University of Toronto, but there was clearly a stigma of dealing with the university.96

These comments echo a similar rationale for the initial establishment of the Foundation in 1980: that to be effective in interacting with business, the Foundation needed to be detached from the university. However, the early architects of the Foundation had, according to the interviewees quoted above, not gone far enough. Instead of a university outpost within the business community, the Foundation was redesigned as a private business, but with strong links to the university.

Aside from the shift in how it dealt with external industry partners, there were also important shifts in how it interacted with the university community, and how it

95 Ibid.
96 Ibid.
identified which inventions would be commercialized. With regard to the former, the context for the incoming president was one in which disclosures had sunk to their lowest numbers in a decade, almost reaching the single digits in 1990 (Hoye, 2006). Interviews indicate a perception among the new Foundation staff that the outgoing group had become very insular in the late 1980s: “they were seen as off campus [by inventors]…it was clear after talking to a few people along the way, there was no interaction between the inventors and the staff, certainly not the [executive director].”97 Thus the new leadership made outreach to faculty a priority. They walked the halls of the university in efforts to inform inventors about the new policy, the nature of the Foundation’s services, and to seek to rebuild the relationships with key inventors that had disintegrated in the second half of the 1980s.

It was not long before invention disclosures rebounded substantially, which may be mostly attributable to the change in the Inventions Policy (Hoye, 2006), but which one interviewee felt was also a result of the relationship-building and outreach efforts of the new Foundation staff:

Honestly at the end of the day I don’t think it was as much the Inventions Policy that got the invention disclosures up, than it was, it was just a different set of people…we talked to them, you know, told them stories and [that] if we are not successful after a year or two or whatever it was, we are going to give you your invention back, we’re not going to starve it, that’s the last thing we want to do.98

This statement and similar comments from other interviewees reinforce the notion that relationships between the former staff and faculty members had in many cases broken down and were in need of rebuilding. The reputation of the Foundation had suffered in the late 1980s, and now significant time and resources were needed to rebuild it.

As for developing a system for vetting inventions, this became one of the most important of the Foundation’s internal operations. Under the old model, nearly every

97 Interview with former Innovations Foundation staff member, Toronto, 21 August 2012.
98 Ibid.
invention was accepted. Under the new model of operation, selectivity was paramount. One lesson that had clearly been learned from the experience of the Foundation under the previous model was that it could not afford to take on all inventions. In fact, the Foundation was now interested only in the “cream of the crop,” and of the 100 or so inventions that the Foundation was assessing each year by 1993, it would take on only 20 (Liberante, 1993). The new decision-making paradigm also involved a greater sensitivity to the needs of business:

It’s who the licensees are. We had a fairly good feel in a lot of areas as far as what companies were interested in and their wish lists, so depending upon what we saw, we’d make a decision.99

The model was built on the necessity for the Foundation to be self-supported. Foundation leadership was informed from the beginning that its university subsidy, around $500,000 annually in 1991, was intended to shrink each year.100 It attempted to prepare for the eventuality of being left completely to its own devices not only by carefully vetting the inputs to its commercialization process, but also by aiming for a mix of short-term projects that would bring more immediate revenue and some higher-risk projects with a greater outlay in terms of time and resources, but that had larger potential returns in the long-run. The other axis along which inventions were considered had to do with the field of the invention. Initially, the Foundation had a single manager with expertise in the health sciences and another with expertise in the physical sciences.101 Thus, the optimum portfolio of inventions had the right mix of short- and long-term projects, split as evenly as possible across the two scientific fields. While it was

99 Ibid.
100 While the exact commitment of the university to incrementally reduce funding each year is unclear, and appears not to have been codified. One interviewee indicated that the university administration made it known to the Foundation that from 1991 onward they hoped to reduce its funding subsidy from around $500,000 in 1991 to zero within five years, in increments of $100,000 per year (Interview with former Innovations Foundation staff member, Toronto, 21 August 2012).
101 This information is based on three separate interviews with Foundation staff from the period and one with a member of the Board of Directors. In practice the president of the Foundation also took on a handful of projects every year and served as a “player-coach” (Interview with former Innovations Foundation staff member, Toronto, 21 August 2012), which is meant to refer to the fact that he was both overseeing the efforts of the group, and several managing specific projects as well.
recognized that this might result in some missed opportunities, particularly when it came to long-term and potentially highly lucrative commercialization projects in areas like therapeutics, it was a compromise that had to be made for immediate financial reasons.\textsuperscript{102}

The actual process by which the 100 inventions seen per year were turned into roughly 10 physical science and 10 health science commercialization projects began with a project manager hearing the story from the inventor. Next, two to three weeks would be spent doing due diligence: calling companies to gauge demand, assessing the market potential of the anticipated final product, learning about existing competition, and determining how prepared the Foundation was, in terms of existing corporate contacts, to take on the invention.\textsuperscript{103} The manager would then pitch the invention’s merits to the decision-making team, which consisted of the president and the other staff. If the decision was made to move forward, the same manager would generally be responsible for the rest of the project. This included patenting, marketing, negotiating licenses and executing nearly all facets of the commercialization process. The role required managers to be generalists and one former staff member referred to it as a “cradle to grave operation.”\textsuperscript{104}

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A Sustainable Licensing Business
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While success did not come quickly, it did appear to come eventually. The most immediate achievement of the new Foundation model was a marked improvement in the relationship with the AVP Tech Transfer and the Office of Research Administration. By virtue of the infusion of new personnel, selected in part by the AVP Tech Transfer himself, as well as the release of pressure facilitated by the change to the Inventions Policy, the effectiveness of the most important formal channel between the university and its TTO was restored.\textsuperscript{105} The AVP Tech Transfer’s office primarily looked after research contracts and grants, but also received the invention disclosures of faculty members. The Foundation president and AVP Tech Transfer met on a regular basis and to discuss inventions that had been disclosed and how those that had the highest potential might be

\begin{flushleft}
\textsuperscript{102} Interview with former Innovations Foundation staff member, Toronto, 21 August 2012.
\textsuperscript{103} Ibid.
\textsuperscript{104} Interview with former Innovations Foundation staff member, Toronto, 24 August 2012.
\textsuperscript{105} Interview with former Innovations Foundation staff member, Toronto, 21 August 2012.
\end{flushleft}
convinced to work with the Foundation.\footnote{Ibid.} As the Foundation’s new modus operandi was to function as a business, the improved relationship was also important because the AVP Tech Transfer’s office played a critical role in removing bureaucratic obstacles: “they were blocking for [the Foundation] all the way, so they just kept all the red tape off to the side.”\footnote{Ibid.}

As noted above, invention disclosures also improved markedly and hovered between 90 and 120 per year from 1993 to 1999. While the vast majority of inventors now chose to take personal ownership,\footnote{One interviewee estimated that on average, 90 percent of inventors chose to take personal ownership of inventions (Interview with former Innovations Foundation staff member, Toronto, 21 August 2012).} the Foundation was not just relegated to working with the 10 percent that were left over. Its new model allowed it to approach those who had chosen to go it alone and to be ready in cases where they came to realize that it was more work than they were prepared for, which, according to staff from the period, was not uncommon: “we had some people that tried, and they came back to see us after and said ‘I’ve tried and it’s way too hard.’”\footnote{Interview with former Innovations Foundation staff member, Toronto, 21 August 2012.} The Foundation also had the flexibility to negotiate the share of revenues it would take on particular projects depending on the proportions of time and effort put in by each party. For instance, in one case the Foundation negotiated responsibility for invoicing, collecting and distributing revenues from sales of a pharmaceutical product, but left the major chores of marketing, selling and distributing the product to the inventors. As a result the Foundation agreed to take only 20 percent of the net revenues rather than the usual 50 percent.\footnote{Letter, E. Kenney to A. Marks, 23 September 1993, in the UT Archives, A2008-0021, box 013, file Marks/Baumal Anti-Serum Against S100 Protein.} Not only were agreements such as this one shorter and quicker to negotiate than under the old model, they also indicate the willingness and the freedom of the new Foundation leadership to be more flexible and accommodate the peculiarities of each commercialization project. This contrasts markedly with the approach of the Foundation observed during certain key moments of its first decade, where precise adhesion to the Inventions Policy, and careful authorization from the university administration ruled the day. According to one former staff member, the flexibility of the Foundation increased throughout the 1990s as it
competed to be given the chance to support the development of high-potential inventions.\textsuperscript{111}

The condition of the Foundation improved in more tangible indicators of research commercialization output as well.\textsuperscript{112} In terms of patenting, the Foundation was applying for an average of 16 new US patents per year from 1993 to 1998, and successfully obtaining just over five per year. While in 1991 there were only 13 licenses that were actually earning any licensing income, this jumped to 17 in 1992, and 37 in 1993. From 1993 to 1998 the Foundation reported having a running total of around 40 revenue-earning licenses year-round. Licensing income also increased from a mere $327,000 in 1991 to a high of $2.46 million in 1996. From 1993 to 1998 the Foundation averaged licensing income of about $1.64 million per year, a large improvement over performance from the late 1980s. The Foundation gained positive press from a number of commercialization projects including the licensing of a technology for making asphalt last longer to an Ontario-based company (Rojo, 1992). Ironically, another source of accolades for the Foundation under the new model in 1993 was the dental varnish at the center of the Globe and Mail Affair some five years earlier. In October of 1993, Chlorzoin was finally approved for use in Canada by the federal health protection branch, and pitched as a revolutionary drug with potential sales that “could reach $3 billion a year worldwide” (“Anti-decay tooth drug,” 1993, “Briefs,” 1993).

The improvement from the past model under which the Foundation operated was such that the TTO was able to retain a measure of autonomy until at least 1998. According to one interviewee, the AVP Tech Transfer and the Board of Directors generally maintained a relatively ‘hands-off’ approach because “the story was pretty good, you know, our income was going up every year.”\textsuperscript{113} Indeed, by 1996 when licensing revenue peaked,\textsuperscript{114} the road ahead appeared to be smooth, seemingly validating

\textsuperscript{111} Interview with former Innovations Foundation staff member, Toronto, 24 August 2012.
\textsuperscript{112} Data in this section is generated from the Association of University Technology Managers (AUTM) Statistics Access for Tech Transfer (STATT) database. The STATT database contains academic patenting, licensing and startup data for the University of Toronto since 1991. This data is collected through an annual survey completed by staff of university TTOs, in this case, the Innovations Foundation (Association of University Technology Managers, 2013).
\textsuperscript{113} Interview with former Innovations Foundation staff member, Toronto, 21 August 2012.
\textsuperscript{114} According to AUTM data, not until 2009 would yearly licensing revenue obtained from commercialized inventions surpass the $2,458,607 earned in 1996.
the changes to its model and to the Inventions Policy that had taken place half a decade earlier. In a 1998 interview, the AVP Tech Transfer even went so far as to say that the new policy had helped the university to retain professors associated with inventions and that it appeared “to be keeping them happy” (Zehr, 1998).

