The role of technology transfer offices in growing new entrepreneurial ecosystems around mid-sized universities

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Abstract: The role of universities has evolved from its traditional focus on education and research to active participation in regional economic development. Technology transfer offices (TTOs) were created at Canadian universities to help regulate and monetise the transfer of knowledge created by the university researchers to the marketplace. In this paper, we examined the role TTOs can play in developing a new entrepreneurial ecosystem around mid-sized research universities, based on the perceptions and expectations of the key stakeholders, involved in the technology transfer process, about the role of TTOs, and if their role can help in developing entrepreneurial culture in their universities. We found that the ability of TTOs to effectively support the commercialisation of university research results is related to the existence of an entrepreneurial culture in the university. If the culture and an entrepreneurial ecosystem do not exist, the role TTOs can play is more limited to its well-established facilitation role. Our findings confirm that TTOs can play a critical role in coordinating different bottom-up initiatives to promote entrepreneurship, and in attracting and integrating new external resources to the university.

Keywords: technology transfer office; TTO; entrepreneurial universities; commercialisation; new venture creation; entrepreneurial ecosystem; regional development.

1 Introduction

It is widely believed that productivity growth is key to economic success in the global knowledge-based economy. Productivity can be increased either by reducing the cost of production and/or by increasing the value of what is produced. This requires innovation i.e. the introduction of new goods, services or processes that increase the value of what we produce relative to its cost. University research and development can be a great source of innovation, however the translation of research results to market useable products, services and processes depend on the university research intensity, and the existence of entrepreneurial culture supported by entrepreneurial ecosystem. The capacity of a university to create new knowledge through research and development (R&D) is used here to define the university size. A mid-sized university in our study is defined as having an R&D budget equal to or below 1 billion Canadian dollars while a small size university has a very limited capability of generating new knowledge through research and it focuses mainly on teaching activities. These are universities that are not large enough to raise the resources needed to develop an entrepreneurial ecosystem internally. The concept of an entrepreneurial ecosystem around a university refers to the collective and systemic nature of accessible entrepreneurial support in the region. According to Isenberg (2014), an entrepreneurship ecosystem consists of elements that can be grouped...
into six domains: a conducive culture, facilitating policies and leadership, availability of dedicated finance, relevant human capital, venture friendly markets for products, and a wide set of institutional and infrastructure supports. Gibb (2005, p.3) considered universities to have an entrepreneurial culture “when they are not afraid to maximize the potential for commercialization of their ideas and create value in society without seeing this as a threat to academic values. These universities create a culture of innovation on their campuses and attempt to install an entrepreneurial mindset in every graduate and faculty member by building the structure and processes designed for stimulating innovation and customer’s value creation”.

University spin-offs (USOs) are one channel that co-exists with other channels such as licensing, industrial partnerships, contract research, and students to mobilise the knowledge created inside the university to enter the marketplace, thus creating economic value to the community. Empirical evidence from the US suggests that USOs are growth-oriented, with high survival rates and with high likelihoods of attracting venture capital compared to the average start-up (Shane, 2004). There is also a tendency among USOs to locate close to the parent university, which means that their economic benefits in terms of job creation and taxable wealth accumulate locally (Steffensen et al., 2000).

Many universities have established their technology transfer offices (TTOs) as a monopoly, centralising all university invention and commercialisation activities. These centralised TTOs were created to help regulate/monetise the transfer of knowledge, for commercial benefit, from the universities to the marketplace. They do this by requiring all university faculty members to work through these offices, notifying them of their discoveries and delegating to them all rights to file patents and to negotiate licenses on their behalf. The premise was that if universities can create commercially valuable intellectual property (IP) that industry could access through a centralised specialised unit, some of this value could be extracted.

Questions have arisen regarding the role that TTOs could or should play in commercialisation of university research, promoting an entrepreneurial culture in the university, and contributing to the building of an ecosystem capable of supporting the business activities related to taking an idea from the lab to the marketplace.

In this paper, we examine the role that TTOs could play in developing a new entrepreneurial ecosystem around mid-sized research universities. The focus of the research is on universities in Ontario, which operate in a similar political and economic framework through public funding mechanisms. However, the results of the research would be useful to any region that has a traditional research university and an involved government. Traditional research universities are defined as universities that are focused mainly on contributing to knowledge through research/teaching, and their mission statements tend to emphasise non-economic goals (Orton, 2009).

The focus of this paper is on USOs as a commercialisation channel. Throughout the paper, when the term ‘commercialisation’ is used, this refers to starting up a new business based on university-initiated research.

2 Literature review

There have been numerous studies focusing on TTOs as units of analysis to examine the university commercialisation ecosystem (Thursby and Thursby, 2002; Siegel et al., 2003; Belenzon and Schankerman, 2009; O’Shea et al., 2005). Siegel et al. (2003) suggested
a general flow model outlining the roles different stakeholders play in the commercialisation process (Figure 1).

