Role of Technology Transfer Offices in Patenting and Commercialization of Research Results in Public Funded University: Case of South Africa

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Abstract
This study investigates the role of Technology Transfer Offices (TTOs) in facilitating patenting, licensing, and commercialization within South Africa's publicly funded universities. As universities are increasingly expected to contribute to national innovation systems, TTOs have become central to translating academic research into marketable outputs. The study is guided by two specific objectives: to determine the role of TTOs in facilitating patenting, licensing, and commercialization for social and country's economic growth; and to identify the challenges facing TTOs in executing these functions. Using a quantitative research approach, data were collected from 49 respondents across several public universities, including TTO managers, and researchers who were working in TTOs in the selected public institutions. The findings reveal that while South Africa stands out as a regional leader in technology transfer and research commercialization their effectiveness is constrained by lack of buyers of new technology inventions, insufficient commercialization expertise in some institutions, lack of startup policy to effectively commercialize new technology and lack of enough funding to conduct researches. The study concludes that, the government should enact policies that support IP in public institutions and form the national IP management offices to support establishment of TTOs that guide the public universities in terms of recruitment of staffs, capacity building, and support research funding, patenting and commercialization.

Keywords: *Technology Transfer Offices, Patenting, Commercialization*

INTRODUCTION

In the 21st-century knowledge-based economy, universities are increasingly recognized not only as centers of learning and research but also as critical drivers of innovation and socio-economic development. Around the world, Technology Transfer Offices (TTOs) have emerged as

institutional mechanisms designed to bridge the gap between academic research and its application in the marketplace. These offices facilitate the identification, protection, and commercialization of intellectual property (IP), primarily through patents, licensing agreements, and the creation of spin-off companies. The growing pressure on universities to demonstrate real-world impact from publicly funded research has accelerated the development and institutionalization of TTOs across higher education systems globally (Etzkowitz & Leydesdorff, 2000).

Countries with advanced innovation ecosystems such as the United States, Germany, and the United Kingdom have long benefited from supportive policies and institutional arrangements that enable effective technology transfer. Notably, the Bayh-Dole Act of 1980 in the United States catalyzed university-based innovation by allowing universities to retain ownership of inventions developed through federal funding. This act led to an explosion in patenting and commercialization activities, positioning American universities as key players in technology-driven economic development. Similar models have been adopted or adapted by other countries seeking to strengthen their innovation capacity (Mowery, Nelson, Sampat & Ziedonis, 2001).

In contrast, developing and emerging economies continue to face significant barriers in leveraging university research for economic benefit. This line of thinking concurs with Chaminade & Vang (2008) hold that the challenges such as inadequate funding, limited infrastructure, fragmented innovation policies, and a lack of skilled personnel hinder the effectiveness of TTOs in these contexts. Nonetheless, many regions, particularly in the Global South, are making deliberate efforts to strengthen their national systems of innovation, with universities playing a more central role in knowledge transfer and enterprise development.

In Africa, the role of universities in technological innovation and economic transformation is increasingly acknowledged. However, the continent continues to grapple with systemic weaknesses, including limited public investment in research and development (R&D), weak intellectual property regimes, and a lack of industry-academia collaboration. A recent study published in *Springer Open Journal of Innovation and Entrepreneurship* (2024) highlights that only a minority of African universities have fully functional TTOs, and most lack sufficient capacity for effective patent management and

commercialization (Mensah & Owusu, 2024). Nevertheless, initiatives such as the Science, Technology and Innovation Strategy for Africa (STISA-2024) and regional training programs by organizations like WIPO signal growing political and institutional will to strengthen IP governance in African research institutions (African Union Commission, 2024).

Among African nations, South Africa stands out as a regional leader in technology transfer and research commercialization. The country has made significant strides in formalizing its innovation ecosystem, particularly through the enactment of the Intellectual Property Rights from Publicly Financed Research and Development Act (IPR Act) in 2008. This legislation mandates that public institutions protect and manage intellectual property resulting from publicly funded research. The Act also led to the creation of the National Intellectual Property Management Office (NIPMO), which oversees the implementation of the IPR Act, offers capacity-building support, and monitors IP outputs across the public research landscape (Department of Science and Innovation (DSI), South Africa, 2008).

Most public universities in South Africa such as the University of Pretoria, University of Cape Town, Nelson Mandela University, and University of South Africa (UNISA) have established Technology Transfer Offices in response to these policy directives. These offices are tasked with managing invention disclosures, securing IP rights, facilitating licensing deals, and, in some cases, supporting the creation of spin-off enterprises. For example, UNISA's Directorate of Innovation. Technology Transfer, and Commercialization (DITTC) has expanded its patent portfolio significantly, holding over 75 active patents across South Africa, the EU, and the US by the end of 2022 (University of South Africa (UNISA) 2022).

