FROM INNOVATION TO MARKET: INTEGRATING UNIVERSITY AND INDUSTRY PERSPECTIVES TOWARDS COMMERCIALISING RESEARCH OUTPUT

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ABSTRACT

In creating an innovative nation, Malaysia has taken various steps towards promoting the national agenda to commercialise their research output at university and research centres. Universities should aggressively identify research by creating products which have commercial value. Many initiatives have been undertaken for effective collaboration between both parties to materialise; nevertheless, the subject is likely to be treated as less significant. Thus, this paper aims to discuss strategies for effective collaboration between universities and industry for the successful commercialisation of research output. For this purpose, qualitative methods in the form of interviewing eight people - academic researchers and those involved in industry – were conducted. Both parties were selected because they have experience in dealing with commercialisation activities at university level. A thematic approach analysis was used to analyse the interview data, and three themes emerged from the data. The findings suggested that the effective strategies for collaboration between universities and industry are related to the commercial value of research products, intellectual property rights aspects and commitment from both universities and industry. However, barriers that hamper collaboration between the two parties must be removed to ensure effective collaboration between universities and industry in promoting commercialisation activities.

KEY WORDS

Academic researchers, industry partner, intellectual property rights, research output, effective partnership.

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Introduction

Significantly commercialising research output at universities has been considered an essential element of promoting creative and innovative processes. Thus, rather than creating a novel research product per se, academics are encouraged to focus on creating and developing research output that potentially has commercial value. This is because making a research product alone is not sufficient to guarantee the success of commercialisation at universities. Since then, universities have increasingly been focusing on commercialising their research output as they view this as

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an avenue towards wealth creation (Miller and Acs, 2013). There are many benefits in commercialising research output, for example, to encourage economic advancement (Dietz and Boseman, 2005) and to create new jobs (Perez and Sanchez, 2003). It is of the utmost importance that research products should be designed based on industrial needs and relevant to the private sector (Powers and McDougall, 2005; Agrawal and Henderson, 2002; Nicolaou and Birley, 2003). In 1980, the trend for commercialising research output had started in the United States after the introduction of the US Bayh-Dole Act 1980. This Act has led to a significant change in intellectual property and technology that allows universities and research institutions to own all their inventions created with the help of federal funding (Christie et al., 2003; Payumo et al., 2012; Glover and Keiller, 2013).

Furthermore, this Act was drafted to promote the rapid diffusion of technologies from universities to firms (Markman et al., 2008). European countries have taken a similar step towards commercialising their research and development (R&D) products through the establishment of the Organisation of Economic Development (OECD) (Markman et al., 2008). In Malaysia, commercialisation has been undertaken through the introduction of the Tenth Malaysian Plan, whereby the Ministry of Higher Education addressed the development of commercialisation and innovation as "Niche 1" that implies its importance in the development of the nation (Abd Aziz et al., 2011). In order to accelerate economic growth through commercialisation activities in Malaysia, implementation was continued under the Eleventh Malaysian Plan (2016-2020). The plan for commercialisation activities has been put forward in the next Twelfth Malaysian Plan (2021--2025) for economic empowerment. Many universities have adopted entrepreneurial strategies to promote the commercialisation of research output and innovation (Gertler, 2010), including Malaysia. Some universities have employed internal, quasi-internal and externalisation approaches to identify research output with commercial potential (Markman et al., 2008); others have adopted collaboration with regional universities, research centres and other organisations (Siegal and Wright, 2007). Most universities collaborate with industry to ensure that their research output has been commercialised successfully (Ramli et al., 2013). To tap into the needs of industry and become relevant to industry, universities should produce research output that meets the market requirements as well as the technology trends in industry (Yusuf, 2006; Van Der Steen and Enders, 2008). Furthermore, there should be a bridge to link the gap between industry and universities to maximise a university's research output (OECD, 2013; Domańska, 2018). However, the progress of commercialisation of university output remains low (Ismail and Mohamed, 2016), although various incentives have been introduced, as universities seem unable to innovate to grasp industry demand (Ab Rahman et al., 2018). Therefore, the research question which is the focus of this article is: how do universities and industry view the commercialisation of products, and where can the two perspectives intersect?