**Figure 1** Transferring university IP to a firm or an entrepreneur

![Diagram showing the process of transferring university IP to a firm or an entrepreneur](source)

In their analysis, Siegel et al. (2003) assumed that TTOs are the main conduit for commercialisation of university IP. The purpose of their study was to analyse the university-industry technology transfer (TT) process and its outcomes. They identified three key stakeholders involved in the process:

a) academic scientists

b) TTO officers

c) entrepreneurs and firm managers.

In their study, 98 structured interviews were carried out with representatives of these groups. They concluded that there are numerous barriers for effective TT including culture clashes, bureaucratic inflexibility and ineffective TTO management. Most of the recommendations focused on how to encourage the stakeholders to carry out their assumed roles by aligning their motivations and objectives. By understanding the roles and incentives of the key stakeholders, the problems, leading to cultural clashes and ineffective knowledge transfer between different entities/individuals, would be alleviated. As shown in Figure 1, the authors treated an entrepreneur starting a new venture based on the IP similarly to licensing the IP to an existing firm.

Nelles and Vorley (2011) agreed with Siegel et al.’s (2003) findings in recognising that the effectiveness of the TTOs is influenced by internal and external factors such as the culture and leadership of the universities. Numerous researchers have explored the different factors that influence these offices (Markman et al., 2005), suggesting that the size, age, experience and structure of a TTO affect the productivity of its spin-off generation (Nosella and Grimaldi, 2009; Powers and McDougall, 2005; Bray and Lee, 2000). Roberts and Malone (1996) proposed that two dimensions are key in analysing spin-off policies: the level of selectivity and the level of support by academic institutions. They argue that only two academic spin-off strategies work in terms of selectivity and support: either the low-selective/low-support strategy or the high-selective/high-support strategy. The low-selective/low-support strategy consists of spinning off many ventures, but with little support. It reduces the costs of spinning off, but seeks safety in numbers: “Choice is left to external agencies (such as venture capital funds) who are generally felt to have greater experience and expertise in ‘picking winners’ and less potential for
conflicting objectives than the R&D organization” [Roberts and Malone, (1996), p.41]. The high-selective/high-support strategy consists of the university spinning off a few carefully chosen well-supported ventures. This relies on picking winners and supporting them to increase their chance of success as much as possible. Roberts and Malone’s (1996) analysis revealed that high-selective/high-support spin-off strategy is better suited to environments with weak entrepreneurial infrastructure and culture. However, implementing such strategy requires resources that are out of reach of most universities in such regions. Analysing the characteristics and conditions of successful universities/regions such as Massachusetts Institute of Technology (MIT) in the Boston-Cambridge area is not usually useful in developing new ecosystems in regions that lack them. Usually these conditions are impossible to emulate or adopt by universities who are starting to build their ecosystems (Di Gregorio and Shane, 2003; Roberts and Malone, 1996; O’Shea et al. 2007).

Although, Siegel et al. (2003) discussed entrepreneurship and USOs throughout their paper, there was more focus on the licensing model with industry as licensees. Also, their study focused on five major universities who have already spun-off a number of start-ups and already have strong ties with industry. Another key observation about the study was that they did not include the different private and governmental ‘boundary spanning’ organisations in their group of major stakeholders. Wigren-Kristoferson et al. (2011) defined these boundary spanning organisations as ‘brokers on the boundaries’, which bridge the gap between traditional research/teaching activities and non-traditional entrepreneurial activities. In typical traditional universities that do not have an existing entrepreneurial culture, these boundary-spanning organisations, which we refer to as ‘intermediary organisations’, play a vital role in the commercialisation process.

USOs are usually the end-result of longer and more complex development paths than indicated in Figure 1. More recently, the widely utilised policy direction, to promote entrepreneurial activities by setting up formal mechanisms such as TTOs, has been challenged. According to the authors (Wigren-Kristoferson et al., 2011), a centralised TTO might work when there is an existing entrepreneurial culture and inclination in the existing ecosystem. However, most universities do not have such a culture and do not exist in entrepreneurial regions such as Boston-Cambridge or Silicon Valley. Earlier, Gill et al. (2007) noted that a centralised structure around a TTO providing IP services to firms would be appropriate for the transfer of ‘packaged’ IP, and that more relational or ‘people centred’ links would be better supported by more decentralised arrangements. This led to revisiting the role other organisations and intermediaries can play. These intermediaries can help in the exchange of both the tacit and explicit knowledge between academia and the outside world. In their follow-up work, Phan and Siegel (2006) suggested that TTOs should adopt a value-chain model. Litan et al. (2007) and Wright et al. (2008) argued that such model would lower the costs involved in moving the results of research activity from inside the university to the marketplace.

