

Practices Malaysian Research Universities: Patent Profile in The Lens Database

Mohd Arif Mohd Sarjidan¹, Azizi Abu Bakar², Noor Hidayati Ismail³, Sharifah Nur Syafiqah Syed Omar⁴, and Noreena Nordine⁵

¹Low Dimensional Materials Research Centre (LDMRC), Department of Physics, Faculty of Science, Universiti Malaya, 50603 Kuala Lumpur, Malaysia.

²UM Community Engagement Centre (UMCares), Research and Innovation Complex (RMIC), Universiti Malaya, 50603 Kuala Lumpur, Malaysia

³UM Power Energy Dedicated Advanced Centre (UMPEDAC), Wisma R&D, Univesiti Malaya, 59990 Kuala Lumpur, Malaysia

⁴Academic Development & Enhancement Centre (ADEC), Universiti Malaya, 50603 Kuala Lumpur, Malaysia

⁵UM Halal Research Centre (UMHRC), Universiti Malaya, 50603 Kuala Lumpur, Malaysia

Email: mohd.arif@um.edu.my

Received Date: 20 December 2022

Acceptance Date: 20 March 2023

Published Date: 1 April 2023

Abstract. Patents are a valuable outcome of research activities in universities as a foundation for commercialization. The idea of transforming research work into products or services that are beneficial to the public has become the priority for almost all universities in the world. This paper focuses on the profile of patents produced by Malaysian Research Universities (MRU). The profiling considers the number of patents, stages of patents, collaboration effort for the patents, citation of the patents, and jurisdiction of the patents within 10 years from 2010 to 2020. The finding indicates that there is an association between patenting activities with the initiative by the government and the university ranking systems.

Keywords: Lens.org, patent profiling, malaysian research universities, information management

1 Introduction

A patent refers to an invention or innovation of an existing product. If we have invented an invention or technology that does not yet exist in this world, then this invention can be protected under a patent and each patent protection is valid for a period of 20 years. Thus, patents are very important in preventing the unauthorized use of inventions or innovations and economic exploitative activities. In Malaysia, research universities have been given a role to promote new discoveries that can further enhance new

inventions and innovations for the country. Although the Ministry of Higher Education (MoHE) has provided various types of support to research universities in the form of funds, facilities, technology, or expertise, the number of patents published in research universities is still low compared to the total patents published by Malaysia. The main purpose of this study is to examine patent profiles in terms of number, type, citations, and collaborations for five research universities in Malaysia, i.e., Universiti Malaya (UM), Universiti Putra Malaysia (UPM), Universiti Kebangsaan Malaysia (UKM), Universiti Sains Malaysia (USM) and Universiti Teknologi Malaysia (UTM) from 2010 to 2020. To find out the profile patents studied, The Lens database was used to extract the required information. Results demonstrated that Malaysian research universities (MRUs) are facing difficulties in transferring knowledge or technology from research laboratories to services or products in the marketplace. Thus, this work is presently able to provide an overview of the research patent contribution by MRUs from an open database, i.e., The Lens. Discussions of this work are perhaps able to ignite the Malaysian research universities in producing novel output and secure the invention through patent protection. This needs courage by the research universities in formulating strategies to improve technology transfer that fits the needs of the industry.

2 Literature Review

Inventions, literary and creative works, designs, symbols, names, and pictures used in business are all examples of intellectual property (IP). Patents, copyrights, and trademarks, for example, are legal protections that allow individuals to profit financially or get notoriety from what they innovate or produce. The IP system aims to foster an environment where creativity and innovation may thrive by finding the correct balance between inventors' interests and the larger public interest (WIPO, 2022). A patent is an exclusive right awarded for an invention, which is a product or a method that gives a new technological solution to a problem or provides a new way of doing something in general (WIPO, 2022). Patents provide the owner with a competitive edge and enable them to become a dominating player in a certain market, such as the technology sector. It also raises the economic worth of the idea, attracting additional investment and money to commercialize it, particularly if the invention is still in the early stages of development.

Universities are acknowledged as one of the entities that create patents as a research product, in addition to the industry. Although most universities perform research projects that result in research publications such as papers in Scopus or web of science (WoS) indexed journals, some of them translate the study into IP (patent) if the idea has economic potential. Furthermore, patents have been an important outcome for government-funded research projects. For example, in Malaysia, the Ministry of Higher Education (MoHE) established the Prototype Development Research Grant (PRGS) to fill the gap between both laboratory discovery/research and the pre-commercialization stage with the aim of fostering new technologies, compatible with the requirements of the K-Economy and the New Economic Model (MASTIC, 2022). Other MoHE's research grants, such as the Long-Term Research Grant Scheme (LRGS) and the Exploratory Research Grants Scheme (ERGS), encourage universities to develop patents based on their research.