1.Literature review

There are commercialisation policies and other legislation for the commercialisation of research products at universities. For example, in Malaysia, the Intellectual Property Commercialisation Policy for Research and Development (R&D) Projects Funded by the Government of Malaysia 2009 was introduced by the Ministry of Science, Technology and Innovation with

the following objectives: (1) to establish a common framework for intellectual property ownership and management from the related creation, protection, innovation, exploitation and technology transfer; (2) to promote and facilitate intellectual property protection; (3) to promote and facilitate the exploitation and commercialisation of intellectual property. This policy is adopted by the majority of the universities in Malaysia for intellectual property protection and management of ownership rights at the universities. These policies are important when it comes to establishing proper management of intellectual property rights and protecting processes related to the commercialisation of research products (Ramli and Zainol, 2013).

The commercialisation of research output has become a critical agenda at universities and is considered the engine of wealth creation (Markman et al., 2008; Kobylińska and Lavios, 2020). The relevant literature discusses the commercialisation of research output at universities, involving the process of translating research knowledge into new and improved products or processes (Diane, 2004); and using all possible opportunities to gain profits from technological innovation (Khan et al., 2020). It also reflects the fact that a university transfers its technological knowledge to industry in exchange for some of the rights. Thus, universities have now recognised the potential for the commercialisation of their research output, in this way transforming from the "ivory towers" model towards "entrepreneurial universities" (Ramli et al., 2013). To ensure that the commercialisation of research output and innovation at universities is a success, universities should implement an innovation strategy (Khademi and Ismail, 2013), involving different actors in the innovation process (Perkman et al., 2013); adopt various innovation strategies (West and Bogers, 2013) and research activities (Sivertsen and Meijer, 2020; Máté et al., 2017). To fit research output and innovation to industry demand, academic experts should be considered the source of innovation (Purcarae et al., 2013). Those academics who have experience in industry might be useful in terms of bridging the knowledge gap for commercialisation (Kotha et al., 2013) because they exhibit innovative quality towards commercialisation (Schafer and Richards, 2007). Furthermore, industries have increasingly recognised the importance of scientific knowledge creation from universities, which motivates them to enhance their knowledge as well as to gain a competitive advantage (Tseng et al., 2020). Inevitably, universities have changed their function to become the central agent in an innovation system that brings the research output to industry (Fischer et al., 2019).

Collaboration between university and industry is referred as "interaction between any parts of the higher education system and industry aiming mainly to encourage knowledge and technology exchange" (for example Ankrah and Al-Tabbaa, 2015; Bodas Freitas et al., 2013; Gorączkowska, 2018). Thus, collaboration between universities and industry has been the focus of a great deal of attention due to the associated innovation and economic growth (Li et al., 2018; Rajiani and Ismail, 2019; Lewandowska and Stopa, 2018, 2019). There are considerable benefits from such collaboration, including reducing the costs of research and development, adopting a multidisciplinary approach, and improving collaborators' reputations and developing expertise in a particular field (Draghici et al., 2015). Furthermore, the collaboration benefits both parties from the perspective of long-term cooperation – companies will gain access to cutting edge research and talent, and universities will gain access to financial support (Liefner et al., 2019).

Collaboration with universities is important for industry to remain competitive and help them in solving industrial problems (Draghici et al., 2015). It has been proven that medical research funded by industry is more likely to have a positive result (Bourgeoise et al., 2020).

To date, there is no 'one size fits all' and systematic approach for collaboration between universities and industry – albeit some might propose a collaborative framework (e.g. Awasthy et al., 2020) or a strategic framework (e.g. Garousi et al., 2016). There are many forms of collaboration such as through consultancy and technical provision, R&D agreement, licensing, contract research and spin-off companies (Rast et al., 2012); or collaboration formed through an academic spin-off, patenting and licensing of university inventions, networking and consultancy, sabbaticals and mobility schemes for researchers (OECD, 2019). Some universities offer different approaches, such as a project management approach for supporting collaboration in terms of setting structured objectives, monitoring progress and effective communication (Fernandes et al., 2015); or through industry grants (Boardman and Ponomoriov, 2009).

