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Technology Transfer Management Practices among Selected State Universities and Colleges in Davao Region, Philippines

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Abstract. This study examines the technology transfer management practices of selected State Universities and Colleges (SUCs) in the Davao Region, focusing on intellectual property (IP) registration, commercialization, and barriers. Using a mixed-methods approach, data were collected from Knowledge and Technology Transfer Division staff and IPTBM Office heads. Quantitative results revealed that SUC 1 recorded 15 patents, 34 copyrights, and 10 utility models, while SUC 2 registered 5 patents, 43 copyrights, and 12 utility models. Despite these achievements, commercialization remained minimal, with SUC 1 leading in patents and SUC 2 excelling in utility models and products. The analysis using the 7Ps framework showed strong performance in patents (mean = 4.88) and promotion (mean = 5.00), but policy gaps (mean = 2.75) hindered SUC 2. Identified barriers included misalignment between research and commercialization (mean = 4.5) and high project costs (mean = 4.0). These findings highlight the need for stronger university-industry linkages, enhanced IP awareness, and policy reforms to improve technology transfer outcomes. By addressing these challenges, this study provides actionable insights that can drive more effective technology transfer strategies, fostering innovation-driven economic growth in the region.

Keywords: Davao Region; Innovation; Intellectual Property; SUC; Technology transfer.

1.0 Introduction

The role of universities has evolved through successive academic revolutions encompassing teaching, research, and innovation. With the enactment of the Bayh-Dole Act in 1980, universities intensified their focus on technology transfer, facilitating the translation of research outputs into commercial applications (Munoz, 2023). Technology transfer refers to transferring knowledge, skills, or technologies from one organization to another, often involving intellectual property (IP) rights (Sundaram & Rajavenkatesan, 2020). Despite global advancements, universities and research organizations face barriers hindering efficient technology transfer, including limited industry collaboration, resource constraints, and regulatory challenges (Quiñones et al., 2019). These barriers have prompted initiatives to strengthen technology transfer offices (TTOs) and implement supportive policies. However, gaps persist, particularly in aligning academic research with industry needs and overcoming bureaucratic hurdles (Micozzi et al., 2021).

In the Philippines, enacting the Technology Transfer Act of 2009 signaled the government's commitment to facilitating technology transfer activities. However, challenges remain, including limited commercialization of university research and inadequate industry partnerships (Colcelli, 2019). While several initiatives have been launched to enhance IP registration and commercialization, the regional context—such as Davao—remains underexplored. Understanding the specific practices and barriers SUCs face in this region is crucial to designing effective interventions. This study addresses the gap by examining technology transfer management practices and barriers among selected SUCs in the Davao Region. By focusing on the 7Ps framework (Policy, Partnership, Patent, Product, People, Process, and Promotion), the study aims to provide a localized perspective on the strengths, challenges, and opportunities in managing technology transfer. The findings enhance the efficiency and impact of technology transfer initiatives, aligning with the broader goals of regional and national innovation systems.

2.0 Methodology

2.1 Research Design

This research employed a multiple case study design, which involves the systematic integration of quantitative and qualitative research within a single study. This approach encompasses the collection and analysis of data to explore and comprehend a research problem comprehensively.

2.2 Study Locale

The Davao Region, designated as Region XI, is in the southeastern portion of Mindanao. It consists of five provinces—Davao de Oro, Davao del Norte, Davao Oriental, Davao del Sur, and Davao Occidental—and one highly urbanized city, Davao City. This study focuses on two State Universities and Colleges (SUCs) within this region: one located in Davao City and the other in Davao Oriental. SUCs in the Davao Region play a crucial role in higher education accessibility, regional development, and human capital formation. These institutions are crucial in facilitating technology transfer operations by providing a conducive environment for innovation and collaboration between academia and industry. Through their technology transfer offices and initiatives, SUCs bridge the gap between research and practical application, fostering the development and commercialization of intellectual property.

The selection of these two SUCs was based on the following criteria: a) Technology Transfer Engagement – SUCs that have established Intellectual Property (IP) and technology transfer initiatives, b) IP Portfolio – SUCs with active or recorded patents, utility models, copyrights, and commercialization efforts, c) Geographic Representation – Selection of one SUC from an urban area (Davao City) and another from a provincial area (Davao Oriental) to examine potential disparities in technology transfer practices, d) Institutional Capability – SUCs with functional Knowledge and Technology Transfer Offices (KTTOs) and participation in government-funded research programs.

SUCs in the Davao Region play a crucial role in higher education accessibility, regional development, and human capital formation. These institutions facilitate technology transfer operations by providing a conducive environment for innovation and collaboration between academia and industry. Through their technology transfer offices and initiatives, SUCs bridge the gap between research and practical application, fostering the development and commercialization of intellectual property.

2.3 Respondents of the Study

The study employed a purposive sampling design, and the researchers intentionally selected participants with specific characteristics relevant to the research objectives. The study's respondents were the Knowledge and Technology Transfer Division (KTTD) staff and the Intellectual Property Technology Business Management Office (IPTBMO) Head of State Universities and Colleges in the Davao Region. The respondents in this study were referred to as SUC 1 and SUC 2. The researcher chose the respondents based on the following criteria: a) name of office designated, b) job designation, and c) no. of years in service. The above-mentioned criteria helped the researcher gain deep insight and achieve accurate information about this research's stated problem. The structured survey questionnaire and interview were used to determine the technology transfer management practices and barriers of selected SUCs in the Davao Region.

2.4 Research Instrument

The research instrument used in this study was an adapted and modified questionnaire. Data were gathered through a survey and structured interviews. The questionnaire was divided into three parts. The first page presented the letter to the respondents, the purpose of the study, the confidentiality clause, and informed consent. In the first part of the survey, the questionnaire contained questions about the numbers of registered intellectual property, people and services, and commercialized intellectual property; the second part introduced the management practices of technology transfer of selected SUCs in the Davao Region. The third part of the questionnaire produces questions regarding the barriers to technology transfer. A structured interview utilized questions regarding the challenges of SUCs to implementing technology transfer. To ensure the reliability of the research instrument, a pilot test was conducted with a small sample of respondents before the main study. The Cronbach's alpha coefficient was used to measure internal consistency and determine whether the questionnaire items produced stable and consistent results. To ensure validity, content validity was established through expert evaluation. University technology transfer specialists and intellectual property experts reviewed the questionnaire to assess its relevance and clarity. Additionally, triangulation was used by comparing survey results with interview findings to validate consistency in responses.

