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Exploring Human Capital and Infrastructural Deficit in Intellectual Property Technology Transfer Offices in Nigeria

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Abstract:
Intellectual Property Technology transfer offices (IPTTOs) provide access to new knowledge and expertise to drive innovation, research collaboration, contract services and consultancy. They identify, collate and license potentially useful technologies, inventions and intellectual property that are relevant to business. They represent a one-stop shop for knowledge outputs in the institution and have the potential to transform the competitive landscape of institutions' regions. The performance of these offices depends largely on both internal and external forces, including available capabilities, funding, infrastructure and operational policy. Due to the observed poor performance of IPTTOs in Nigeria over the years, it becomes imperative to shed a searchlight on inherent weaknesses in these offices, including human capital and infrastructural issues. The quality and quantity of the workforce, level of training and availability of requisite facilities have significant effects on the service delivery of any system, including IPTTOs. Management structure also matters in channelling office resources and sharing responsibilities towards achieving the goals of these offices. This paper analyses human capital and infrastructural deficits in the TTOs across the country using primary data collected from fourteen IPTTOs in 2019. The IPTTOs were visited in May/June of 2019, during which qualitative and quantitative data on the operation of the offices were collected. The results of the analysis show that most of the heads of the IPTTOs in Nigeria (85.7%) are academics with PhDs, while others possess master's degrees. These degrees are mostly in the field of sciences (50%), while others are in engineering (29%) and management sciences (21%). Most of the heads of IPTTOs (64.3%) were exposed to relevant Intellectual Property (IP) training which was sponsored by NOTAP/WIPO (44.4%), the institution (44.4%) and the World Bank (11.2%). Weak staff strength, lack of relevant training and poor training opportunities are generally observed among staff in these offices. There are fairly adequate office facilities, but the ICT facilities are largely inadequate. The study also observed poor collaboration among the IPTTOs across the institution, which limits their knowledge-sharing potential. These challenges are exacerbated by poor funding and bureaucratic practices. The paper concludes with appropriate policy recommendations and a framework for strengthening these offices for improved performance and impact.

Keywords: *IPTTO, technology transfer, human capital, infrastructure, knowledge institutions*

1. Introduction

Transitioning from a resource-based economy to a knowledge economy has placed huge responsibilities on the knowledge institutions to support innovation. Evidence from developed and newly industrializing economies has consistently shown that knowledge generation and exploitation are critical to the technological and socio-economic progress of nations (Adelowo, Olaopa & Akinwale, 2017; Adelowo, 2018; Adelowo & Surujlal, 2021; WIPO, 2023). In fact, the difference between developed and developing countries also lies in their ability to create a positive atmosphere for new knowledge production, utilization, and exploitation (Adelowo, 2021). Studies have also affirmed that knowledge provides critical input to innovation (Okebukola, 2015; WIPO, 2024).

New knowledge creation and dissemination are fundamental roles of higher educational institutions (HEIs), research organizations (ROs), and knowledge institutions (KIs), although some large corporations sometimes establish research bases. The core mandates of these institutions have consistently undergone changes over time to reflect different

levels of economic and technological development (Adelowo, 2021). For instance, educational institutions are set up to supply critical human capital needs at all levels to provide leadership and appropriate governance to both administrative and technical systems in society. Later, research and development (R&D) activities were added, given the substantial knowledge pool that exists in the institutions. Translating R&D outputs to useful products, processes and services in the industry has become part of the mandates of knowledge institutions in the last few decades, and for this to happen, these institutions have to be entrepreneurial in their approach. The arguments for knowledge institutions to become entrepreneurial in their engagements were clearly articulated in the knowledge spill-over theory of entrepreneurship (KSTE) and theory of entrepreneurial universities as advanced by Acs et al. (2004; 2009; 2013), Clark (1998) and Etzkowitz (1998) respectively. The two theories hinged their arguments on the belief that knowledge institutions possess talents and tangible research results that are capable of transforming society or an economy. This argument becomes more obvious when economies with the most innovative firms and regions, including global leaders in high-tech, are considered. For instance, most of the top twenty leading innovative companies globally emerged from the developed and newly industrializing economies that have not only invested heavily in knowledge creation but also created channels through which those knowledge outputs are transferred for economic renewal and societal benefits (Adelowo et al., 2024). These economies are also home to many top-ranked universities and research institutions, supplying critical skills and knowledge inputs to the industries in a coordinated manner.

