

# Integration versus separation: structure and strategies of the technology transfer office (TTO) in medical research organizations

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**Abstract** Establishing technology transfer offices (TTOs) within research organizations is one initiative used to facilitate successful commercialization. Research organizations may choose to either outsource the commercialization expertise (separation model) or incorporate it within their organizational structure (integration model). Ensuring the success of these integration TTOs, face many challenges, including challenges based on tensions from researchers within research organizations about the perceived differences in opinions, rules, norms and reward systems of research and commercialization. Using qualitative data from interviews from researchers and the integrated TTO personnel, this paper describes the interactions of researchers and integrated TTO personnel in five Australian medical research organizations. Despite strong researcher concerns and fears about research commercialization, a number of strategies employed by integrated TTOs were identified to encourage researcher engagement. These include the flexibility of TTO policies to researcher needs; offering collective incentives; and being visible within the organization.

**Keywords** Technology Transfer Office (TTO) · Research Management · Qualitative research · Commercialization

## 1 Introduction

Research organizations are increasingly faced with the challenge of establishing technology transfer offices (TTOs) in order to facilitate successful commercialization. However, establishing and ensuring the success of a TTO faces its own set of challenges (Gittelman and Kogut 2003; Krinsky 1991; Markman et al. 2008; Owen-Smith and Powell 2003; Slaughter and Leslie 1997; Stern 2004; Ambos et al. 2008). This paper uses qualitative

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interview data to discuss the success of strategies used by five medical research organizations to facilitate commercialization through integrated and through separated TTOs. This article also investigates the operationalization of the integrated TTO and the indirect benefits that emerge from its presence within an organization (Integration Model). These factors have been overlooked in the past with analyses preferring to concentrate on quantitative research outcomes (patents, licences etc.) as the sole measure of a TTO's success.

Increasing entrepreneurialism of universities coupled with the change in government policy regarding the intellectual property of publicly funded research, has stimulated proprietary activity within universities through the establishment of TTOs (Sampat 2006; Shane 2004). Moves that include commercialization as a main objective, have been met with hostility from research traditionalists who view obtaining intellectual property as contrary to the aims of objective research sectors and hence a threat to their scientific integrity. As an operational part of research organizations, TTOs face these inherent tensions from individual researchers as representatives of research commercialization. The tensions are based on perceived differences of opinions, rules, norms and reward systems between research and commercialization (Etzkowitz 2003) as well as previous reports of how commercialization intrudes on academic activities (Blumenthal et al. 1996, 1997; Campbell et al. 2000, 2002). Therefore, by extension, these tensions are a source of researcher reluctance to engage with entrepreneurial activities (Etzkowitz et al. 2000) and therefore, with the TTO.

A number of strategies have been associated with successful TTOs and increased researcher engagement, including the use of incentives (Debackere and Veugelers 2005; Friedman and Silberman 2003; O'Gorman et al. 2008); education programs (Hatakenaka 2006) and the active participation of university inventors (Markman et al. 2005). Indirectly, Siegel et al. (2003) emphasises the importance of reducing the cultural divide between university and industry, recommending that TTO staff possess an industry background as a move to limit the cognitive distance between academics and managers (Siegel et al. 2004; Siegel and Waldman 2003) as a method to increase researcher engagement. However, it was also noted that involving a TTO with a low level of cognitive distance between academics and TTO managers may slow the entrepreneurial process due to a tendency for the TTO to safeguard research interests and maximise the concerns of the university (Siegel et al. 2004; Siegel and Waldman 2003). This is contrasted by studies that acknowledges that although TTO staff must "respect" the academic world, the involvement of non-academic staff (presumably industry related) contributes to the increased interaction between universities and industry (Muscio 2010). Future research into the relationship between the cognitive distance of TTO staff and TTO efficiency, taking into account an appreciation of the potential, indirect benefits of TTO characteristics is recommended by Siegel et al. (2004).

Despite these strategies, previous research suggests that research and commercialization cultures are incapable of co-existing. In order to avoid these cultural tensions, Etzkowitz (2003) hypothesised one of four main approaches could be implemented for research commercialization management. These included; (1) prohibition of the activity; (2) a requirement of disclosure; (3) separation of activities; or (4) integration of the activities. After rejecting the ideas of prohibition or disclosure, Etzkowitz (2003) insists that the *separation model*, in which the financial interest is separated from the research interest by defining boundaries or creating structures that mediate between the two activities, is preferable over the *integration model*. According to Etzkowitz (2003), the separation model will always be chosen when an attempt is made to combine new roles with existing

missions. As such, and in accordance with the separation model, Etkowitz (2003) recommends placing as much distance as possible between the activities involved in the advancement of knowledge and those involved in commercialization. Proponents of this separation between the entrepreneurial and academic activities of research state that university research groups and researchers need to be protected from the intrusions of non-academic considerations that erode the norms of science (Tuunainen and Knuuttila 2009; Elzinga 1980), although these views are made in relation to individual researchers and research groups, rather than organizational policies and structures. Although, in some countries integrated and separated TTOs can coexist (Fisher and Atkinson-Grosjean 2002), Debackere and Veugelers (2005) suggest that creating a specialised, decentralised technology transfer office is instrumental to secure a sufficient level of autonomy to develop relationships with industry. This structure provides a better buffer against possible conflicts of interest between commercialization and the research and teaching activities of a university (Etkowitz 2003) and is used to pool resources from across the university. However universities, in general, are more diverse players in the innovation process than smaller and more specialised medical research organizations. Therefore, the ability to form long lasting, mutually agreeable relationships is limited by the size and diversity of the university, rather than the size of the TTO as suggested by Siegel et al. (2003). Analysing the effectiveness of the TTO structure and strategies becomes more difficult, and arguably requires more diverse methodology, when dealing with more specialised TTOs such as those found within the sample of medical research organizations in this article.