However, there were chinks in the armour that had contributed to the Foundation’s apparent success. By 1999, these deficiencies had resulted in yet another reorganization of the operating model of the Foundation, and while this time the Inventions Policy would remain intact, the importance of the shift in the university’s approach to research commercialization would nonetheless be substantial.

“The Pig Stress Test”

Bringing in nearly two and a half million dollars in 1996 and an average of some $1.64 million in licensing income from 1993 to 1998 was a major accomplishment given where the Foundation had (re)started in 1991. It allowed the TTO to maintain its relatively autonomous, business-oriented disposition, and even to hire an additional manager by 1997, bringing the total FTE licensing managers to four (Association of University Technology Managers, 2013). Figures 3 through 8 provide an overview of several key research commercialization statistics from the period 1991 to 1999 including: a) the university’s research spending from industry; b) gross licensing income; c) licensing income as a percentage of industry research spending; d) invention disclosures; e) new US patent applications and patents received; and f) new licenses or options executed in the year and cumulative licenses or options active as of the last day of the fiscal year. These figures show a decline in the successfullness of licensing operations after the highly productive two-year period from 1995 to 1996. From 1997 to 1999, licensing income continued to fall while industry-supported research funding rose. The rise and fall in prominence of licensing as a subcomponent of the university’s overall efforts to enhance university-industry partnerships is evident in Figure 4, which portrays licensing income as a proportion of industry research funding. After peaking near 15 percent in 1993, by 1999 the licensing of inventions was failing to keep pace with increases in industrial research contracts.
Figure 2. Research expenditures from industry sources (1991-1999)

Figure 3. Total licensing income (1991-1999)

Figure 4. Licensing income as a percentage of industry-funded research (1991-1999)

Figure 5. Invention disclosures (1991-1999)

Figure 6. Patent applications and patents received (1991-1999)

Figure 7. New licenses executed and cumulative licenses active (1991-1999)
With regard to other important metrics such as invention disclosures, patents and numbers of licenses negotiated, findings are more equivocal. Cumulative licenses appeared to be rising steadily even while new licenses peaked in 1997. New patent applications generally increased after 1993 and 1994, but numbers of patents issued remained low.

What the AUTM data from 1991 to 1999 are unable to show is that from the mid-1990s onward the Foundation’s licensing income was highly dependent on a single invention. According to one interviewee, the Foundation “had one patent that was paying its expenses, that was about it.”115 The patent license being referred to was on a diagnostic test for Porcine Stress Syndrome (PSS) developed in the lab of David MacLennan of the university’s Banting and Best Department of Medical Research. PSS was known to be a major drain on pork industry profitability because many pigs were genetically predisposed to this condition that led to a significantly lower quality of meat. MacLennan developed a quick, simple, and accurate DNA test to detect the genetic marker for pigs that carried PSS-inducing genes, which ended up providing a major economic boost to the pork industry. The Innovations Foundation worked with MacLennan to patent the DNA test, and once licensed, the test generated millions in revenue.116

The nature of how the test was used, however, soon contributed to its increasing obsolescence. The Ontario Ministry of Agriculture and Food (OMAF) notes that “the DNA test provides the pork industry with a powerful tool to detect the PSS gene in live pigs and eradicate it from the entire pig population” (Ontario Ministry of Agriculture and Food, 2011). As a result of the test being used to breed out the gene itself, the licenses’ revenue generating lifespan was relatively short. One former staff member remarked that by 1998 the PSS-test business started to dry up and new licensing activity was not as lucrative.117 The importance of this one invention is evidenced in the comments of a member of the Board of Directors from the period, who noted with regard to the topics covered in the meetings up to 1999: “A lot of it was funding, we were always short of

115 Interview with former Innovations Foundation staff member, Toronto, 24 August 2012.
116 It is unclear exactly how much the PSS test invention generated for the Foundation, but interviews indicate that it brought in around one million per year for several years. In a newspaper article from 1998, it was reported that the invention brought in some $800,000 in royalties in 1997 (Zehr, 1998).
117 Interview with former Innovations Foundation staff member, Toronto, 24 August 2012.
funds. I mean the pig project was the big one that brought in a lot of money to it, but we were always short of funding.”\textsuperscript{118}

While the PSS test license wasn’t the only revenue-generator for the Foundation, its decline and the lack of a blockbuster deal to replace it appeared to be a factor undermining the faith of the administration in the model of the Foundation as a licensing business. Interviews indicate that there were also deeper structural issues relating to the way that the Inventions Policy and the university’s ‘self-reliance above all else’ approach to the Foundation negatively affected the probability of hitting the types of home-run inventions that successful university TTOs elsewhere appeared to live off of.

As mentioned earlier, the need for quick returns on investment led to the Foundation avoiding some of the potentially highly lucrative inventions that required long-term development, purely for reasons of expediency. However, many inventors, the majority in fact, were turned away for business reasons relating to lacking potential profitability or underdevelopment of their inventions. The Foundation eventually earned a reputation among some faculty members as engaging only in “cherry-picking and not really helping the researchers to develop their technologies.”\textsuperscript{119} Another interviewee remarked that while some inventors had no genuine interest in using institutional support to develop their inventions, many were actually hopeful that the Foundation would step in to help commercialize their technology because they lacked the experience, time and resources to do so on their own.\textsuperscript{120} Thus, by 1999 the reputation of the Foundation was again beginning to suffer. This time not because it took on all inventions and mishandled them, but rather because it rejected a majority of inventions without providing substantive guidance to the inventor on what to do next.

According to another interviewee, the new Inventions Policy also curtailed the Foundation’s ability to take advantage of the efforts of experienced inventors. It allowed any inexperienced inventors that did make it past the Foundation’s filter with their first invention to learn the ropes, make industry contacts and then for their next invention, they could go it alone. These much sought after ‘serial inventors’ were benefitting from the Foundation’s expertise and contacts on their earlier and less lucrative inventions, and

\begin{itemize}
\item \textsuperscript{118} Interview with former member of Innovations Foundation Board of Directors, Toronto, 28 August 2012.
\item \textsuperscript{119} Interview with former Innovations Foundation staff member, Toronto, 27 August 2012.
\item \textsuperscript{120} Interview with former Innovations Foundation staff member, Toronto, 22 August 2012.
\end{itemize}
then putting what they’d learned to the advantage of their second, and usually more successful, commercialization efforts but without benefit to the Foundation.\textsuperscript{121}

The Inventions Policy also had the effect of empowering certain important areas of the institution to further disengage from the centralized efforts of the university represented by the Foundation, thereby depriving it of valuable potential invention sources. One staff member notes how professors of the Faculty of Chemistry had historically been very entrepreneurially oriented but with a “do it yourself” mentality. Under the new policy they were empowered to become even more independent in their commercialization efforts and the revenues from these efforts were even less available to be tapped into to help increase the capacity of the Foundation.\textsuperscript{122}

The causes of lost opportunities to work on and generate revenue from valuable, high-potential inventions were not limited to academic departments such as chemistry. Interviews indicate that by the mid-1990s the emergence of small venture capital groups active in the Toronto area and the development of independent technology transfer offices in the affiliated hospitals began to take its toll on the stock of commercialization opportunities available to the Foundation.\textsuperscript{123} In the lead up to the bursting of the ‘Dot-Com’ information technology investment bubble in the early 2000s, venture capital firms began playing a much greater role in Toronto’s high-tech business ecosystem, which included the university and its affiliated hospitals, in some cases crowding out the Foundation.\textsuperscript{124} Government policies in the late 1990s also played a role. In particular, the federal government’s Intellectual Property Mobilization (IPM) program, which took shape in the mid- to late-1990s, helped many institutions to build capacity in their TTOs. The program is thought to have played a particularly important role in supporting TTO staff salaries at research hospitals (Goss Gilroy Inc, 2008).

\textsuperscript{121} A former staff member remarked that “if you were professor [X], and you had the ability to take ownership of the next invention that came about…and now as a professor, you have not only the scientific background, but the experience of going through this commercialization with us, right?...because you have some of the knowledge and some of the contacts, as a matter of fact, you have investors that have invested in you looking for your next best thing, do you really need the Innovations Foundation? No you don’t” (Interview with former Innovations Foundation staff member, Toronto, 15 August 2012).
\textsuperscript{122} Interview with former Innovations Foundation staff member, Toronto, 21 August 2012.
\textsuperscript{123} Interview with former Innovations Foundation staff member, Toronto, 24 August 2012.
\textsuperscript{124} Ibid.
Direct engagement of the affiliated hospitals in research commercialization also expanded because while the university had relinquished its right to ownership of inventions, the hospitals had not. Each affiliated hospital had its own policy on inventions and they were all ‘institution ownership’ policies. The hospitals still had to share invention revenues with the university, but not with the Foundation. With the influx of funds from the new government program, one interviewee remarked that “all the hospitals recognized: well why do we have to be giving this away to the Innovations Foundation when we can be doing it ourselves?” This incursion into territory that had once been the exclusive domain of the Foundation began depriving it of many high-potential inventions and stripped the university of direct control over the commercialization efforts of its cross-appointed medical faculty.

Finally, and related to the broad emergence of greater competition in the Toronto-area research commercialization environment, was an important shift in the policy context. Expectations for university research commercialization were increasing, and so while $1.5 million in licensing revenues per year was substantial by 1980s standards, by 1999 the bar had been raised in Canada and around the world (Atkinson-Grosjean, 2002; Industry Canada, 1996). All of this led to a growing disenchantment with the Foundation, which was perceived as not living up to its potential. In particular, its focus on licensing meant it was missing out on the possibility of startup ventures. “We were 99 percent licensing,” notes one interviewee with regard to allocation of Foundation resources up to 1999. The Foundation was billed in one newspaper article as the “less adventurous” option for those faculty members who made inventions but weren’t interested in the risks or rewards of starting a company (Zehr, 1998).