Therefore, for developing countries in Africa, particularly Nigeria, to harness knowledge outputs for development, there is a need for the knowledge institutions to embrace entrepreneurship and innovation as parts of a coherent policy to achieve both institutional and developmental goals. Part of the process to embrace innovation and entrepreneurship includes creating and/or strengthening existing mechanisms for knowledge transfer in these institutions, including IPTTOs, technology incubators, knowledge parks, innovation hubs and other innovation infrastructure. Since 2006, Nigeria has established IPTTO technology transfer offices in its knowledge institutions to serve as a collation hub for R&D outputs and to foster linkages with industry for the purpose of technology commercialization, among others. To date, about forty-three IPTTOs have been created/established in different institutions across the country. The performance of a few of these offices was assessed in 2019 by the National Office for Technology Acquisition and Promotion (NOTAP) to identify areas of intervention for better performance. The report suggests improvement in the patenting activities among scientists and researchers, albeit with peculiar challenges (NOTAP, 2019; Adelowo et al., 2023). The performance of IPTTOs is dependent on several factors, including their technical competencies, office capabilities, funding and management practices.

This study, therefore, focuses on human capital development and infrastructural deficits in the selected IPTTOs to explain why their performances have been low and sparse. The study utilizes data collected from IPTTO managers in 2019 through a questionnaire and interview guide.

2. Methodology

Data for the study were collected directly from fourteen selected managers of IPTTOs in Nigerian universities, research institutes, and polytechnics, and they were purposively sampled. Before 2019, there had never been any data on the operation and performance of IPTTOs across the country since its inauguration in 2006/7. It should also be noted that the sampled IPTTOs represented a fair percentage of the total in existence at the time, fourteen out of forty-four (32%). Although mixed methods were used to collect both qualitative and quantitative data, the latter was reported in this paper. The quantitative data were collected using a validated questionnaire. The questionnaire has nine sections, and the three main sections that are relevant to this paper include information on human resources, infrastructure, ICT facilities within the offices, and funding matters. Under human resources, the instrument captured the highest academic qualification, areas of expertise, and training attended. The cumulative effect of the human resource section was to establish the capability of the office to perform its functions effectively.

On the infrastructure and ICT facilities, a Likert rating scale was used to assess the level of adequacy and how conducive the offices were for optimal performance. More so, a list of office items was provided, and the study participants were asked to indicate '0' for non-adequate, '1' for fairly adequate and '2' for very adequate.

Data collected were analyzed using SPSS version 20. The results are presented in the next section of the paper.

3. Results and Discussion

The quality and quantity of human resources in charge of the IPTTOs are crucial to their effectiveness and performance. The key driver of these offices is inherent in the quality and experience of the managers and the staff. The quantity of human resources was measured by the number and the quality by qualifications, training received, and specific areas of IP specialization. The results presented in table 1 reveal that 52 academic staff and 42 non-academic staff are working in all the fourteen (14) IPTTOs sampled. By implication, the results suggest that a ratio of six academics to four non-academics (6:4) is present in the Nigerian's IPTTOs. However, the actual headcounts in each of the IPTTOs showed that some are better staffed than others. It should be noted that most of the IPTTOs are headed by a professor within the university. Although there are no clear-cut criteria for the selection per se, the vice-chancellor has to ensure that the best hands are hired to man the office in the host university. Unfortunately, most of the IPTTO managers are still encumbered with academic and administrative work in the university, which negatively impacts their commitment to effective knowledge transfer and commercialization at the offices.

Highest Academic Qualification	Academic Staff	Non-Academic Staff	Total
PhD	21	1	22
MSc.	23	7	30
BSc.	6	19	25
HND	1	4	5
OND	1	11	12
Total	52	42	94

Table 1: Summary of Highest Academic Qualifications of Staff at the IPTTOs (Staff Quality)

Moreover, most of the staff possessed postgraduate degrees, MSc. and PhD, as presented in figure 1**.** The result reveals that IPTTO personnel who were M.Sc. holders were the highest in number (31.9%), followed by BSc. (26.6%) and PhD. (23.4%). Those with HND (5.3%) were the least in number. The results further suggest a high quality of staff operating in the TTOs, with the majority having first degree and above. Considering the spread of the staff across the IPTTOs, some offices have as few as two (2) and three (3) staff members, while others have as many as 15 and 13 staff members.