2.5 Data Collection Procedure

During the quantitative strand of this study, a survey questionnaire was administered personally to the respondents in their respective locations in the Davao Region. Informed consent was sought before administering the survey questionnaire. If respondents raised questions or clarifications about this study, these were answered before the survey proper. The quantitative data were collected personally from the respondents. For the qualitative strand, structured interviews were conducted as the primary data collection method. The interviews were held at locations preferred by the participants to ensure their convenience and focus. Prior to the interviews, the study's purpose was clearly communicated. While a predefined interview guide was followed, the interviewer also allowed for open-ended questions and discussions. With participants' consent, interviews were recorded to ensure accurate documentation. Interview durations were kept within an hour or less based on the participants' comfort. Subsequently, qualitative data from the interviews was transcribed and interpreted. Both qualitative and quantitative data were then utilized to analyze results, draw conclusions, and make recommendations in the study.

2.6 Data Analysis

The quantitative data in this study was analyzed using descriptive statistics, including standard deviation and mean, as part of the descriptive design. After conducting interviews, the verbatim data was collected, validated, and used to extract phenomenal themes. Participant responses were transcribed and analyzed after all recorded discussions from the in-depth interviews were collected. Detailed descriptions were obtained from participants, and phenomenal reductions were maintained throughout the analysis with an articulated structure. Non-English interview data were translated into English. The following steps were taken for quantitative data analysis: listing relevant expressions, coding the data, conducting thematic analysis, building a sequence of events, searching for data to answer specific questions, and synthesizing the texture and structure into an expression.

2.7 Ethical Consideration

To maintain ethical standards, the research study was completely independent of any governmental, non-governmental, or private institutions. Invitations were sent to the participants for the survey and interview. The Innovation & Technology Support Office Manager, Technology Transfer Officer, and Intellectual Property Technology Business Management Office Heads of State Universities and Colleges were briefed on the study's procedures as research participants. All participants provided their consent and were not coerced in any way. Discrimination was strictly prohibited throughout the study. Participants were treated with respect as they were the sole source of pertinent data for the study. In addition, participants were asked for permission to video or audio record, and their identities were concealed to maintain confidentiality. Pseudonyms or other identifiers were used in place of their real names. If participants expressed discomfort with the lengthy interview process, their concerns were addressed based on their needs.

3.0 Results and Discussion

3.1 Registered Intellectual Property, People, Services, and Commercialized Intellectual Property

Granted Intellectual Property

Figure 1 shows the number of Granted IP Rights between SUC 1 and SUC 2 from 2021 to 2023. There is a significant disparity in the number of registered patents, with SUC 1 having the highest count (15) and SUC 2 the lowest (5). Both SUCs registered a similar number of UMs. SUC 2 holds the highest count of registered copyrights (43), while SUC 1 holds the lowest (34). Both SUCs have an equal number of registered trademarks (2). Notably, no industrial designs were registered from 2021 to 2023.

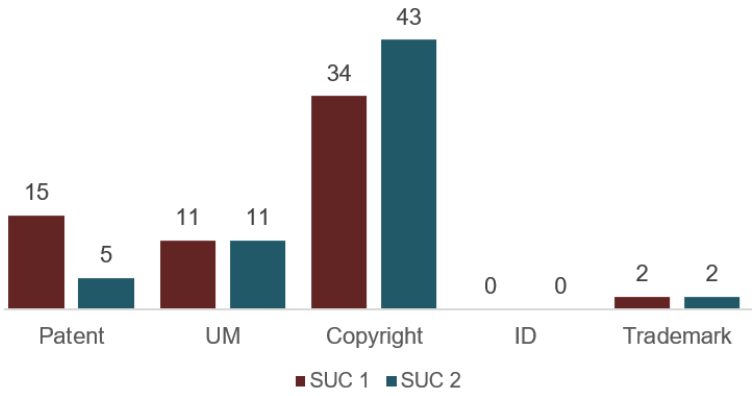

Figure 1. *Number of Granted IPs from 2021 to 2023*

The intellectual property (IP) analysis granted to SUC 1 and SUC 2 revealed interesting insights about their innovation and IP strategies. SUC 1 leads with the highest number of patents registered, demonstrating a proactive approach to patent awareness. In contrast, SUC 2 has the least patents registered, indicating potential areas for improvement in their innovation and IP strategies. Cheng (2019) suggests that preferential policies regarding university patent applications may contribute to the observed lower patent registration rates in SUCs. This indicates a need for SUC 2 to enhance its focus on patent development and protection. Jain et al. (2023) reports that institutional support, funding availability, and industry partnerships significantly influence patenting activities in academic institutions. Both SUCs obtained similar registered utility models, indicating comparable capabilities in developing and implementing utility models, potentially signaling similar levels of technological advancement and expertise.

SUC 2 obtained the highest number of registered copyrights, suggesting a strong emphasis on creativity and intellectual property protection, potentially indicating a culture of artistic expression within the institution. However, SUC 1's lowest count of registered copyrights suggests an opportunity for the institution to strengthen its focus on fostering creativity and protecting original works. The fact that both SUCs obtained similar registered trademarks indicates parity in their branding and intellectual property strategies.

The data suggests that State Universities and Colleges (SUCs) should focus on acknowledging their successes and identifying areas for growth. This commitment highlights the importance of SUCs obtaining legal protection for their Intellectual Properties, as demonstrated by the data provided. According to Ikomi (2022), adequate protection of intellectual property (IP) developed within universities is essential for turning ideas into valuable assets and preventing potential infringements. Through effective use of the IP system, technology universities can gain financial benefits from their research, creativity, and innovation. This, in turn, provides support for further innovation funding and serves as motivation for other researchers.

Figure 2 displays the overall percentage of intellectual property (IP) granted for SUC 1. Copyrights have the highest rate at 54.84%, suggesting that SUC 1 finds copyright protection more accessible and well-suited to their outputs than other forms of IP. This aligns with the observation by Rooksby (2019) that universities tend to favor

copyrights over patents, indicating a preference for the more straightforward and more suitable nature of copyright protection for their intellectual output. Copyrights are automatically granted upon creating original work, making the process more concise and accessible compared to the rigorous application and examination process for patents.