A recent trend in research on USOs is a focus on studying holistically how to develop a commercialisation culture and ecosystem around universities that lack them. Rasmussen and Borch (2010) proposed that, despite their unfavourable conditions, these universities could develop capabilities that increase the rate of producing USOs. Based on a longitudinal study for four Norwegian spin-offs, they found that a university needs three main capabilities to grow an entrepreneurial ecosystem;
a capabilities that open new paths of action  
b capabilities that balance academic and commercial interests  
c capabilities that create new resources.

An intriguing finding of this study is that the university capabilities are correlated to the TTO capabilities only to a limited extent. Rather, the university entrepreneurial capabilities are developed in many ways both within and outside the university organisation. The authors suggested some activities that would help in developing and/or communicating such capabilities. For example, having an incubator can help to develop capabilities that balance academic and commercial interests and signal an interest in doing so. However, no clear framework or model was suggested to grow such capabilities.

Another recent direction of research studies has focused on academic researchers and how to motivate them to get involved in the commercialisation process. In a traditional average sized university, academic researchers are usually focused on research and teaching. Vestergaard (2007) discussed the fruitless efforts carried out by policymakers to promote commercialisation and knowledge transfer cultures in such universities. He concluded that developing IP policies that financially benefit both researchers and universities did not lead to more commercialisation activities. Zerbinati et al. (2012) suggested that universities could be more successful by commercialising high potential ideas without the participation of the inventors. They argued that the ability of ‘just the technology’ to attract interest from independent entrepreneurs and investors is the real test of its potential. However, a large body of research has stressed the early stage nature of university technologies and the fact that they need the tacit knowledge of the academic inventors to further develop them (Jensen and Thursby, 2001; Goldfarb and Henrekson, 2003). Jensen and Thursby (2001, p.247) reported that at least 71% of university inventions require further involvement by the academic researcher if they are to be successfully commercialised. The idea of separating the technology from the inventor may be a higher risk for the entrepreneurs or industries interested in commercialising or licensing the IP in question.

Many researchers have studied how universities can find a balance between their traditional roles and commercialisation activities. Tuunainen (2005) argued that trying to have hybrid entities that combine academic and commercial activity would lead to a destabilised and tense environment inside the university. Jain et al. (2009) and Fogelberg and Lundqvist (2013) discussed how policymakers and university management could help in supporting academic researchers balance their primary role in teaching and research with their secondary role in the commercialisation process. Through their intensive interviews in a top US research university, Jain et al. (2009) identified two mechanisms, ‘delegation’ and ‘buffering’, that inventors use to protect their academic role while participating in commercialisation activities. The delegation mechanism is used to balance the dual role and depends on having other resources, mainly human in this context, that can carry out and lead the commercialisation activities. The buffering mechanism is used by academics mainly to protect their primary academic roles from the impact of the commercialisation activities. One of the simplest ways to achieve this buffering goal is by clearly establishing their work priorities, stressing that their first priority is their academic duties. Fogelberg and Lundqvist’s (2013, p.10) study confirmed Jain et al.’s (2009) findings that academics are more comfortable in participating in
commercialisation activities if they feel they are in control of all decisions related to their primary role, including research directions, publication release and student supervision. According to their interviews, researchers were “agreeable to integrating roles only if given reasonable control of the circumstances of this integration process”.

In the following sections, we will provide a background about the Canadian context, highlighting the programmes the Canadian government has implemented to stimulate the extraction of economic value from university research. This will be followed by a discussion about the research methodology used in our study. Based on our research findings, we analyse the role TTOs can play in growing the regional entrepreneurial activity in the context of the three key capabilities outlined by Rasmussen and Borch (2010). In order to conduct quantitative analysis on qualitative data, we broke the aforementioned three capabilities into three hypotheses, related to the role TTOs can play in developing them, as follows:

Hypothesis 1 TTOs can help in growing the capability related to opening new paths of action capability.

Hypothesis 2 TTOs can help in growing the capability related to balancing the commercialisation and academic interests.

Hypothesis 3 TTOs can help in growing the capability related to integrating new resources to the university.

2.1 The Canadian context

Canada has a long tradition of government involvement to promote the economic utilisation of scientific research. One survey identified 178 initiatives that represented an expenditure of $3.2 billion CAD per year [Rasmussen, (2008), p.507]. Because of its decentralised higher education system (Leslie and Slaughter, 1997), initiatives need to be developed in collaboration with the research institutions to address the real needs for support, rather than being imposed from a government level. Furthermore, policies need to be induced both top-down from the government and its agencies, as well as bottom-up from individuals and entities inside the universities (Goldfarb and Henrekson, 2003). Current federal initiatives, to help translate knowledge into commercial success effectively, include: the Natural Sciences and Engineering Research Council of Canada (NSERC) Idea to Innovation Programme (I2I), the Canadian Innovation Commercialisation Programme (CICP) and the Centres of Excellence for Commercialisation and Research (CECR). Other programmes to improve collaboration are the Business-Led Networks of Centres of Excellence and the Applied Research and Commercialisation Initiative. Rasmussen and Sorheim (2012) identified three main types of programmes used to bridge the wide gap between having a good research idea and introducing a new product/service to the market;