Despite this institutional progress, several challenges persist. Less majority of South African TTOs struggle with limited human and financial resources, a lack of commercialization expertise, and weak links to the private sector. Moreover, a performance gap exists between p0atent protection and actual commercialization outcomes, with relatively few inventions making it to the market. These challenges mirror broader issues seen across the continent but are particularly pressing given South

Africa's comparatively strong research base and policy infrastructure Kruss & Visser, 2017).

Therefore, this study seeks to investigate the effectiveness of Technology Transfer Offices in South Africa's publicly funded universities, with a specific focus on patenting and commercialization activities. By situating South Africa within global and continental trends, the research aims to identify both enabling factors and bottlenecks in the country's technology transfer system. The study uses a combination of policy analysis, institutional case studies, and performance data to provide a comprehensive assessment of how TTOs are contributing to national innovation goals. The findings will offer insights for improving the effectiveness of TTOs not only in South Africa but also in other emerging economies striving to build robust research to market pipelines.

RESEARCH METHODOLOGY

This study employed a quantitative research approach to investigate the role of Technology Transfer Offices (TTOs) in patenting and commercialization activities within publicly funded universities in South Africa. Data were collected through a structured survey questionnaire administered to 49 respondents across multiple public universities. The respondents included TTO managers, staff and researchers actively engaged in technology transfer activities within their respective institutions. A purposive sampling strategy was used to ensure representation from universities with established TTOs, focusing on individuals directly involved in patenting, licensing, and commercialization processes. The collected data were analyzed using descriptive statistics (percentages, frequencies). The quantitative design enabled a systematic assessment of the operational structures, challenges, and performance indicators associated with TTOs, contributing to a clearer understanding of their impact on innovation outputs in the higher education sector. However, ethical issues were observed as author managed to solicit clearance from relevant public universities authorities in South Africa. Data were collected from the University of Johannesburg (UJ), University of Cape Town (UCT), Northwest University (NWU), University of Pretoria (UP), Tshwane University of Technology (TUT), Cape Peninsula University of Technology (CPUT), Central University of Technology (CUT), Rhodes University (RU), Vaal University of Technology (VUT), University of Venda (UV), University of Zululand (UZL), Agriculture Research Council (ARC) and Human Sciences

Research Council (HSRC). These public universities were selected for the study following its only universities that funded by the government to implement IP policy in South Africa.

FINDINGS AND DISCUSSION

The study aimed to investigate the role of Technology Transfer Offices (TTOs) in patenting and commercialization activities within publicly funded universities in South African. Specifically, it sought to determine how TTOs facilitate patenting, licensing, and commercialization processes, as well as to identify and quantify the number of invention disclosures submitted, patents filled, and patents granted.

The Role of TTOs in Facilitating Patenting, Licensing and Commercialization

The first specific objective aimed to determine the role of Technology Transfer Offices (TTOs) in facilitating patenting, licensing, and commercialization. This objective was intended to provide a comprehensive understanding of how TTOs contribute to the innovation ecosystem in South African public universities. A structured questionnaire was used to collect quantitative data from 49 respondents. The questionnaire included four key items: the structural and functional setup of TTOs; the extent of TTO Involvement in the patenting process; strategies employed by TTOs for licensing university-developed technologies; and the role of TTOs in bridging academia and industry to support commercialization.

The Structural and Functional Setup of TTOs

The respondents were requested to indicate what they knew regarding the organizational structure of Technology Transfer Offices (TTOs) within universities, specifically in terms of staffing adequacy, level of expertise, and the availability of resources dedicated to intellectual property (IP) management and commercialization. Questionnaires with a three-point Likert scale were applied to collect quantitative data. Individual TTO managers, staff and researchers were required to respond to a series of statement in the questionnaires by indicating whether they agreed (A), were neutral (N) or disagreed (D) as shown in Table 1 below.

Table 1
Perceptions on Organizational Structure of TTOs

Perceptions on organizational structure of TTOs	Level of Agreement		
	Agree	Neutral	Disagree
The TTOs has adequate staffing to manage IP and commercialization activities	38 (77.55%)	3 (6.12%)	8 (16.32%)
TTOs staff possess sufficient expertise in IP management and commercialization	39 (79.59%)	1 (2.04%)	9 (18.36%)
There are sufficient resources financial, legal infrastructure dedicated to IP work	42 (85.71%)	3 (6.12%)	4 (8.16%)

Field data, 2022.