The licensing company model was devised to generate short-term income and not to foster the next fast growing global technology company. This made it increasingly out of sync with the growing societal, and public policy fixation on entrepreneurship at the time (Audretsch, 2007; Hart, 2003). The public and policymakers in Canada had observed with great interest the growth in economic value of high tech hubs like Silicon Valley in California and Route 128 near Boston, and were well aware of the role that

125 Ibid.
126 Interview with former member of Innovations Foundation Board of Directors, Toronto, 28 August 2012.
universities like Stanford and MIT, among others, had played in the emergence of these regional innovation hot spots. It can be safely claimed that the Foundation was not doing much to harm the innovation ecosystem in Toronto, as had perhaps been the case nearly a decade earlier when faculty members took to expressing their frustrations through the media. Yet, it was clear that it was not helping the university to build a reputation for driving economic growth that could match its reputation in research.

The Entrepreneurship & Startups Model: 1999 to 2006

Throughout the 1990s, the importance of making university research more commercially relevant in Canada grew. In 1991, a landmark report by Harvard economist Michael Porter, commissioned by the federal government and the National Council on Business Issues, called for greater emphasis on creating more intimate linkages between universities and industry (Porter, 1991). From 1991 to 1997, several important government reports, consultations, program reviews and department reorganizations combined to signal that public investments in universities needed to better translate into commercial outcomes (Atkinson-Grosjean, 2002). The specter of a Canadian ‘Innovation Gap’ entered popular consciousness. To curb this development, new initiatives were announced, such as the $800 million Canadian Foundation for Innovation in 1997, and the forming of an Expert Panel on the Commercialisation of University Research in 1998 by the federal government’s Advisory Council on Science and Technology (Atkinson-Grosjean, 2002).

By 1998, the imperative for university research to drive economic growth and industrial innovation was front and center on the agendas of policymakers, university administrators and the public. A big part of university science’s impact was seen to come not only from academic licensing, but from supporting the creation of startup companies. In a survey of 124 US universities, Feldman, Feller, Bercovitz and Burton (2002) found that while the earliest reported instance of a university taking equity in a company licensing a university technology was 1978, by 1990 two-fifths had taken equity in at least one such venture and by 2000 this figure had jumped to 90 percent. In Canada, a similar trend was taking place, as the number of university-based startups between 1991
and 2001 more than doubled from the previous decade (Colapinto, 2007). While licensing was still an important component of many universities’ research commercialization strategies, focus for many was shifting to creating the conditions to foster university startups and their successful growth. In this context, the Foundation’s relatively small-scale, licensing-only operation was seen as ineffective. One interviewee who joined the Foundation shortly after the shift that was taking place remarked that:

[The new Foundation president] was given a mandate to change things, and my perception of that was that his mandate was to move more to a startup model and more an investment or entrepreneurship model, rather than simply an academic licensing business model. I think that the perception at the time was that there was more money to be made in startups. Licensing was a long process, a very slow process with a low return, and I think the idea was that if you had equity in startups that you could realize a sale of that equity at a higher revenue.¹²⁷

Up to 1998, the Foundation had been trying to do what the administration originally asked of it, which was to be economically self-sufficient. It was believed among the Foundation leadership at the time that sticking to their approach to licensing was the best way to accomplish this. But even in this respect there were problems, as the Foundation appeared to be hanging on to self-sufficiency only by the thread of a single highly profitable invention. In fact, in 1998 the Foundation would run a deficit of $500,000 (Fairley, 2000), indicating just how precarious its hold on profitability over the mid-1990s had become. Worsening matters in the eyes of the administration, according to a board member from the period, were the optics of the commission-based employment of some of the Foundation managers.¹²⁸ Even as the TTO flirted with the edge of profitability, some of its managers, for instance those involved with the PSS test, took home substantial pay checks, at times even rivalling those of the university’s president. This factor and others led the administration to reconsider the Foundation’s model once again in the late 1990s.

¹²⁷ Interview with former Innovations Foundation staff member, Toronto, 27 August 2012.
¹²⁸ Interview with former member of Innovations Foundation Board of Directors, Toronto, 28 August 2012.
In 1998, the office of the Vice-President, Research acted. Deemed incapable of hitting the kind of commercialization jackpots obtained by several of its US and Canadian peers with its current cast, the first action taken was to change leadership on the Board of Directors.\textsuperscript{129} As had been the case in 1989, through the installation of new personalities with new skills and orientations, a reshaping of the Foundation’s core model of operations began. As noted previously, the chair from 1994 to 1999 played a very active role in the Foundation’s affairs over his tenure, in part because of the overlap of his profession as a patent lawyer, and the Foundation’s focus on patents and licensing. However, in 1998 a prominent Toronto-area entrepreneur and businessman, Joseph Rotman, was brought by the Vice-President, Research to restructure the Foundation (Grand Challenges Canada, n.d.). The first order of business was the replacement of the existing chair and the instalment of a new emphasis on entrepreneurship and startups.\textsuperscript{130}

The restructuring began rather innocuously with a request from the board to existing Foundation staff in 1998 to investigate options for supporting university startups. The Foundation staff returned with the response that it would take more people with a different skillset and a lot of extra investment from the university.\textsuperscript{131} Soon thereafter, the decision was made to terminate the president and in late 1998 a Foundation search committee posted an advertisement in the Globe and Mail. The Foundation was seeking an “entrepreneurial individual” to serve as its president, someone who would be responsible for “assisting in the creation of new companies based on university or hospital technologies,” in addition to supporting the traditional functions of patenting and licensing (“Display Ad 101,” 1998).

The eventual selection was announced in late 1999. Prominent in the announcement was the new president’s “more than 18 years as an innovative and accomplished scientist, entrepreneur and professor” (“University of Toronto Innovations Foundation,” 1999). These were the characteristics valued in the new operational model for the Foundation. One interviewee who observed the changeover noted of the difference in personality of the new president:

\textsuperscript{129} Interview with former Innovations Foundation staff member, Toronto, 21 August 2012.
\textsuperscript{130} Interview with former member of Innovations Foundation Board of Directors, Toronto, 28 August 2012.
\textsuperscript{131} Interview with former Innovations Foundation staff member, Toronto, 21 August 2012.
He spoke entrepreneur’s language, he had started up companies, he had failed companies and he had the scars on his back from all of that. So he talked easily with entrepreneurs and CEOs and his approach was much more business-like.¹³²

On the other hand, the previous president was described as “much more of a traditional manager.”¹³³ Paralleling the restructuring of 1991, around half of the existing staff were initially carried over, and some new staff were brought in. Of particular importance was to fill a hole in the management of physical sciences and engineering projects that had formed due to a retirement in the late 1990s.¹³⁴ More than just a change in skillsets, the shift away from pure licensing had deeper implications for the university as an institution. A successful faculty-inventor with experience in licensing and in startup creation who worked with the Foundation both before and after the shift remarked that:

> It was a transformative stage in intellectual property for the University of Toronto because it got people opening up their minds that there could be many different ways by which commercialization could be valuable to the university as an entity and to its business and rationale and everything other than just pure cash.¹³⁵

In addition to the influx of entrepreneurial skills and energy, and widening of the concept of commercialization and its role in the university, came an infusion of funds. The funding that had eluded the Foundation under its previous management, despite multiple requests by the president and the Board of Directors in the mid- to late 1990s,¹³⁶ materialized for the new president, albeit in the form of a loan. The Foundation was advanced a $2.45 million line of credit and tasked with “broadening the [Foundation’s] role from licensor to high-tech incubator” (Fairley, 2000). By 2001, the Foundation could boast of a $3 million annual budget and a mandate that had expanded from the

¹³² Interview with former Innovations Foundation staff member, Toronto, 24 August 2012.
¹³³ Ibid.
¹³⁴ Interview with former Innovations Foundation staff member, Toronto, 27 August 2012.
¹³⁵ Interview with faculty inventor, Toronto, 17 July 2012.
¹³⁶ Interview with former Innovations Foundation staff member, Toronto, 21 August 2012; Interview with former member of Innovations Foundation Board of Directors, Toronto, 28 August 2012.
“patenting, licensing and marketing of research,” to include hatching companies (Solomon, 2001).

However, before the new focus on startups could begin in earnest, a certain degree of clean up and preparation needed to take place. For starters, existing licensing projects had to some extent languished under interim leadership. As was the case in the previous change of management of the early 1990s, the process of handing off ongoing commercialization projects was time and resource consuming in and of itself. However, it was an unavoidable responsibility. This set of tasks was of critical importance if the university hoped to avoid losing face with inventors or to have any chance of recouping the many substantial investments that had been made in earlier inventions. Major tasks for new staff during the first year in 2000 included getting up to speed on the status of existing agreements, going after companies that were behind on payments, and ironing out a variety of legal conflicts that had been simmering among feuding co-inventors and between inventors and the licensees.

Another important initiative taken on during the change in leadership was to attempt to create better relationships among the various units within the university that worked on university-industry relations. In addition to the Foundation, there were by this time three other components of the university’s system established for managing university-industry relations. These components included a) Research Services (UTRS) which worked with faculty to access standard federal grant funding, negotiated research contracts, accepted inventions disclosures, and administered the Inventions Policy; b) The Research Partnerships Initiative (RPI) which assigned administrative staff known as business development officers (BDOs) to key faculties and departments. The Mandate of

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137 The critical importance of effectively bridging commercialization projects from one management group and business model to the next is evidenced by the fact that several major commercialization successes under the two latter TTO models resulted from relationships with inventors that had been initiated under their predecessors. For instance, the PSS test licenses that carried the Foundation as a licensing business was based on the research of an inventor whose relationship with the Foundation was initiated under the previous leadership (Memorandum, P. Walsh to D.H. MacLennan, R.G. Worton, & B. Britt, 3 May 1990, in UT Archives, A2008-0021, box 022, file McLenman et al MH Diagnostic File 1); In addition, in the early 2000s one of the first startup successes for the Foundation was the establishment of new company, Interface Biologics Inc., which ad emerged from a relationship between an inventor and Foundation staff that began in the mid- to late 1990s (Interview with former Innovations Foundation staff member, Toronto, 15 August 2012; “Interface Biologics,” 2002).