IP, such as patents, is recognized in Malaysia to assess the performance and quality of universities, according to the Malaysian Research Assessment Instrument (MyRA). MyRA is a comprehensive system designed to examine all Malaysian Higher Education Institutions' (HEIs) research capabilities and performance (USM, 2015). The primary goal of development in 2006 was to satisfy the MRU agenda of the Ministry of Higher Education (MoHE), which was to nominate five Malaysian institutions for MRU status. Five Malaysian universities, UM, UKM, USM, UPM, and UTM, were identified as research universities (RUs) under the 9th and 10th Malaysian plans, with additional funding for research and commercialization. To drive the nation's growth, these five RUs needed to concentrate more on research and innovation and become referral institutions (Tan et al., 2015). MyRA was originally designed to accredit and monitor the research performance of public universities, but starting in 2014, all HEIs in the country were required to participate in the annual assessment exercise to coincide with the opening of MoHE research grants to all universities (public and private) in the country (USM, 2015).

The patenting activities in Malaysia regarding applying for and granting patents in the Malaysian and US patent system has been reported (Chandran Govindaraju & Wong, 2011). On the other hand, the correlation between patents filed by academic institutions and government research institutes, with two national policy instruments has been examined (I. M. Azmi, 2014). However, no study was conducted specifically to investigate the patent of the MRU. Realizing the importance of patents produced by MRU, this paper presents the profile of patents by the MRU in terms of numbers, types, citations, and collaborations from 2010 to 2020. Such a study is beneficial to lay the foundation and strategy to enhance the technology translation from research work into commercialization in the future.

3 Methodology

The Lens is a worldwide open cyberinfrastructure that provides access to digital all the world's patent filings as transparent, annotatable digital public goods connected with academic and technical literature and regulatory and corporate data. Developed by an Australia-based non-profit organization, named Cambia, The Lens enables users to share, annotate, and embed document collections, aggregations, and analyses to create an open map of the world of knowledge-directed invention. Its database covers more than 115 million patent records from over 95 different jurisdictions and nearly 200 Million Scholarly records, compiled and synchronized from PubMed, Crossref, Microsoft Academic, CORE, and PubMed Central (Ellen et al., 2019).

It has been claimed as the “most comprehensive scholarly literature database, that exceeds in its width and depth two leading commercial databases (Web of Science and Scopus) combined” (Penfold, 2020). The Lens is an agglomeration database that aggregates bibliometric data from several databases (such as PubMed and Crossref) into a single, deduplicated, and unified search syntax. Particularly in Malaysia, the Lens has been recognized as the database to perform a patent search analysis for applying for research grants funded by MoHE (KPT, 2020).

The patent information of each MRU has been collected by searching for the name of each MRU in the “Applicant Name” of the Lens.org database system using the URL

<https://www.lens.org/>. The search query string used in the lens.org database is “Applicant Name: ("UNIV MALAYA") OR (Applicant Name: ("UNIV OF MALAYA") OR (Applicant Name: ("UNIV PUTRA MALAYSIA") OR (Applicant Name: ("UNIV PUTRA MALAYSIA UPM") OR (Applicant Name: ("UNIV SAINS MALAYSIA") OR (Applicant Name: ("UNIV KEBANGSAAN MALAYSIA") OR (Applicant Name: ("UNIV KEBANGSAAN MALAYSIA UKM") OR (Applicant Name: ("UNIV KEBANGSAAN MALAYSIA (UKM)") OR (Applicant Name: ("UNIVERSITI KEBANGSAAN MALAYSIA") OR (Applicant Name: ("UNIVERSITI KEBANGSAAN MALAYSIA UKM") OR (Applicant Name: ("UNIV MALAYSIA TEKNOLOGI") OR Applicant Name: ("UNIV MALAYSIA TECH")))))))))))))))”.

The data is then filtered to select only from 1st January 2010 to 31st December 2020. These ten years are a sufficient timeline to analyze the patent profile that covers three Malaysian Plans, the 9th, 10th, and 11th, which includes the early stage of the establishment of MRU. All data were retrieved in September 2021. It is important to note that the information may vary over time as it is updated frequently. For example, a patent can change its status from “filing” to “granted” at different time frames.

The collected data were then visualized with suitable plots and graphs using Microsoft Excel and discussed by focusing on the number of patents, types of patents, number of citations, and collaborations of patent documents produced by the MRU. Several research articles and references have been referred to further understand and get a better insight for explaining the obtained results.