Previous research investigating the optimal model for the technology transfer office have concentrated on using indicators of research productivity outputs or commercialization, such as number of patents, spin-off companies, revenue raised or other quantitative indicators (Algieri et al. 2013; Hulsbeck et al. 2013; Curi et al. 2012) as a measure of TTO “success”. These overlook the importance of the indirect benefits stemming from a potential integrated commercialization ambassador of the integrated TTO (Integration model), that require a more qualitative approach to assess. A closer understanding of how different organizational structures incorporating TTOs influence researcher’s attitudes and willingness to engage in entrepreneurial activities is needed.

## 2 Research design to investigate institutional TTO structures and strategies

In a review of the organizational factors necessary to influence knowledge transfer, Jacobson et al. (2004) outlined a need for further studies where institutional and organizational factors influence researchers’ engagement in knowledge transfer activities (Jacobson et al. 2004). Likewise, there is an expressed need for *qualitative* evaluations to assess the extent changes in the identified domains actually improve knowledge transfer efforts. As such, the organizational dynamics of entrepreneurial engagement by researchers has been relatively unexplored qualitatively.

The sample of research institutes within this article, support a variety of integrated and separated TTO structures. As institutes, they are considered differently from universities as they are significantly smaller and grouped around a common research discipline (medical research) and organizational objective. These institutes therefore balance the academic/business divide whilst never fully integrating and are therefore examples of Etkowitz’s (2003) “quasi-firms”. For these institutes, maintaining a positive public “image” is particularly important to research institutes in order to reach both fundraising and/or philanthropic goals.

In this research, the “boundary” as defined by Etkowitz (2003) as mediating the difference between the research and commercial activities of the research organization, is institutional: where some research organizations choose to outsource their commercial activities to an external entity (*separation*) and other choose to incorporate a permanent TTO within the organization (*integration*). Unfortunately, within our sample of research institutes, none had adopted a hybrid approach of both the Integration and Separation TTO models. As such the benefits of this hybrid approach were not investigated in this study. This research will investigate the benefits of *integration* versus *separation* of the technology transfer office within these smaller, more specialised research institutes. To achieve this, we analyse the structure and strategies of current technology transfer efforts in five Australian medical research institutes. Of these, three organizations (INT-1, INT-2 and INT-3) supported their own, *integrated* TTO (*Integration model*). Two institutes (SEP-1 and SEP-2), however, used *separated* TTO expertise for their commercialization activities (*Separation model*).

## 2.1 Interviews and analysis

Two sets of semi-structured interviews were employed with (1) The Institutional Researchers; and (2) The TTO Staff. In total, 82 researchers (Researcher) and 4 integrated TTO staff (TTOStaff) were interviewed. Of the researchers, all were Laboratory heads and were recipients of at least one government funded grant, ensuring that all participants had managerial level experience. For the TTO staff, as not every institution had the same number of personnel in each TTO, specific care was taken when analysing the results. All interviews were conducted in person, recorded and transcribed for analysis.

The interview questions were framed around the main concerns from the literature regarding commercialization in research previously discussed in-depth by Derrick and Bryant (2012). Specifically, this research was concerned with personal accounts of attitudes, beliefs, interpretations, motivations and behaviour of the office professionals and researchers within each participating organization. More importantly, it was concerned with how researchers and the staff of the integrated TTOs (INT-1, INT-2 and INT-3) interact. During the interviews, participants were asked to use examples where possible and specific attention was paid to places in the interviews where researchers discussed the TTO and TTO staff; as well as when the TTO staff described their experiences with the organization’s researchers.

The two sets of interviews (Researchers and TTO staff) were initially coded separately to ensure that codes and themes were developed separately. In addition, interviews from different organizations were also initially coded separately in order to identify institute-specific themes. Themes identified within each set of interviews were compared independently and the strong and reoccurring themes, identified during the analysis were analysed further to test their levels of validity and reliability. For the researcher interviews, additional themes that were explored in relation to this paper were: researcher’s impressions and opinions of their organization’s TTO arrangements; their level of engagement and interaction with the TTO and the TTO staff; and their level of satisfaction (or not) with the TTO. In contrast, the interviews with the integrated TTO staff were analyzed for themes related to the barriers associated with working with researchers (past and current); and their impressions of how research works and how this presents obstacles for efficient technology transfer. More concretely, TTO staff was asked about the specific strategies of the TTO; their impression of their success and how they thought this reflected on the reputation of the TTO within the organization. The themes and descriptions of the

interactions were then cross referenced between the two sets of interviews. This cross-referencing served as a triangulation tool (for the examples used by researchers and TTO Office staff) as well as a method to allow the further development of themes from the combined interviews.

In the sections outlined in the results below, case evidence is presented in terms of the key themes identified from the interviews. These themes include: Researcher concerns about commercialization engagement (using Researcher interviews); and the strategies of the TTOs (combining Researcher and TTO staff interviews). Both these themes are discussed in light of the response of researchers towards commercialization (combining Researcher and TTO staff interviews).