138 Interview with former Innovations Foundation staff member, Toronto, 22 August 2012; One major legal battle was a patent infringement lawsuit launched by the Foundation against Draxis Health Inc. in 2000 and was related to a patent filed by the Foundation in the early 1990s (“Lawsuit against Draxis,” 2000)
the BDOs was to “increase both the quantity and quality of research collaboration with companies in specific sectors: biotechnology, information technology and advanced materials;” and c) the Government Research Infrastructure Programs (GRIP) secretariat which worked with BDOs and researchers to maximize funding received from federal and provincial programs such as the Canada Foundation for Innovation (CFI) and Ontario R&D Challenge Fund.\(^\text{139}\)

Those in the office of the AVP Tech Transfer felt that the Foundation was not cooperating with these complementary units optimally for three reasons. First was the lack of a full-time Foundation staff member devoted to physical sciences and engineering, particularly since the aforementioned retirement in the late 1990s. Second was the lack of openness to joint stewardship over technologies and commercialization projects. Finally, there was the “lack of a common forum in which to identify technology commercialization opportunities and plan how the resources of the entire technology transfer system could be employed to capitalize on those opportunities.”\(^\text{140}\) In other words, the Foundation was too heavily focused on biomedical licenses, and more importantly, its model of operation and separation from the university was not allowing it to cooperate as fully as it might with other important, newly emerging initiatives to foster university-industry partnerships. As a means of rectifying the problem, the BDOs were soon co-located with the Foundation, whereas before they had resided within each of the respective targeted faculties and departments.\(^\text{141}\)

Rebuilding internal relationships also required outreach to inventors, many of whom felt abandoned under the model of the Foundation as a licensing company. In 1999, invention disclosures dropped to their lowest point since 1991 (Association of University Technology Managers, 2013), necessitating new efforts by the incoming leadership to once again push the number of disclosures upward. In a charm initiative similar in many ways to that used in the early 1990s to provide information on the new Inventions Policy and rebuild the image of the Foundation, staff in the early 2000s again


\(^\text{140}\) Ibid, p. 4.

\(^\text{141}\) Interview with former Innovations Foundation staff member, Toronto, 24 August 2012; Part of the massive spike in Foundation staff reported between 2000 and 2005 was due to the relocation of BDOs in to offices shared by the Foundation.
spread out across the university. Part of the outreach was educational and related to providing information about IP, patenting, licensing and startup companies. Another component was to try to overcome the “stigma” of the Foundation as an inventor support structure for which “nothing is ever good enough.”

According to AUTM figures, invention disclosures rebounded from 90 in 1999 to 127 in 2000 and then hovered between 130 and 140 per year from 2001 to 2003 before spiking to 164 in 2004 and 224 in 2005 (Association of University Technology Managers, 2013). While this is a significant increase, it bears mentioning that research funding was also rising rapidly throughout this period. The average total annual research expenditure of the university from 2000 to 2004 was $45 million greater than the average during 1995 to 1999, representing an increase of 22 percent (Association of University Technology Managers, 2013). Yet, an interview with a Foundation staff member that arrived after 1999 and a Foundation document from the period both indicate that the number of inventions actually offered to the Foundation to be commercialized (at the discretion of the inventor) increased even more drastically than the invention disclosure figures reported to the AUTM indicate.

The Foundation continued to actively pursue academic licensing, and in terms of the selectivity of the inventions selected to commercialize, it remained quite high with no more than five to ten percent of discoveries seen by the Foundation being taken on. With the new funding, new staff were hired to fill the gap that had formed in physical sciences and engineering and to expand operations in general. The BDOs were also now more closely integrated with the Foundation, although they remained primarily focused on research funding contracts and were directly accountable to the AVP Tech Transfer, and not the Foundation president. As a result of these actions, the FTE staff reported in the annual AUTM surveys for the foundation climbed from six in 1999, to 21 by 2002 and 25 in 2004.

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142 Interview with former Innovations Foundation staff member, Toronto, 22 August 2012.
143 Interview with former Innovations Foundation staff member, Toronto, 22 August 2012; (“Increase in Disclosures,” 2003)
144 Interview with former Innovations Foundation staff member, Toronto, 24 August 2012.
145 AUTM reports FTE licensing staff and FTE administrative staff for TTOs. These two figures are combined in the data reported above.
The Foundation continued to pursue licenses for certain inventions, following much the same process used in the past.\textsuperscript{146} However, the process for conducting due diligence to assess the potential of a disclosed invention changed fundamentally in that it now included the preferred option of building a company around the discovery. For inventions that were taken on with a view to starting a company, three factors weighed principally on the decision of whether or not the Foundation would initiate a project: a) the state of technical development of the invention; b) the condition of the market for the invention and its readiness to accept such a technology; and c) the patentability of the invention.\textsuperscript{147}

If an invention was taken on as the basis for a startup, the next step in the process was to develop a commercialization plan outlining the steps needed to move the project to a commercial reality. Generally these steps included identifying who would manage the endeavour and devising a strategy to scale it up, as well as finding the capital to pay for the operation.\textsuperscript{148} In a 2000 article, a staff member of the Foundation was quoted saying that:

\begin{quote}
We don't encourage professors to start their own companies because this isn't their area of expertise…We help to put a company together properly with top management and development teams so that a professor can continue to do what he does best, which is research. (Fattori, 2000)
\end{quote}

Developing the management teams and finding capital investment were both major challenges for the Foundation’s new model and represented new obstacles not faced under the model of the Foundation as a licensing company. In addition to hiring more staff with greater experience in supporting new ventures, the Foundation also

\textsuperscript{146} Continuity in licensing operations was maintained even after the change in leadership as at least one staff member and the former president both continued to work on a part-time basis for the Foundation as consultants. Upon the termination of his employment, the outgoing president negotiated for himself to continue to lead the PSS test project for a period of two years (Interview with former Innovations Foundation staff member, Toronto, 21 August 2012). One former staff member in the biomedical field was retained to ensure continuity with existing licensing projects and for support in new projects (Interview with former Innovations Foundation staff member, Toronto, 15 August 2012).

\textsuperscript{147} Interview with former Innovations Foundation staff member, Toronto, 27 August 2012.

\textsuperscript{148} Ibid.
enlisted the support of the Rotman School of Management. Together with business professors, the Foundation co-developed a course that allowed second-year MBAs to help assess the market potential of disclosed inventions, and to work with scientists, lawyers and Foundation staff to determine whether to take on specific commercialization projects and how (Fairley, 2000). Two even more substantive actions taken to foster the creation of startups were the launch of a ‘startup incubator’ and a major lobbying effort to spur the creation of venture capital funds specifically targeted to startups emanating from the university and its hospitals.

Building a Business Incubator

The Exceler@tor program was launched in early 2001 as a business incubator with “both business development expertise and technology infrastructure support” intended to support a select group of university startups (Del Nibletto, 2001). It was based on the recognition that new ventures launched from university technology had trouble getting to the market place (Solomon, 2001). The aim of the program was to nurture the growth of businesses based on the inventions of students, graduates and faculty by providing basic services including meeting space, copiers, phone and computer systems as well as the opportunity “to meet with business advisors as [the companies] hone their business plans and prepare for the future” (Clayton, 2003). Originally established to support information technology (IT) and internet-based companies, by 2003 the program was expanding to support business teams from biotechnology and the physical sciences. The program’s physical facility could house up to ten companies and maintained strict entrance requirements with an emphasis on technologies that were potentially disruptive to existing industry and had the potential to make a global impact (Del Nibletto, 2001).

While as of 2003, the incubator could not provide direct access to the kinds of manufacturing or laboratory facilities beneficial to biotechnology or engineering startups (Clayton, 2003), it had amassed an impressive technological infrastructure to support IT companies. There was major demand for the incubator and the Foundation had little
trouble finding industrial partners to provide in-kind donations of computer hardware and software, accounting, legal and business services.\textsuperscript{149}

Rather than taking equity in the companies that were granted entry to the program, the Foundation asked for a share of any profits made and its portion of profits depended on the amount of services that the program invested into the startup (Fruitman, 2001). Companies participating were also required to pay a monthly fee of around $1,000 in order to help cover the incubator’s costs. Marking a major break from all prior Foundation commercialization activities, the incubator also accepted entrants from inventors not based at the University of Toronto, and even left open the possibility of allowing other non-university based companies to participate at its discretion. The Exceler@tor was not just a way to get high tech university inventions off the ground, it was part of an overall initiative to enhance the image of the university as an entrepreneurial hub. The incubator’s manager remarked in a 2001 interview that:

We are building the Exceler@tor program as a catalyst to make the university an entrepreneur and also to stop the brain drain in this country. We work to accelerate Canadian technology entrepreneurs with resources they could not afford. They can locate here or elsewhere on a pay-per-use model. (Del Nibletto, 2001)

Another part of this broader initiative was a Canada-wide business plan competition sponsored by the Foundation and launched in 2001. The competition was aimed at encouraging university staff, students and graduates “to come up with marketable ideas or bring out early stage companies” in order to win the chance to meet with venture capitalists for advice and possible financing (Solomon, 2001). The competition was also leveraged as a way of funnelling ideas into the Exceler@tor, which opened within a month of the awards ceremony for the first business plan competition cohort.

\textsuperscript{149} Exceler@tor partners between 2000 and 2003 included Compaq Canada (Del Nibletto, 2001), Microsoft (“Microsoft Joins Exceler@tor,” 2001), Macromedia Canada (Clayton, 2003) as well as Q9 Networks, Spencer Stuart Inc, and J.L. Albright Venture Partners (Fruitman, 2001).
Venture Capital for University Startups

Accompanying the initiatives described above to build entrepreneurial support mechanisms was a concerted effort to assemble sources of funding for early stage ventures. Part of the challenge for creating new firms based on technology that is not market-ready, is finding the resources to pay for further development. The term ‘valley of death’ has often been used to describe the challenge faced by companies based on early stage technology as they seek to find the kinds of risk-taking investors needed to push their inventions to the market (Auerswald & Branscomb, 2003). In the case of University of Toronto startups, there was a particular challenge in that Canada has long been thought to be deficient in early stage venture capital, particularly when compared to the US. This lack of investment funding may be due to regulatory restrictions on banks and pension plan investments, as well as a perceived culture-based aversion to risk-taking (Evans, 2006). In 2002, the Canadian Federation of Independent Business (2002) noted the problem of a lack of access to seed capital (angel funding) for young, high-risk firms in technology and health science fields as a major impediment to these firms’ success.

To overcome this problem, the Foundation embarked on a major campaign to lobby for the creation of a number of venture funds by approaching major banks, government agencies and other financial institutions that might have the resources to invest in startup companies. By 2004, as many as ten “community sponsored business investment funds” had been established with support from the leadership of the Foundation, opening access to essential sources of funding for university-based startups in the Toronto area. By one estimate, between 30 and 40 startup companies were able to obtain funding from these new sources between 2000 and 2004, thereby increasing their chances to survive the ‘valley of death’.