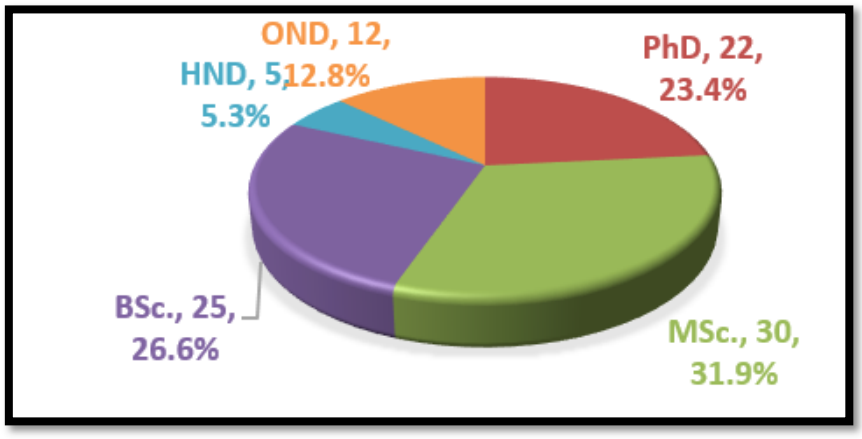

Figure 1: Highest Academic Qualifications of Staff of the IPTTOs

More specifically, figure 2 shows that the IPTTO in Covenant University has the highest number of human resources (N=15), including four academic and eleven (11) non-academic staff members. The office in the Federal Polytechnic, Bauchi, has twelve (12) academic and two (2) non-academic staff members. The office with the lowest number of staff is ATBU, with only one (1) staff member who is also the Director of the Centre.

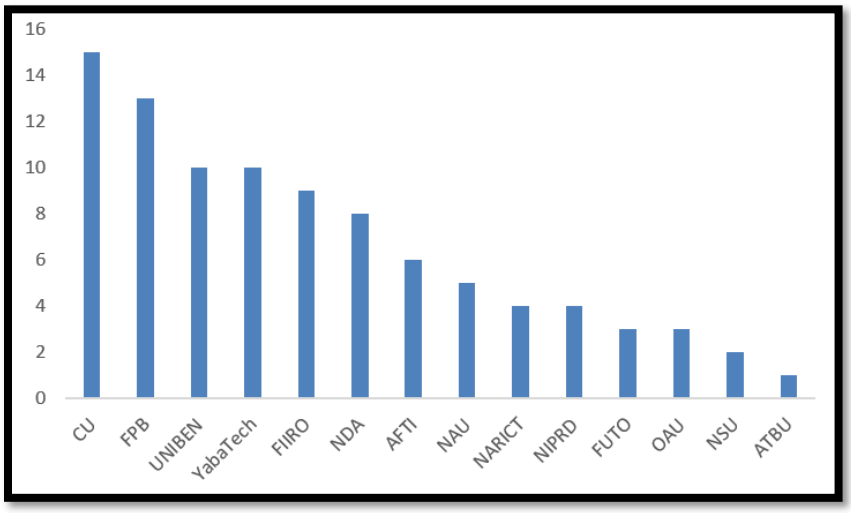

Figure 2: Total Number of Personnel at the Selected IPTTOs

It was observed during the field visit that the majority of the IPTTOs operate with staff pooled from various departments of the institutions, and only a few of them have technical expertise in IP matters. From the global perspective, in the USA, for instance, the size of the Technology Transfer Office (TTO) in terms of the number of staff members ranges from 2 full-time equivalents (FTEs) in the smallest institution to 18 in the largest (NOTAP, 2019). In China, staff undergo a degree programme in IP and other informal short-term courses for effective management of the offices. The result suggests weak staffing guidelines and procedures for the IPTTOs, which allows the heads of institutions to appoint and pool staff into the offices. Here, NOTAP needs to engage more actively with these offices to ensure that the heads of institutions provide a sufficient number of skilled and experienced personnel to manage the offices. The next step is to

examine the areas of specialization and relevant training received for effective performance in their roles. The recently published guideline for the management of IPTTOs by the World Intellectual Property Organisation emphasized the roles of experienced IPTTO officers and Technology Transfer Professionals in the effective management of IPTTOs (World Intellectual Property Organization, 2024).