### 3 Results

#### 3.1 Researcher concerns about commercialization

Commercialization is still considered by researchers as a new influence in research. In fact, when asked about the role of commercialization in research, researchers mentioned that it was once considered a “dirty” aspect to research and that commercialization was something that researchers only did if they were not academically successful; “...if you went back into the 80s in Australia the culture with regards to commercialization was very much –‘the poorer the scientist, the better the research’” *INT-1-Researcher-01*. “Disinterestedness” towards research outcomes was valued highly as no scientist should have a vested financial interest in their research. This sentiment however has changed dramatically; “...when I started in research, commercialization was a dirty word whereas commercialization now is very much highly regarded.” *INT-3-Researcher-04*. However, researchers still approach commercialization with a level of “cautious scepticism”. They acknowledge that despite commercialization being a method of linking research with patient outcomes (an outcome researchers expressed as ideal), they are aware of the potential risks of commercial engagement. These include: the different research goals between researchers and industry; and the fear of losing control of the research path. Despite fears, the evolving maturity of the internal TTOs appeared to reduce the perceived risks associated with commercialization. In addition, as success stories emerge, research “myths” are silenced, gradually attracting more researchers to commercialization engagement as the process is perceived as less burdensome and risky.

I think here it’s developed quite rapidly over the last decade or so and its [TTO procedure] becoming lots more streamlined in terms of procedures and forms for viewing potential IP to getting it ratified and getting lawyers to draw up patents if it looks as if it is a viable entity. *INT-2-Researcher-06*.

Institutes ensure researchers remain involved in the research, and maintain a level of “scientific integrity” by placing distance between the researcher and the forefront of industry (Etzkowitz 2003). This, at least, relays concerns researchers may have about industry partners dictating the direction of the research;

...we go to a lot of effort to make sure that the tail doesn’t wag the dog, If a major pharmaceutical company or industry came to us saying ‘we want you to do research on x’ If that wasn’t exactly what we wanted to do anyway, we wouldn’t even contemplate it. *INT-1-Researcher-01*.

Indeed, the above quote reflects the results of previous research that suggests researchers engage with industry primarily to further their own research careers, rather than as an alternative source of funding (D'Este and Perkmann 2011). For this reason, researchers maintain a personal level of separation by stressing that the “tail doesn't wag the dog” and that they continue their research agenda irrespective of its commercial application.

Despite this personal separation, a major concern of researchers about engaging in commercialization remains the risk associated with the freedom to publish their results. Internal rumours (myths) abound with reports of commercial partners delaying the publication of scientific articles because of commercial conflicts. With publication still regarded as the primary contributor to career advancement, researchers were unwilling to engage with activities perceived to interfere with professional ambitions. However for the researchers interviewed at organizations with an integrated TTO, this is not a concern. In fact, very little publication disruption was experienced by researchers;

If I'm working on a paper that is really cutthroat and in a competitive field so I have to get it out quickly, sometimes it can make me feel really anxious but the thing is that we've got a lawyer [in the TTO] here and we can make up the contract and it says that if a publication is coming out they [the commercial partner] is bound to check it and approve it within a couple of days so that is fine. *INT-1-Researcher-04*.

In contrast, the quote below demonstrates that this publication delay seemingly imposed by commercial partners is a real concern for some researchers involved in commercialization. In the example below, these fears were dispelled by a smaller distance between themselves and the integrated TTO that allowed delays to be reduced, thereby reducing their “fears” of this barrier to commercialization engagement.

The only thing they require is that if we write a publication they want to see the manuscript before we submit it. Initially we were fearful that maybe they would sit on it for a very long time but it actually turned out to be much better than we thought. The last manuscript that we sent to them they okayed it for sending off within 24–48 h of us sending it to them, that's a heck of a lot better than I feared so we haven't had any problems *INT-3-Researcher-11*.

Differences between institutes were observed in researcher attitudes towards commercialization, in relation to publication delays. When this theme was further investigated, each institute's success in communicating the benefits and advantages of commercialization in research were greater if that institute supported an integrated commercialization reference point through the TTO.

Researchers at the INT-1, an institute with an integrated TTO, had a positive attitude towards the role of commercialization in research. For INT-1 specifically, the institute has developed a reputation for their commercialization success and for transforming the culture of the institute. This is mainly due to the success their researchers have had with past commercialization ventures but also because of the range of incentives the INT-1 offers researchers who engage with commercialization. This sharing of success of the commercial partnerships benefits both the researcher and the institution. For to researchers not involved in commercialization, the benefits of commercialization are still shared, adding to cultural acceptance of commercialization and encouraging other researchers to engage.

Conversely, for SEP-1, an institute with a separated TTO, researchers overwhelmingly believed that their ability to formally and informally communicate their research is

restricted by commercialization engagement. Myths relating to publication delays were reported as longer for researchers at SEP-1 who were involved in commercialization compared with the perception of delays for researchers at the INT-1, INT-3 or INT-2. In addition, further myths of the restrictions of commercialization engagement propagated; "...When you try and discuss it [your research] with other people, you can't anymore because people now repeat the same experiments over and over again because no-one actually tells you what they have already been done." *SEP-1-Researcher-20*.

Researchers at SEP-1 feel restricted in their freedom to publish their results if their research is engaged with commercialization. The researcher below, although not involved in commercialization, views engagement as inhibiting the role of a researcher to communicate his research to other parties freely and inhibits the development of "good ideas". This dissuades other researchers from considering commercialization in the future.