These new funds were not just open to startups created through the Foundation. For instance the Discovery District Biotech Fund, despite being established through the leadership of the Foundation, was also open to proposals from the technology transfer offices of most affiliated hospitals (“$6 Million Venture Fund,” 2001). However, Foundation supported startups, such as Interface Biologics, a company specializing in

150 Interview with former Innovations Foundation staff member, Toronto, 22 August 2012.
enhancing the surfaces of biomaterials such as catheters, did successfully receive funding. Interface Biologics received $1 million in venture funding in 2002 (“Interface Biologics,” 2002), a long-term investment that according to one interviewee is only now beginning to pay off for investors.151

Another even higher profile startup company created by the Foundation and with the support of the newly established venture funding programs was the BIOX Corporation. BIOX had been established under the initiative of the Foundation to build commercial scale biodiesel production facilities able to use vegetable oils and waste products from meat producers to create diesel that is economical to produce and more environmentally friendly than petroleum diesel. The process was invented in the mid-1990s, but it wasn’t until 2000 that the Foundation identified it as a potential commercialization target. Working with the inventor David Boocock from the Department of Chemical Engineering, the Foundation led efforts to patent the process, compose and implement a business plan, and within one year of the initiation of the project, identify an investor to provide the capital necessary to hire a competent management team and the engineering expertise needed to scale up the process (Gibbons, 2007). After a $5 million grant from Sustainable Development Technology Canada in 2004, the company built its first commercial-scale facility, capable of producing some 67 million litres of biodiesel per year in 2007 (Hamilton, 2010).

In its 2003 Annual Report, the Foundation claimed many important accomplishments and seemed poised to continue forward with a much more ambitious commercialization agenda than the one that had been replaced in 2000. The Foundation reported $4.5 million in total revenues, the successful operation of its first incubator, plans for a satellite incubator on the Mississauga campus, $30 million in seed venture funds raised, and a total of $15 million invested in 21 startup companies that had also leveraged some $35 million from co-investors (Innovations Foundation, 2003). Moreover, the previous year a new strategic plan had been approved by the university, which included securing a $8.5 million increase to its university line of credit to continue on its existing trajectory of expansion. The plan also included a forecast of $20 million in annual retained revenue and $16 million in royalties and capital gains from equity in

151 Interview with faculty inventor, Toronto, 17 July 2012.
Foundation supported startups by 2010 (Wahl, 2002). It appeared that while the transformation from the TTO as a more narrowly focused licensing company to a comprehensive university entrepreneurship support organization had not come quickly or without major expense, the future was relatively bright. The AVP Tech Transfer was quoted in 2002 stating that the several years previous had proven that the Foundation could be “active and successful” in “patenting and protecting technology produced at U of T.” His assessment was that “The trick now is to keep that momentum going and to maximize the ability of the foundation to both help our faculty and to generate money for the university” (Wahl, 2002). However, despite the accumulation of apparent successes in 2002 and 2003, the next two years would turn out to be disastrous for the Foundation.

The Manley Report

In June of 2004, as part of a review sparked by the early departure of university President Robert Birgeneau and under the leadership of John Challis, the new Vice-President, Research and International Relations, the university commissioned a report on commercialization and technology transfer at the university. The result, released in November, was the *Report of the Manley Panel on Commercialization and Technology Transfer at the University of Toronto* (hereafter the Manley Report). The Manley Report was produced by a four-member panel chaired by the Honourable John Manley who had recently retired from politics after appointments as Minister of Industry, Foreign Affairs, Finance and most recently, as Deputy Prime Minister. Also included in the high-profile group were the Vice-President, Research of Vancouver Coastal Health, a Senior Vice-President of the Royal Bank of Canada Financial Group, and the Director of Stanford University’s Office of Technology Licensing.

In no uncertain terms, the Manley Report called for the Innovations Foundation to be closed down. It recommended that a process be set in motion to create a replacement TTO that would be better designed to work in partnership with the affiliated hospitals and housed within the new MaRS Discovery District, a major science park and
commercialization hub under development in downtown Toronto. In the interim, the report recommended that the university focus its efforts on simplifying and concentrating its commercialization efforts around the singular goal of maximizing invention disclosures and not on bringing in revenue. It urged immediate action towards uniting the functions of the Foundation (patenting, licensing, startups) with those the Office of the AVP Technology Transfer (industry partnerships and contract research) into one office. While consolidating the university’s two major arms for industry engagement, and refocusing available resources on the earliest stage of commercialization were suggested to be undertaken with the greatest urgency, the report also recommended that a new research commercialization organization be created to eventually house the newly integrated body. The new entity was given the working title of “Toronto Partnership for Innovation,” and was envisioned as a multi-institutional “commercialization agent” placed administratively and physically outside of the university (Manley, Bressler, Ku, & Smith, 2004, p. 9).

The principal difference between the proposed entity and the Innovations Foundation was that the new entity would be controlled not just by the university but also jointly with the affiliated hospitals. As such, it would be able to leverage a much wider-resource base in order to create economies of scale that the Foundation lacked in the handling of commercialization processes and also foster an improved culture for commercialization among each stakeholder institution. As for the governance of the new

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152 Concerted effort to begin developing the MaRS Discovery District began in 2000. In 2001, the University of Toronto made a commitment of $5 million in support of the project (Crane, 2001). MaRS was envisioned as a cluster of three facilities to be constructed on land on the southern edge of the downtown Toronto campus purchased owned from the University Health Network. With an anticipated total investment cost of some $500 million in 2001, MaRS was planned to be a physical and virtual cluster of commercial tenants such as venture capitalists, banks, legal service providers, a public research facility and a biotechnology incubator (Crane, 2001). The first phase of the MaRS Discovery District became a reality in 2005 (Sá & Lee, 2012).

153 The Manley Report does not make clear whether the new “Toronto Partnership for Innovation” should also be responsible for all of the contract research responsibilities of the AVP Tech Transfer office, but this is the implication. While the report is fairly explicit in describing what the final integrated commercialization agent will look like, it is not explicit about whether, in the interim, the Foundation should absorb the responsibilities of the AVP Tech Transfer, or vice versa. The only related guidance for implementation reads as follows: “An important element of this strategy would be to engage an interim CEO for [the Foundation] with the specific mandate of integrating [the Foundation] and the [office of the AVP Tech Transfer] and orienting the integrated body towards a larger partnership that would include the affiliated research hospitals” (Manley, Bressler, Ku, & Smith, 2004, p. 14).
model, each institution’s interests would be represented “in line with their degree of participation in the new entity” (Manley et al., 2004, p. 10).

The authors’ recommendation to integrate the Foundation and the Office of the AVP Tech Transfer and to outsource the latter stages of commercialization (beyond disclosure) to a new multi-institution TTO were based on the contention that the Foundation’s performance in commercialization did not match the university’s performance as a top-tier research institution. To make this assessment and recommend a course of action to remedy it, the authors of the Manley Report had gathered evidence from interviews with some 70 ‘interested parties’ from within Canada and the US including representatives of the university, the Foundation, the affiliated hospitals, venture capital and legal communities, among others. While the report did not directly cite any empirical data, it made clear that the authors were given the impression of the Foundation as an underperformer:

We found a widespread feeling that [the Foundation] is not performing optimally. Despite the effort, skill and hard work of its staff, it is not giving the university the stature it should have (and is increasingly expected to have) as a superb research organization that also creates economic activity and social benefits through its inventions and ideas. (Manley et al., 2004, p. 4)

The authors were careful to spare the Foundation leadership from direct criticism by emphasizing that the report’s findings should not be taken as a criticism of the Foundation, but rather as “the best response to a new dynamic in the research community that has created an exciting opportunity” (Manley et al., 2004, p. 13). Further the report indicated that:

While [the Foundation] is justified in saying that it is meeting some of the goals of its strategic plan, we are not sure that they are the right goals. We believe [the Foundation], and consequently commercialization in general, is held back by a lack of clear direction from its owner and by a business model that seems counterproductive. (Manley et al., 2004, p. 5)
The only specific Foundation initiative that the Panel took issue with was the Excelerator, which was singled out as an unneeded expense. The “considerable time and resources” spent sponsoring it were counterproductive, according the report, particularly owing to the fact that the incubator occasionally supported businesses “not necessarily within the University” (Manley et al., 2004, p. 8).

Overall, the Manley Report represented a proposal for a major overhaul of the way that the university managed and promoted interactions with industry. It suggested that the university needed to be concerned singularly with increasing the number of disclosures and to leave the latter stages of the commercialization process to the envisioned partnership organization that included all of the hospitals. The report was critical of the university’s ‘pay your own way’ financial approach to the Foundation and to commercialization in general, instead urging the use of steady-state financing and the provision of commercialization support to inventors as a service. The Panel also strongly urged the university to rewrite its Inventions Policy so as to reclaim the university’s right of first refusal over inventions that had been given up in 1990, but also to make the revenue sharing provisions more favourable to the inventors. Finally, the report promoted the MaRS Discovery District, then an emerging biomedical research and industry hub, as the ideal institutional home of the envisioned multi-institution TTO. To the authors, the appearance of the MaRS project provided the perfect opportunity for the university to refocus its commercialization efforts and to work closely with the affiliated hospitals and the city’s financial and business communities to make inroads where the Foundation had failed.

\[154\] In total, the report recommended six major changes to facilitate improvement to the commercialization performance of the university: “Restructuring its commercialization and technology transfer activities to follow a model for commercialization that is not driven mainly by the need to earn returns but rather to transfer knowledge; Bringing together the existing separate functions of technology transfer and commercialization into a single unit, and better leveraging relationships with industry and potential investors; Developing strong links to the university’s affiliated hospital-based research institutes to build economies of scale; Engaging actively with the Medical and Related Sciences (MaRS) Discovery District; Changing existing policies to give investigators a greater share of the revenue created by their ideas, and to simplify ownership of the related intellectual property; and Working on several fronts to build a culture that is more receptive to commercialization” (Manley et al., 2004, p. 3).
The Fall of the Innovations Foundation

The Foundation’s president and CEO resigned shortly after the initiation of work on the Manley Report (Riggall, 2006), not waiting to hear the verdict. While the university did not immediately dismantle the Foundation, it quickly began planning for this eventuality. After issuing a $2 million extension to the Foundation’s line of credit to cover shortfalls during the restructuring period, the university formally closed the Foundation in early 2006, putting an end to its 26 year history (Riggall, 2006).