3.1. Personnel Area of Competencies, Training and Development

Evidence and experiences across the globe have shown that having personnel with competencies in key areas of IP Management is very crucial to the optimal functioning of the TTOs (WIPO, 2024). This partly informed investigation into key areas of competencies in IP management among the personnel of the IPTTOs. The results presented in figure 3 showed that the predominant areas of competencies among the IPTTO personnel are IP assessment (21), IP valuation (11) and industrial relations (9). However, there are a limited number of staff members with core competencies such as IP agents, IP attorneys, and IP venture capital relations, while the others are Patent Attorneys (3), IP Agents (3) and Venture Capital (3). The results suggest that there is clear evidence of weak technology transfer professionals in the IPTTOs across the country.

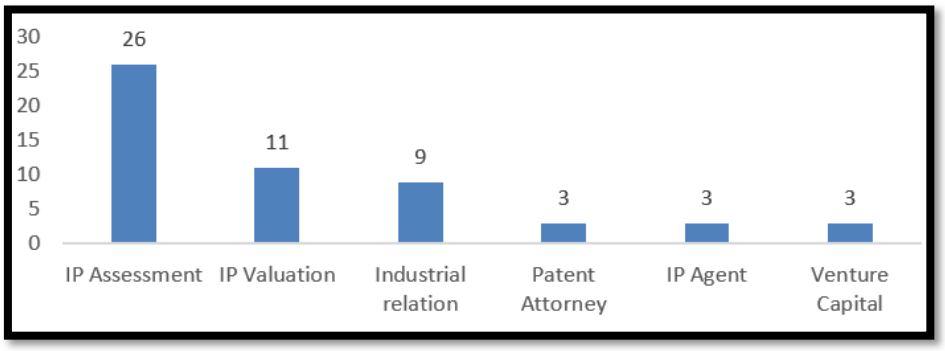

Figure 3: Number of Personnel with Key Competencies in the Selected IPTTOs

Continuous capability enhancement of personnel through exposure to relevant training and development programmes remains essential for every serious and successful organization (Adelowo et al., 2022). Therefore, the study also beamed a searchlight on the types of training received by the personnel of the selected IPTTOs. The results in table 2 showed that the most common types of training received by the personnel were IPR management, R&D and innovation management, R&D commercialization and electronic record management while training on technological entrepreneurship and information security management were the least. It is commendable to see that the IPTTOs are providing relevant training to the staff members to improve their skills for effective management of the offices. However, the number of staff trained in each office is abysmally low. For instance, about eighteen staff members were trained from thirteen TTOs, indicating an average of one officer per office, which is low compared to well-established TTOs in other climes. More importantly, the database management of the R&D outputs and inventions in the selected institutions could also be seen to be low as only ten officers indicated to have received training in this aspect.

SN	Types of Training Received	Number of Staff	N
	IPR Management	18	13
1.	R&D and Innovation Management	13	10
2.	R&D Commercialization	11	11
3.	Electronic Record Management	10	10
4.	Database Management	10	10
5.	Management Information System	9	10
6.	Data Recovery System	9	10
7.	Technological Entrepreneurship	8	10
8.	Information Security Management	8	10

Table 2: Types of Training Received by Personnel

3.2. IP Infrastructures and Facilities

Central to the operational activities of the IPTTOs is the availability of adequate infrastructure and facilities, including physical facilities (i.e. office space, library, seminar rooms and service rooms), material resources and ICT facilities (i.e. computers, printers, scanners, and internet). One of the key priorities is to provide a conducive office environment where staff and managers can collectively collate and package R&D outputs for commercialization. Creating this impression in the minds of the faculty and students required that they have a great impression when visiting the IPTTOs. In fact, the National Office for Technology Acquisition and Promotion (NOTAP) was to supply all the necessary equipment for the establishment of the offices. However, this depends greatly on whether the office applied to NOTAP (or not) for support. The general impression of the work environment at the TTOs, as revealed in figure 4, is that there is an adequate and conducive work atmosphere in place. The office spaces occupied by the IPTTOs are generally adequate, as

revealed by the analysis. In terms of number, 50% of the study participants reported that the offices were partially conducive, while 43% and 7% indicated that their offices were conducive and highly conducive, respectively.