The survey results indicate a generally positive perception of Technology Transfer Offices TTOs among respondents regarding their capacity to manage intellectual property (IP) and commercialization. A significant majority 38 (77.55%) believe that TTOs have adequate staffing, while an even higher percentage 39 (79.59%) agree that the staff possess sufficient expertise in IP management. Furthermore, the higher agreement 42 (85.71%) was observed in relation to the availability of financial, legal and infrastructural resources dedicated to IP activities. Although a small portion of respondents remained neutral or disagreed across the items, the overall findings suggest strong confidence in the operational capacity and resources readiness of TTOs to effectively handle IP and commercialization tasks. This finding concurs with those of the study conducted by Uctu & Essop (2022), which stated that TTO staffing, expertise, and resources directly reflect the intended outcomes of the IPR-PFRD Act, as discussed by Uctu & Essop (ibid). The high level of agreement on these aspects suggests that the policy interventions implemented after 2008 have been effective in building institutional capacity for IP management and commercialization. Based on these insights, the findings provide empirical support for the paper's conclusion that the post-IPR-PFRD era has resulted in more structured and capable TTOs, better equipped to handle the demands of innovation commercialization in South Africa.

The Extent of TTO Involvement in the Patenting Process

The second item under the first objective aimed to assess the extent of Technology Transfer Offices' (TTOs) involvement in the patenting process within selected public funded universities. The respondents were

asked to rate their perceptions of TTO involvement using three point-Likert scale. The results are displayed in Table 2.

Table 2
The Extent of TTO Involvement in Patenting Process

TTO Involvement in Patenting Process	Level of Agreement		
	Agree	**Neutral**	**Disagree**
The TTO provides comprehensive support throughout the patent application process	30 (61.2%)	12 (24.5%)	7 (14.3%)
The TTO is actively involved in drafting and reviewing patent applications	27 (55.1%)	13 (26.5%)	9 (18.4%)
The TTO takes the lead in managing communication with patent offices.	33 (67.3%)	10 (20.4%)	6 (12.2%)

Field data, 2022

As shown in Table 2, great number 30 (61.2%) of TTOs managers, staff and researchers agreed that The TTO provides comprehensive support throughout the patent application process in public funded university. This implies a generally positive perception of TTO effectiveness in facilitating intellectual property activities. This suggests that a majority of stakeholders recognize the TTOs' active role in guiding and assisting researchers through complex patent procedures, reflecting a growing institutional capacity and commitment to supporting innovation. In the same vein, African Union Commission (2024) hold a national survey conducted by the National Intellectual Property Management Office (NIPMO) and the National Advisory Council on Innovation in South Africa found that a majority of higher education and research institutions reported their Technology Transfer Offices (TTOs) actively support researchers throughout the patent application process, a finding further corroborated by the detail that approximately 60% of universities felt empowered to commercialize

Moreover, Table 2 reveals that 27 respondents, representing 55.1% of the sample, agreed that the Technology Transfer Office (TTO) is actively involved in drafting and reviewing patent applications at publicly funded universities in South Africa. This level of engagement reflects a significant institutional commitment to supporting researchers through the technical and legal complexities of intellectual property protection. Active involvement by TTOs in patent drafting and review is a critical

component of effective technology transfer, as it helps ensure the quality and patentability of inventions before submission. The fact that over half of the respondents recognized this involvement suggests that many South Africa TTOs are not merely administrative bodies but are increasingly functioning as strategic partners in research commercialization. Is strongly supported, Cullen, Calitz & Chetty (2020) they affirm that active TTO involvement in patent drafting and review is central to enabling effective technology commercialization and researcher engagement in institutional IP processes.

In addition, Table 2 also, indicates that 33 of the respondents, representing 67.3% of the total sample, agreed that the Technology Transfer Office (TTO) takes the lead in managing communication with patent offices. This reflects a strong endorsement of the TTO's active role in overseeing the formal and often complex interactions required during the patenting process. Such communication includes responding to office actions, coordinating legal documentation, clarifying technical claims, and ensuring compliance with procedural timeline, all of which are essential for securing patent protection. It also indicates that many South African TTOs have developed the institutional expertise and administrative capacity necessary to handle these responsibilities effectively. In the same vein, Mokoena (2025) views this as a clear indication that TTOs are not only central to facilitating the often complex and technical interactions required during patent prosecution but have also built the necessary institutional expertise to do so effectively. Mokoena (ibid.) further notes that this level of agreement reflects the maturity and capacity of many South African TTOs to handle these responsibilities, highlighting their evolving role as key enables in the commercialization of research and protection of intellectual property.