...'commercial in confidence' means that you can't publicly present your data to other researchers but if we set that aside and think of more general ways in which it might affect communication, then I think that it probably tends to inhibit free communication because purely academic researchers would tend to free-associate when they are chatting to their colleagues or with people at meetings which is often how good ideas emerge. *SEP-2-Researcher-6*.

During the interviews researchers were asked about their experiences with "withholding behaviour", in order to determine whether the practice of withholding information, results, methods or reagents was commonplace in Australian medical research. Some researchers indicated that they thought withholding behaviour in research was against the "spirit of research" believing that every piece of information available should be used for the benefit of public health as a whole.

If someone asks for our results or reagents we will give it to them...that is what research is all about. That's the spirit of research and I know that the reagents that I will give will contribute to someone else's research and maybe even a cure for cancer. *SEP-1-Researcher-5*.

A researcher recalled his experience at conferences where presenters would withhold information, frustrating other researchers from the field. Researchers believed that withholding such information would considerably slow the progress of research whereas others believed that competition in research is a catalyst for bigger discoveries; "People are constantly evasive about materials, it's an integral part of competitive research....information is at the heart of research and people tend to keep information to themselves." *INT-3-Researcher-5*. Most researchers described the nature of research as "mostly still collegial" where open and fair communication in research was still practiced.

Research is still largely collegial but it is different....there is also that the competition is stronger. I think people's willingness to give you reagents and willingness to share things with you has probably dropped a little bit but I think that it is still largely collegial. *INT-3-Researcher-04*.

Despite stating the above, this researcher also noted that she would be unwilling to freely share information with any of her competitors. This dual loyalty was a common trend amongst researchers;

In terms of a reagent certainly if it wasn't patented or hadn't been published nevertheless, because we are working in this field if somebody asks for it [the reagent] we wouldn't give it to them until we had filed a provisional patent and published it...not just commercialization that has inhibited it, its competition as well. *INT-3-Researcher-04*.

However, many of the researchers who indicated that they regularly withhold results also mentioned that if a Material Transfer Agreement (MTA) is in place and fostered by the integrated TTO, they have little aversion to sharing. These MTAs are preferred by researchers to protect results and to ensure that their competitors do not have access to their research; "We have used MTA's for vectors and things. It is actually a good mechanism to stop people passing things around without you knowing it." *INT-3-Researcher-13*. The MTA's are administered by the integrated TTO on the researchers' behalf. On one hand, researchers invoke MTA's in order to protect themselves and their data from being used without proper recognition. On the other hand, researchers admitted to using MTA's in order to establish large collaborations with other research groups, perceived as essential to publish in higher impact journals (Derrick and Bryant 2012). They reported that with more authors, "big research" can be produced. Also, any successes from MTA-related materials would be attributed back to the individual researcher and their institution, thereby adequately acknowledged.

You do say to people sometimes that there has to be a MTA. That basically just means that if they use something and get some benefit from it that that will accrue back to the institution and me. Most people don't have any problems with that. *INT-1-Researcher-07*.

The MTA has allowed research to remain "mostly collegial" but the efficiency of implementing an MTA is considered essential. The integrated TTO is adept when aiding researchers with MTAs when needed and the ease with which researchers referred to their use of the MTAs reflects the trust and maturity of the sample of integrated TTOs. In addition, the above extract demonstrates a further advantage of an integrated TTO where the quotation: "get some benefit from it that will accrue back to the institute and me", relates to how the researcher views his entrepreneurial activities as institutional, and not primarily an individual endeavour.

The above results suggest that without the continual presence of an integrated TTO, researchers are sensitive to the actions of other, commercially engaged researchers and more sensitive to negative reports of commercialization. We have termed this behaviour as "myth making". Berkowitz and Feldman (2008) emphasised the importance of less tangible factors, including the socialisation and norms of research groups to commercialization, in encouraging researcher engagement with entrepreneurialism. In Göktepe-Hultén (2008), the views of senior researchers towards entrepreneurialism influenced the norms of other research group members and how they relate to entrepreneurial activities. Therefore, "myth-making" based on negative opinions of senior researchers, can have a detrimental effect on the willingness for other researchers in that community to engage with entrepreneurialism. As an extension; this can further negatively influence the institute's commercialization outcomes. Indeed, at SEP-1, there have been a number of negative experiences with publishing and commercial involvement. As such, this fails to positively promote the benefits of commercialization to other researchers, and affects their willingness to engage in the future.



### 3.2 Structure of the TTO: integration versus separation

Both INT-2 and INT-3 have hosted integrated commercialization offices since 2000 whereas previously, technology transfer was handled externally. At INT-3, the current TTO manager was initially hired as an external consultant to develop the TTO. At first, introducing the researchers and institute to the concept of commercialization as a “partnership” with research was difficult;

...It has been a steep learning curve for the institute; backing 1986 through to about 1999 they [the institute] had a company called [XX] doing all of this tech transfer, in the classic sense of “tech transfer”. So it meant that the institute itself had been protected all the way through the nineties from issues of translation and commercialization... *INT-3-TTOStaff-01*.