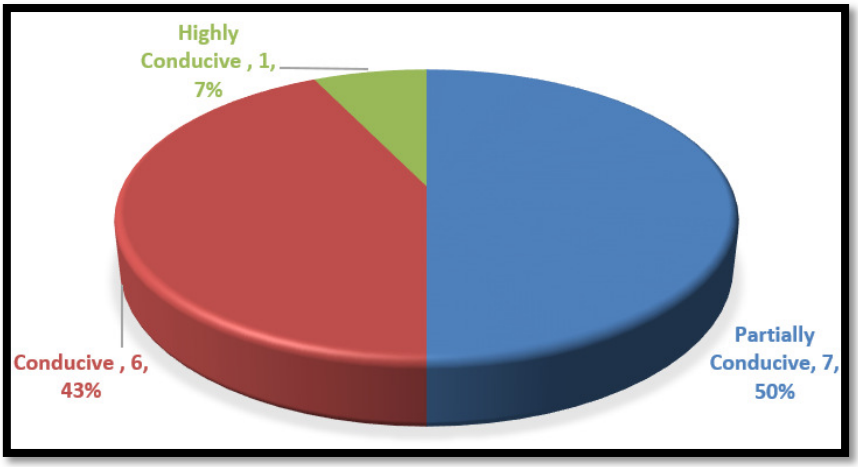

Figure 4: Conduciveness of the Work Environment in the IPTTOs

More specifically, the level of adequacy and conduciveness of the work environment was also investigated in the study. The results, as presented in table 3, showed that libraries and seminar rooms were reported as inadequate, probably because these two facilities are generally shared with other units/departments of their respective institutions. The service rooms, such as toilets, stores, etc., were reported to be fairly adequate. Some of the material resources, such as filing cabinets, furniture, air conditioner/fan and refrigerator, were reported as adequate. Notice boards and alternative power sources were reported to be fairly adequate, while utility vehicles and motorcycles were reported to be inadequate. The results suggest that the office accommodation for staff is fairly suitable while other office materials and equipment need to be improved upon. A lack of utility vehicles in IPTTOs could potentially impede their progress, especially when it comes to reaching out to the industry for collaboration and research output uptakes. The mobility of staff to discuss with industry is very germane to the success of the IPTTOs.

Physical Facilities	N	Remarks (%)			Remarks
		Adequate	Fair	Inadequate	
Office Spaces	14	50	21.4	28.6	Adequate
Library	14	14.3	28.6	57.1	Not adequate
Seminar Rooms	14	42.9	14.3	42.9	Fairly adequate
Service Rooms (Toilets, Bath, etc.)	14	28.6	50	21.4	
Other Material Resources					
Filing Cabinets	14	42.9	28.6	28.6	Adequate
Furniture	13	61.5	23.1	15.4	
Air Conditioner/Fan	14	35.7	28.6	35.7	
Notice Board	14	28.6	28.6	42.9	Fairly adequate
Dedicated Power Generator/ Inverter	14	21.4	35.7	42.9	
Utility Vehicles	13	15.4	0	84.6	Not adequate
Motorcycle	11	18.2	0	81.8	
Refrigerator	11	36.4	27.3	36.4	Adequate

Table 3: Adequacy of Physical Facilities and Material Resources at the IPTTOs
NB: Inadequate=1, fair=2, adequate=3

3.3. ICT Facilities

ICT facilities like computers, printers, servers, and the Internet are very central to the operations of every organization in today's highly dynamic work environment, especially in reaching out to customers and for feedback purposes, to mention a few. Information and data exchange across the globe is facilitated by ICT through e-mails, faxes, social media, and intranet, among others. The study gauged the availability and adequacy of ICT resources at the disposal of IPTTOs, and the results showed that computers, printers and photocopiers were available and adequate in the selected offices. However, it was reported that internet access and wireless LAN were only fairly adequate. Other ICT resources, including computer servers, functional websites, file backup systems and database management software, were reported to be inadequate, while intercom availability and adequacy were poor. It should be noted that four (4) of the fourteen (14) IPTTOs reported that they had a database management system in place at the time of the visit.

The ICT resources, including internet access, computer servers, file backup systems, and database management software, are crucial to the effective and efficient operations of the IPTTOs. Therefore, the current situation demands immediate attention for improvement and, where necessary, up-scaling.