1 proof of concept programmes that seek to lower the technological uncertainty associated with university technologies

2 pre-seed programmes that address the lack of business and market competence in the university setting by supporting the development of business cases and strengthening the team

3 seed funding programmes that provide early stage financing.
In 2008 [Rasmussen, (2008), p.509], half the Canadian spin-offs have received Industrial Research Assistance Programme (IRAP) funds, and 23 out of 35 investments, made by Business Development Bank of Canada (BDC) technology seed investments, involved USOs. On the provincial level, the Ontario government invested in programmes and agencies, through the Ministry of Research and Innovation such as the Ontario Centers of Excellence (OCE) and the MaRS Discovery District to stimulate commercialisation in universities.

All of the Canadian research-oriented universities have TTOs or industrial liaison offices (ILOs) that act as coordinators of commercialisation activity. It is also important to note that Canadian universities have a diversity of approaches to IP ownership, IP strategies, and the organisation of their TT activities. Of the 20 most active Canadian universities in commercialisation, the IP ownership is creator-owned in eight cases, university-owned in eight cases, and the remaining four have joint ownership or case-by-case negotiations (Clayman, 2004).

2.2 Research methodology

Our results and recommendations are based on semi-structured, in-person interviews with three categories of stakeholders:

1. academic inventors and researchers
2. intermediary agents, including early stage venture capitalists VCs, entrepreneurs and directors/executives of governmental intermediary organisations (GIOs)
3. TTO officers/directors.

Even though their motivations are different, we grouped the different intermediary agents with the early stage VCs because both groups are willing to invest in early stage technologies.

We focused our analysis on mid-sized universities throughout Ontario. The universities we selected represent the average university experience with TT rather than universities that have the most favourable environments for stimulating this activity. At each university, we interviewed academic researchers (both those who have commercialised technologies and those who chose not to), department chairs, TTO directors, university senior management and students involved in commercialisation activities. Within the surrounding region of the university, we interviewed founders of start-up companies, directors of business development, directors of regional innovation centres, and non-profit organisations with an interest in commercialising university research. We only interviewed early stage VCs who are currently investing in Canadian universities spin offs. We conducted 33 interviews representing 6 medium sized universities in Ontario (there are 22 publically-funded universities in Ontario): 15 managers, VCs and directors of Regional Innovation Centers (RICs), 8 TTO directors/officers, and 10 university researchers. Even though we recognise students’ contributions, we focused on faculty members, as they are the main source of university IP.

The interviews consisted of two parts. In the first part, the participants described their experience, involvement and role in commercialising university IP. In the second part, the researcher used a series of open-ended questions that were designed to determine how various stakeholders defined the role of the TTO and universities in commercialisation of
university IP, to identify impediments to successful TT, and to provide suggestions for improving this process. Questions varied slightly depending on the category of the interviewee. For example, only TTO directors and officers were asked to comment on the managerial practices of the TTO. On average, the interviews lasted 1.5 hours and were recorded with the consent of interviewees. An independent typist was employed to transcribe the recordings, in order to ensure a complete and unbiased recording of the interview material. All interviewees were promised anonymity and their identities were protected during the data analysis. The risk of aligning interviewees’ statements with respect to the issues discussed in this paper is considered to be very low.

In order to conduct a quantitative analysis of the qualitative interview data, we employed procedures outlined in Miles and Huberman (1994). The analysis of the qualitative data was broken into three main processes: reducing data to an analysable form, organising the data to help in drawing justified conclusions, finally drawing and verifying conclusions.

We utilised three main strategies for verification of our research results;

a. reviewing outliers and looking for alternative explanations
b. triangulation during data collection
c. validating the results and conclusions by comparison with other researchers’ work and discussion with commercialisation experts.

Throughout the paper, to strengthen the internal validity of the data, we drew upon several additional sources of information, such as publications and annual reports of universities and intermediary organisations. A cross validation with different published models and theories, drawn from an extensive literature review, was carried out.