Thus, to ensure effective collaboration between universities and industry, many factors are at play. According to Frolund and Riedel (2018), there are five success factors for strategic collaboration between university and industry, namely (1) the selection of the focus area between university and industry; (2) the selection of partners for potential interaction; (3) suitable collaboration formats; (4) dedicated people, processes and organisation, and (5) regular evaluation of the partnership. Furthermore, Pertuze et al. (2010) claimed that the success of collaboration depends on the following: (1) defining the project's strategic context as part of the selection process; (2) selecting boundary-spanning project managers with three key attributes; (3) sharing the vision of how collaboration can help the company with the university team; (4) investing in long term-relationships; (5) establishing strong communication links with the university team; (6) building broad awareness of the project within the company; and (7) supporting the work internally, both during the contract and until the research can be exploited. The accessibility and proximity between universities and industry are also one of the reasons for effective collaboration (Maietta, 2015). In Korea, the collaboration between university and industry is mainly encouraged by the government policy known as the "triple-helix statist model, 2003" (Nam et al., 2019). The research capacity, education capacity and organisational capacity of the government's financial support for universities are also considered important factors for university-industry collaboration (Nam et al., 2019). The collaboration between universities and industry serves as a strategic approach for the benefits of both players. In fostering such collaboration, many universities have developed a "third mission" (Gulbrandsen and Slipersaeter, 2007) to facilitate and promote the transfer of technology between universities and industry (D'Este and Perkmann, 2010; Gulbrandsen and Slipersaeter, 2007; Howitt, 2013; Aziati et al., 2014) with the goal of creating an "entrepreneurial university" (Giones, 2019; Audretsch, 2014).

There is a significant amount of tension in the relationship between universities and industry. There are different underlying values, beliefs, and processes therein (Ehrismann and Patel, 2015; Čiuladienė and Walancik, 2020). The distinct priorities and cultures which universities and industry have might affect collaboration (D'Este and Perkmann, 2010; Howitt, 2013; Aziati et al., 2014; Ramli and Zainol, 2013; Lind et al., 2013). Furthermore, academic

researchers choose to share knowledge and publish their research results, whilst industry tends to keep their research findings secret from competitors (Ramli and Zainol, 2013; Aziati et al., 2014; Schulze-Krogh and Calignano, 2019). Furthermore, the conflicting understanding between the two parties makes it difficult for them to establish trust and commitment (Barnes et al., 2002). It is always a challenge to bridge the gap between universities and industry. It has been claimed that the expertise of universities is vague and less well-known within industry (Ramli and Zainol, 2013). A challenge also arises in navigating non-disclosure agreements and creating a flexible research agreement that accounts for potential intellectual property (IP).

When it comes to emphasising the importance of collaboration for the successful commercialisation of research products, there are limited academic discussions emphasising the strategies for effective collaboration between universities and industry in Malaysia. Furthermore, due to different orientation and cultures, effective collaboration becomes even more complex. The perspectives of industry are always ignored (Frolund and Riedel, 2018; Giones, 2019); thus, this paper aims to discuss strategies for effective collaboration between universities and industry towards achieving successful research product commercialisation at Malaysian universities.

2. Methodology

This research employs the qualitative research method to identify the effective strategies for successful collaboration between universities and industry in commercialising research output. The selection of respondents is based on purposive sampling to yield rich data and for an in-depth understanding (Patton, 2002). For this purpose, four prominent academic researchers and four industry partners who have been directly involved with commercialising research output have been selected for the interview. The four academic researchers were selected based on their achievement in commercialising their research products, and they are experts in their fields. They were also chosen because they have been involved in innovation and research activities for at least five to 10 years, and they represent public universities in Malaysia. The four industry partners were selected based on their engagement in commercialising universities' innovation and products. They have been cooperating with universities for between five and 10 years in the scope of innovation and commercialisation activities, representing companies which have commercialised a university's products. Both types of respondents were chosen because they were able to provide the right perspective of commercialising research output at universities. For reasons of anonymity, the four academic researchers are identified as U1, U2, U3, U4, and the four industry partners are identified as B1, B2, B3, and B4.