Several factors contributed to the failure of the Foundation’s third major business model. For one, despite the successful high-profile launch of companies such as the BIOX Corporation and Interface Biologics, among a handful of others, these companies still faced a long and uncertain path to financial solvency. The Foundation had successfully attracted millions in venture capital for several of these companies, but it would be a long time before the results of these investments would be known. Building startup companies was by all accounts much more expensive than licensing inventions that had been handpicked for their potential for quick returns under the licensing business model. The initial $2.45 million loan in 2000 and the first extension of $8 million in 2002 were used up quickly in the efforts to build an infrastructure capable of supporting the wider commercialization agenda that was committed to under the startups and entrepreneurship model. Part of that infrastructure was the Exceler@tor, which became a particularly burdensome drain on Foundation resources. Running the incubator came at a cost of nearly $1.5 million per year and by 2004 it was bringing in only a little more than half of that in revenues (Ernst & Young LLP, 2004). In addition, as noted in the Manley Report, the openness of the Exceler@tor to non-university startups raised the ire of university administrators and faculty. Ironically, the rationale behind opening up the incubator to non-university inventors was to help cover its costs:Because [the Foundation] was an external body, it was available to do commercialization work for the hospitals or any other institution, in fact it did

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155 This additional $2 million pushed the total line of credit owed by the Foundation to the university to $13 million (Riggall, 2006).
156 Interview with former Innovations Foundation staff member, Toronto, 22 August 2012.
take some on for private individuals, as a means of finding other ways to pay the bills. The incubator was perhaps one of the most off-purpose initiatives that the innovations foundation had, but it was consistent with the whole idea of startups rather than licensing.157

By late 2003, the university administration and the Foundation’s Board of Directors were increasingly anxious about the prospects of the line of credit being repaid, and the topic of repayment became a regular disturbance.158 Even the supposed success stories such as BIOX, which generated substantial positive press for the Foundation and the university (McClearn, 2002), only had value on paper in the form of the Foundation’s equity ownership. Moreover, the value of this equity was highly speculative in the early years after the company’s formation. According to several interviewees, the reality of lengthy gestation periods required for Foundation supported startups to begin bringing in revenue contradicted the terms of the line of credit used to finance them.159 Payments on the line of credit were to begin in 2006 and the entire $11 million was expected to be repaid by 2010 (Wahl, 2002). However, after a major drop in Foundation revenue between 2002 ($3.8 million in revenue) and 2003 ($1.2 million in revenue) (Ernst & Young LLP, 2004), the Foundation’s board and the university administration appeared to begin losing faith in its ability to deliver on the initial projections and commitments:

The expectation appeared to us on the floor, on the working floor, to be that the university expected a faster payback on their line of credit. It was only a five-year line of credit, and after about three years they started to challenge where the revenues were coming from.160

Contributing to the Foundation’s woes was the collapse of the Dot-Com bubble. It was at the time the single largest stock market collapse in history (Cassidy, 2002).

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157 Interview with former Innovations Foundation staff member, Toronto, 27 August 2012.
158 Interview with former Innovations Foundation staff member, Toronto, 15 August 2012.
159 Interview with former Innovations Foundation staff member, Toronto, 15 August 2012; Interview with former Innovations Foundation staff member, Toronto, 22 August 2012; Interview with former Innovations Foundation staff member, Toronto, 27 August 2012.
160 Interview with former Innovations Foundation staff member, Toronto, 27 August 2012.
Between March of 2000 and September of 2002, NASDAQ stocks alone lost some US$4.4 trillion in market value. This unprecedented event had the effect of dampening entrepreneurial enthusiasm and the type of risk-taking behaviour on which startup formation depended. More importantly for the Foundation, according to one interviewee, was the effect it had on drying up venture capital in Canada:

And then the venture capital industry self-destructed right, there was the Dot-Com bubble in 2001 and it wiped out most of the venture guys… there was venture capital money around in the 1990s, 2000. [The Foundation] set up all these funds that had 5 million dollars each, so we had ten of them so we had 50 million bucks we could spend on starting up businesses, so obviously it was easier to start up a business than to go, you know, pound the pavement and find somebody to license a technology for a few bucks and you know so, in today’s world, venture capital doesn’t exist, the early stage guys don’t exist. Even the venture capital that does exist is in late stages, not in early stage deals, so I think the only way you can commercialize something at the university now is to license it, because there is no venture capital.161

Another interviewee similarly viewed the lack of venture capital as a limiting factor that not only expedited the demise of the Foundation, but that continues to be a bottleneck for research commercialization in Canada:

That’s our problem, is that the venture capital community in Toronto…Ontario, maybe Canada, doesn’t really exist. One or two…Quebec has got maybe a few, and handful here in Toronto, one’s that play in our domain, early stage, right? So you’ve got [venture capitalists] that don’t really want to play with you, if they exist, you have a gap that you can’t close, right?162

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161 Interview with former Innovations Foundation staff member, Toronto, 22 August 2012.
162 Interview with former Innovations Foundation staff member, Toronto, 15 August 2012.
Taken together, difficult to achieve performance expectations and a downward trend in revenue after 2002, coupled with a costly ‘off-purpose’ incubator and the collapse of Canadian early stage venture capital in the wake of the burst of the Dot-Com bubble appear to have provided a compelling reason for the university to once again reassess its approach to commercialization. However, this time, unlike in the past, the university did not simply install new leadership and try another business model. Rather, it chose the route of disbanding the Foundation altogether and setting in motion a plan that would eventually result in the outsourcing of the commercialization process to a new entity created in partnership with the hospitals and other Toronto-area universities.

The Foundation was replaced by Innovations at the University of Toronto (IUT) a group directly within the portfolio of the Vice-President, Research, and run by a new executive director rather than a president and CEO. The new entity integrated the Foundation with the portfolio of the AVP Tech Transfer and was physically housed in the MaRS Discovery District. By 2008, the multi-institution TTO envisioned in the Manley Report materialized in the form of an organization named MaRS Innovation. This multi-institution research commercialization organization took responsibility for an important part of the commercialization process formerly handled by TTOs in many of the three area universities and twelve hospitals and medical research institutes that joined forces to create it.

Creating the space for MaRS Innovation was viewed by several interviewees as a central cause of the closure of the Innovations Foundation that took place from 2004 to 2006. MaRS Innovation is in 2013 a central component of the MaRS Discovery District, but in 2004 and 2005 it was no more than an idea in its earliest stages of development. Ensuring that the Discovery District would be allowed to play host to the inventions generated by the university was no doubt deemed important to the survival of

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163 This larger vision was manifested in the creation of MaRS Innovation which is the official commercialization agent for Baycrest Centre for Geriatric Care, Centre for Addiction and Mental Health, Holland Bloorview Kids Rehabilitation Hospital, MaRS Discovery District, Mount Sinai Hospital, OCAD University, Ontario Institute for Cancer Research, Ryerson University, St. Michael’s Hospital, Sunnybrook Health Sciences Centre, The Hospital for Sick Children, Thunder Bay Regional Research Institute, University Health Network, University of Toronto, Women’s College Hospital, York University (MaRS Innovation, n.d.).

164 Interview with former Innovations Foundation staff member, Toronto, 15 August 2012; Interview with former Innovations Foundation staff member, Toronto, 22 August 2012; Interview with former Innovations Foundation staff member, Toronto, 24 August 2012.
the fledgling technology incubation hub. In fact, the university was one of the founding backers of MaRS, having already invested $5 million in its development prior to the Manley Report (Crane, 2001). One interviewee noted that the university’s decision to close the Foundation and eventually outsource many of its functions to MaRS Innovation was because “the university was betting the farm, and still is as far as I understand, on MaRS Innovation.”165

The decision to work towards building a multi-institution TTO appears to have been made at the highest levels of the administrations of the university and the affiliated hospitals: “it was done at the [vice-president] level…you might say, in spite of the objections of the tech transfer managers, because the local management kind of resisted being all drawn together, but now their vice-presidents were drawing them together.”166 While the commercialization managers on the ground may not have been eager to cooperate, high-ranking administrators saw the potential for the creation of “an academic health sciences network that could be second to none in the world, if it ever got its act together.”167

Efforts towards bringing the envisioned partnership together were buttressed in 2007 by the creation of the $163 million Centres of Excellence for Research Commercialization (CECR) grant program. While the creation of MaRS Innovation was in the works prior to the creation of the CECR program (“MaRS ramping up,” 2008), the securing of $15 million of CECR funding over five years in 2008 left no doubt that it would become a reality. The stated objectives of the CECR program overlapped conveniently with the proposed aims of the multi-institution TTO to maximize the benefits of public spending by scaling up research commercialization efforts (“Delivering on Budget 2007,” 2007). The CECR program helped to galvanize the commitment to closer cooperation: “the [vice-presidents] committed they would be one in seeking this fund…and they applied for [it] and successfully got it.168

165 Interview with former Innovations Foundation staff member, Toronto, 15 August 2012.
166 Interview with former Innovations Foundation staff member, Toronto, 27 August 2012.
167 Interview with administrator in the Faculty of Medicine, Toronto, 14 August 2012. The interviewee noted that the challenge and the opportunity of the university’s situation related to the huge scale of its health sciences complex. She further noted that: “if we ever got this right, it’s unstoppable, but the question is trying to get the thing aligned…it’s about, this isn’t aligning a single tanker. You’ve got a fleet of them and they are all going in different directions right now.”
168 Interview with former Innovations Foundation staff member, Toronto, 27 August 2012.
Clearing the path for the creation of a jointly controlled commercialization organization is an important underlying cause of the Foundation’s closure. Since the mid-1990s, the hospitals had taken on greater responsibility for commercialization owing both to the availability of government funds for their own TTOs and to the university’s withdrawal from providing support for their inventors under the small-scale and highly selective licensing business model. Despite the efforts made by the Foundation after 2000 to claw its way back into the relevance for hospital-based inventors, including by hiring a president with impressive experience in biotechnology entrepreneurship, this was not achieved. According to interviews, the university’s ownership of the Foundation was itself a major impediment to cooperation: “there was a long history of mistrust between the hospitals and the university.”\(^1\)\(^6\)\(^9\) Another interviewee remarked that:

The hospitals didn’t like the Innovations Foundation, they didn’t like that the [Foundation] was trying to make its presence known and offering its services to the hospitals, and they would not cooperate with the [Foundation]. So if you were ever going to put them all under one umbrella, you had to get rid of the [Foundation] first, and I think that was what the Manley reported directed.\(^1\)\(^7\)\(^0\)

Overall, the Foundation’s third iteration as an entrepreneurial support service and startup incubator experienced a similar trajectory to the first two experiences. There was a degree of success, particularly early on, but it could not be sustained. A number of factors, chief among them a failure to become self-reliant financially within the university’s expected timeframe, led the university to reconsider its model and to lose faith in the Foundation leadership. The key difference between the renewal taking place in 2004-2006 as compared to that of 1989-1990 or 1998-2000, was that by 2004 there was a powerful coalition of stakeholders including local financial and business leaders, proposing a model of research commercialization that required the closure of the Foundation in order to truly take root.