3 Discussion and results

As discussed in the literature review, there is a common underlying assumption that TTOs are responsible for the transfer of knowledge, for commercial benefit, from the universities to the marketplace. Accordingly most research is focused on how to optimise the TTO organisation and its processes in its role as the main conduit for IP commercialisation. From our interviews, it was clear that the facilitation role of the TTOs was a valued function by all the stakeholders. More specifically, GIOs expect TTOs to:

• secure the IP protection of the technology/idea
• help inventors apply for the different governmental funds, available only for universities, which can help with commercialisation
• play a proactive role in finding university-developed technologies that have market potential
• help the inventors in translating their research ideas and results into commercial products and/or services
• manage the inventor expectations about what is involved in starting a knowledge-based company.
One of the interviewees expressed his opinions as:

“A TTO is, in some way, a translator – a bridge between the academic community and the business community – and by business, it could be receptor industry, it could be the investor community. You have to have people that can speak to both communities. And it’s a challenge because the academics, as you well know, if they sense that you don’t know what their wonderful stuff is about, they will crucify you. You have no credibility with them. And yet, there is no value in having a really savvy PhD who gets what the prof is talking who then sits next to the prof in front of a VC and makes exactly the same mistakes and doesn’t talk compelling business speak. You need people who are articulate in both communities. So you have to have enough so that the academic at least has enough respect that they’re willing to work with you and then, you need to be able to add to them a whole dimension of other skills when you sit out with the business community and that’s what most offices don’t do. They’re so concerned about keeping the academic happy, they don’t have the people that have the credibility outside.”

However, the inventors expect their TTOs to carry out their facilitation role by:

- making more resources available to them either via university channels or by bringing them to the attention of the inventors
- promoting the commercialisation culture by inviting other academics that started their own businesses to share their experience with the faculty members
- inviting experts such as serial entrepreneurs and venture capitalists VCs who can guide them in their early commercialisation activities.

One of the inventors mentioned:

“I think the role of the Technology Transfer Office should be to make again, to facilitate greater impact of the ideas that are generated. Whether that is through licensing the companies, things of that sort. Or trying to help start-up companies. That’s that.….I think what they should do is try to provide a sort of complement. If it’s a researcher who’s going to start-up a company, then they should provide information on – they should hold hands for the student or the professor who is starting up the company on all the aspects that they don’t know about. So the technical aspect is the only thing they’re going to know about. So how do you do market research, for example. And how do you do this? And how do you do that?..., they should provide things like these kits or models of how university research has been commercialized in a local context…. Specific examples. Basically, let’s say that my next-door-neighbour started a company ten years ago. What are the processes that they went through month-by-month in order to – what are the struggles? So basically, I don’t have to re-invent the wheel. What I don’t want to do is re-learn the whole thing. My interest is in commercialization of this technology but again, that is not going to happen if I am completely re-inventing the wheel. It is going to be easier and more successful if I have, for example, case studies of people have done that and then say, “Well, this one is closer to mine, so let me adopt this model first.” Now I have a framework to work on. I will fiddle around the framework as things progress but at least I have a model but at least I have a framework.”

On the other hand, TT officers were very careful in using the word ‘facilitator’ and they stressed that this role entails many tasks that require experience and effort. They were worried about the word ‘facilitator’ might imply that their role is one that has a low value. Moreover, the officers did not feel empowered to effectively play the role of facilitators. They felt that since there is no clear budget allocation, there is no long term
planning. One of the interviewees mentioned the lack of time or budget to even visit local industries and organisations.

One of the TT officers we interviewed described his role and the challenges he is facing as follows:

“So I think the greatest value our office can play is in brokering relationships between parties who are going to be doing the commercialization, not – so not specifically doing commercialization ourselves but finding companies to work with to licence technologies or entrepreneurs to work with technologies; and ensuring the things they need, like some basic decent intellectual property has been filed, access to funding, access to – hopefully connections to the kind of people that will help, you know. So I hesitate to use the word ‘facilitate’ because it would suggest that we don’t do anything at all. But it’s really trying to put the connections in place for people to do things as opposed to doing – rarely do we step in and do the full time business development role that you would have in a start-up company, though there have been cases when we’ve done that.”

As we mentioned earlier, the interviews were carried out in regions and traditional universities who currently do not have an established entrepreneurial ecosystems and culture. The absence/weakness of such culture led to the obvious discrepancy between the perceptions and expectations of the three stakeholders about TTOs’ facilitation role and how to carry it out. For example, from the government intermediary organisations (GIOs) standpoint, they believed that decisions regarding resource allocation, such as supporting patent filings, are sometimes based on the seniority and prestige of the researchers rather than on the merits and potential of the proposed idea. On the other hand, there was a consensus among TT officers that, regardless of whether it was implicit or otherwise, their job is to serve the inventors. In one of interviews with a TT officer, he mentioned:

“And we have a lot of these – there’s politics involved, you know, the favoured professor. He just wants this – we have to do it for him for political reasons or it’s a last minute thing and sometimes you don’t get a chance to do the market and the prior art and everything that you should. But, it looks like it has value or someone has said it has value so we do a provisional on it.”

In the next section, based on the interview findings, we will study the role TTOs can play in growing an ecosystem in traditional mid-sized research universities according to Rasmussen and Borch’s (2010) capabilities theory.