Semi-structured interview questions have been designed to capture the real experience, expectations, opinions and feelings of the respondents (Patton, 2002) concerning research product commercialisation. Thus, face-to-face interviews with eight interviewees have been conducted in different contexts and at different times, and each interview lasted approximately one hour to one-and-a-half hours. The talks were then recorded and, and after each session, the interviews were transcribed manually. The transcription was then summarised and sent to the selected respondents for cross-checking and data validation. These follow-up checks from the respondents ensure that the subjectivity of the researcher did not dominate the interpretations of the data (Holliday, 2007; King and Horrocks, 2010).

A thematic approach to the organisation and interpretation of data was employed in which the data were cut and arranged under meaningful interpretation (Holliday, 2007). To allow possible themes to emerge from the data, they were organised and analysed inductively by looking for key phrases, terms and practices within the data. These themes were further analysed and matched with the existing themes identified from the literature review.

3. Research results

The summary of research results is depicted in Table 1. The findings from this study suggest that there are three most effective strategies for successful university-industry collaboration in terms of commercialising research output. However, some barriers exist in implementing those strategies.

Table 1. Summary of research results

Respondents	U1	U2	U3	U4	B1	B2	B3	B4
Producing research output with commercial value	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Intellectual Property Rights	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
University and Industry Commitment	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No

Source: Own elaboration.

Interviewee B2 argued that some academic researchers only produced research output that is related to their research interests rather than society at large. He said:

"…sometimes, for me, they [academic researchers] produce products based on their own interest and areas of expertise without giving any consideration to the use of the product in society at large. For us, the costs of production in terms of machines and materials are too expensive. Furthermore, we are an SME (Small or Medium-sized Enterprise) and will not be able to invest in that type of product."

Similarly, producing a high operational cost of research products may not encourage industry representatives to collaborate, as observed by interviewee B1:

"…to tell the truth, we have experience in situations in which the university has produced products which were not workable, […] the cost was too high. To take up the project, the risk was too high."

Interviewee B3 emphasised this by saying that *"nowadays, the cost of producing materials is increasing. We want to produce a quality product but we also have to consider the cost of producing it. Industry only focuses on the cost of the product".*

Academic researchers may find it difficult to determine the viability of the research product. Interviewee U3 shared his view that "*I have personal experience where I found it difficult to identify the viability of my research product, especially at the moment I started the research project. I did not know where I should refer to, where I should get advice. I had a dilemma. I had to do it on my own, which I thought was too risky.*" Interviewee U4 further elaborated: *"we are aware that we should create and produce research products that match the needs of the industry. Sad to say, at a certain point, you can expect many issues in such collaboration, and sometimes the collaboration did not work effectively*".

Thus, merely producing a research product per se without carrying any potential market value will be treated by industry as less significant. Interestingly, most universities have now appointed panels to choose possible products for commercialisation.. According to interviewee U1, "*for me, to commercialise and attract potential busi-*

ness people, not all products should be commercialised. We all know that the commercialisation journey requires a long and complex process. It is also too costly. In my university, there are certain areas which have been treated as more important, such as biotechnology, when compared to other areas." Similarly, interviewee U2 shared that "*usually the potential products will be introduced to the industries and public through business networking. We also promote our research products through scientific and technical exhibitions. We also manage to set up licensing agreements between researchers and industry for collaboration*". In a similar vein, interviewee U4 stated that "*for each product that a patent could potentially be secured for, experts from various areas are appointed to assist the university. This panel will screen and evaluate products, whether the product is novel or not and whether it has commercial value*".

Within the university context, the issue of intellectual property rights is always critical, as shared by interviewee U3: "*at a certain point, academic researchers will always claim that "this is my idea*". *When the university offers a certain percentage as profit sharing, they are really reluctant and feel that their rights have been denied because they claim that whatever they created at the university was their idea*". Similarly, interviewee U4 contended that the same issue would arise at universities when profit was involved. He said that "*commercialisation is related to profit. For our university, a large percentage of profit will go to the researcher. The university only shared a small percentage. The intellectual property belongs to the university, but the researcher becomes the inventor.*"