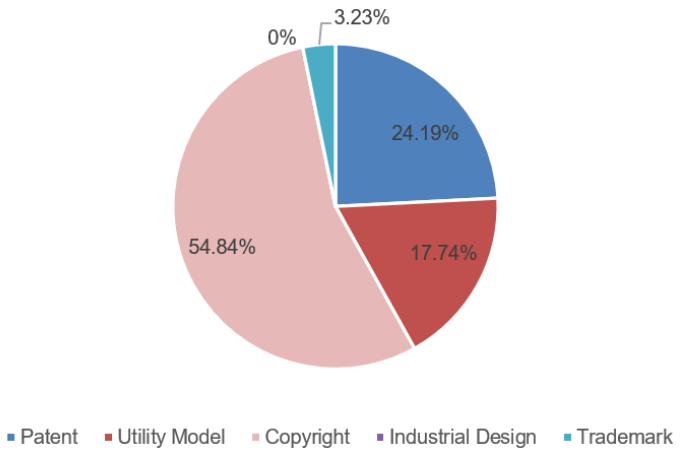

Figure 2. *SUC 1 Total Percentage of Granted IPs*

On the other hand, SUC 1 has a 0% registration for industrial design, suggesting a lack of emphasis on product design in their academic and research programs or the complexities and resource requirements associated with registering industrial designs. As stated by Novoa (2018), there is a need to modernize design education to meet current industry standards, indicating potential skill and knowledge gaps among designers. Applying invention standards in engineering design requires a high level of technical expertise, which may pose challenges for some university designers (Yan, 2022).

Figure 3 indicates that SUC 2 has a copyright registration rate of 70.49%, showing a strong emphasis on creating copyrightable materials such as research papers, educational content, and software. This aligns with the trend in universities favoring copyrights over patents due to their ease of access and suitability for their intellectual output. On the other hand, SUC 1 has a 0% rate of registered industrial designs, suggesting a lack of focus on product design in their academic and research programs. This could be attributed to resource demands and the complexity of registering industrial designs. Additionally, there may be a gap in design education and technical expertise required for invention standards in engineering design at SUC 1.

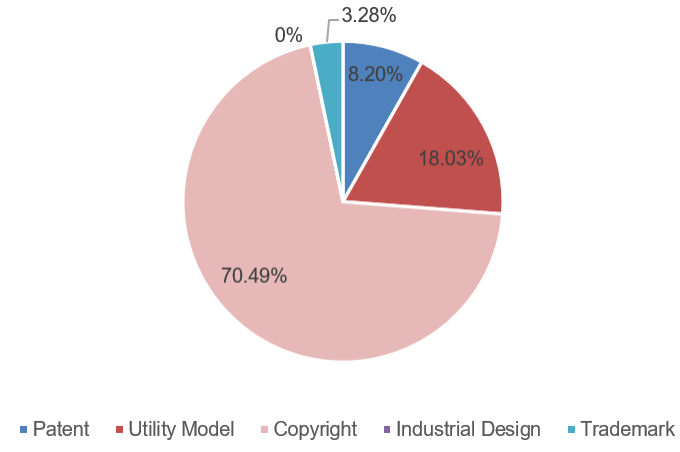

Figure 3. *SUC 2 Total Percentage of Granted IPs*

People and Services

Figure 4 details the analysis of people and services from 2021 to 2023 for SUC 1 and SUC 2. Notably, SUC 1 has more local industry partners (3) than SUC 2 (2). Regarding startups assisted, SUC 2 has supported two startups, while SUC 1 has not assisted any. Both SUCs have six personnel involved. Regarding innovation training sessions, SUC 2 conducted 15 sessions, while SUC 1 conducted 12 sessions.

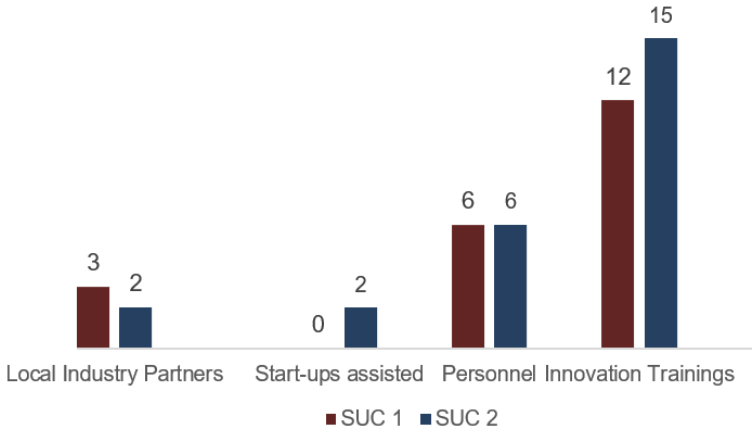

Figure 4. *Number of People and Services*

The data indicated that State Universities and Colleges (SUCs) are well-equipped to facilitate technology transfer operations. SUC 1 stands out with the most local industry partners, suggesting that it effectively leverages these relationships to enhance practical learning opportunities, research collaborations, and potential commercialization of innovations. As highlighted by Abbas (2019), cooperation between universities and industry supports the transfer of knowledge and technology through the sharing of intellectual property rights (IPRs), thereby driving innovation. On the other hand, SUC 2 has the lowest number of industry partners, indicating a potential area for growth and development in terms of industry collaboration and engagement. This observation suggests that SUC 2 may have untapped opportunities to establish partnerships with local businesses, potentially providing valuable resources, expertise, and opportunities for applied research and innovation.

Both SUCs have equal personnel involved in technology transfer, implying that both institutions prioritize allocating human resources to facilitate the transfer of knowledge and technology from academia to industry. Liu (2018) emphasizes the importance of considering employees' interests, regulatory frameworks, and prevailing mindsets to foster an effective technology transfer process. SUC 2's high number of conducted training programs suggests that it is actively educating its stakeholders about the importance of IP protection, technology transfer, and innovation management. By offering many training programs, SUC 2 demonstrates its commitment to empowering individuals with the knowledge and skills necessary to navigate the complexities of IP and innovation processes effectively.

Universities are crucial in technology transfer processes as they are key knowledge integrators (Shmeleva et al., 2021). SUC 1, with the fewest training programs, suggests that it focuses more on other forms of knowledge dissemination or has adopted a more specialized approach, offering fewer but more targeted training sessions. Considering the capacity of an SUC to allocate human resources and conduct training, it is noteworthy that SUC 2 has the highest number of start-ups assisted, demonstrating its capability to support startups effectively by leveraging their expertise and resources through training programs, according to Kim et al. (2020), startups are bridging the gap between universities and industries by improving collaboration. Moreover, SUCs can provide valuable guidance and mentorship to aspiring entrepreneurs, helping them navigate the complexities of starting a business. Finally, universities worldwide recognize the significance of providing entrepreneurship training to students, as mentioned by Shenkoya et al. (2023), to bolster their ability to create their startup ventures.