4 Results

4.1. Patent Publication Overview in Malaysia

Figure 1 shows the number of patents published by MRUs as compared to overall Malaysia within 10 years, starting from 2010 until 2020. The total number of patents published by MRUs is 1585, equivalent to only 9.97% of the total patent published by Malaysia (15900). Publication of patents by MRU increased significantly about 234.86 %, from 2010 (109) until 2014 (256), before declining dramatically to the lowest point in 2020 (21). Surprisingly, a similar trend is observed for overall patents published by Malaysia.

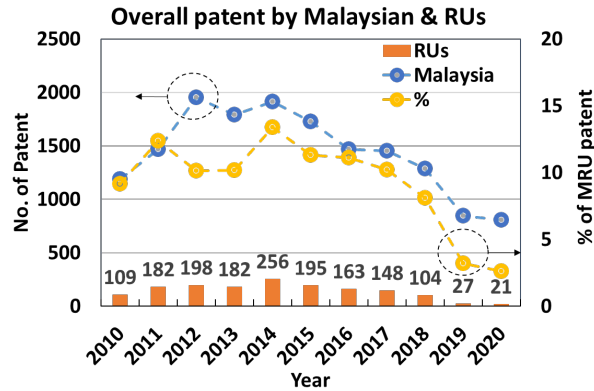


Fig. 1. An overall patent published by Malaysia and RUs collected from the Lens database.

4.2. Patent Published by MRUs

As can be seen in **Figure 2**, the number of patents published by the five RUs is not constant over the years, with a decreased number in 2019 and 2020 for all the RUs. The decrease can undeniably be explained by the pandemic COVID-19, which forced the closure of higher education institutions in Malaysia for more than a year. In most cases, patent production needs to be carried out physically due to its experimental nature. UTM has a stable publication pattern from 2011 to 2016. However, no data is available in the Lens database for the number of UTM patents published from 2017 to 2020. UPM has been a forerunner in pattern publication since 2010 with a constant number of publications but was taken over by UM in 2014. However, there is a significant decreasing trend from 2017 onwards. There has been a sharp increase in the patents published by UM from 2013 to 2014, but it also has been decreasing ever since. UKM has the least number of patents published throughout the 10 years, but with a constant trend.

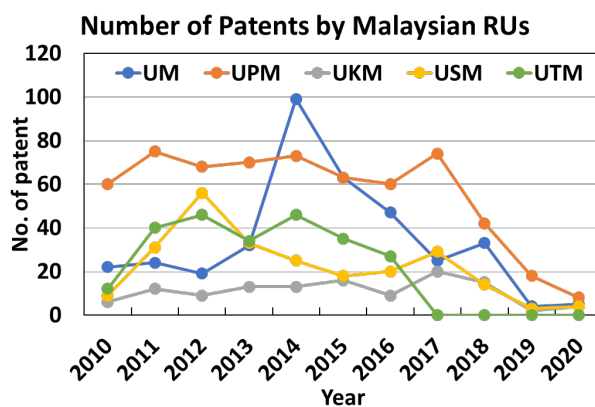


Fig. 2. Number of patents published by Malaysian RUs from 2010-2020 from Lens database.

4.3. Patent Stages by MRUs

4.3.1 Patent Application

Figure 3 shows the number of patent applications submitted by 5 MRUs. For both 2010 and 2011, only UPM and USM have shown an increasing trend compared to other MRUs. In 2012, USM recorded the highest number of patent applications (46), while UPM (28), UM (7), UTM (3) and UKM (1). However, starting from 2013 USM has experienced a very significant decrease until 2020. From 2013 until 2015, UM has shown an increased number of applications, but the number decreased from 2016 to 2020. UTM recorded only 15 applications between 2010 and 2020 of which there were no patent applications from 2013 to 2015 and from 2017 to 2020. UKM recorded 12 patent applications in 2015 and the number declined slowly from 2016 to 2020.

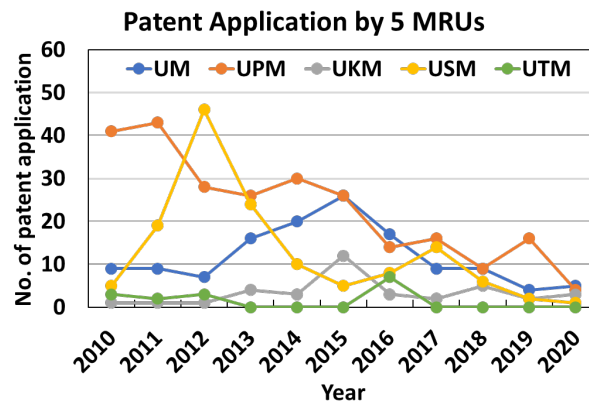


Fig. 3. Patent application by 5 MRUs.