External companies might have succeeded in protecting the institute prior to having an integrated TTO, but acting externally as the TTO made it difficult to bridge the gap between researchers, the institute and this external entity. The aim of the TTO is to work in partnership with the researchers of the institute; “My job is to maximise, or at least enhance the chance of translational research” INT-3-TTOStaff-01. Further, INT-3-TTOStaff-01 explains how this “enhanced chance of translational research” is not always measured financially. Instead, he emphasises the importance of more nuanced success indicators such as, communication of INT-3’s research to stakeholders in order to increase the effectiveness of translational research to businesses. This objective of the TTO is in line with O’Gorman et al. (2008), with the principal benefit of the TTO being to put external partners in contact with scientists committed to commercialization.

At INT-2, establishing the TTO was similar to INT-3, although when the contract with the external company ended; INT-2 did not immediately establish its own integrated TTO. Instead, INT-2 engaged yet another external organization to handle its technology transfer activities. This arrangement was perceived as further disadvantaging the institute as the TTO and researchers were separated from commercialization expertise yet again. As explained below, another disadvantage of the external partnership was that intellectual property was invested back into the external company rather than back into INT-2. Subsequently, researchers did not benefit from any commercialization success, inadvertently affecting the reputation of commercialization amongst researchers at the institute.

A lot of technology from INT-2 was put into the CRC. INT-2 in its own right would not drive commercialization or a fair proportion of its own IP. [External TTO-Entity] would do that and I don’t think that it did it very well as they didn’t involve the researchers very effectively. *INT-2-TTOStaff-01*.

Despite not involving researchers in the past, the integrated TTO recognised that communication with researchers was essential to engage them with future commercialization ambitions. It was suggested that if INT-2 had initially integrated the TTO, not only would their commercial intellectual property portfolio be larger but also the TTO would be more mature, having developed firm relationships with the institute’s researchers.

...I do know that those sorts of arrangements are not healthy for a research institute that wants to drive its own commercialization agenda. If they didn’t have these frivolous interruptions INT-2 would be further along and more mature in relation to commercialization. *INT-2-TTOStaff-01*.

An institute that runs its own commercialization agenda has the advantage of maturing alongside the scientific community, maintaining the best interests of the institute, and also the advantage of working with the institute's researchers. This also has an educational advantage where the integrated TTO can work with the researchers about commercialization and its role in research. The interviews suggest that the absence of external, "frivolous" company interruptions and by integrating the TTO sooner, INT-2 researchers would have been more relaxed about commercialization's role in their research, as well as be "further along" and "mature" in their entrepreneurial ambitions.

At the INT-1, however, the TTO has always been integrated internally. The current TTO has been working at INT-1 for 4 years and prior to this; the manager was an eminent scientist who established the TTO in 1997. When he left the institute considered outsourcing the TTO but decided to continue to integrate it internally, recognising the importance of maintaining a relationship with the institute and its researchers; "... I actually deliberately put together a team approach to how we handle everything." *INT-1-TTOStaff-01*. The team comprised of people from a variety of different backgrounds including staff with sufficient scientific expertise as a method to build relationships and communicate with the researchers; "So whilst I say I'm not a scientist, I recognise the importance of having a scientist on our team." *INT-1-TTOStaff-01*. Interestingly, this organizational decision of the TTO is in line with strategies designed to reduce the cognitive gap between researchers and TTO staff (Siegel et al. 2004; Siegel and Waldman 2003). In addition, this institute's commercialization training program (described below) for researchers specifically addresses the issues surrounding commercialization and allowed researchers an opportunity to engage with the TTO and voice their commercialization concerns, attempting to further reduce the cultural divide (Siegel et al. 2004; Siegel and Waldman 2003). For the TTO, this training program ensured that researchers were correctly informed about commercialization, and how the TTO can assist researchers in their commercialization endeavours. The specific strategies used by integrated TTOs to facilitate researcher engagement with commercialization are outlined in the section below.

### 3.3 Successful strategies of integrated TTOs

Despite the negative associations of commercialization from researchers described previously, the TTO is still required to positively engage with researchers. In this study, three main strategies used by the TTO in order to increase their effectiveness and improve interaction with researchers, were identified: (1) Establishing partnerships and becoming a recognised member of the organization's research community; (2) Educating researchers about the importance of commercialization; and (3) Altering TTO guidelines to accommodate the professional needs of researchers. An additional strategy, the distribution of incentives, was also identified. These results of these incentive programs are only briefly discussed here and are explored more thoroughly in Derrick and Bryant (2012).

As traditionally, commercialization is not well regarded by researchers, developing and maintaining good relationships with the researchers, and not be considered as a hindrance, is imperative to the integrated TTO's success;

Everything is based on empathy and personal chemistry. So, each scientist you have to treat totally on their terms. At the end of the day they are the prima donnas, the propeller heads, they have egos as big as the Grand Canyon some of them. You just have to work exactly on their terms. Which means a slightly different style of relationship for each scientist and how you add value for them *INT-3-TTOStaff-01*.

The reference in the above quote to “a slightly different style of relationship for each scientist...” highlights the benefits an integrated TTO can have for research organizations. By allowing the proximity and time necessary to build a relationship and to understand the nuances of individual researchers (the “propeller heads”, “prima donnas”, and the “egos”), the TTO is able to identify aspects of the commercialization process that are considered by an individual researcher as a barrier to successful engagement, and navigate them accordingly.