ICT Resources	N	Adequate	Fairly adequate	Inadequate	Not Available	Remarks
Printers	14	42.9	21.4	28.6	7.1	Adequate
Desktop/Laptop Computers	14	28.6	35.7	28.6	7.1	Adequate
Photocopying Machine	14	28.6	35.7	14.3	21.4	Adequate
Internet Access	14	21.4	28.6	42.9	7.1	Fair
LAN/Wireless Internet	14	21.4	28.6	21.4	28.6	Fair
Computer Servers	14	14.3	7.1	42.9	35.7	Inadequate
Functional Dept. Website	14	14.3	14.3	14.3	57.1	Inadequate
File Backup Systems	14	7.1	14.3	50	28.6	Inadequate
Database Management Software Applications	14	0	14.3	35.7	50	Inadequate
Intercom	14	0	0	7.1	92.3	Poor

Table 4: Adequacy of ICT Resources Available at the IPTTOs

3.4. Budget and Funding

The provision of adequate funding for the IPTTOs is very critical to their operations and sustenance. Funding for personnel cost (i.e. staff salary), overhead (running cost), training and development, and capital projects are required for the effective performance of the IPTTOs' operations. The results presented in table 5 indicate that 58.3% of the IPTTOs reported that they get funding for personnel. In all the offices visited, the staff are first and foremost members of the community before being redeployed to the IPTTOs. This implies that none of the staff was recruited mainly to run the operations of the IPTTOs, meaning that the salary of each staff is paid from the central salary allocation to the institutions. It was noted that funding for other critical budget items, including training and development (7.1%), overhead (15.4%) and capital projects (16.7%), is abysmally low and needs urgent attention for improvement as these items were poorly provided for. The universities and research institutions where these TTOs were established are yet to treat them as revenue centres. They view IPTTOs as cost centres funded by peanuts through the imprest system rather than investment centres capable of bringing huge returns to the institution in the future.

Budget Items	N	Number of Respondents	Percent (%)
Personnel	12	7	58.3
Training and Development	14	1	7.1
Overheads	13	2	15.4
Capital Projects	12	2	16.7

Table 5: Budget Items

4. Conclusion and Policy Recommendations

The study explored human capital development and infrastructural deficit in the Nigerian IPTTOs with a view to providing appropriate policy intervention necessary to improve performance and technology commercialization. The study utilized datasets collected from fourteen functional IPTTOS across Nigeria using a cross-sectional survey. Considering the dynamics of knowledge institutions and their roles in stimulating innovation in society by making research outputs available to the industry, there are no clear guidelines for the IPTTOs to pursue their mandates. More importantly, the human capital and infrastructure needed to run the offices effectively are largely inadequate. Although the quality of personnel working in the IPTTOs is relatively high, considering that the majority of them are graduates and postgraduates, the number is low compared to what is obtained in other climes. However, some IPTTOs are better staffed than others. There is a dearth of full-time managers in the offices as the majority, if not all of them, still belong to a functional faculty or college in the university. This situation has to change going forward to allow the managers to prioritize the attainment of IPTTO's primary goals. Although the staff of the offices may start with routine operations such as the collation of inventions and research outputs in the university, they should acquire essential competencies and improved professional qualifications with time. There are several suitable but free programmes/courses on the World Intellectual Property Organisation (WIPO) website to better prepare the staff for the task of IPTTO management. Also, general manpower mapping and planning for the offices is critical for sustainable management of the office as pooled staff may not be effective in the long run.

On the level of infrastructure and ICT facilities, each institution needs to pay adequate attention by providing adequate and conducive office space, internet and a clearly accessible website where inventions from the universities may be showcased to attract potential investors. A dedicated utility vehicle for the IPTTOs could improve staff mobility and movement in the vicinity to link up and network with industry partners.

To manage the office more effectively, each IPTTO should articulate a succinct vision and mission statement to run with. In addition to the general mandates of the office, the chief executive officer in each institution should set achievable objectives and monitor and evaluate the office regularly for improved performance and impact. This suggests that the chief executive officer should champion the promotion of the office in their respective institutions.

Finally, improved funding and budgetary allocation to the offices should be prioritized for effective steering of the IPTTO operations.

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