4.3.2 Patent Search Report

As can be seen from **Figure 4**, UPM recorded the highest total number of patent search reports between 2010 and 2020 with 54 reports, which is equivalent to 21% of the applications submitted. UM with 13 reports (10%), UKM with 6 reports (16%), USM with 5 reports (3.6%) and UTM with 4 reports (26%). In the patent process, the patent search report is an important stage because it is a way to protect an invention by assessing the patentability of the invention to be produced. It can help researchers find out what others are doing in the field they are researching, and confirm whether the researcher's work is unique, important, and innovative. Typically, a patent will expire after 20 years, which means anyone can use the invention after it expires. After reviewing the application, the Patent Office will issue a patent search report and will comment briefly on its relevance in providing preliminary guidance and advice before proceeding with the invention. Basically, the report provides a list of all current and pending patents that are similar or identical to the claimed invention.

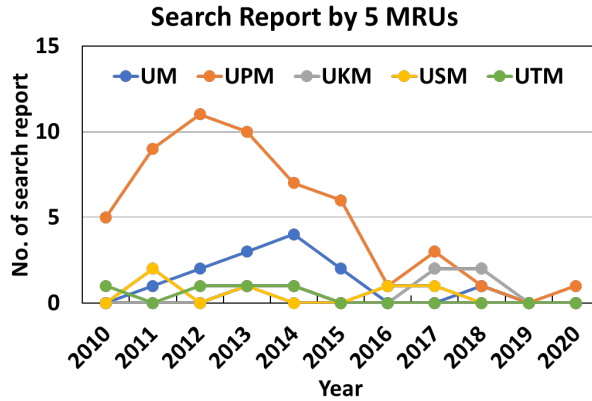


Fig. 4. Patent search report by 5 MRUs

4.3.3 Patent Amended Application

From **Figure 5**, UPM recorded the highest total number of applications that need to be amended which is 5, UM and USM are 3, while UKM and UTM are 1. Amendments are part of the patent application procedure, and most applications will be amended in some way prior to the grant. It's better to make changes earlier to the design to circumvent a competitor's patent rather than waiting for the launch before discovering issues. An amended application is usually to address objections raised by the patent examiner, where the patent examiner will review the patent application to determine whether it meets the country's patentability requirements. Among the reasons for the objection may be because the invention is not novel, cannot be used industrially or the invention is not inventive enough based on the patent searches that have been found. This is one of the reasons why patent applications should be drafted by a qualified patent examiner, who requires full details of the invention to do a thorough job.

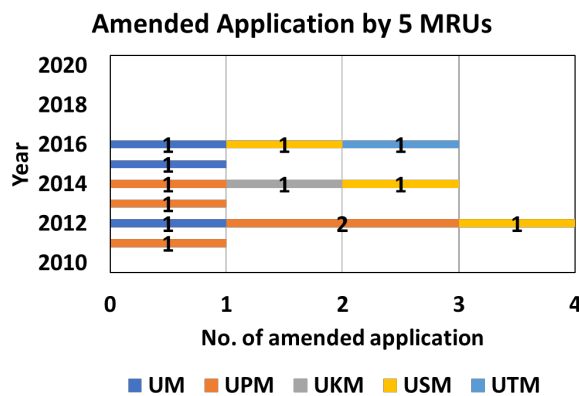


Fig. 5. Patent amended application by 5 MRUs.

4.3.4 Patent Granted

Figure 6 shows the number of granted patents by the 5 MRUs between 2010 and 2020. Overall, UPM recorded the highest total number of granted patents (292), followed by UM and UTM (220), USM (91) and UKM (75). In 2010-2014, the total number of patents granted by all MRUs was 494.

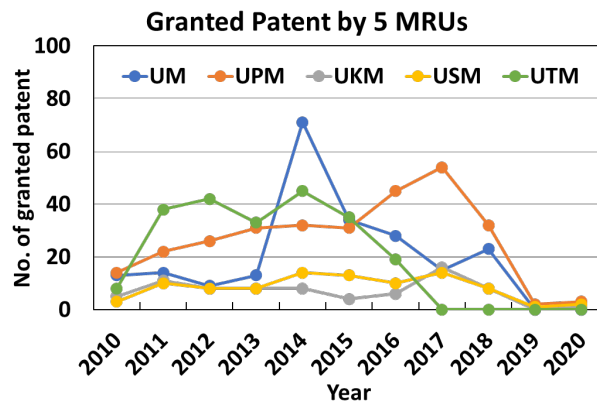


Fig. 6. Granted patent by 5 MRUs.

4.4 Patent Collaboration by MRUs

From **Figure 7**, there are four entities that collaborate with the MRUs in producing patents which are industry players, government agencies, local universities, and international universities. From the figures, collaboration with industry players makes up most of the patent counts, followed by collaboration with government agencies, and local universities and with the least amount of collaboration counts, collaboration with international universities.