Universities and industry can enter into an exclusive or non-exclusive licensing agreement for the rights to a given product. However, in certain circumstances, it is quite hard to determine the profit sharing and ownership from intellectual property rights between the university and industry. Interviewee B1 shared his experience in dealing with intellectual property aspects with the university. He said that *"we have had a series of discussions when they [researchers] had agreed a certain point. Nonetheless, upon completion of the research product, they changed their mind in terms of profit sharing. The university demanded a share and we could not agree to that. We offered the funding, due to this issue, we discontinued our engagement and collaboration with them. We lost a lot on the project."* Interviewee B2 shared his view: "*we have experience with some researchers who are very difficult to handle and collaborate. They wanted to control everything. It is always a difficult situation".*

Another problem is understanding the language of the law pertaining to IP rights. This was admitted by interviewee U1 where he found it difficult to understand and to write the legal terms. Similarly, interviewee U3 explained that he has difficulty in convincing researchers to take part in activities that make them better informed about legal terms. He said that "*to be honest with you, when we want to educate people, but they don't really have the intention of learning, there is nothing we can do. But still we should not stop providing the opportunity for people to learn. Maybe we have to change the strategy somewhere [...] they don't understand. I had a very difficult time convincing them [...] to be honest with you, it is hard for me and other researchers to understand the policy […] the policy is always written by lawyers. I mean, the language is not straightforward [...]. I hate reading all this. I just asked somebody to read it and explain to me".*

There are some other procedural and cost matters from universities which are difficult for industry to fulfil. According to

B4, *"universities are subject to various rules and procedures, which we thought make it so complicated for us to collaborate. It is so difficult for us to fulfil the requirements. For example, if we want the product, we need to invest hundreds of thousands, and then we have to share from 3 percent to 5 percent for the royalty. It is quite a burden for us."* Similarly, interviewee B3 shared that "*the price of intellectual property was sometimes not reasonable. I know everything involves cost, we also have something to protect in our company. We also have our processes and procedures in developing the products, which we need to protect. This is the cost that we need to consider.*"

Another problem is with the Technology Transfer Office (TTO) or Research Management Centre (RMC), as stated by UI: *"…For me, there is no clear guideline on how to commercialise research products at the university. I am not sure whether the research management office can assist us in terms of personnel. We want dedicated personnel to work for us so that we can focus on the research. We need someone who is an expert and has business skills to help us to deal with industry and commercialise our product. This person is also crucial in assisting us in drafting intellectual property, especially patents."*

Certain problems arise during collaboration between universities and industries. Interviewee U1 commented:

"We want to commercialise the product but it requires a lot of time to monitor. Although the product has commercial potential, we do not have time to monitor the product."

Furthermore, according to interviewee U2,*"most of the lecturers involved in research are willing to be involved in commercialisation…but the problem is…we don't have any industry which is willing to work together with us".* Interviewee U3 agreed, admitting that the biggest challenge in commercialisation is finding the right business partner to work with. He further clarified that *"sometimes, industry is not genuine in their intention, and takes advantage of the university in terms of rights and expertise. The university might get some grants, industry might use the funds to their advantage."* Complicated procedures may affect obtaining funding, as shared by interviewee B3: *"there is a difference between universities and industry in terms of the deadline and timeframe. The process at the university is too complicated, especially when it relates to funding procedures. Industry wants to be quick, if we see some potential in the deal. In business, time is very important. But when it comes to the university, they have to sit with the committee to make a decision. Sometimes it takes longer for us to wait".*

Also, as mentioned by interviewee U4, *"for me, not all academic researchers are well prepared and ready to become entrepreneurs; to commercialise their research product. This could limit the collaboration from industry".* Another concern was listed by interviewee U3: *"…the process of commercialisation is not easy, the agreement is also not easy. The procedures are too complex and not flexible; we do not know how to move into industry".* The procedures set by a university may not draw the attention of industry. According to interviewee B1, *"there are a lot of procedures that we must abide by. We need to convince top management at the university. We need to explain our roles. We feel that this was too complicated and time-consuming".* Similarly, interviewee B2 commented that *"actually, when we talk about collaboration, "who needs who..?" The university tends to set a lot of requirements, which we thought were too complicated to fulfil".*

4. Discussion

Research product commercialisation at universities has been considered the primary catalyst for the creation of wealth. To achieve this goal, therefore, universities and industry play a significant role in commercialising research products. Admittedly, the commercialisation process is complex and there are a lot of challenges that universities have to face, especially when commercialisation is still at the early stage of development in Malaysia (Abd Aziz et al., 2011; Ab Rahman et al., 2018). This paper aims to study strategies that need to be adopted by universities and industries to strengthen the collaboration in order to commercialise research products. These strategies are discussed in considerable detail below.