Universities play a vital role in actively facilitating technology transfer by allocating human resources to perform duties and responsibilities that enhance efforts to foster innovation. University-industry linkages have a positive impact on reaching the university's commercialization level. Technology transfer from universities to industries is a competitive strategy because academic research can aid business growth by providing new scientific discoveries and advanced technologies that accelerate innovation (Rosa et al., 2021).

Figure 5 presents the distribution of people and services focusing on innovation training. The figure indicates that innovation training has the highest percentage at 57.14%, reflecting a strong emphasis on enhancing innovative skills and knowledge. This suggests a concerted effort to promote creativity and provide participants with the necessary tools and methodologies to drive innovation. The capacity of universities to promote intellectual property (IP) awareness through training is evident in several studies. Trencheva (2017) emphasizes the role of universities in providing IP training, particularly within the library and information management sector. Ngwenya (2023) explores the dissemination of IP knowledge in universities, emphasizing policies, library web pages, workshops, presentations, and advisory services. Conversely, startup assistance received 0%, indicating potential gaps in entrepreneurial training, funding, mentorship, or essential infrastructure to support start-ups. Munari (2018) discusses the financial challenges faced by start-ups emerging from universities, while Závodská (2016) advocates for developing a comprehensive start-up education framework focusing on entrepreneurial competencies.

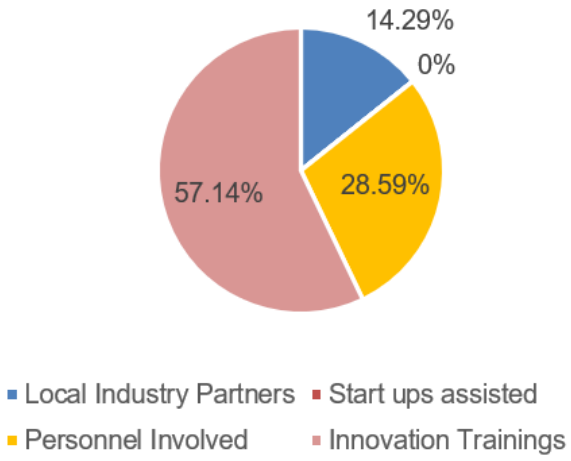

Figure 5. *SUC 1 Total Percentage of People and Services*

As shown in Figure 6, the innovation training program at SUC 2 has achieved a substantial 60% participation rate, highlighting a significant investment in promoting innovation within the institution. This proactive approach suggests a commitment to enhancing the innovative capabilities of both staff and students. According to Grigoreva (2020), such training is crucial in cultivating a culture of innovation among students and faculty, equipping them with the necessary skills and mindset to adapt to evolving challenges and contribute meaningfully to societal progress. Additionally, as Michaelis (2017) points out, innovation training has the potential to lead to more effective product offerings within the university. However, it's worth noting that local industry partners and personnel engaged in technology transfer only account for 8% each, the lowest percentages in the data. This suggests a potential gap or limited engagement between the institution and local industries regarding collaborative innovation and technology transfer activities.

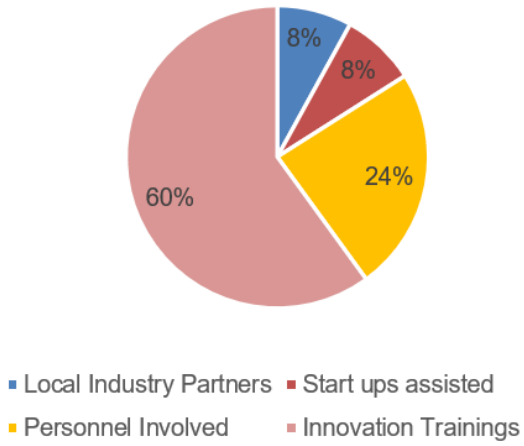

Figure 6. *SUC 2 Total Percentage of Total People and Services*

Shen (2016) underscores the challenges in connecting universities with industry, primarily due to industrial organizations' reluctance to collaborate with network participants. The equal percentages of 8% for local industry partners and personnel involved in technology transfer indicate a notable disconnect between the institution and regional industries, potentially impeding collaborative innovation and technology transfer efforts. These findings underscore the importance of fostering stronger partnerships between academia and industry to maximize the impact of university research and innovation. Addressing challenges such as industry reluctance and enhancing knowledge exchange for societal benefit can significantly contribute to overcoming these barriers.

Commercialize Intellectual Property

Figure 7 presented the commercialized IPs from 2021 to 2023 for SUC 1 and 2. There is a notable contrast in commercialized patents, with SUC 1 having three and SUC 2 having none. Regarding commercialized utility models (UMs), SUC 2 leads with 11, while SUC 1 has two. SUC 2 also leads in commercialized products with 11, in contrast to SUC 1. Regarding commercialized trademarks, SUC 2 has one, and SUC 1 has none. Both SUCs have not commercialized any copyrights or industrial designs. The data indicates a strong capacity for SUCs (State Universities and Colleges) to commercialize intellectual property, evidenced by the notable numbers. This aligns with the discussion by Breznitz and Feldman (2015) on the role of universities in fostering innovation and commercializing research outputs, particularly public universities.

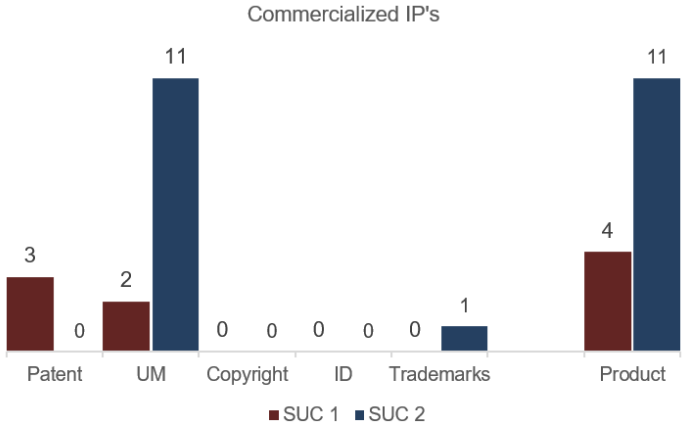

Figure 7. *Number of Commercialized IPs*

SUC 1's achievement in having the highest and only commercialized patents demonstrates success in translating intellectual property into tangible economic outcomes. This suggests effective navigation of technology commercialization through industry partnerships or licensing agreements. On the other hand, SUC 2's leadership

in commercialized utility models and products signifies significant success in leveraging intellectual property for commercial purposes. SUC 2's sole commercialization of trademarks also represents a unique accomplishment in establishing and monetizing its brand assets. Moreover, the highest number of commercialized products by SUC 2 highlights a strong capability to transform research outcomes into market-ready products. This underscores SUC 2's effective engagement with industry partners or entrepreneurial activities, resulting in successful product commercialization. Conversely, the lower number of commercialized products by SUC 1 suggests potential challenges or barriers in technology transfer and commercialization.