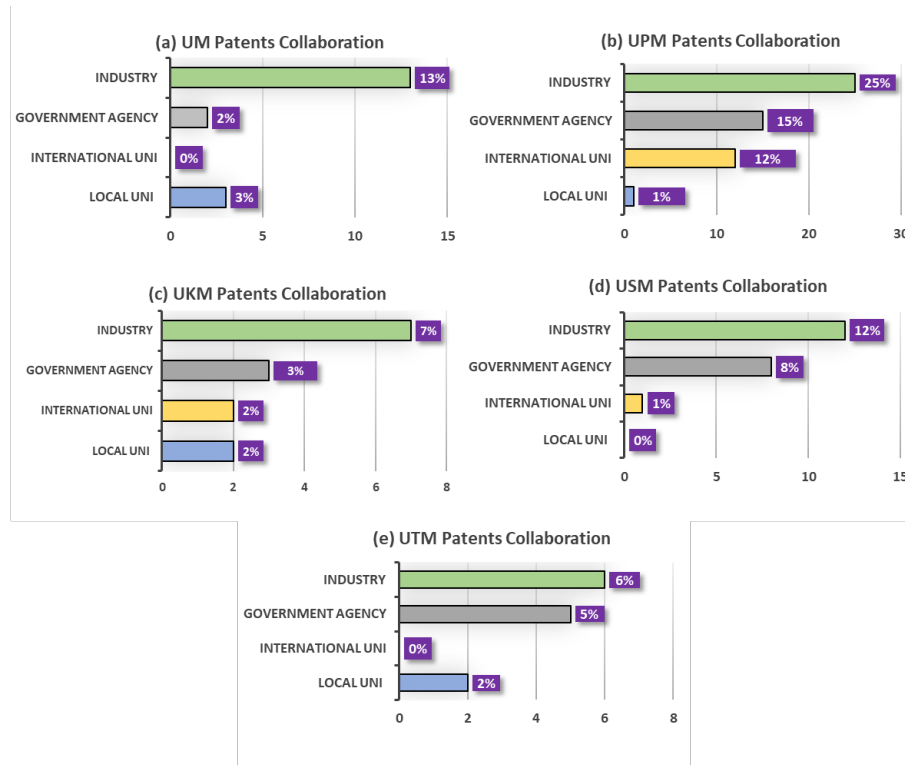


Fig. 7. Percentages of patent collaboration for Malaysian RUs.

4.5 Patent Citation by Malaysia Research Universities

As depicted in **Figure 8 (a)**, Cites Patent Count with the highest number of patent documents that cites other patents according to year is recorded by UTM in 2015 with 208 patents and **Figure 8 (b)**. Cited by Patent Count with the highest number of cited patent count among the MRUs is acknowledged by UM in 2014 with 119 patent documents following the result set that are cited by other patent documents. The highest citation count for patent per se in this study was recorded in 2015 with 42 cites of pattern. This highest citation count for the patent title is ‘Method and apparatus for high intensity ultrasonic treatment of baking materials’ from UPM. Whereas the highest cited patent per se in this study was recorded in 2011 with 86 patent citations. This highest cited patent title is ‘Process to Design and Fabricate a Custom-Fit Implant’ from UM. This result implied that the generation of high patent documents by MRUs that are cited by other patents as recorded in **Figure 8 (a)** does not reflect with citation by other patent documents for the patent document in the result set as recorded in **Figure 8 (b)**.

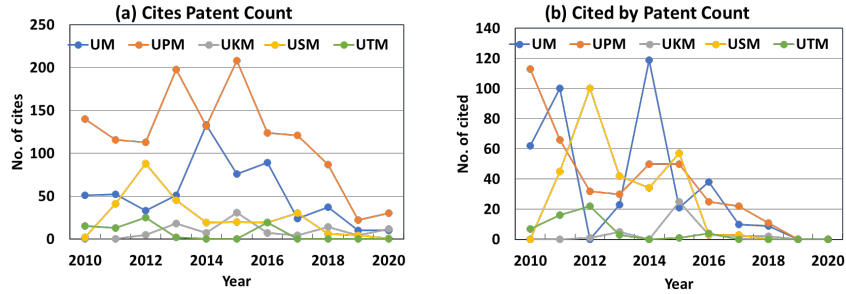


Fig. 8. (a). Cites Patent Count and (b). Cited by Patent Count for five research universities in Malaysia from 2010 to 2020 collected from Lens database.

