



## COLLABORATIVE TECHNOLOGY COMMERCIALIZATION IN MALAYSIAN PUBLIC UNIVERSITIES: GAPS AND SOLUTIONS IN CLASSICAL SHARIAH FRAMEWORKS

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### ABSTRACT

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With the motivation to improve the commercialization rate of Malaysian public universities, this study aims to explore the collaborative elements found in the classical Shariah frameworks that can be adopted to develop a dynamic collaborative technology commercialization framework. To answer this question, literature review was conducted on commercialization strategies and frameworks, and collaborative elements in classical Shariah frameworks. Apart from modern literatures, the historical accounts of Ibn Khaldun in The Muqaddimah, the jurisprudence on partnerships during the Ottoman Empire in The Al-Majalla, and Shariah Standards for Mudarabah and Musharakah in The Accounting and Auditing Organization for Islamic Financial Institutions were also reviewed. This study finds that the protective approach in the Intellectual Property (IP) strategy commonly adopted by the Malaysian public universities limits the success and increases the gap in commercialization. Furthermore, there is a concern on the high redundancy and coordination cost of collaboration. It was found that IP strategies based on openness and connectedness offers solutions to the issues identified. This study also highlights the collaborative frameworks in Mudarabah, Musharakah and Shariah partnership structures that the universities can use that provide a clear collaboration outcome. In addition to the alternative frameworks, the parties involved also need to upskill in monitoring and managing commercialization in the best and most efficient way to fulfill commercialization in Malaysia, as captured in the Twelfth Malaysia Plan. The outcome of this study seeks to provide Malaysian public universities with a guideline in enhancing collaborative technology commercialization.

**Contribution/Originality:** This research is one of the very few studies that studies the classical Shariah frameworks which can be used in collaborative technology commercialization. It provides the foundation for building of legal frameworks and guides for the universities' Technology Transfer Offices (TTO) or Research Management Centers (RMC).

## 1. INTRODUCTION

Malaysian public universities have an important role in producing research that benefits the Malaysian economy and society as well as the rest of humanity (Razak & Murray, 2017). This role can be mapped to the backdrop of sustainability as per the United Nations Sustainable Development Goals as well as the *maslahah* of the people, the country and even the *Ummah*. However, such benefits can only be deemed as delivered when the

research is fully commercialized for the benefit of the intended beneficiaries in the economy and society. It is commendable that Malaysia's scientific research output has increased by 4.5 times between 2008 and 2018 (Edwards, 2021). This increase is likely due to the increasing trend of government funds being provided for operating expenses for research universities between 2006 and 2011.

There are five Malaysian public universities that are recognized as research universities namely, Universiti Teknologi Malaysia (UTM), Universiti Kebangsaan Malaysia (UKM), Universiti Putra Malaysia (UPM), University of Malaya (UM) and Universiti Sains Malaysia (USM). As reported by Amran, Rahman, Salleh, Ahmad, and Haron (2014), the amount allocated based on percentage of funds required by Malaysian research universities are USM (92%), UTM (84%), UKM (80%), UPM (78%), and UM (67%).

It is important for the Malaysian government to continue supporting the research universities in order not to disrupt the research and development (R&D) activities at the universities (Amran et al., 2014). However, despite all the support, a study conducted by Shahidan, Latif, and Wahab (2019) found that only 8% of intellectual property rights produced by universities in Malaysia are being commercialized. Data from the Malaysian Science & Technology Information Center (MASTIC) also shows that the country's commercialization rate in general sits only between 5-10%, a drop from 8.3% from the period between 2005 and 2015. This is much lower compared to countries such as China and South Korea as their commercialization rates are above 30%. In addition, the commercialization rates in highly developed economies such as Japan and the US are reported as high as 60% (Edwards, 2021).

Universities generally require researchers to register the patent of their research in the name of the university. The need to own and control research patents may be attributable to the traditional IP strategy of protecting the university's ownership and using patent registration as a sword and shield with a full exclusion approach (Palfrey, 2011). Notably, IP refers to not just the patent, but also trademark, copyright, and service mark. The IP strategy between profit and not for profit organizations tend to also differ due to the differences in the mission and purpose of the organizations. In the context of Malaysian public universities, both research and non-research universities appear to be not for profit. Nevertheless, research universities generally set a higher aim for patented research with commercialization potential (Aziz, Harris, & Norhashim, 2011).