### 4 Analysis in the context of the capabilities approach

Rasmussen and Borch’s work (2010) focused on how to create or build a commercialisation ecosystem in regions that do not have it. They found that there are three main capabilities a university needs in order to enhance the rate of producing USOs, and to grow, over time, an entrepreneurial ecosystem. These three capabilities are:

a capabilities that open new paths of action

b capabilities that balance academic and commercial interests

c capabilities that integrate new resources.
4.1 Capabilities that open new paths of action

These capabilities are mainly related to triggering the interest of inventors to explore the path of commercialisation that is still considered to be non-traditional in the academic environment. Universities need both to establish an infrastructure and to promote a culture that signals the validity of commercialisation activities. University management support and its flexibility towards commercialisation play a huge role in developing such capabilities. According to Rasmussen and Borch (2010), top-down initiatives such as active support from the university management and incentive systems that reward entrepreneurial behaviour, would be very effective in developing these capabilities. Also, bottom up factors such as success stories, role models and entrepreneurial students can have huge influence on the inventors as well.

Based on our interviews and the perceptions of the different interviewees in traditional universities, TTOs cannot directly impact universities’ top-down initiatives, which are mainly focused on the university structure. However, TTOs can certainly play a significant role in influencing some of the bottom-up factors that help in promoting the required culture. TTOs can focus on initiatives such as inviting successful commercialisation role models, GIos and serial entrepreneurs to promote entrepreneurship among the faculty and the students. All the interviewed stakeholders have specifically stressed the importance of this role and that TTOs are best suited to carry it out.

4.2 Capabilities that balance academic and commercial interests

When academics start pursuing a commercialisation path, there is potential for conflict between their role as researchers/educators and their newly acquired role as entrepreneurs. The academic culture values publishing and research, with papers and peer recognition being the desired outputs. On the other hand, commercialisation activities value risk-taking, with expected output of products/services and profits. USOs usually depend on using tangible and intangible university resources to establish themselves as independent firms. Academics are expected to lead such activities while protecting what they consider their primary role (the traditional academic role). Increasing the legitimacy of commercialisation activities inside the university helps in lowering the potential of conflict between the two roles.

Regarding increasing the legitimacy on university level, the university management needs to be supportive of the commercialisation activities carried out by their faculty members. For example, granting access to a university incubator can help establishing a clear relationship within the university, thus enhancing its legitimacy. At the departmental level, arrangements that allow start-ups to utilise university resources without straining departments were considered to be extremely valuable. This can be done through granting leaves for commercialisation purposes, modifying the performance evaluation system, etc. Also, the university has to have clear IP policies that legitimise the relationships between the university and the inventor, as well as between the inventor and their students. Actually, according to Siegel et al. (2003) and Rasmussen (2008), clarity of the IP policy is more important than the policy itself. Discussions in the context of unclear policies can be extremely time-consuming and frustrating to the participating stakeholders. This was confirmed through our interviews with venture capitalists, student entrepreneurs, as well as the intermediary organisations.
During our interviews with the GIOs, it was mentioned that only three universities in Ontario have stated the word commercialisation in their mandates. Some of the intermediary agencies attributed this to the lack of required credibility with respect to commercialisation. Goldfarb and Henrekson (2003) attributed this lack of commitment to the fact that there are no government incentives that reward universities for committing to the success of the commercialisation activities carried out by its academic researchers. Moreover, during our interviews with the academics, it was clear that faculty members believed that their main roles, as well as that of the universities, are teaching and research. Faculty members, especially untenured professors, will not participate in any commercialisation activities if they will conflict with their clearly delineated main roles. Furthermore, our interviews with all faculty members, both those pursuing commercialisation and those that were not, confirm that they do not believe that the university should invest more resources in supporting commercialisation. They believe that universities should invest its resources in its traditional missions, research and teaching. However, they expect the administration/management not to oppose or prevent those who want to commercialise their ideas. Accordingly, there is a limited role that TTOs can play in increasing the legitimacy of the commercialisation activities in the universities.

Another key factor, that can help academics balance their dual role, is establishing resources that can support the delegation and buffering mechanisms mentioned earlier. Siegel et al. (2003) mentioned that academic researchers view the TTOs as an important source of delegation. This contradicts our findings. During our interviews with the inventors, they felt that the TT officers are better suited in finding the right people to delegate to and to formalise the relationship with, than to delegate to the TT officers themselves. There was a consensus that academic researchers prefer to delegate the leadership of the commercialisation activities to their own graduate students, who have the technical background and interest in commercialising the output of their research. Others attributed this lack of credibility to the fact that faculty members only trust themselves, or researchers with the same level of expertise in the field, when it comes to assessing the potential of their ideas/IP. Furthermore, in one of interviews, there was the observation that from reviewing different websites of Ontario universities TTOs, it is clear that none of the personnel responsible for commercialisation had sales experience. Another interviewee viewed it as a major weakness that most of the TTOs lack the network needed to interface with the outside world.