\(^1\)\(^6\)\(^9\) Interview with former Innovations Foundation staff member, Toronto, 22 August 2012.  
\(^1\)\(^7\)\(^0\) Interview with former Innovations Foundation staff member, Toronto, 27 August 2012.
Chapter 4: Discussion & Conclusions

This study delineates three phases that correspond to distinct business models under which the University of Toronto’s technology transfer office, the Innovations Foundation, operated: invention marketer (80-90), licensing business (90-99), and startup incubator (99-06). Table 2 is an overview of the three phases including descriptions of key elements of each phase.

A key contribution of this study is in its reinforcement of the importance of path-dependency as a concept used to understand research commercialization in universities. The case of the Innovations Foundation confirms that the university’s previous experience with commercialization is a key explanatory factor of its present condition (O’Shea et al., 2005; Phan & Siegel, 2006). At multiple points in the Foundation’s history, the trajectory of change up to that point constrained the options available moving forward. The sets of conditions surrounding the Foundation’s creation, its two major reorganizations and its closure each typify instances of constrained change in that “certain options were not feasible because of earlier sequences of decisions” (Kay, 2005, p. 554).

Mahoney suggests that truly path-dependent analyses must go beyond just highlighting the importance of causal sequences, a feature of nearly all historical explanations. Rather, a particular characteristic of path-dependent sequences is that they hinge primarily on important and highly contingent “events that take place in the early stages of an overall historical sequence” (p. 510). Indeed, central to this study’s argument for the path-dependent nature of Foundation’s record of performance is that early events under the first business model (1980 to 1990) were particularly important because of the path that these events forced the Foundation to go down.

The launch of the Foundation under its first model and its lack of success was an important ‘fork in the road’ for the university. The results thereof set the Foundation on an unfortunate course that ultimately resulted in its closure 26 years later. However, It is important to note that the decision to launch with the first model in 1980 was also shaped by some 60 years of history of the institution dealing with issues of research commercialization. Up until 1980 the university approached opportunities presented for
commercializing campus inventions passively and without much enthusiasm, always wary lest its reputation be sullied by the perception that its actions were not complicit in protecting the public good. Decisions whether to help inventors or invest university resources into patents were made by an Inventions Committee operated under the auspices of the Office of Research Administration.

Table 2. Three Phases of the Innovations Foundation (1980-2006)

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<td><strong>Structure of Relationship with University</strong></td>
<td>• Inventions Committee oversees TTO, selects inventions to be commercialized</td>
<td>• Board of Directors replaces Inventions Committee</td>
<td>• Board of Directors and CEO</td>
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<td></td>
<td>• Executive director accountable to the research office</td>
<td>• Executive director replaced by president and CEO accountable to the board</td>
<td>• University provides line of credit to be repaid between 5-10 years from being granted</td>
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<td>• University pays all costs, expects self-sufficiency within first five years.</td>
<td>• University provides shrinking subsidy for budget</td>
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<td><strong>Staffing and Infrastructure</strong></td>
<td>• 2-4 Full-Time Equivalents (FTEs)</td>
<td>• 4-5 FTEs</td>
<td>• Up to 20 FTEs</td>
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<td></td>
<td>• work focused on marketing and licensing.</td>
<td>• work focused on licensing and negotiations</td>
<td>• work divided between startup management; operating an incubator; running a business plan competition; developing &amp; leading venture capital funds; and licensing.</td>
</tr>
<tr>
<td></td>
<td>• Limited resources invested in individual inventions</td>
<td>• heavy investment of resources in individual licensing deals</td>
<td></td>
</tr>
<tr>
<td><strong>IP Policy</strong></td>
<td>• University and hospitals have right of first refusal over all inventions.</td>
<td>• Inventors have right of first refusal over all inventions, except if cross-appointed to a hospital.</td>
<td>• Inventors have right of first refusal over all inventions, except if cross-appointed to a hospital.</td>
</tr>
<tr>
<td><strong>Incentives for faculty to work</strong></td>
<td>• Inventors have no choice</td>
<td>• Inventors may be</td>
<td>• More entrepreneurial</td>
</tr>
</tbody>
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with TTO but to work with the Foundation if they wish to commercialize their inventions motivated to work with TTO if their work falls within the TTOs target research area and they wish to license it • Hospital inventors are forced to work with hospital TTOs inventors may be motivated to work with the TTO to launch a company • Hospital inventors are forced to work with hospital TTOs

| Standout Cases from the Phase | • The Chlorzoin invention and the Globe and Mail Affair • The Establishment of the position of AVP Tech Transfer | • The change in the Inventions Policy • The “Pig Stress Test” license | • The launch of Biox Corp and Interface Biologics • The Exceler@tor incubator and venture capital funds • The Manley Report |

| Average Annual Research Budget | $85 million** | $199 million | $277 million |
| Average Invention Disclosures* | 25 | 80 | 155 |
| Average New Patent Applications | 11-12*** | 18 | 39 |
| Average Patents Granted | 3.6*** | 4 | 10 |
| Average Licensing Income | N/A | $1.33 million | $1.8 million |
| Average New Companies Formed | 0*** | 0**** | 6 |

* Invention disclosure data for all three periods is extrapolated from the graph presented by Hoye (2006), which is based on data she obtained directly from the university’s research office. All other figures are generated from AUTM data unless otherwise indicated.

** This figure is extrapolated from a report on University of Toronto research funding prepared for the office of the Vice-President, Research in 1989 by Professor David M. Nowlan. The report does not include figures for 1980, 1989 or 1990, therefore the average provided in the table represents the intervening years of 1981 to 1988 inclusive (Nowlan, 1989).

*** These are approximate figures generated from information published in newspaper articles from the late 1980s (Deverell, 1989; Dotto, 1987) and confirmed in interviews.

**** AUTM data indicate that the university generated a total of 34 startup companies between 1995 (the first year that the university began reporting this information to the AUTM) and 1999. However, interviews confirmed that these companies were not supported in any substantive way by the Foundation, and were instead the result of independent actions of university faculty members.

A changing appreciation for the importance of research commercialization in the 1960s and 1970s led to the creation of a dedicated structure, staffed by four or five people to handle the marketing of university discoveries to potential licensees. The university
was among the first in Canada to launch a TTO, but did so following the example of the numerous US schools that were at the time doing the same.

An executive director ran the Foundation, but the Invention Committee remained in place and controlled which inventions would be passed to the Foundation for commercialization. In practice, the routine was to pass nearly all inventions to the Foundation, but by 1989 this appeared to become more than the limited staff could handle. The small Foundation staff faced a steep learning curve as they struggled to effectively commercialize a wide variety of inventions of different types and requiring different technical and business expertise. Additional pressure came from the university administration’s expectation that the Foundation would become self-reliant within its first five years, and cuts to provincial funding for university TTOs in 1987.

This study shows that a mismatch between expectations on the TTO, and the resources allocated to it helped to undermine its success in the first decade. The business model employed was that of the TTO as a marketing agency for inventions, which did not fully account for the embryonic nature of university discoveries. It also discounted the benefits of investing more time and resources into relationships with inventors and with private sector licensees, even if this might mean taking on fewer projects. There was also very little leeway for strategic decision-making by the director under the model, particularly because of the powerful role of the Inventions Committee. By 1989, the Foundation had acquired a negative reputation among inventors for its perceived incapacity to support commercialization. The AVP Tech Transfer, a position created in the late 1980s at least in part to look for solutions to the Foundation’s problems, led an initiative to fundamentally alter the IP regime of the university, transferring the default ownership of inventions from the Foundation to individual inventors so as to alleviate the pressure from aggravated faculty members.

In 1990, under the new Inventions Policy, there was a leadership overhaul at the Foundation. The Foundation was reformed as a licensing business, with a much more narrowly focused private sector mindset. The Inventions Committee was replaced by a new Board of Directors that was much more independent from the university administration, and the onus for selecting inventions to commercialize was transferred to the Foundation staff. The Foundation went from a service to the university, operated
under the close watch of the research office, to a small and much more independent business. Under this new model, the Foundation was again expected to be self-sufficient, and was provided with a subsidy that was to shrink substantially each year after 1990.

Despite one major success in the form of a DNA test for porcine stress syndrome in the mid-1990s, the reformed licensing business failed to generate the level of success that would have allowed it to pay its own way as the university still expected. Moreover, the expectations for the university to contribute to an increasingly entrepreneurial economy were by this time on the rise. Again contributing to the failure of the business model was a perceived inadequate investment in relationships with university inventors. The propensity of the Foundation under this model to ‘cherry-pick’ only the inventions that could be commercialized quickly and to provide little support or guidance for a majority of inventions that were disclosed to it led again to a general dissatisfaction with the Foundation’s efforts on campus. As the 1990s came to a close, the university made a change to the Foundation’s Board of Directors, which precipitated another leadership change at the president position and a re-orientation of the business model towards greater support for startup companies and the marginalization of licensing operations.

The new president was given a measure of security in terms of budgeting by successfully acquiring a line of credit from the university worth $2.45 million in 2000 and then an extension in 2002 of an additional $8 million. Staffing was substantially increased over the first two years under the startups and entrepreneurship model. This allowed for more time to be spent building relationships with campus inventors, to acquire staff with expertise in a wider range of research fields and to build up two support structures for academic entrepreneurs: a startup incubator, and a series of university-focused venture capital funds. However, the third model failed for several reasons.