Technology commercialization for public universities in Malaysia typically occurs in two ways. First, when the researchers who are more inclined towards doing business, would set up a venture and commercialize their research themselves. Secondly, through collaboration partners who have the ability to scale the research to market readiness, and with access to market, would commercialize the research under a commercialization agreement with the university. The second approach is usually done through the universities' TTOs or RMCs, once the research output is patented. Malaysian public universities often prefer open innovation and joint ventures as a collaborative technology commercialization framework where they would be able to initiate the research independently and could prioritize their rights over the IP registered in their name.

The current commercialization approach has seen the low conversion of research output to commercialization success. In response to this issue, the Malaysian government has put in place measures in the Twelfth Malaysia Plan to increase their support in university technology commercialization activities with more focus on increasing the capacity of researchers in entrepreneurship. However, the majority of researchers may not have the business acumen skills required and do better in making discoveries and creating new innovations. The odds of having more commercialization success from the universities can be increased if a more dynamic collaborative technology commercialization framework can be put in place that would benefit both the universities and the industry.

With the motivation to improve the commercialization rate of Malaysian public universities, this study aims to explore collaborative elements found in classical Shariah frameworks that can be adopted to develop the said dynamic collaborative technology commercialization framework to close the issues faced by the TTOs and RMCs. The study begins with analysis and identification of the gaps between the existing collaborative technology

commercialization frameworks and other available frameworks which have been successfully adopted by others. In the investigation, this also includes study of the alternative IP strategies that could be adopted. These alternative frameworks have allowed collaboration partners to be involved at various stages of innovation and commercialization. In some cases, the collaboration partners were also able to drive the demand for the research to enhance their own brand positioning in the market. From the gaps identified, the study then reviews the collaborative elements present in structured and unstructured collaborative classical Shariah frameworks. Structured classical Shariah frameworks refer to existing structures which already embody collaborative elements that support entrepreneurship, namely, Mudarabah and Musharakah. Whereas, non-structured collaborative classical Shariah framework refer to collaborative elements from the practice of early Muslim scholars from Ibn Khaldun's historical accounts and the jurisprudence practiced during the Ottoman empire. With the gap analysis and identified potential solutions, this study provides TTOs and RMCs with an insight into the low commercialization rate caused by the gaps due to the existing collaborative technology commercialization frameworks, and the strategies that could be adopted for a better rate of conversion from research output.

## 2. METHODOLOGY

The literature review is segregated into two parts consistent with the parts of the research questions.

### 2.1. Commercialization Strategies and Framework

Finding peer reviews on current collaborative technology commercialization strategies and frameworks used by Malaysian public universities was a challenge for the study. This was due to the different terminologies used by the various parties to describe collaboration. A lot more emphasis is also found in the capacity of researchers to do business.

In identifying the sources for the literature review, multiple databases were used. Initially the International Islamic University Malaysia (IIUM) Library search database selector was utilized to take an initial sample of what types of articles were available. Broad search terms were used to establish a list of research articles that were primary source and peer reviewed. Using basic search, from the article titles and research data derived from the IIUM library, this study was able to use a better list of more refined terms when utilizing other databases.

The search terms selected for this literary analysis consisted of "commercialization strategies", "commercialization framework", "university commercialization", "public university commercialization", "collaborative commercialization", "joint venture", "joint development agreement" and "brand strategy in commercialization". These terms were combined in various ways with the "AND" commands in the effort to obtain the most narrowly defined and appropriate articles. In addition to database searching, several articles were located using the snowball method. Each of the search terms used was selected due to their appropriateness and relevance in consideration of the purposes of the literature review.

### 2.2. Collaborative Elements in Classical Shariah Frameworks

Finding peer reviews on collaborative elements in Mudarabah and Musharakah was a challenge as application of the structures are only mostly found in finance and investments. Whereas for collaborative elements practiced by the early Muslim scholars, the study found a lot of historical accounts by both Muslim and non-Muslim scholars as opposed to reviews of the collaborative elements.

In identifying the sources for the literature review, multiple databases were also used. Broad search terms were initially used to establish a list of research articles that were primary source and peer reviewed. The search terms selected for this literary analysis consisted of "Shariah commercialization strategies", "Islamic commercialization strategies", "Shariah commercialization framework", "Islamic commercialization framework", "Islamic collaborative commercialization", "Islamic joint venture", "Islamic joint development agreement", "early Muslim scholars" and

“16th century Islamic research”. These terms were combined in various ways with the “AND” commands in the effort to obtain the most narrowly defined and appropriate articles. This study found substantial and relevant information in historical accounts by Ibn Khaldun in *The Muqaddimah* (1967) legal practice of the Ottoman empire in the *Mejelle* (Al-Majalla, Al Ahkam, & Al Adaliyyah, 2022) and Shariah standards in The Accounting and Auditing Organisation for Islamic Financial Institutions (AAOIFI) for AAOIFI (2022) and AAOIFI (2022).