Strategies Employed by TTOs for Licensing University-Developed Technologies

This item intended to depict the strategies employed by Technology Transfer Offices (TTOs) for licensing university-developed technologies, with a focus on understanding their approaches, challenges, and effectiveness in facilitating the commercialization of academic research outputs. Quantitative data were collected using questionnaires based on a three-point Likert scale. Respondents, were asked to respond to a series of statement by indicating their level of agreement: Agree (A), Neutral (N), or Disagree (D), as illustrated in Table 3 below.

Table 3
TTOs Licensing Strategies

Strategies Employed by TTOs for Licensing University-Developed Technologies	Level of Agreement		
	Agree	Neutral	Disagree
TTO has clearly defined strategies for licensing university-developed technologies	39 (79.59%)	4 (8.16%)	6 (12.24%)
TTO faces significant challenges in the licensing of academic research outputs	28 (57. 14%)	1 (2%)	20 (40.81%)
TTO has the necessary expertise and capacity to manage licensing processes effectively.	38 (77.55%)	2 (4.08%)	9 (18.36%)

Field data, 2022

The findings revealed that majority of Technology Transfer Offices (TTOs) 39 (79.59%) reported that they have clearly defined strategies for licensing university-developed technologies. This indicates a strong institutional focus on structured and strategic technology commercialization. Meanwhile, 4 (8.16) may have indicated that their strategies are either partially defined, informal, or still under development. This suggests that a small subset of institutions is in the process of formalizing their approach to licensing but may not yet have complete or documented strategies in place. Finally, 6 (12.24%) of the offices reportedly lack defined or evolving strategies altogether, potentially operating in a reactive, possibly due to resource constraints or lower institutions demonstrate strategic readiness, there remains a notable minority that may benefit from further support or guidance in developing formal licensing frameworks. This highlights the need for targeted support to help some institutions formalize and strengthen their licensing strategies (Bansi, 2016).

Also, Table 3 the data reveals that the Technology Transfer Offices (TTO) is encountering notable difficulties in the process of licensing academic research outputs. A majority of respondents 28 individuals, accounting for 57.14%, expressed agreement with this assessment, indicating a shared perception that licensing challenges are a significant barrier within the TTO's operations. This majority suggests that more than half of the stakeholders, lack of industry partnerships, insufficient market readiness of research. In contrast, 20 respondents 40.81%

disagreed, implying that a substantial portion of participants either do not perceive licensing as a major challenge or believe that the TTO is performing adequately in this area. This divergence in views may reflect variability in experiences across departments or disciplines, differences in awareness of licensing procedures. Only 1 (2.04%) respondent remained neutral, suggesting that most individuals had a clear stance on the issue, which further reinforces the importance and relevance of licensing challenges as a topic of concern. In the same vein, Stofberg (2019) noted there is the need for a deeper investigation into the factors contributing to licensing difficulties and potentially signals an opportunity for institutional reforms or capacity building within TTO.

The, Table 3 also indicates that a significant majority of respondents, 38 individuals 77.55%, believe that the Technology Transfer Office (TTO) possesses the necessary expertise and capacity to manage licensing processes effectively. Additionally, 9 respondents, accounting for 18.36%, seem to express a more neutral or uncertain stance, possibly indicating partial agreement or a recognition of some limitations in the TTO's capabilities. Meanwhile, only 2 respondents, equal 4.08%, disagreed with the statement, implying minimal concern regarding the TTO's competence in handling licensing matters. Overall, the figures indicate strong confidence in the TTO's proficiency, with limited reservations among stakeholders. The ideas supported by Mustapha et al., (2021) critically review national indicators for university technology transfer in South Africa. They underscore that while the system has institutional support under the IPR-PFRD Act of 2008, measurable performance remains uneven, suggesting that strong confidence in TTO capacity depends heavily on monitoring, resources, and aligned objectives.

Role of TTOs in Bridging Academia Industry and to Support Commercialization.

This item is focused on understanding and evaluating how TTOs function as crucial bridging agents between academic research and the private sector in South Africa, with the goal of stimulating innovation-led economic growth through effective commercialization. Quantitative data were gathered through questionnaires utilizing a four-point Likert scale. Participants were asked to indicate their level of agreement with a series of statements by selecting one of the following options: Agree (A), Neutral (N), or Disagree (D), as shown in Table 4 below.

Table 4
TTOs in Bridging Academia and Industry to Support Commercialization.