In conclusion, there is a limited role TTOs can play in increasing the legitimacy of commercialisation activities in traditional research universities, or to directly help balance the inventors’ academic and commercial interests.

### 4.3 Capabilities that integrate new resources

There is no dispute that most of the technologies that come out of universities are very early stage and require additional resources to make them market/investment-ready. Universities/TTOs can play a major role in integrating the required resources to their spin-offs. The university’s reputation can help in providing credibility to the start-up. However, in Canada, the government is considered the most influential supporter of USOs.
Both the academic inventors and GIOs’ representatives agreed that TTOs have a key role to play in growing the university’ integrating new resources capabilities. However GIOs mentioned two obstacles for establishing collaboration between inventors and the university on one hand, and the external entrepreneurs, funding agencies and investors on the other hand. The first obstacle is ‘academic expectations’. An executive in one of Ontario’s GIO mentioned:

“The problems with tech transfer, as long as I’ve been in business, you keep hearing the AUTM people – that’s the Association of University Technology Management – it’s always the same. And basically, what they’re saying is you’ve got professors that don’t work at the time frame or have any sensitivities of what it takes to commercialize IP that they may create. I’m sure that you’ve heard this story before. They’ll say, “Gees, I’ve done the hard work. I’ve done 90% of the work. I’ve come up with whatever I’ve come up with. So how hard can it be? You know, people are just going to bang down the door to buy this stuff you guys are lucky to get it and the hard work is really done.” When really, they haven’t done 90% of the work to commercialize this stuff, they’ve maybe done 10% of it. The hard work is just about to begin, so you have that problem.”

Working closely with industry and the private sector can help alleviate this obstacle. Academic researchers, who work closely with industry, have more practical expectations, leading to better appreciation of the efforts needed to take an idea to the market. TTOs can help in alleviating this problem. Also, units such as innovation parks, incubators, entrepreneurship centres, play a key role in establishing such collaboration between industries and academia.

The second obstacle is related to the misalignment of objectives between the university and the GIOs. Based on our interviews with GIOs, there is a perceived misalignment between the university interests to serve a broader public interest as compared to the TTO’s interest to create economic value for the university. An executive in a leading GIO mentioned that TTO’s primary interest is realising revenues for their own universities, rather than focusing on the benefit, whether to the local community or some other country. However, the objective of that executive’s organisation is local economic development.

In conclusion, TTOs can help in integrating external resources to the university by promoting more collaboration between industry and academics, and by better alignment of the university objectives with the external stakeholders’ ones. Currently, the Canadian government is trying to come up with new initiatives that focus on identifying the needs of different universities/TTOs and addressing them individually instead of offering one solution or one programme that fits all.

5 Quantitative analysis

In order to conduct quantitative analysis on qualitative data, we broke the aforementioned three capabilities into three hypotheses, related to the role TTOs can play in developing them, as follows:

Hypothesis 1  TTOs can help in growing the capability related to opening new paths of action capability.
The role of technology transfer offices

Hypothesis 2  TTOs can help in growing the capability related to balancing the commercialisation and academic interests.

Hypothesis 3  TTOs can help in growing the capability related to integrating new resources to the university.

In the next step, based on our previous analysis, we sub-divided the first hypothesis into:

Hypothesis 1a  TTOs can help in the bottom-up initiatives related to opening new paths of action capability.

Hypothesis 1b  TTOs can help in the top-down initiatives related to opening new paths of action capability.

We decided to eliminate Hypothesis 1b from the quantitative analysis. It was consistently clear, throughout the interviews and the qualitative analysis, that TTOs are not empowered to play a role in developing top-down initiatives related to opening new paths of action capability. The results show that the TTOs can play a role, provided that the university management is supportive. An example is the ability of TTOs to offer incubation services to their faculty members. However, TTOs are limited in influencing the decision of establishing an incubator. More importantly, TTOs can help the academics access the different governmental pre-seed programmes that address the lack of business and market competence in the university setting. We simplified and transformed the interview data into an analysable form, using an initial list of three general categories:

1  academics’ perceptions/expectations about the role of TTOs

2  GIOs’ perceptions/expectations about the role of TTOs

3  TTOs’ perceptions/expectation about the role of TTOs.

This was followed by analysing these perceptions/expectations about the tasks and functions TTOs should carry out and classifying them into one of the three possible activities: bottom-up activities related to opening new paths of action capability, activities that can help in growing balancing academic and commercialisation capability, and activities that can help in growing the capability related to integrating new resources to the university. In this step, we used examples and definitions from Rasmussen and Borch (2010) of the different activities as guidelines.