Researchers were asked what other aspects of communication were important when interacting with the integrated TTO. Although general communication was regarded as important, it was more important for the office’s to maintain the trust of the scientist by acting as an ally; “Trust is the other crucial thing so you end up being regarded as an ally, an asset rather than a hindrance.” *INT-3-TTOSTaff-01*. At INT-3, as mentioned above, it is important for the officer to work on the researcher’s terms in order to be seen as an ally. Similarly, at INT-2, the TTO Staff member considers himself as more than an “ally”. He considers his role as that of a “partner” in the scientific research process;

We see our role as a partner, rather than getting a hand ball over the fence and running with it....there are times that we want to be out in the front office but most times we are in the back office yelling and encouraging instructions saying “why don’t you try this”. That is the model I adopt anyway. *INT-2-TTOSTaff-01*.

This hands-on model contrasts with INT-3’s model which is more non-interventionist. However, the INT-2 method emphasises the importance of positively engaging researchers. The TTO at INT-2 adopts a long term approach by educating and guiding its researchers about commercial opportunities for their research; from the grant writing stage up to the product development stage. This reminds researchers that the TTO is there to work for them; “...you need a positive engagement with the research and the researchers. You need to be there working for them, to be seen to be working for them and that’s a lot of work.” *INT-2-TTOSTaff-01*.

INT-2-TTOSTaff-01 sees their role as building positive relationships with the researchers that are open and relaxed. Otherwise, as described below, INT-2-TTOSTaff-03 may find out about a researcher’s technology second-hand and therefore not eligible to be commercialised, disrupting the commercialization process. The proximity afforded by an integrated TTO, also allows TTO staff to be available to act on these potential technologies more efficiently;

A lot of it is developing that relationship so that they trust you because they have two options when they publish a paper, publish a poster or do anything communicative. They can give you a call first and ask you what you think or you can find out 3 months later, or not at all... *INT-2-TTOSTaff-03*.

To achieve the reputation of “working for the researchers”, INT-2-TTOSTaff-01 approaches the task of commercialization using a “cradle to grave” approach. This helps to nurture the relationship with the scientist. In addition, the strength of this relationship and by ensuring a good experience with commercialization, researchers are more aware of the TTO’s role in the research process.

For commercialization my philosophy is that you need a little bit of cradle-to-grave approach in that you need to work with researchers right at the beginning, when the grant is written, in terms of discussing commercial opportunities right through to seeing if something comes out of it, submitting a patent with them, discussing the

commercial opportunities...If you just came up for 3 months saying essentially “what have you got?” Then that is not the same? *INT-2-TTOStaff-01*.

Further, the above extract emphasises the benefits of an integrated TTO where TTO staff adopt a “cradle-to-grave approach”, building long-term, mutually beneficial relationships rather than only contacting the researcher when needed. Contacting the researcher only to ask “what have you got” arguably has inadvertent effects on the entrepreneurial outcomes of the institute, as well as the experience of the researcher. At INT-1 however, the office enforces a teamwork approach to the commercialization process with clear roles for each participant. The TTO even employs a staff member with a strong scientific background to participate in meetings and provide a translational buffer between the researcher and the TTO. This strategy again echoes Siegel and Waldman’s (2003) recommendation that TTO staff possess an academic priority as a priority to reduce the cognitive distance between researchers and a TTO (Siegel and Waldman 2003).

...when we have a potential new discovery we all sit down together at that initial meeting so that they actually understand us and the patenting process timelines but not because they have to do anything and I think this is a really important point. *INT-1-TTOStaff-01*.

In contrast to the INT-2, INT-1-TTOStaff-01, is not involved in the initial grant writing stage of the research, but instead emphasises that the office does not interfere or try to “direct” the research. By removing the TTO’s influence from the initial research planning stage, INT-1-TTOStaff-01 attempt to raise the reputation of the TTO by emphasising to the researchers that commercialization is available but it is not essential for all INT-1 researchers; ...they are researchers and that is what they should be. So our office in no way shape or form tries to direct their research in an overt way. *INT-1-TTOStaff-01*. If they are seen to be directing the research, the TTO runs the risk of damaging the relationship by the appearance to assert themselves on the scientific decision making process. Likewise, any appearance of or “myth” of “directing” any researcher, can negatively impact the TTO’s reputation with other researchers at the institute, as well as any entrepreneurial outcomes. These separate roles for researchers and the TTO helps to outline the responsibilities of the participants without attempting to “overtly direct” the research. Integrated TTOs ensure that researchers remain the main protagonist in the commercialization process, with the role of the TTO to provide the best outcome for the researcher and the institute, and continue to act as a research “partner”.

The positive opinion of commercialization by researchers in institutes with integrated TTOs, reflects the efforts of the integrated TTO office staff in not only in their increased day to day interaction, but is also the result of an intensive commercialization education program run in house by the TTO;

What I noticed coming in is that they didn’t really understand what patents and patenting is really about apart from a number that you put at the end of your grant application...what I have done or tried to do is, first of all to educate the researchers about what commercialization is but that is actually the pointy end of it... *INT-1-TTOStaff-01*.

Through commercialization education, INT-1-TTOStaff-01 feels that this fosters a better relationship between the TTO and researchers. This method is used to not only educate researchers about the potential benefits of commercialization but also combat “myths” about the restrictions of commercialization on academic freedom. In addition the

training also helps researchers to view commercialization as something more than a paragraph to be “put at the end of their grant application”.