Role of TTOs in Bridging Academia and Industry to Support Commercialization.	**Level of Agreement**		
	Agree	**Neutral**	**Disagree**
TTOs actively support the protection and commercialization of research outputs	30 (61.2%)	10 (20.4%)	9 (18.4%)
TTOs effectively facilitate collaboration between academia and industry	36 (73.5%)	7 (14.3%)	6 (12.2%)
TTO-led commercialization initiatives contribute to economic development	45 (91.8%)	1 (2.04%)	3 (6.1%)
There is ongoing training and support for TTO personnel	24 (49%)	8 (16.3%)	17 (35%)

Field data, 2022

The findings reveled that a majority of respondents 30 (61.2%) agreed that TTOs actively support the protection and commercialization research outputs. While 10 (20.4%) held a neutral stance, indicating some uncertainty or lack of direct experience with TTO activities. And, a smaller portion of respondents 9 (18.4%) disagreed, suggesting that there is still doubt or dissatisfaction regarding the effectiveness or visibility of TTO support. These ideas supported by Myeki and Temesco (2019) who suggest that while TTOs are largely seen as supportive, there remains room for improvement in visibility, accessibility, or consistency of their services across institutions.

In addition, majority of respondents 36 ((73.5%) agreed that TTOs play an effective role in bridging the gap between these sectors, indicating recognition of their importance in promoting innovation and knowledge exchange. However, a notable proportion of respondents 7 (14.3%) selected neutral on the statement. And respondents 6 (12.2%) disagreed and highlighting ongoing challenges such as limited resources, bureaucratic barriers, inconsistent engagement practices. Generally, while the data reflect a generally favorable view, it also points to areas for improvement to enhance TTOs impact and efficiency in fostering meaningful partnership.

The findings also, indicate a generally positive perception of the contribution of TTO-led commercialization initiatives to economic development in South Africa. A significant portion of respondents 45 (91.8%) agreed that these initiatives support economic growth by promoting innovation, creating job opportunities, and enabling the

commercialization of academic research. However, a smaller yet notable group of respondents expressed neutral or disagreed responses, suggesting some skepticism regarding the measurable impact of such initiatives or concerns about their scalability and effectiveness. Overall, the data suggest that while TTO-led commercialization is viewed as beneficial to economic development, its full potential may not be consistently realized across the sector.

Also, in Table 4 indicates that 24 (49%) of respondents agreed that there is ongoing training and support, while 8 (16.3%) remained neutral, possibly reflecting uncertainty or inconsistency in training availability. And 17 (35%) of respondents disagreed that there is ongoing training and support. Therefore, although there is a positive indication that some training and support mechanisms are in place, the notable proportion of disagreement and neutrality highlights the need for more consistent, visible, and accessible capacity-building initiatives across institutions to strengthen the effectiveness of TTO personnel. (Veer Ramjeanwon & Rowley, 2020)

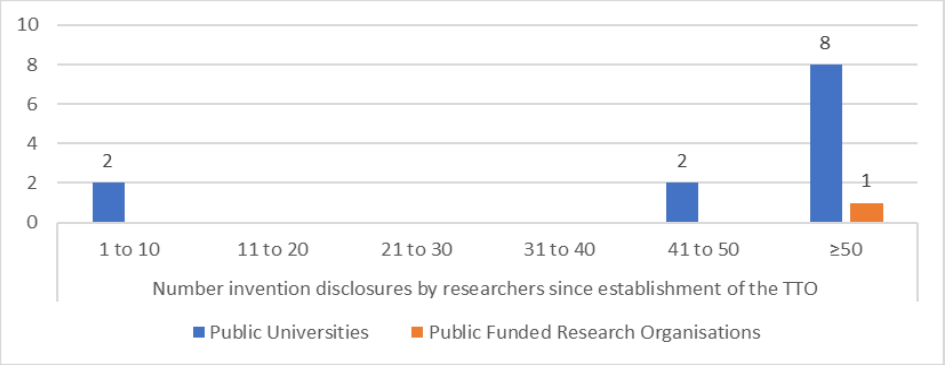
Invention Disclosures Submitted, Patents Filled, and Patents Granted.

The second objective was to measure innovation output by tracking the number of invention disclosures within a defined period. Quantitative data were collected using a structured questionnaire. The respondents rated their perceptions of how effectively their organizations quantified innovation output based on seven items: Such as, the number invention disclosures, the technical fields of the invention disclosures, the number of patents filed, the technological fields of the filed patents, the number of patents granted, the number of patents commercialized through license ng, and the number of patents commercialized through start-ups.