For all parts of the research, sources were analyzed according to several criteria. First, the source had to be in line with the purpose of the literature review based on the research questions of the study. Second, the sources had to be primary source research. Any source that focused on secondary source research was removed. Third, sources had to be from a peer-reviewed journal source. In addition to these primary criteria, this study also looked for types of journals that normally includes research articles that are aligned with the themes according to this study’s purpose. Thus, this study gives greater weight to articles that focuses on collaborative commercialization. This study also examined journals that would be characteristic of their respective fields. Finally, this study tried to ensure that the journals used had the most recent publication dates, going back no further than 2016. However due to the challenges faced by the study as described earlier, this study retained substantial sources for analysis.

When examining the data in the articles and other documents, this study looked for statements that indicated proper research procedures being conducted. For quantitative data, this study looked for larger samples with a degree of diversity in demographic data. In quantitative analysis, this study also sought for information in the data collection that reflected research questions that were most in line with its purpose, as well as seeking data with the clearest presentation. Finally, in examining qualitative data, this study examined the collection procedures and the demographic data to verify that the researchers had adhered to practices that would ensure reliability and validity.

### **3. CURRENT COLLABORATIVE TECHNOLOGY COMMERCIALIZATION FRAMEWORKS ADOPTED BY MALAYSIAN PUBLIC UNIVERSITIES**

This study finds that Malaysian public universities do require researchers to register patents of their research in the name of the university. To some extent, they are using the patent registration as a sword and shield with a full exclusion approach (Palfrey, 2011) with some openness to collaboration. The willingness to collaborate however is dependent on the willingness to involve the collaborative partners at an earlier stage and the need to accommodate their needs & requirements.

#### *3.1. Open Innovation Driven Commercialization*

Open innovation is a common commercialization approach used by most of the universities’ TTOs and RMCs. This approach provides a way for the offices to create visibility of their researchers’ R&D and innovation to potential commercialization partners. Open innovation is typically done by university through sharing, promoting, and contributing ideas or resources during the innovation stage via online or physical platforms (Aziz et al., 2011; Siegel, 2019). The university would typically first secure their rights over the IP of the research. With the IP, the university would assign the rights to the interested collaborative partners for them to use the research and go-to-market, in return for royalty payments (Amid, 2015; Razak & Murray, 2017). This approach is depicted in Figure 1 to visualize open innovation driven commercialization.

*Right to Use*



Figure 1. Open innovation driven commercialization.

3.2. Collaboration Driven Commercialization

Apart from the open innovation approach, some TTOs and RMCs set-up joint ventures, joint developments, and strategic alliances with their commercialization partners (Commercialization Strategies, 1998). This collaborative commercialization framework is visualized in Figure 2 where the university would bring their technical knowledge and the commercialization partner would bring their industry knowledge as they both work together towards technology commercialization. In this collaborative technological development framework, both the universities and their commercialization partners would be invested in the commercialization process and outcome. This strategy of collaborative commercialization could involve two or more independent companies cooperating on certain business activities (Henttonen & Lehtimäki, 2017). With more partners involved in this collaborative development, the commercialization partners could be both large corporations as well a consortium of small and medium enterprises who join forces and imitate a large, vertically integrated company. This was part of the findings of Henttonen and Lehtimäki (2017) when they developed case studies for 13 technology intensive Small and Medium Enterprises (“SMEs”) in the forestry sector in Finland.

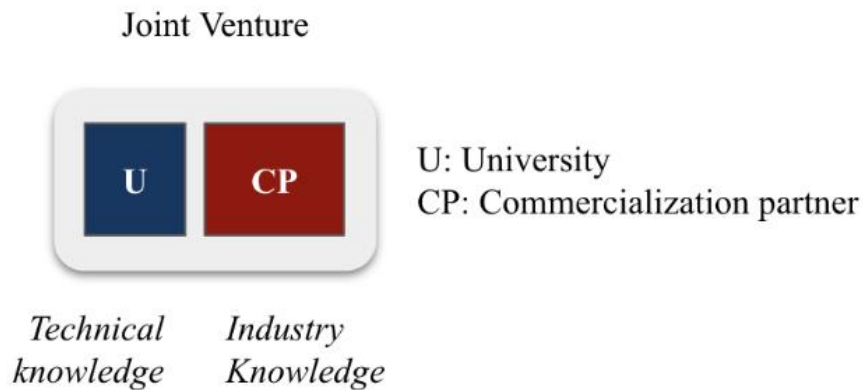


Figure 2. Collaboration driven commercialization.