The INT-1 is not alone in using such strategies to promote commercialization to researchers. At the INT-3, financial incentives are used. However, these financial incentives are not restricted to those involved in commercialization, but are allocated to the entire institute. This “internal distribution” model for the financial revenues from the institute’s commercialization activities is particularly important. If all researchers benefit from the institute’s commercialization activities, it sets a firm precedent for other researchers not involved in commercialization. Additionally, if all benefit from commercialization, it reduces the antagonism between the researchers who commercialise their research and the researchers who still view commercialization as akin to “selling out” in research. This is encouraging to those researchers in research programs with little opportunity to commercialize, who expressed negative views on the role of commercialization in research (Derrick and Bryant 2012). This also emphasises the type of financial rewards for researchers that can potentially stem from commercialization, encouraging future engagement, and negating any pre-existing “myths”.

A final strategy employed by the integrated TTO was to change their practice towards patent filing and other bureaucratic processes. As discussed in the previous section, one of the major myths among researchers about commercialization is that it leads to disruptions of published work. As such, the TTO works hard to dispel these myths as a barrier to researcher engagement. As such, integrated TTO guidelines allow researchers to publish at the same time as patenting their work. This flexibility is not common in commercialization procedures, but the integrated-TTO is aware of researchers’ need to publish and, as such have altered industry practices in order to accommodate this; “Now people [commercialization officers] are slowly coming around saying “publishing is important and we just have to get the timing right”.... Publishing always been important and probably in some ways you say that it was more important than the patent...” *INT-2-TTOStaff-01*. This flexibility directly combats the fears and myths of researchers that their research can either be patented or published but not both. Below, *INT-2-TTOStaff-01* explains below why these guidelines have been changed;

Sophistication—sophistication of the people in the offices is one issue. I think the people who are in these [TTO Staff] positions are slowly becoming a little more experienced.... now they understand is that there is a balance between the two [publishing and patenting], kind of a maturity I think.... *INT-2-TTOStaff-01*.

At INT-1, and as a result of the change in commercialization guidelines, it is now possible to publish and patent simultaneously. The commercialization training program has also informed researchers of the internal TTO’s growing sophistication in relation to the need to publish. This is also a strategy to directly combat perpetuating research “myths”. In addition to re-evaluating their TTO-practices, the TTO concentrates on changing the casual nature of internal research communication such as, researchers using informal means of communication; “The issue is more probably capturing people who are out and about talking to people and just forget.” *INT-3-TTOStaff-03*. As a result, the new guidelines allow researchers to publish their work and avoid the problem of people who “just forget” by increasing the speed with which the TTO processes applications.

Certainly regarding publications, it’s rare now to miss anything and I don’t think people, and this is the whole point about having a patent attorney who is visible to

the scientist, is that they will turn around applications quickly if needed. *INT-1-TTOStaff-01*.

By being visible to the researchers, the integrated TTO is actively responsive to researcher requirements even if this means submitting provisional patents within tight deadlines. The willingness to work to these tight deadlines for the researchers reflects the strength of the relationship, and the increased sophistication of integrated TTO procedures.

So if a scientist will come in and say that he has to go to a conference in 2 weeks, the patent attorney is fantastic and we have trained them up—they are part of the team and understand what we are trying to achieve in this office—and so they'll get cracking. *INT-1-BD01*.

This allows researchers to continue to publish, patent and continue “chatting to their colleagues or with people at meetings which is often how good ideas emerge.” SEP-1-Researcher-6. The integrated TTO accommodates the need of the researchers to publish and patent by processing preliminary commercialization applications in a minimum of 48 h. This good relationship (as an “ally” or “partner”), built on accommodating researcher needs demonstrates a good working relationship between commercialization and research in institutes with an integrated TTO.

## 4 Discussion

### 4.1 Integration versus separation of the TTO

The results show strong evidence in favour of the integration model in contrast to previous research arguing that “integration” is likely to produce tension (Etkowitz 2003). In this study, when the TTOs were willing to change their practices to accommodate researcher needs, tensions were reduced. Indeed, when cultural norms were altered by the TTO, research and entrepreneurial activities were able to work cooperatively.

Three of the participating institutes; INT-2, INT-1 and the INT-3 employ the integrated TTO model. Despite Etkowitz (2003) recommending the separation model, these three institutes have chosen to negate this by reducing the “distance” between scientific research and entrepreneurialism by incorporating the TTO in house. In contrast, two other institutes, SEP-1 and SEP-2, use the separation model, where the “financial interest” is separated from the “research interest” by defining a boundary that mediate between the two activities, that is organizational. Although not against the idea of commercialization, researcher outlook's at SEP-1 and SEP-2 for the future of research and industry was expressed pessimistically and along the lines of commercialization “myths”. In contrast, researchers from the INT-3, INT-2 and INT-1 considered the negative associations of research commercialization as a thing of the past, and acknowledged the role commercialization plays in translating their research. In contrast, those who work with a separated TTO focused on expressing negative commercialization myths, such as restrictions to publishing and the shifting of research agendas.