The Number of Invention Disclosures

The number of invention disclosures, in this context, refers to the quantitative measure of innovations formally reported to Technology Transfer Offices (TTOs) by researchers and inventors. To gather this data, the researcher employed questionnaires directed at managers and researchers within TTOs, enabling the collection of structured, quantitative insights. This approach aimed to capture the frequency and trends of invention disclosures, in public universities and research institutions. As shown in Figure 1 below.

Figure 1
Number of Disclosures Since Establishment of TTO



The number of invention disclosures reported since, the establishment of TTO in public universities and research institutions is presented in figure 1 above. The responses from TTO managers at public universities show that the majority 8 (62%) out of 13 respondents reported having received ≥50 invention disclosures since their TTOs were established. A smaller number of respondents 2 (15.4%) reported between 41- 50 disclosures, while another 2 (15.4%) reported between 1 – 10 disclosures. In contrast, only 1 (8%) response was received from a TTO manager at a public research institution, indicating ≥50 disclosures since establishment. The other 2 (5.88%) respondents from public research institutions stated that their institutions focus on policy and social science issues, which are not typically patentable. Therefore, they were excluded in the invention disclosure responses.

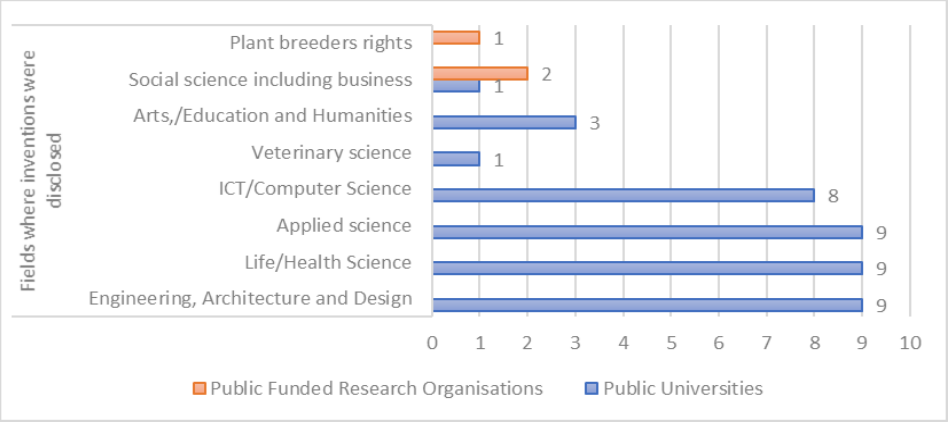
In the same vein, Siegel, Waldman, & Link (2003; Tseng & Raudensky. 2014) emphasized that universities with well-structured TTOs tend to report higher invention disclosures and commercialization activity. Thus, the high number of disclosures reported in this survey suggests that TTO performance is good in terms of high numbers of invention disclosures. Thus, the TTO managers and their staff are effectively capacitating and motivating researchers in these public universities and research institutions to innovate more and to disclose their inventions to the TTOs.

The Technical Fields of the Invention Disclosures

The fields of invention of disclosures are shown in figure 2 below. The responses from TTO managers and staff from public universities show

majority (N=9) to indicate the technology disclosed were engineering, architecture and design, while another majority (N=9) to be in the field's life/health science, other majority (N=9) applied science and other majority (N=8) computer science. While the public research institutions the TTO Managers disclosed the fields social science including social bussness and Plant breeders right (N=2).

Figure 6.2
Distribution of responses by fields where inventions were disclosed



The fact that majority of respondents of TTO managers from both public university and research institutions indicated to have a lot of inventions disclosure in different fields of technologies, it is regarded as a strength in these institutions that they are producing knowledge that are solving different need of the citizens supporting the objective of the IPR act of 2008. However, the technology fields shown in this table depend on the area of the focus of research specialized by the university.

The Number of Patents Filed

The researcher employed questionnaires to collect quantitative data, whereby respondents were asked to indicate their views regarding issues related to patents filed in their institutions. The results are presented in Table 5 below.

Table 5
Number of Patents Filed Since Establishment of TTO

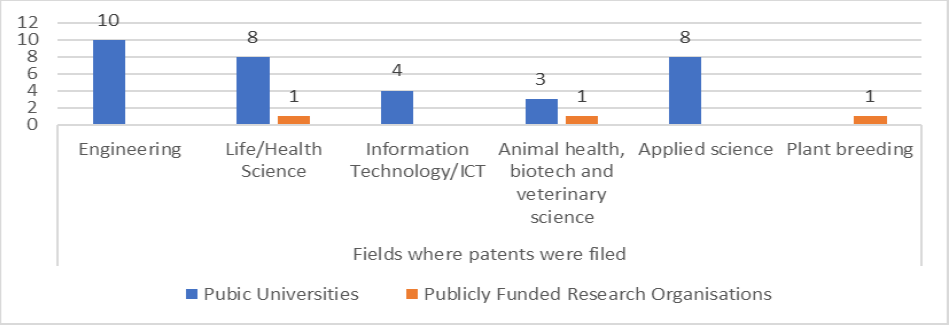
Number of patents filed since establishment of TTO	Public Universities	Public Funded Research Organizations
≤10	1	
11-20	1	
21-30		2
31-40		
41-50		
≥50	9	