4.6 Patent Jurisdiction by Malaysia Research Universities

Figure 9 represents jurisdiction as assigned to countries' government bodies and it has shown that all research universities in Malaysia have recorded the highest patent documents from similar legal realms of jurisdiction, i.e. Malaysia as the most common jurisdiction applied except for USM with The World Intellectual Property Organization (WO - IPO) is the highest jurisdiction recorded. Other than that, common top jurisdictions applied are European Patents, the United States, WO-IPO which issues Patent Collaboration/Cooperation Treaty (PCT) patents, the Republic of Korea (South Korea), and Australia. **Figure 9** indirectly explained that the patent secured the inventions from Malaysia jurisdiction play explicitly a major role for research universities in Malaysia to legally protect inventions from infringement as well as to elevate the value of the inventions to be significantly recognized in technology.

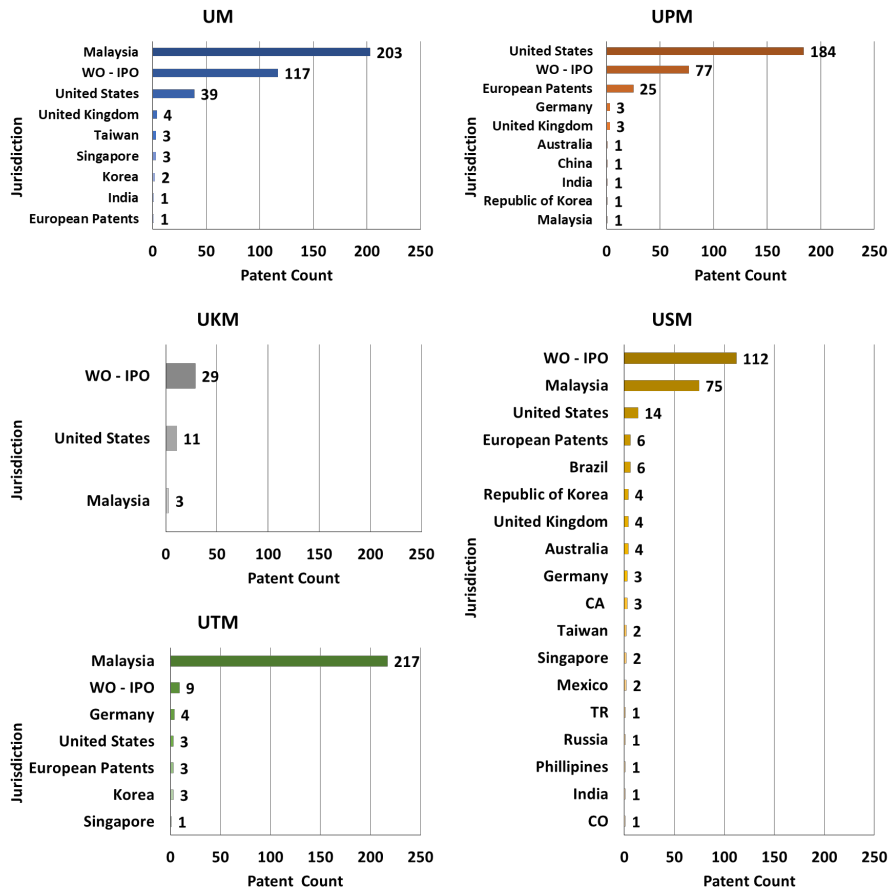


Fig. 9. Jurisdiction allotted to facets by document count from The Lens, a patent and scholarly literature search facility for five research universities in Malaysia.

5 Discussion

The establishment of MRUs status has driven academia to perform a high volume of research and innovation (Sheriff & Abdullah, 2017). This contributes to high numbers of research output including Scopus and WoS-indexed research articles and patents. Many research grants have been provided by the government to support the growth of scholarly activities in universities, especially in the MRUs. However, along the way, the government starts to reduce the research fund, and at the same time, they need to compete with the other local and private universities, which are also progressively expanding their research activities. This is attributed to a rapid decrease in patent production by the MRUs.

Besides patents, MyRA and other ranking systems acknowledge another research output, an academic journal article and the number of citations of that article as the prominent quantitative and qualitative performances indicator. In order to gain a higher score in the ranking system, researchers in the RUs are urged to publish as many as possible of research articles, especially in highly reputed journals to obtain a higher number of citations. As a result, instead of producing patents, efforts and focus have been directed toward publishing the article journal (van Looy et al., 2006).

Another reason for the decline is that producing a patent is relatively difficult as compared to publishing a journal article. Researchers can straightaway submit an academic article to a journal after preparing the manuscript. However, to produce a patent, they need to consult with a patent agent and the process consumes a lot of time. Moreover, fundamental research works performed in universities generally focus on the creation of new ideas or theory, which have less commercial value.