The commercialization of university inventions is a complex endeavor involving multiple stakeholders. Bansi (2016) emphasizes the importance of executive support, financial incentives, and streamlined decision-making within universities. Strong government backing, as Yang (2018) highlighted, is crucial for successfully commercializing science-driven innovations, particularly in the era of Industry 4.0, where innovation and interconnectedness are crucial (Chandra, 2019). These findings underscore the importance of fostering a supportive ecosystem for technology transfer and commercialization, enabling universities to maximize the impact of their research efforts and contribute significantly to economic development and industrial growth.

Figure 8 illustrates the percentage of commercialized intellectual properties (IPs). Commercialized products have the highest rate of 44.44%, indicating a substantial success in converting intellectual property into marketable products. This strongly connects the institution's research and development endeavors and commercialization strategies. Bansi (2016) emphasizes the significance of support from top executives, financial incentives, and efficient decision-making processes within universities for the success of the commercialization process. Conversely, the 0% commercialization for copyright, industrial design, and trademark indicates potential opportunities or challenges in translating these forms of IP into commercial products or services. Daniel (2020) highlights that inflexible university procedures and inadequate research, and development funding are significant obstacles in the commercialization process. Additionally, Ncube (2018) underscores the importance of addressing entrepreneurial challenges, such as concerns about copyright infringement and unfair contractual terms, to enable authors to derive economic benefits.

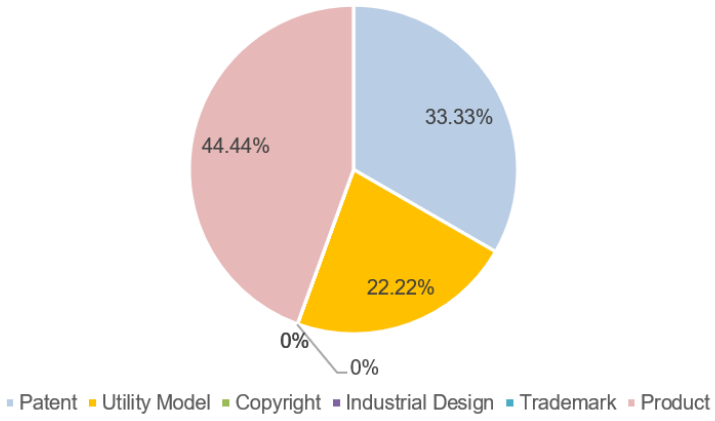

Figure 8. *SUC 1 Total Percentage of Commercialized IPs*

In the case of SUC 2 (Figure 9), the comparable percentages of 47.83% for both commercialized utility model and product indicate a balanced emphasis on both technological innovations and tangible product development. This balanced approach is in line with Loredo's (2019) findings, which underscore the importance of a balanced focus on technological innovations and tangible product development for utilities and manufacturing firms. Furthermore, non-formal search processes have been identified as central to product innovation in utilities, while sustainability orientation has been found to increase the likelihood of both product and process innovations.

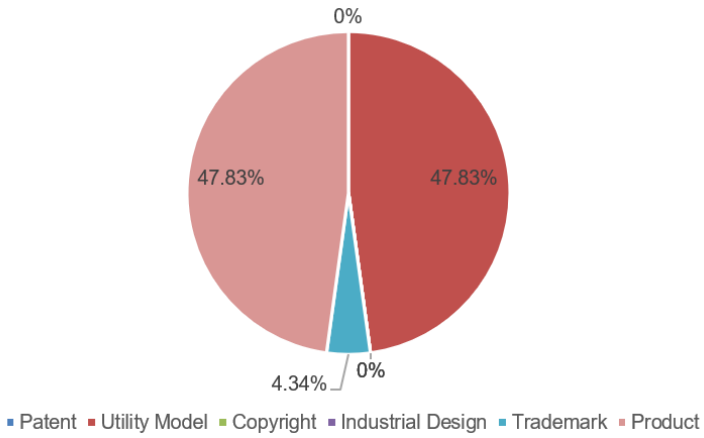

Figure 9. *SUC 2 Total Percentage of Commercialized IPs*

In contrast, commercialized copyright and industrial design scored 0%, reflecting a trend like that of SUC 1. This suggests potential challenges in converting these intellectual properties into marketable products or services. Daniel (2020) points out that rigid university procedures and inadequate funding for research and development are significant barriers to commercialization. Additionally, Ncube (2018) stresses the importance of addressing entrepreneurial obstacles, such as concerns about copyright violations and unfair contract terms, to enable creators to realize economic benefits.

3.2 Technology Transfer Management Practices

Table 1 details the technology transfer management practices of selected State Universities and Colleges (SUCs) in the Davao Region, focusing on Policy, Partnership, Patent, Product, People, Process, and Promotion. It includes the overall mean, standard deviation, and descriptions used in the study. The 7P's framework was employed to assess various facets of technology transfer thoroughly. The study aims to pinpoint strengths and areas for development, thus ensuring a comprehensive approach to managing and improving technology transfer activities within these academic institutions.

Table 1. *Technology Transfer Management Practices*

Management Practices	SUC 1			SUC 2		
	Mean	Description	SD	Mean	Description	SD
Policy	4.38	Strongly Agree	1.92	2.75	Disagree	0.46
Partnership	4.13	Agree	0.83	4.13	Agree	0.64
Patent	4.88	Strongly Agree	0.74	4.38	Strongly Agree	0.35
Product	4.38	Strongly Agree	0.74	4.75	Strongly Agree	0.46
People	4.86	Strongly Agree	0.38	4.29	Strongly Agree	0.76
Process	4.75	Strongly Agree	0.46	4.63	Strongly Agree	0.52
Promotion	4.63	Strongly Agree	0	5	Strongly Agree	0.52

Policy

Upon reviewing the data presented in Table 1, it is evident that there are significant disparities in policy implementation between SUC 1 and SUC 2. SUC 1 attained a mean score of 4.38, signifying strong agreement among respondents regarding the consistent practice of the indicated policy within their institution. Conversely, SUC 2 received a considerably lower mean score of 2.75, indicating disagreement among respondents regarding this variable. The standard deviation for SUC 1 exceeds 1.0, suggesting high variability within the dataset, while SUC 2 exhibits a standard deviation below 1.0, implying greater consistency in respondent ratings.