The findings revealed that 10 (77%) out of 13 TTO managers from public universities said that their institutions filed more than fifty (≥50) patent applications since establishment of their TTO, while less majority about 1 (7.69%) TTO respondent said to have filed 10-20 patent applications. Also, 1 (7.69%) hold that their institutions filed (less than 10 patent applications. However, only 1 (2.94%) respondent from public research institutions indicated that their institution filed (1≤10) patent applications. Having majority of ten (N=9) (69%) respondents of TTO managers indicating to have filed more than 50 patents and 15% rspondents to have filed 21-30 patents since establishing of their TTO is one of good TTO performance in terms of high numbers of patent filing in these institutions under this study. This view is also supported by Brant & Sibanda (2018) Who hold a study on public universities in South Africa where he observed the increase in patenting after IPR act and other regulations that was put in place government to support these institutions. However, the less majority of 16% show 1-10 patent filed since the establishment of their TTO.

The Technological Fields o f the Filed Patents

Majority of ten (10) TTO managers from public universities said to have filed patent applications in the field of engineering, while majority of (8) indicated to file patent applications life science another eight (8) in applied sciences (8) as shown in Figure 3 below. While responses received from research institute TTO managers said the filed patents in the field of life sciences, animal health, biotechnology and plant breeding.

Figure 3
Distribution of responses by fields where patents were filed



The fact that majority of TTO managers from public universities and research institutions indicated to have filed their patent applications in different fields of technologies which is one of strength of the organizations under study. These findings on Figure 6. above, means these public institutions are doing researcher in different fields of technology trying to solve the problems affecting the south Africa universities from health, food security, Information Technology, and others. These results are in line Sect 2(1) of IPR act where the research conducted should solve the problem of citizens. However, the technical fields of invention disclosed depend on university technical focus for example medicine, or agriculture, energy while some fields can be patent centric or confidential information on military or for other security reasons.

The Number of Patents Granted

In this item the researcher intended to reveal the number of patents granted in public universities and research institutions. The reseasercher employed questionnairs so as to collect quantitave data, as it has shown in table 6 below.

Table 6
Number of Patents Granted Since Establishment of TTO

Number of patents granted since establishment of TTO	Public Universities	Public Funded Research Organizations
≤10	1	
11-20	1	2
21-30		
31-40	2	
41-50		
≥50	7	

The data revealed that about 8 (62%) out of 13 TTO managers and staff from public universities and public research organizations indicated to have grated more than 50 patents, while less majority 2 (15.38%) said to be granted 31-40 applications, and 1 (7.69) granted between 11-20 and 1 (7.69) grated less than 10 patent applications. Only 1 (7.69%) response was received from TTO manager from public research institution said to receive granting between less than 10 patents.

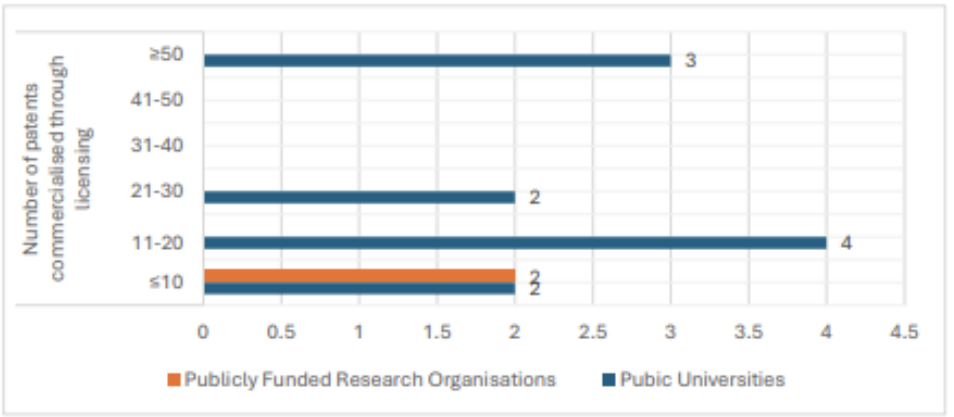
Thus, having majority of 62 % of response from TTO managers indicating to having more than 50, 15% responses for 11-40 Patent granted since establishment is good sign of effective TTO in the institution under study. An effective TTO is measured by the numbers of Patent granted Lee (2023) cited Vinig & Lips, (2015). Though this thesis measuring patent filed, but patent granted add more weight to the TTO effectiveness since having more granted patents it shows good quality of the patent file. Thus, majority of TTO show high performance of their TTO in terms of filing high quality of patents which most of them ended up to be granted. However less majority of 16% respondents have 1-10 patent granted since their establishment which do not show a good performance of the TTO.