4.1. Producing research output with commercial value

Industry expects universities to create and produce research output that taps into market needs. In other words, a university should produce research output that has commercial value and offers a solution to social needs. However, this is not always the case, as academic researchers have tended to focus on novel research output and expand their research areas. Furthermore, due to the tacit nature of knowledge, academic researchers in Malaysia may not have the necessary experience in producing research output that has commercial value (Aziati et al., 2014; Ismail and Mohamed, 2016).

Thus, there are many factors for academic researchers and universities to consider when they want to embark on the commercialisation of research output. The product should benefit the public at large, and by producing novel and original research products without tapping into the market, needs will not guarantee collaboration between universities and industry (Awasthy et al., 2020). It is worth mentioning that the direction of the research output in Malaysian universities is now moving towards producing high impact research. An award-winning research product may be treated less significantly unless it can contribute to society. In realising this critical issue, the government has taken various steps, including offering matching grants that tap into the existing industrial problem. Furthermore, due to the differing orientation, motivation and culture of both parties, universities should think of minimising the cost of production, operation and materials to increase the investment attractiveness to industry.

Academic researchers are aware that research product should be created to meet the requirements of the market; however, they have admitted that it is not so easy to do so. Although educational researchers have considered products which meet the needs of the market, it is less likely to be an effective collaboration between university and industry (Ankrah and Al-Tabbaa, 2015; Wróblewski, 2020).

Academic researchers need to be well informed that not all research products can be commercialised. Industry people are mostly prone to focusing on products which have commercial value (Garousi et al., 2016). Thus, when it comes to the question of whether or not to commercialise, academic researchers may seek advice and assistance from the personnel at the Research Management Centre (RMC) or Technology Transfer Office (TTO) at the respective universities. Such personnel (other than academic researchers) must possess special skills such as management, marketing and business skills to specifically communicate with the industry to market university research products. Matching grants between universities and industry have now been introduced to consider the needs of both parties. Fur-

thermore, in order to identify whether a research product is viable or not, academic researchers have to do a market survey and tap into the needs of industry.

4.2. Intellectual property rights

Intellectual property rights and commercialisation policies in Malaysia were first introduced by the Ministry of Science, Technology and Innovation (MOSTI) in 2009. The purpose of the policy, among other things, is to govern the ownership and commercialisation, profit sharing, and the exploitation of intellectual property, especially research funded by the government. In line with the government's aspiration, most universities have adopted these intellectual property rights and commercialisation policies which provide some room for academic researchers to understand their rights.

Collaboration between universities and industry is marked through interactions whereby research remains relevant at the university, and industry manages to obtain access to the expertise, resources and facilities at universities (Bodas Freitas et al., 2013). Generally, intellectual property ownership is given to the university if the university provides substantial funding for the research. For example, section 20 of the Malaysian Patents Act 1983 clearly states that inventions made by an employee or under a commission shall belong to the employer. Still, the employee shall be entitled to equitable remuneration which may be fixed later if the invention acquires an economic value much greater than the parties could reasonably have foreseen initially. The other challenging part is that the policy and related documents were prepared using legal terms, which can be quite difficult for those who have a technical and scientific background.

It is clear that the phenomenon of university-industry collaboration is complex, all the more so when it involves intellectual property rights. Certain intellectual property issues arise when it involves collaboration between universities and industry (Draghici et al., 2015). Normally, the university and industry will agree on certain rights and responsibilities which will be laid out in a formal document. It is advisable to have an explicit agreement at the moment when the collaboration is formed between the university and industry, to avoid any dispute in the future (Bourgeois et al., 2020). In determining the rights and responsibilities for each party, both parties will usually enter into contract research, contractual agreement or Non-Disclosure Agreements (NDAs).