These findings underscore differing perspectives on establishing and enforcing policy within the two surveyed State Universities and Colleges (SUCs). The comparatively high mean score for SUC 1 suggests strong agreement among respondents regarding the approved and well-practiced nature of the IP policy within the institution. Conversely, the low mean score for SUC 2 indicates that its IP policy may not yet be approved or is still in development. This aligns with Sattiraju's (2022) assertion that the lack of a supportive policy framework hinders

the potential of State Universities and Colleges (SUCs) to advance the national economy through innovative and commercially viable research and development efforts.

It is worth noting that research universities rely on their intellectual property (IP) policies to oversee IP disclosure and protection procedures and determine revenue distribution from commercialization (Bratton, 2015). Section 230 of Republic Act (RA) 10372, which amends RA 8293 (the Intellectual Property Code), mandates the establishment of IP policies. This provision requires schools and universities to implement IP policies to govern the utilization and creation of intellectual property and safeguard the intellectual creations of educational institutions and their personnel. Moreover, these policies should align with locally established industry standards for fair use. They may also be formulated in line with licensing agreements held by the educational institution with collective licensing organizations (IPOPHL, 2021).

Partnership

Similarly, Table 1 showed that the partnership indicator had a mean score of 4.13 for SUCs 1 and 2, indicating a high level of agreement among respondents regarding the active practice of this indicator and emphasizing the collaboration and cooperative efforts of SUCs within their respective industries. The low standard deviation for both SUCs suggested minimal variability in the data, reflecting consistent ratings from respondents. The findings indicated that both SUCs recognized and practiced this variable, aligning with Alexandre et al. (2022), who emphasized the importance of university-industry connections in facilitating technology transfer. Effective university-industry linkages were crucial for knowledge and technology transfer, contributing to developing a Science and Technology Innovation System. These linkages aimed to drive collaborative research projects with the industry, leading to technology creation, adoption, and adaptation in local industries. Furthermore, university-industry collaborations fostered technological innovation by providing access to critical resources, expertise, and funding for research and technology development (Abebe Assefa, 2016).

Patent

Table 1 revealed notable differences regarding this indicator between SUC 1 and SUC 2. SUC 1 had a mean score of 4.88, signifying strong agreement among respondents regarding their active practice of this indicator. Conversely, SUC 2 had a mean score of 4.38, suggesting strong agreement that the patent indicator was actively practiced in their institution. These high mean scores indicated effective management and implementation of protection and patent-related processes in both SUCs. The standard deviation for this indicator was 0.74 for SUC 1 and 0.35 for SUC 2, both below 1.0, which signified low variability in the dataset and consistent ratings from respondents in both SUCs. This finding demonstrated the understanding of the importance of safeguarding intellectual property by both SUCs, not only for the inventors but also for those who utilize it. These results were consistent with Al Kassiri and Čorejová (2015) assertion, which suggested that patenting had broader benefits for individuals and the economy reliant on knowledge. Additionally, the results suggested that both institutions actively protected intellectual property, leading to a high number of patents granted and filed.

Product

Table 1 presents the product indicator for SUC 1 and SUC 2. SUC 1 had a mean score of 4.38, indicating that respondents strongly agreed that the product indicator was intensely practiced. In contrast, SUC 2 had a mean score of 4.75, suggesting that respondents also strongly agreed that product-related activities, such as product development, were intensely practiced in their SUC. The standard deviations were 0.74 for SUC 1 and 0.46 for SUC 2, below 1.0, indicating low variability and consistent respondent ratings. This finding demonstrated the understanding of the importance of safeguarding intellectual property by both SUCs, not only for the inventors but also for those who utilized it. These results were consistent with Al Kassiri and Čorejová (2015) assertion, which suggested that patenting had broader benefits for individuals and the economy reliant on knowledge. Additionally, the results suggested that both institutions actively protected intellectual property, leading to a high number of patents granted and filed.

People

The mean scores for the people indicator for SUC 1 and SUC 2 were presented in this section. SUC 1 had a mean score of 4.86, indicating substantial agreement among respondents that this indicator was actively practiced. On the other hand, SUC 2 had an overall mean of 4.29, suggesting strong agreement with this indicator. The standard

deviations were 0.38 for SUC 1 and 0.76 for SUC 2, reflecting low response variability, indicating consistently high ratings. These results confirmed that respondents recognized people's need, importance, and involvement in facilitating technology transfer very favorably within the SUCs. The findings affirmed that State Universities and Colleges (SUCs) intensely practiced the people indicator, as evidenced by the significant number of people involved in facilitating technology transfer and the presence of dedicated offices. The role of technology transfer professionals, including those working as TTOs in Research Support Offices, University-Business Engagement Offices, and Impact Offices (WIPO), was crucial in bringing knowledge and technologies to society. Their involvement significantly impacted the success of technology transfer. Furthermore, empirical evidence showed a strong relationship between the number of people employed in TTOs and technology transfer outcomes, such as new spin-off companies and licensed patents (Cartaxo & Godinho, 2017).

Process

The process indicators for SUC 1 and SUC 2 demonstrated strong agreement among respondents, with overall means of 4.75 and 4.63, indicating well-defined and communicated technology transfer management frameworks within SUCs. The low standard deviations of 0.46 and 0.52 suggested minimal variability within the dataset. This data indicated that SUCs fully embraced their responsibilities and were committed to operating technology transfer, fostering industry-university linkages, and developing technologies. As Maresova (2019) noted, successful patenting, licensing, and commercialization of academic inventions reflected the dedicated efforts of universities and their Technology Transfer Offices (TTOs) to facilitate recognition and financial rewards for innovators.

Promotion

The promotion indicator for SUC 1 had a mean of 4.63, reflecting strong agreement from respondents that promotion activities were actively practiced. In comparison, SUC 2 achieved the highest category mean of 5 among the seven indicators, indicating that respondents strongly agreed on the effectiveness and importance of promotional efforts within the SUC. This demonstrated a strong consensus on the exceptional performance and value of promotional efforts in these academic settings. The standard deviation for SUC 1 and SUC 2 was below 1, indicating low response variability.

According to Bernal and Cárdenas (2014), there were many established examples of promoting innovation within education, with numerous subjects aimed at teaching students to enhance their creativity. Indeed, encouraging innovation spanned the entire educational system, including universities, institutes, and schools. Across all levels of the educational system, from universities to institutes and schools, there existed a myriad of established examples aimed at promoting innovation. Subjects such as design thinking, project-based learning, and entrepreneurship courses were increasingly integrated into educational programs to provide students with hands-on experiences and opportunities to explore their creativity. Moreover, initiatives like maker spaces, innovation labs, and research centers were hubs where students could collaborate, experiment, and prototype innovative solutions to real-world challenges.