First, even with the new line of credit and an increase in scale, The Foundation was not able to deliver on the promise of self-reliance within the time it was allotted. By 2004, the university administration had become alarmed that the Foundation’s expenses, which included $1.5 million per year to operate the Exceler@tor incubator program, were far exceeding its revenues. The administration viewed with scepticism the prospects of the Foundation being able to begin repaying the $11 million outstanding on its line of credit by 2006 and to repay the loan in its entirety by 2010, as per the agreed upon
conditions. However, the failure of the final operating model was not solely due to the misalignment of university expectations with Foundation performance and capability under the third model. By 2004, there was a wider movement being spearheaded by a powerful consortium of private and public sector interest groups in Toronto to create a commercialization hub in the city that would transcend its many individual research institutions. The failures of successive business models, and the lack of convincing performance under the third model despite a significant boost in resources allocated by the university, made the Foundation an easy target for those proposing an entirely new multi-institutional approach to commercialization in Toronto.

The multi-institutional approach came to fruition only in 2008 with the creation of MaRS Innovation, however the closure of the Innovations Foundation beginning with the Manley Report in 2004 was a necessary prerequisite. The Foundation’s historical path had led it away from the kind of close cooperation with the university’s affiliated hospitals that would allow for greater economies of scale and less duplication. A combination of early failures with, and later ambivalence to, hospital commercialization projects, as well as an important change to the IP regime at the university led to individual hospitals developing their own TTOs. When the Foundation was recalibrated for the final time in 2000, it was furnished with a new president experienced in commercializing hospital technologies. Yet despite this, and the major boost in resources and commercialization infrastructure, it was not welcomed by cross-appointed faculty in the hospitals, or by hospital administrators. As a result, it gained back very little of the foothold that had been lost from the late 1980s onward. The Foundation’s inability to work more closely with the hospitals and to be a naturally cooperative partner in the development of the MaRS Discovery District were fatal weaknesses that the Foundation could not overcome.

The termination of the Foundation under the final business model described above carries all the markings of path-dependent development. Pierson (2000) notes that in a path-dependent pattern “earlier parts of a sequence matter much more than later parts, an event that happens ‘too late’ may have no effect, although it might have been of great consequence if the timing had been different” (p. 263). For the Foundation, attempts in 2000 to fix long-developing problems including under-investment, weak relationships
with inventors and duplication of efforts with the hospitals, may have happened too late to create the desired effect.

Other parts of the explanation must be acknowledged as well. For instance, luck has a role to play in the success of universities when they seek to establish commercialization infrastructure. Had the Foundation been fortunate enough to come across an invention of the calibre of insulin during its 26 years in operation, the resulting revenue stream could have quite possibly drastically changed the organization’s fate. The reality is that over its 26 years, the Foundation staff had to work hard for every dollar earned, and it could never sustain a situation in which it earned more than it cost to run. The closest the TTO ever came to hitting the jackpot was the PSS test, the scale of which was not large enough to break the entity away from its progression towards closure.

The Effects of Unrealistic Expectations

This study adds to evidence that unrealistic expectations for research commercialization success can be a critical factor leading to failure (Rothaermel et al., 2007). Moreover, it provides multiple examples of the specific mechanisms by which this relationship plays out at the organizational level (as opposed to the level of individual inventions). Successive university administrations placed what appear in hindsight to have been rather onerous expectations for financial self-reliance on the Foundation under each of its three operating models. This had the effect of shortening the horizons of each Foundation leader as he or she sought to plan and allocate resources. Under each model, short-term successes were necessarily emphasized either as an explicit component of the business plan (e.g. under the licenser model from 1990-1999) or implicitly within the terms of the Foundation’s funding arrangements (e.g. under all three models but specifically the last). This emphasis on short-term self-sufficiency failed in all three models. Potentially even more damaging is that it very likely weakened the university’s capacity to generate the kinds of major successes in the long-term that may have actually allowed the TTO to become self-sufficient. This took place both because the Foundation was forced to pay less attention to the hospitals, and because it faced pressure to avoid
investing in projects that were longer-term and involved greater risk, but carried greater potential returns.

In a recent review of academic entrepreneurship, Grimaldi et al. (2011) set the following question as part of the agenda for future research: “How do universities shift path dependencies from traditional activities?” (p. 1053). The present study addresses this question with concrete examples of how a major Canadian university not known for its ability to foster research commercialization, has sought to purposefully shift from its existing trajectory through the implementations of major changes to its TTO. Each attempted shift was coloured not only by the decisions that had been made previously, but by several other important contextual factors, such as the ongoing evolution of societal expectations in Canada about how and to what extent universities should contribute to the economy and to industrial innovation. Another important contextual factor is shown to be the unique and evolving relationship between the university and the affiliated hospitals. Together, by 2004 these hospitals accounted for half of all research funding brought in by university faculty (University of Toronto, 2005). However, the particular evolution of the Foundation and its multiple false starts, as well as the university’s policy towards inventions, left open the space for these institutions to become more and more independent in the 1990s. This became a problem by the mid-2000s as consensus emerged that scaling up efforts and eliminating duplication were critical to making the large overall investments in research in Canada’s largest city as economically fruitful as possible. Research is still lacking on whether the most recent attempt by the University of Toronto, the creation of MaRS Innovation, may have finally succeeded in shifting the institution from its long enduring path in the area of research commercialization. However, the evidence presented in this study may serve to indicate that substantive change to a university’s historical trajectory in this regard is neither simple nor quick to achieve.

This study also contributes to the debate concerning the appropriateness of university-ownership of IP generated by faculty (Kenney & Patton, 2011). Recent evidence appears to demonstrate that a great deal of commercialization is happening outside of the formal IP system monopolized by university TTOs (Fini et al., 2010), and some authors suggest that the ‘institution ownership’ IP regime may not be as important
to successful technology transfer as has been vigorously argued in the past (Kenney & Patton, 2011). The case of the Innovations Foundation adds to this discussion by documenting the events surrounding the change in the IP ownership regime that took place in 1990. It provides a relatively rare\textsuperscript{171} real-world example of a shift in university IP policy and the results thereof.

In the US, the debate around university IP has centered on the importance and possible revocation of federal legislation that mandates default ownership of IP to universities. However in Canada, where no such legislation exists, there is a wide range of IP regimes among universities and the perception of greater flexibility for universities to experiment. The 1990 experiment at the University of Toronto serves as a source of information for both countries. The policy was changed as the best available response to an increasingly corrosive relationship between university inventors, who were often key faculty members in disciplines such as engineering, computer science and medicine, and both the university administration and its TTO. While the policy change appeared to be in some ways modelled on other universities, and in particular on the unfettered inventor ownership regime in place at the University of Waterloo, the university did not go so far as to forgo its entire share of commercialization revenues. In fact, even though default ownership of inventions was granted to inventors, giving them the freedom to pursue commercialization however they chose, the university maintained its right to a relatively high share of any of the revenues (Hoye, 2006). At the University of Toronto at least, this policy change was not a magic bullet to commercialization bottlenecks, and the university later sought and failed to revert back to the old model.

Perhaps a key lesson is that IP policy change was far from a quick fix to enhance research commercialization performance. The effects of a change to the IP policy on any given campus will depend importantly on the history of that institution and the structures and culture established therein to support commercialization efforts. Moreover, the fact of ownership or control over decision-making related to university IP is not the only important element when it comes to regulating IP. In fact, changes to the division of

\textsuperscript{171} To the author’s knowledge, no studies have been undertaken to explore IP policy shifts in Canadian universities. In the US, all inventions developed using US university facilities are owned by the institution and have been since the implementation of the Bay-Dole Act in 1980. According to Kenney and Patton (2011), the exception was Stanford, which was one of the only universities that maintained an inventor-owns policy until 1994 when it converted to a university ownership regime.
revenue shares may be just as important as a means of enhancing incentives and altering commercialization outcomes on campus. Critics of the status quo among most US universities and many Canadian universities with institution ownership regimes have pointed to the University of Waterloo as a model to be followed (e.g. Bramwell & Wolfe, 2008; Kenney & Patton, 2011). However, in addition to contextual differences such as its lack of medical research, Waterloo has since its inception not only granted ownership of inventions to the faculty, but also 100 percent of any revenues collected. Institutions in Canada and the US that currently maintain right of first refusal over all inventions as well as a share of any revenues may not be in a position to give up their claims to all future revenue even if it could be shown that this would increase the benefits of university research to society more broadly, as some have argued is the case.

Aside from broader theory and policy implications, the study reinforces not just that inventor involvement in the commercialization process is important to success (Agrawal, 2006; Jensen & Thursby, 2001), but that it can be exceedingly difficult to manage. Evidence from the University of Toronto suggests that incentives for fostering inventor involvement depend not only on issues related to invention ownership, and revenue sharing, but also on faculty member’s impressions of the capabilities or track record of the TTO. The university’s multiple false starts in establishing a competent, sustainable campus structure for commercializing inventions generated repeated periods of disenchantment among faculty members. Consequently, each new TTO leader installed was forced to spend substantial time and resources cultivating an improved relationship with faculty members, rather than getting on with the business of commercializing inventions already being disclosed.

This study also provides insight as to the effects of discontinuity in research commercialization models, specifically with regard to the impact that lengthy transition periods have on the commercialization environment and on outcomes at a university. Overhauls in 1989-1990, 1999-2000 and 2004-2006 created major gaps in the provision of commercialization services to inventors, undermined the health and reliability of relationships with industrial partners, and adversely affected the efficiency and success of

172 This is the case unless the inventor decides to employ the services of the university’s TTO (Kenney & Patton, 2011).
ongoing commercialization projects that required bridging from one model to the next. The commercialization of university inventions is a long-term process that carries with it substantial uncertainty and risk even when undertaken by a single, consistently operated TTO and management team. However, when several years of work to move towards a successful commercial outcome is handed off to interim management, and eventually to a new incoming team, this exacerbates the problem of discontinuity. The point here is not to suggest that shifts in the direction of a TTO should never be contemplated. When the current approach is not successful, substantial changes may be necessary. However, university administrators would be wise to remain conscious of the negative effects of prolonged transition periods and to consider them during any risk-benefit analysis concerning changes to a TTO.

What this study tells us about the ability of Canadian universities to commercialize research is that at least some of the failures to do so are deeply rooted in path-dependent processes not likely to be fixed by abrupt shifts in organization or policy. In fact, the case of the Innovations Foundation demonstrates that abrupt recalibrations of TTOs may often be among the most deleterious influences on medium- and long-term commercialization performance, in and of themselves. Therefore, incoming administrators looking to jump-start commercialization efforts on campus would be well-advised to explore the possibility of building on existing structures and established relationships in lieu of restarting them from scratch.
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