Although there is a trend of increase and decrease in patent applications overall, these 5 MRUs have successfully produced 576 patent applications between 2010-2020, in line with their important role in intellectual property created for the country and the main recipients of public R&D funding (WIPO, 2011). The increment may have been driven by government intervention in advancing appropriate science & technology (S&T), and fiscal and economic policies since the mid-1990s (I. M. A. G. Azmi et al., 2009). Since then, the institutions have had to change the university's corporate paradigm and culture with respect to patent interests (I. M. Azmi, 2014).

This phenomenon can be linked to government initiative through the 10th Malaysia Plan (2011-2015) with 3 additional grant schemes by MOHE namely ERGS, PRGS, and LRGS. Through the plan, funds for the first two years of the five-year plan have been allocated and used. Therefore, the government has intensified the matching of university R&D activities with commercialization programs and business opportunities, which proves the government's commitment to enhancing research development and commercialization (Bakar et al., 2016). However, the total number of patents granted by all MRUs in 2015-2020 has decreased to 404. This may be due to a submitted invention that fails to meet the patentability requirements where the patent is granted by the patent office if it passed certain standards of novelty and utility potential (Jaffe & Lerner, 2011). In addition, internal changes in the university's corporate culture and academic research can also be the cause of the downward trend (I. M. Azmi, 2014).

The majority of the collaborators for the patent counts are industrial partnerships which is contributed by factors such as the introduction of the Public-Private Research Network (PPRN) by the Ministry of Higher Education Malaysia (MOE) since 2014 which has driven the collaboration work between local universities and industry players (Suhaimi et al., 2022). Collaboration and linkages between local universities and industry players can bring positive impacts to both parties. By having these collaborations, local universities can speed up their product commercialization of inventions and novel creations with assistance from the industry player that is more experienced and more well-versed in business management (Dooley & Kirk, 2007). Among other benefits that can be attained by the universities are possibilities of research funding, assistance with experimentation, technology, and material for product development (Rappert et al., 1999). Indirectly these will improve the university's expertise and enhanced knowledge

while keeping abreast with the current technology and development. The industry players can gain benefits from this collaboration by having access to the fundamental knowledge gained through extensive public research works that have been done in universities and highly skilled researchers (Dooley & Kirk, 2007). Industry players will gain benefits too by having chances to recruit highly trained graduates as future employees in the company (Fabrizio, 2007).

Patent citation is one of the powerful tools to measure the quality of research (van Raan, 2017). Reliability of the patents to be reproduced from the perspective that the patentor is aware of the previous piece may not be the prospect of other competitors. Nevertheless, this is not relatively referring to specific types of citation either forward or backward citation.

From the findings, it is recommended the MRUs publish patents in an international treaty for example WO - IPO as this treaty simultaneously provides a larger number of countries protection for the invention with only a single international application rather than singly applying for several countries or regions for application. Besides that, the benefit of applying through the treaty will reduce objections by several single patent offices and thus, lowering prosecution costs. It is also suggested that the patent jurisdiction can be harmonized in a united system across the globe in the future (Park, 2001).

6 Conclusions

An overview of the patent trend by MRUs has been presented and discussed. All data were extracted from the Lens.org database. Overall, MRUs contribute 9.97% of patents published by Malaysia between 2010 to 2020. Research initiatives by the government could be the main factor in enhancing the innovative output products by the MRUs. In contra, fulfilling the requirement of ranking systems, specifically in producing a high number of scholarly outputs i.e. research publication, may discourage and divert the focus in patenting activities. MRUs have a high tendency to collaborate with industry in producing patents, which can promote better output and greater quality research. Mutual benefits can be shared by the local universities and the collaborators such as sharing of technology and resources that can expedite product or service commercialization, thus increasing the commercial value of the research ideas and promoting income generation. There is no clear similarity in patent jurisdiction among the MRUs. International jurisdiction has been a great option for better protection and recognition of patents. MRUs are actively producing patents so that the responsibility as a catalyst for local economic development as desired by the government is achieved, despite financial constraints from all parties. Correlation between patenting activities with research funds and scholarly output such as research publications of MRUs will be the future focus.

Acknowledgments

The authors would like to congratulate those who had committed to initiating this research question and developing the study framework. Similar acknowledgment for

the undivided attention and time to mainly analyze The Lens dataset until this work is presented.

Author contributions

All authors contributed to the study conception and design. Investigation, methodology, writing – original draft preparation was performed by Mohd Arif Mohd Sarjidan, Azizi Abu Bakar, Noor Hidayati Ismail, Sharifah Nur Syafiqah Syed Omar and Noreena Nordin. Methodology, writing – review and analysis conception by Mohd Arif Sarjidan. All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Disclosure statement

The authors have no conflicts of interest or financial interests relating to this work.