3.3 Technology Transfer Management Barriers

Table 2 presents a comprehensive list of 24 barriers impeding effective university technology transfer. Technology transfer, the process of transferring scientific findings from one organization to another for further development and commercialization, is critical for fostering innovation and economic growth. However, universities face numerous challenges in this domain. Each barrier listed represents a specific challenge that universities must navigate, spanning administrative and organizational issues to cultural and financial constraints. The mean scores for notable barriers exceeded 3.5 points.

Among the 24 identified barriers in this study, it was confirmed that the "Misalignment between research and commercialization" barrier had the highest mean score of 4.5, indicating a consensus among respondents about its significance. This supports Quiñones et al.'s (2019) report, which identified the same barrier as the most influential based on its high in-degree measure. The misalignment can be attributed to industry partners' high expectations regarding the commercialization potential of university academics, leading to conflicting objectives.

Table 2. *Technology Transfer Management Barriers*

Barriers Description	Mean	Description
Misalignment between research and commercialization objectives	4.5	Strongly Agree
High costs of managing joint research projects in terms of time and money	4.0	Agree
Cultural differences between academia and enterprises	4.0	Agree
Lack of national benchmark to evaluate successful collaboration	4.0	Agree
Prototype technology is not compatible with the demands of mass production	4.0	Agree
Knowledge being too theoretical for practical purposes	3.5	Agree
Lack of venture capital	3.5	Agree
Lack of appropriate partners	3.0	Undecided
University proponents have unrealistic expectations regarding the value of their technologies	3.0	Undecided
Remote geographic distance	3.0	Undecided
Complex procurement process	3.0	Undecided
Lack of sales distribution centers within the university premise	3.0	Undecided
Process complexity	2.5	Disagree
Time constraints	2.0	Disagree
Lack of resources	2.0	Disagree
Risk of information leakage	2.0	Disagree
Insufficient rewards for university researchers	2.0	Disagree
Poor marketing/technical/negotiation skills of Technology Transfer Office (TTO)	2.0	Disagree
Lack of recognition for university-industry linkages	2.0	Disagree
Inconsistent rules and regulations	2.0	Disagree
Complex organizational structure	2.0	Disagree
Institutional bureaucracy	2.0	Disagree
Problems concerning intellectual property rights	2.0	Disagree
Lack of personal motivation	1.5	Strongly Disagree

The following barriers followed with a notable mean of 4. Barriers (High costs of managing joint research projects in terms of time and money) The high costs associated with managing joint research projects, both in terms of time and financial resources, often pose significant challenges for universities and enterprises. It can limit the scope and scale of potential collaborations, particularly in the early stages of partnership development (Fisher, 2019). (Cultural differences between academia and enterprises) Cultural differences between academic institutions and industrial enterprises frequently lead to misunderstandings and conflicts. These differences in organizational culture, communication styles, and objectives can hinder the establishment of effective collaborative relationships (Johnson, 2018).

The absence of a national benchmark for evaluating the success of university-industry collaborations creates uncertainty and inconsistency in assessing partnership outcomes. This lack of standardized metrics can impede the ability to measure progress and compare performance across different initiatives, and (Prototype technology is not compatible with the demands of mass production), as stated by Hayes (2021), one of the critical barriers to the commercialization of university-developed technologies is the frequent incompatibility of prototypes with the demands of mass production. This gap between innovation and scalability often prevents promising technologies from reaching the market.

Meanwhile, the barrier (Lack of personal motivation) has the lowest mean of 1.5. This indicates that this barrier is not experienced by State Universities and Colleges (SUCs), as the respondents strongly disagree with its presence. This suggests that SUCs have developed effective strategies to overcome this challenge or that it is not relevant in their specific contexts. This result was supported by Siegel's (2021) statement that state universities and colleges (SUCs) demonstrate a notably higher level of personal motivation among their staff involved in technology transfer activities. This intrinsic motivation, supported by strong institutional frameworks and effective incentive mechanisms, ensures that SUCs do not face the typical barriers associated with a lack of personal drive observed in other institutions.

3.4 Qualitative Findings

This section reveals the findings obtained from the structured interviews. It delves into emergent themes and conducts data analysis on the qualitative results obtained from this study.

Theme 1: Vehicles of Innovation

The first theme concerns the available office (authority) and facilities implementing innovation goals and their corresponding enabling mechanisms. Both SUCs have existing offices and their equivalent, such as the Intellectual Property Office, Technology Transfer Office, an accredited Innovation and Technology Support Office (ITSO), and innovation hubs for product development. This was necessitated due to existing policies that enable the operationalization and interaction of innovation actors, institutions, and activities. SUC 1 has an existing research and development (R&D) policy. Its R&D policy is further expanded to strategic innovation plan (framework), intellectual property policy, technology transfer policy, incentivization guidelines, and spin-off policy.

"Our tech trans office was primarily established due to the growing necessity of driving innovation in our institution. As the university realizes the need to operationalize innovation from research to commercialization, so has the establishment of the tech trans office."

The presence of an authoritative agency and its mechanism highlights the institution's vigor in pursuing and involving itself in the dynamic innovation ecosystem.

On the other hand, SUC 2 shares similar groundwork with SUC 1 in establishing its policies. SUC 2's strategic innovation plan and incentivization guidelines are anchored in its R&D framework. This is quoted in the following:

"Since the establishment of the IPTBM Office, several IP inventories from different technology-based programs were conducted to determine the technologies generated with potential on IP protection. Those technologies' enhancement, promotion, and development were initiated to prepare for its pre-commercialization requirements."

SUC 1's driver of innovation is firmly anchored and manifested in its office and policies. As this became apparent, SUC 1 became a mentor to budding institutions with a similar vision toward innovation. SUC 2 followed through and established its drivers of innovation. As state universities, both SUC 1 and 2 serve as key integrators of knowledge in technology transfer processes (Jafari-Sadeghi et al., 2021). Warwick (2021) further substantiates that university technology transfer agencies are instrumental in leveraging innovation and advancements. Through this qualitative exploration, it has become apparent that universities are catalysts for innovation and advancement. Similar themes emerged in both SUCs that house the vehicles of innovation.

Theme 2: Drivers of Innovation

Both SUCs have trained personnel in implementing varying innovation-related activities. SUC 1 and 2 exemplified dedication in training agents to ideate, strategize, and implement promising activities.
SUC 1's staff quoted his extraordinary experiences as:

"Participation in this ambitious position provided me with a multi-faceted opportunity for personal, emotional, social, and professional growth. I was able to become a trainer and a trainee as the manager of our office. I was also honed in how to lead and serve in the bureaucracy of our institution. Moreover, I learned how to manage and balance my personal and professional needs. Lastly, I met wonderful and brilliant people who have become leaders in their respective organizations presently."