Table 1 shows that both TTOs and academics agree that TTOs can help in the bottom-up initiatives needed to grow ‘opening new paths of action’ capabilities and in growing ‘integrating new resources’ capabilities. Regarding the role TTOs can play in developing ‘balancing commercialisation and academic interests’ capabilities, academics believed that TTOs can help them access the different pre-seed programmes, offered by the government, to address their lack of business and market experience. However, as we mentioned earlier, GIOs did not feel that TTOs are empowered to administer these programmes effectively. This was confirmed by some of the TT officers saying that their job is to provide a service to the academic inventor.

GIOs felt that TTOs are generally not empowered to play an effective role in growing the three capabilities in traditional research universities, however they expressed their willingness to support the TTOs if the university management decided to depend on them in growing the three capabilities listed in Table 1.
Table 1  Participants opinion about the ability of TTOs in growing the university capabilities

<table>
<thead>
<tr>
<th></th>
<th>Academics</th>
<th>TTOs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening new paths of action (bottom up)</td>
<td>7/10</td>
<td>8/8</td>
</tr>
<tr>
<td>Balancing commercial and academic interests</td>
<td>4/10</td>
<td>4/8</td>
</tr>
<tr>
<td>Integrating new resources</td>
<td>6/10</td>
<td>7/8</td>
</tr>
</tbody>
</table>

In summary, the quantitative analysis confirmed that TTOs could play a much-needed role in growing two of the capabilities described by Rasmussen and Borch (2010). Regarding the first set of capabilities (that open new paths of action), TTOs can help in promoting an entrepreneurial culture in universities, supported by the bottom-up governmental initiatives (Rasmussen, 2008). Regarding the second set of capabilities (that balance academic and commercial interests), both the inventors and GIOs felt that TT officers should focus on finding both external and internal resources that can lead the entrepreneurial activities, instead of investing resources to carry them out themselves. Finally, regarding the third set of capabilities (that integrate new resources), all interviewees agreed that the TTOs should lead the integration of outside resources to the university commercialisation ecosystem.

Overall, our key finding is that the ability of TTOs to effectively support the commercialisation ecosystem is related to the existence of the entrepreneurial culture in the university. If the culture and the ecosystem do not exist, the role TTOs can play is more limited.

6 Conclusions

In countries like Canada, where the government is a strong supporter of commercialisation of universities’ research, it is important to study how the different stakeholders perceive each other and what they expect from each other. The 33 interviews, representing six mid-sized universities in Ontario, confirm that the inventors and the intermediary agencies are in agreement that the role of universities TTOs should be to act as facilitators between different parties. We also discussed what both academics and GIOs expect from TTOs as part of this facilitation role. GIOs mainly require TTOs to help manage the inventor expectations about what is involved in starting a knowledge-based company, whereas the inventors expect TTOs to mainly help in bringing inside the university the resources needed to commercialise their ideas.

Furthermore, we found that the ability of TTOs to effectively support the commercialisation ecosystem is related to the existence of the entrepreneurial culture in the university. We found that TTOs can play a critical role in coordinating different bottom-up initiatives to promote and support alternative paths of action, and in integrating and distilling new external resources to the USO commercialisation process. However, cultural changes and ecosystem development are challenging tasks that require implementing both top-down and bottom-up initiatives. Accordingly, TTOs can play a role in supporting academics that are willing to participate in commercialisation, but they cannot be the agents of change or champion the development of new ecosystems by themselves.
Our results agree with Wigren-Kristoferson et al. (2011) and Gill et al. (2007) that those central entities such as TTOs are more effective when the purpose is to formalise a deal (licensing technology, administering existing programmes, or formalising a research contract). Our results also agree with Phan and Siegel (2006), suggesting that TTOs should assign the different TT functions to specialists, leveraging the capabilities and resources of the outside organisations and the university itself in the process.

7 Limitations and impact

The majority of the academic inventors interviewed were from engineering departments and the results may not be generalisable to other university faculties. Also, the focus of this paper is on mid-sized Ontario research universities, which exist in regions that lack the commercialisation ecosystem and culture, and the conclusions were specific to that set of conditions. However, we believe that the results and findings would be applicable to any traditional research university that has a strong governmental support and cannot afford developing a commercialisation ecosystem by itself.

These results and findings can be used to develop new policies and programmes to help grow the entrepreneurial ecosystem around Canadian universities. For example, there is a strong consensus that universities cannot afford all the resources needed to support the commercialisation of their research output. This would suggest that the decision to assign the TTOs a more limited facilitation role has already been implicitly made by the universities. Our findings can help the Canadian Government, which is currently trying to come up with new initiatives that focus on identifying the needs of different universities/TTOs, and addressing them individually instead of offering one solution or one programme that fits all.

References


The role of technology transfer offices


Notes

1 More details about the capabilities will be included in the analysis section.