References

- Azmi, I. M. (2014). Intellectual property policy and academic patenting in Malaysia: Challenges and prospects. *Pertanika Journal of Social Science and Humanities*, 22(January), 1–20.
- Azmi, I. M. A. G., Lim, H. G., & Alavi, R. (2009). *Intellectual Property System and Industrial Development in Malaysia*. IIUM Press. https://www.wipo.int/export/sites/www/about-ip/en/studies/pdf/wipo_unu_07_malaysia.pdf
- Bakar, A. N., Omar, A. R., Ambali, A. R., Jaafar, R., Idris, M. F. M., Majid, Z. Abd., Baharen, K., & Rom, M. (2016). Commercialisation Activities in Malaysian Universities : Issues and Challenges. *Journal of Administrative Science*, 13(2), 1–27.
- Chandran Govindaraju, V. G. R., & Wong, C.-Y. (2011). Patenting activities by developing countries: The case of Malaysia. *World Patent Information*, 33(1), 51–57. <https://doi.org/10.1016/j.wpi.2010.01.001>
- Dooley, L., & Kirk, D. (2007). University-industry collaboration: Grafting the entrepreneurial paradigm onto academic structures. *European Journal of Innovation Management*, 10(3), 316–332. <https://doi.org/10.1108/14601060710776734>
- Ellen, K., Steve, S., & Greg, S. (2019). Patent Research and Analysis The Lens. <https://ipo.org/wp-content/uploads/2019/11/2019-10-IPO-Patent-Searching-The-Lens.pdf>
- Fabrizio, K. R. (2007). University patenting and the pace of industrial innovation. *Industrial and Corporate Change*, 16(4), 505–534. <https://doi.org/10.1093/icc/dtm016>
- Jaffe, A., & Lerner, J. (2011). Innovation and its discontents: How our broken patent system is endangering innovation and progress, and what to do about it. In

Innovation and Its Discontents: How Our Broken Patent System is Endangering Innovation and Progress, and What to Do About It.

KPT. (2020). Simplified Patent Search Report. <https://www.iium.edu.my/media/51770/%28FINAL%29%20Simplified%20Patent%20Search%20Report%20%28MyGRANTS%29.pdf>

MASTIC. (2022). Prototype Development Research Grant (PRGS). <https://mastic.mosti.gov.my/index.php/sti/incentives/prototype-development-research-grant-prgs>

WIPO. (2011). World Intellectual Property Report 2011 - The Changing Face of Innovation. World Intellectual Property Organization.

Park, I. (2001). Patents without borders : the future of patent harmonisation. *Australian Intellectual Property Journal*, 12(1), 32–50. <https://search.informit.org/doi/10.3316/agispt.20010960>

Penfold, R. (2020). Using the Lens database for staff publications. *Journal of the Medical Library Association*, 108(2). <https://doi.org/10.5195/jmla.2020.918>

Rappert, B., Webster, A., & Charles, D. (1999). Making sense of diversity and reluctance: academic–industrial relations and intellectual property. *Research Policy*, 28(8), 873–890. [https://doi.org/10.1016/S0048-7333\(99\)00028-1](https://doi.org/10.1016/S0048-7333(99)00028-1)

Sheriff, N. M., & Abdullah, N. (2017). Research Universities in Malaysia: What Beholds?. *Asian Journal of University Education*, 13(2), 35–50.

Suhaimi, N. S., Abdul Halim, M. A. S., & Hashim, H. A. (2022). Commercialization of academic research: assessing the perception of academicians at a public university in Malaysia. *Journal of Applied Research in Higher Education*, 14(1), 59–76. <https://doi.org/10.1108/JARHE-04-2020-0071>

Tan, O. K., Choi, S. L., & Amran, R. (2015). Innovation Management and Performance Framework for Research University in Malaysia. *International Education Studies*, 8(6), 32–45.

USM. (2015, December 14). What is MyRA? <https://www.kpims.usm.my/v2/?p=what-is-myra>

van Looy, B., Callaert, J., & Debackere, K. (2006). Publication and patent behavior of academic researchers: Conflicting, reinforcing or merely co-existing? *Research Policy*, 35(4), 596–608. <https://doi.org/10.1016/j.respol.2006.02.003>

van Raan, A. F. J. (2017). Patent Citations Analysis and Its Value in Research Evaluation: A Review and a New Approach to Map Technology-relevant Research. *Journal of Data and Information Science*, 2(1), 13–50. <https://doi.org/10.1515/jdis-2017-0002>

WIPO. (2022). What is Intellectual Property? <https://www.wipo.int/about-ip/en/>