The difficulty of collaboration due to certain aspects of intellectual property rights could be minimal if the parties have played their own roles appropriately. In term of collaborative research between universities and industry, both parties should specify the period of the agreement at the very beginning of the collaboration. The precise term in the agreement manages to solve issues related to rights and obligations, non-disclosure agreement, profit sharing, ownership rights, and licensing agreement. Sharing knowledge is the ultimate purpose of being an academic, but they should carefully distinguish what to or what not to disclose before entering into a valid agreement (Fernandes et al., 2015). Furthermore, role-playing of TTO/RMC is significant in helping academic researchers to deal with outsiders, including industry representatives. The personnel attached to the TTO/RMC must possess specific skills such as management and business skills to help the academic researchers when it comes to the protection of intellectual property rights.

4.3. University and industry commitment

For successful collaboration, the commitment of both universities and industry is essential (Awasthy et al., 2020). However, being overloaded with a mountain of work, academic researchers need to offset this across teaching, researching and commercialising. When it comes to commercialising research products, there is a complicated road that academic researchers are obliged to endure. They need to forego their time, effort and energy to drum up industry interest in collaboration. Apart from this, academic researchers should possess certain skills in identifying the right industry partner for effective collaboration. Industry expects that universities are ready to commercialise their research products. Many research products are not successfully commercialised because academic researchers are not prepared to become entrepreneurs (Audretsch, 2014).

Furthermore, commercialisation as a form of innovativeness in a university setting is commonly associated with a perceived incapacity to innovate meritoriously. In other words, universities do not display a business-like attitude to innovation where cost-effective innovations are maintained, and less successful practices are abandoned (Rajiani and Ismail, 2019). Furthermore, commercialisation at universities must follow a set of trajectories (Ismail and Mohamed, 2016). For effective collaboration, both parties need to change their attitudes to strengthen understanding. Miscommunication should be avoided, and challenges should be treated as an opportunity to improve the situation. Strong knowledge and an appreciation of different orientations are essential when it comes to sustaining the collaborative agreement.

Conclusions

Although university and industry could adopt many strategies for effective collaboration, this study focuses only on three main approaches, namely producing research products of commercial value, intellectual property rights aspects and commitment from academic researchers and industry partners. Universities should be able to deliver commercial value from research products that tap into market needs (San et al., 2012) to drum up industry interest in effective collaboration. This inevitably enhances the role of universities which support the business and economy of the country (Scandura, 2016). Furthermore, intellectual property rights aspects should be covered at the very beginning of collaboration, in the form of an agreement between the university and industry. Both parties should provide full commitments in term of energy, time and effort, being honestly involved in collaboration so as to achieve successful research product commercialisation (Karlsson, 2014).

This study recommends that products made by universities should be able to solve the problems faced by industry. Producing a novel product alone will not guarantee that industry will invest and collaborate with universities. The modern function of universities should now be seen as the central agent for innovation systems and technological advancement (Fischer et al., 2019). Furthermore, panels should be appointed to select suitable and viable research products for commercialisation to encourage the likelihood of collaboration from industry. In terms of intellectual property rights aspects, the Research Management Centre (RMC) or Technology Transfer Office (TTO) should play an influential role in disseminating knowledge and information related to the rights and responsibilities of parties involved in the collaborative agreements.

Furthermore, personnel attached to the RMC or TTO must be capable of assisting academic researchers and facilitating their negotiations with industry partners. They should possess various skills related to the commercialisation of research products such as business, management, marketing, legal and financial skills. Intellectual property aspects such as ownership and profit sharing need to be identified and determined at an early stage of research development and collaborative agreement, to avoid any disputes which might arise in the future. Furthermore, there is an explicit non-disclosure agreement that governs both parties in disseminating information related to collaborative research. Commitment from both parties is important when it comes to maintaining a good rapport and forming a strategic and synergetic collaboration between universities and industry. This strategic leadership approach is essential to improving commercialisation-related activities, and university academics need to strengthen their leadership skills to be innovative and to expedite the process for commercialisation (Abdul Razak and Murray, 2017). Since universities and industry have a different orientation in term of their preferences, aims and goals, understanding and appreciation must be emphasised and concerted to bridge the two worlds to achieve a common goal when it comes to commercialising research products. A clear set of policies must be highlighted to enhance university-industry collaboration for innovative efficiency at every stage of commercialisation (Shi et al., 2020; Cheng et al., 2020) and to ensure that all research output will enter the market successfully.

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