SUC 2 responded in a similar tone as well:

"Yes! Top management support, and the people who shared the same vision and passion for innovation."

With the innovation agents on board, SUC 1 and 2 vary in their innovation-related activities. SUC 1 has been implementing technology pitching, technology exhibits, and training. These activities are further reinforced by establishing linkages to local industries and diverse research and innovation funding sources. Due to these engagements, SUC 1 was able to assist local start-up companies and later established its Technology Business Incubation Program (TBI). SUC 2 has conducted activities like those of SUC 1. However, SUC 2 is still working on

its TBI program to conduct activities promoting spin-off and start-up companies. Despite their proactive engagements, both SUCs have their strengths and weaknesses. As reported, SUC 1 has commercialized patents that can utilize impactful technologies. As for SUC 2, they commercialized utility models and trademarks. This entails that SUC 2 strategically utilized other forms of IPs.

The implementation of innovation-related activities is greatly influenced by the connections between academia and industries (Alexandre et al., 2022). The linkage is inspired to establish an industry-driven collaboration that will lead to local industries' creation, validation, and modification of technology (AbebeAssefa, 2016). The success of the aforesaid activities is determined by the involvement of the number of people employed in technology transfer offices, technology transfer outcomes, and the number of licensed patents (Cartaxo & Godinho, 2017). Despite the presence of trained personnel and implemented activities, challenges arise when industrial organizations are reluctant to collaborate with network actors (Shen, 2016). This reluctance is apparent to both SUCs, as evidenced by the absence of spin-off companies. Nevertheless, both SUC 1 and 2 have managed to continuously train agents and implement significant activities as drivers of innovation.

Theme 3: Uphill to Innovation

SUCs 1 and 2 have different insights when it comes to identifying challenges. SUC 1 has the more advanced technology transfer office and has stated multifaceted challenges. SUC 1's staff quoted the following:

"I also had a multitude of challenging experiences. Learning from mistakes is the foremost principle in overcoming those experiences. I learned how to choose the best people as teammates to ensure the project flows smoothly. Also, my family served as the best support system during those challenges."

Despite the indirect statement of learning from mistakes, it can be inferred that personnel are central to the operation's success. Given that as personnel assigned, individuals who have a share of personal, social, and professional challenges, he added that support systems are necessary to continue with the hurdles of innovation. From a different perspective, SUC 2's manager offered an objective statement about his experience managing innovation activities in their institution. He quoted:

"Dealing with people in the university who want to get involved in the innovation activities but to gain points for promotion and not for the passion of bringing impact to the university."

It can be inferred that bringing people into the innovation landscape is challenging when intention and motivation are absent. He added that motivation is inherently tied to promotion – personal aspirations – without the required concern to advancing intellectual property promotion. This becomes endemic among state universities as they share similar processes and instruments. Both SUCs projected dissimilar perspectives when it comes to barriers to innovation. This is evidenced by De Ocampo, Jr. et al.'s (2018) exploration of the challenges faced by Philippine state universities, including SUCs, in engaging in innovation activities. They discussed issues such as limited funding, lack of industry collaboration, and institutional constraints, which are different from what was exemplified by the two SUCs. Moreover, Melican et al. (2019) provided another insight that matches SUC 1 and 2's issues, such as limited extension services, inadequate support mechanisms, and difficulties scaling up innovation.

Despite this, both SUCs offered an optimistic view on improving the conduct of innovation activities. Continuous collaboration and collective engagements with the industry enable heightened collaboration, which equips both to better engage in future activities. Their optimism is quoted below:

"Interagency, collaboration, mentorships, and participation in training serve as our avenue in fostering collaboration. R&Ds also invites like-minded visionaries to meet on the same agenda and forges collective participation in innovation." SUC 1

"Building good relationships and involving the industry in creating solutions to their identified problem." SUC 2

Identifying the barriers and challenges to innovation can aid decision-makers in improving the ecosystem. Despite having the vehicle and drivers of innovation, innovation cannot be an innovation without succeeding in reaching the top of an uphill journey, as evidenced by acknowledgments for all the accomplishments of SUC 1 and 2. IPO

was awarded the most prestigious Platinum Award, recognizing their contribution to IP Applications, among other deliverables. Through a fruitful mentorship relationship, SUC 1 and 2 demonstrated exceptional dedication and innovation and effectively implemented intellectual property management and protection strategies. This collaborative effort made notable contributions to advancing and safeguarding intellectual property rights, garnering recognition from a prestigious authority such as IPOPHL. The platinum award serves as both validation and celebration of their collective efforts, underscoring the significance of mentorship in fostering excellence and innovation within educational and professional spheres.

4.0 Conclusion

The study highlights the critical role of structured management practices in improving technology transfer outcomes in the Davao Region. Findings show that SUC 1 excels in patent registrations and commercialization, while SUC 2 leads in copyrights and utility models. However, both institutions face challenges in commercialization, emphasizing the need for stronger institutional policies and industry partnerships. The 7Ps framework analysis revealed SUC 1's strength in patents and SUC 2's excellence in promotion practices, but policy gaps remain a concern. Barriers such as misalignment between research and commercialization goals and high project costs hinder effective technology transfer. Qualitative insights further emphasize the impact of organizational culture, resource allocation, and training on these outcomes.

To address these challenges, SUCs should enhance institutional policies, foster industry linkages, and provide targeted training to bridge the gap between research outputs and market demands. Strengthening innovation culture and aligning academic efforts with commercialization goals are essential steps forward. This study underscores integrating quantitative and qualitative insights to understand technology transfer dynamics better. Future research should explore more strategies to overcome commercialization barriers and expand innovation efforts, ensuring a more significant contribution to regional and economic growth.

To enhance technology transfer outcomes, SUCs should develop clear institutional policies, strengthen industry linkages, provide targeted training, implement commercialization support programs, and foster an innovation culture. Future research should explore comparative commercialization models across SUCs, assess industry engagement strategies, examine sustainable funding mechanisms, evaluate the long-term impact of IP commercialization, and investigate the role of digital platforms in technology transfer. These efforts will help bridge the gap between research and market demands, ensuring greater contributions to regional development and economic growth.

5.0 Contributions of Authors

The authors contributed significantly to this study. Both authors led the conception and design of the study, as well as the analysis and interpretation of results. They played a key role in manuscript writing and revisions. All authors reviewed and approved the final manuscript.

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7.0 Conflict of Interests

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