It must also be noted that the reoccurring indirect advantage of maintaining an integrated TTO, was its ability to mediate these prominent, researcher-led commercialization “myths”. In this study, the term research “myths” refers to the biases researchers hold that are based on popular suggestion, rather than direct experience or evidence. For example, much of the literature describes the potential threats to researcher autonomy such as

secrecy, withholding behaviour, delayed publication (Blumenthal et al. 1996, 1997; Campbell et al. 2000, 2002). Myths can be potentially damaging when attempting to introduce new strategic directions to a research system. Göktepe-Hultén (2008) alluded to the effect of myths in research systems when he found that the views of senior researchers towards entrepreneurialism influenced how other group members related to it. In this study, examples were identified where mythmaking had interfered with a researcher's willingness to engage with commercialization. In this study, the institutional separation between the academic and commercial activities of research resulted in researchers exhibiting more negative attitudes towards commercialization along the lines of myths relating to how commercial engagement promotes secrecy and restricts academic and other commercialisation. The propagation of myths about commercialisation is a barrier faced by TTOs (internal and separated), but as the results show, this barrier is minimised within organizations via an integrated TTO. The more salient advantages, of combatting myths and preventing their wider effect on the research community's opinion of commercialization, has been overlooked in previous studies of TTOs which have preferred to look at commercial outcomes as indicators of TTO model success (Algieri et al. 2013; Hulsbeck et al. 2013; Curi et al. 2012).

The continued reference by researchers to the "maturity" and "sophistication" of the integrated TTO is particularly poignant as it reflects an ongoing and fluid, "earning of respect" between researchers and integrated TTO staff and a method to mediate these myths. Without an integrated TTO, there are no professionals nearby to mediate researchers' fears or wider "myths" about commercialization. There are therefore, indirect advantages to having an internal technology transfer representative present both for the scientific researchers as well as to the evolution of entrepreneurial research institutes. In this study the existence of these indirect, more salient benefits promoted the integration model over the separation model, especially within smaller, more specialised research institutes or Ezkowitz's (2003) 'quasi-firms'. Indeed, it must be emphasised that the study's use of qualitative methodology is more sensitive to understanding these more nuanced benefits, and therefore has advantages over previous research investigating the benefits of integrated and separated TTO structures that have relied primarily on quantitative output measures (Algieri et al. 2013; Hulsbeck et al. 2013; Curi et al. 2012).

#### 4.2 Integrated TTO strategies

For the participating institutes in this study, balancing their reputation for producing academically excellent research with commercialisation engagement via the TTO, by combining three distinct strategies; (1) Office staff and policies surrounding the role of the integrated TTO; (2) Monetary incentives for commercialization; and (3) An understanding of the importance of both the scientist's need to publish and also the institute's need for the scientist to publish.

In regards to the first strategy, Office staff and policies surrounding the role of the integrated TTO, despite the small size of each integrated TTO studied, each TTO recognised the importance of having both an appreciation and understanding of the institute's research. TTO staffs are described in the literature as quintessential "boundary workers" who are charged with translating academic research into intellectual property (Fisher and Atkinson-Grosjean 2002). This boundary role is successful in a number of ways but a number of officers participating in this research described the importance of combining trust and scientific integrity as a method of effectively engaging with their institute's researchers. This boundary role involved strategies such as being involved in the research

project “from the cradle to the grave”, or remaining an active “partner” in the research progress, while not letting the “commercial tail wag the dog”. Building the level of trust and scientific integrity desired by integrated TTO staff was facilitated by the organizational proximity of the integrated TTO to the researchers.

The evidence for the strategic use of monetary incentives to encourage researcher engagement in technology transfer has been discussed extensively in Derrick and Bryant (2013). However, a TTO engaged an “internal distribution” model of incentives, where the financial rewards from successful commercialization were attributed back to the institution. In this way, the TTO ensured that all researchers and research groups benefited from commercial success regardless of whether they had been involved. This served to reduce antagonism between researchers, as well as encourage future researcher technology transfer engagement. Indeed, researchers referred to how the benefits of their TTO engagement could be “accrued back to the institution”, rather than emphasising a desire for a personal gain from the commercialization, a statement that emphasises how the TTO, the researcher and the institute are perceived as interlinked “partners” in the research process.

Another strategy identified was that the integrated TTO understands of how important publishing is to their researchers and institute. Perhaps the greatest disincentive towards engaging with commercialization for researchers was the “myth” that is meant that they would restrict their freedom to communicate through academic publishing. This generated fear among researchers about the trade-offs that commercial engagement demands. Within this study, researchers were more than aware of these possible interruptions to their scientific practice if engaged with commercialization. In some cases the concept of delaying publication as a result of commercial involvement was still daunting. However, these fears have been quickly dispelled by the “maturity” and the “professionalism” of the integrated TTO acting as both a buffer, facilitator, as an internal commercialization ambassador and showing “respect” for the academic world (Musico 2010). For example, researchers referred to the process of establishing MTAs casually, reflecting the ease in which researchers can access trusted assistance from their integrated TTO. In addition, the absence of any withholding behaviour is related to the professionalism of the integrated TTO, and its ability to adapt their procedures to suit the needs of the researchers. This professionalism was not unnoticed by the researchers and the TTO’s flexibility also directly alleviates the propagation of commercialization “myths”. Indeed, the success of the integrated TTOs lies in their flexibility to adapt to the scientific needs of the organization’s researchers to become an accessible partner in the research process.

## 5 Conclusion and recommendations

The results of this study recommend research organizations adopt the integration TTO model. Indirect benefits are associated with this model but an essential component of an integrated TTO is that staff should be prepared to alter their practices to accommodate the academic needs of researchers. Adaptation of the TTO to researcher needs promotes commercialization involvement and does not disrupt the publishing aspirations of researcher, thereby promoting the advantages of commercialization and combatting researcher myths. Despite not being considered empirically in this study, a hybrid approach between the integrated and separated TTO may also be considered by organizations not willing to adopt either the integrated or separated approach completely. These



recommendations ensure that research organizations gain the maximum benefit from the commercialization of their research.

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