The Number of Patents Commercialized Through Licensing

Questionnairs tools were used to collect primary data. The researcher intended to reveal the number of patents commercialized through licensing as shown in figure 4 below.

Figure 4

Number of Patents Commercialized Through Licensing



Therefore, the findings revealed that, 4 (30.76%) out of 13 TTO manager from public universities responded on numbers of invention commercialized by license that 11-20 patents were commercialized by license while second majority 3 (23%) said more than fifty (50) patents commercialized by license. On the other hand, less majority 2 (15%) indicated 21-30 patents were commercialized be license. While 4 (30.76%) of TTO managers and staff from public research institutions said that patents commercialized by license since establishing of their TTO range between 1-10 patent applications.

Thus, having majority (70%) of response from TTO managers from both public universities and research institutions indicating to have 11 to more than 50 Patent scommercialized through licenses, it shows good sign of high performance of TTO in terms of commercialization in the institution under study. An effective TTO is measured by the numbers of Patent licensed among others. Having more patent filed, granted and then commercialized through license, it shows, the patented inventions by TTO are of good quality which can be commercialized to the market, which can generate a return on investment for the institutions and Government.

Thus, these institutions, their TTO are meeting the objective of IPR Act of 2008 which required the PU and PRO to commercialese the inventions generated from public money for the benefit of South African citizens.

The Number of Patents Commercialized Through Start-ups

The responses from TTO managers and staff from public universities is shown on Table 7 below. However, no response was received from public research institutions on patents licensed by spin out or start-up. Majority of respondents 3 (27%) out of 13 said their institution had 6-10 patents licensed as start-ups, while the other majority of three 3 (27%), noted 21-25 patents were commercialized by start-up, where less majority of 2 (18%) has more than 26 start up established through start-ups and also the less majority of 3 (27%) have less than 5 start up established since the establishment of their organizations.

Table 7
Number of Patents Commercialized Through Spin Outs or Start-ups

Number of patents commercialized spin outs/start-ups	Public Universities	Public Funded Research Originations
≤5	3	
6-10	3	
11-15		
16-20		
21-25	3	
≥26	2	

The results presented in Table 7 above, shows majority of TTO managers (73%) under study indicating their TTO to have more than six Patents commercialized through start-ups since establishment, this a is good sign of effective TTOs in the institutions under study. An effective TTO is measured by the numbers of start-ups formed. However, IPR Act do not provide a clause on Start-up, it is to the institution Policy and other factors where TTO operates.

But recently, there has been an increase in the number of new technologies generated by these universities, which require the formation of start-ups. Since there is no government policy, TTO managers face challenges in allocating a buyer. Thus, an increase in start-ups is a good sign of strong TTO performance in terms of commercialization.

CONCLUSION AND RECOMMENDATIONS

This study has pointed out that Technology Transfer Offices (TTOs) play a critical role in facilitating the patenting, licensing and commercialization of research outputs by providing institutional support, legal guidance, and strategic industry linkages. Regarding the first objective, the study found that TTOs streamline intellectual property management by assisting researchers with invention disclosures, navigating patent filling processes, and negotiating licensing agreements with commercial partners, thereby accelerating the path from innovation to market. In relation to the second objective, the study presents data demonstrating that TTOs are performing well. It found that more inventions are being reported to TTOs, with most of these being converted into patent applications. A large number of these applications are granted and eventually commercialized, particularly at research-intensive universities such as the University of Cape Town, University of Johannesburg, and University of Pretoria.

Even some newer universities such as the Cape Peninsula University of Technology have shown positive performance in patenting and commercialization of research results, largely due to the support they receive from NIPMO in intellectual property (IP) management. This indicates that, while there has been overall progress, some public universities still face challenges in patenting and commercialization. These findings highlight the need for strengthened institutional capacity and improved alignment with industry partners. It is recommended that South African TTOs receive increased funding, specialized training, and policy support to enhance their operational effectiveness and to ensure that more research outputs successfully transition into impactful commercial products.

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