A key advantage of the collaboration driven framework is that this framework allows the collaborative parties to complement the gaps in knowledge and resources between them towards successful technology commercialization (Amid, 2015; Razak & Murray, 2017). However, Razak and Murray (2017) when they conducted a survey on 222 public university academics found that these collaborative advantages did not significantly influence commercialization success. They cited high knowledge redundancy and increased coordination costs as factors that reduce the advantages and create collaborative drawbacks.

Traditionally, universities in general tend to feel the need to preserve their IP rights over the research especially in the event of failure by the commercialization partner, disregarding the interests of the partners (Palfrey, 2011). This stance could limit the potential growth for technology commercialization as the intention of

such strategy is to prepare for battle in a courtroom if the IP rights of the university is infringed. Whereas, Palfrey (2011) found that an IP strategy that is grounded in openness and connectedness could offer more benefits to all parties. This is the reason why brands like Facebook and Google provide an open platform for developers to build and integrate their tools on their platform. Technology which are enabled by mobile phones using iPhone Operating System (IOS) and Android interoperability has seen Apple and Google tap into the creativity and enthusiasm of mobile phone users and software developers (Palfrey, 2011). This study has also found platforms that crowdsource solutions from university research which could solve a particular type of problem as defined by industry such as the InnoCentive platform (Innocentive, 2022). These crowdsourcing platforms could be used by the TTOs and RMCs to validate the commercialization potential of a particular research output and reach out to commercialization partners. If the commercialization partner is desirous of owning the IP of the research, Malaysian public universities could also enter into a knowledge sale (patent and technology sale) arrangement where ownership of the knowledge is transferred (Henttonen & Lehtimäki, 2017). With this, Malaysian public universities could monetize the IP by knowledge sale, and this can be a new revenue stream for the universities and diversify their funds for operating income.

In selecting the best collaborative commercialization framework for their universities, RMCs and TTOs need to consider the drawbacks of each framework. Open innovation might allow universities to efficiently convert from research ideas to patented research output. However, without the feedback from the collaboration partners who understand industry needs or who could drive the demand themselves, universities would risk rejection or an extended period of having to make the necessary adjustments post feedback. Based on the existing collaborative commercialization frameworks which have been identified by this study, the gaps found so far relate to the implication of Malaysian public universities initiating innovation, the extent of risk and commitment of both parties. In collaboration driven commercialization, it is important that the knowledge transferred to the collaboration partners by Malaysian public universities are in industry ready form to avoid high knowledge redundancy. Furthermore, the issues related to coordination between Malaysian public universities and their collaboration partners need to be addressed to manage the increased coordination costs. It is also apparent that Malaysian public universities need to adjust their IP strategy from the traditional position of IP as a sword and shield to an IP strategy that is grounded in openness and connectedness which offers more benefits to all parties. To ensure that we have identified all the gaps relating to the current collaborative technology commercialization framework, this study reviews these gaps against other frameworks which are used by others.

#### **4. REVIEW OF OTHER COLLABORATIVE COMMERCIALIZATION FRAMEWORKS**

In ascertaining the most suitable collaborative commercialization framework, TTOs and RMCs should also consider the preferences of the commercialization partners. The partners may want to contribute differently in terms of ideas, requirements, network, timing and financials. Their appetite for risk profiles would also differ at the various stages of innovation where some may wish to collaborate with universities as demand drivers for the research to enhance their own brand positioning in the market. TTOs and RMCs could also adopt several types of IP strategies that accommodate the various preferences.

##### *4.1. Market Driven Commercialization*

In market driven commercialization, industry would drive the demand for innovation which in turn drives the collaboration as shown in Figure 3. As the demand driver, the commercialization partner could drive commercialization with two types of strategies, in-house strategy, and outsourcing strategy. Firstly, as an in-house strategy, commercialization of the research innovation would be applied within the collaborative partner company. In this strategy, the university researchers would be able to apply their knowledge onto the company's own products and services' research and development (Henttonen & Lehtimäki, 2017). The researchers could typically

provide consultancy or advisory in the product development, including to facilitate the technology adoption. The researchers would be actively involved in the product development process, but with the direction provided by the industry partner.

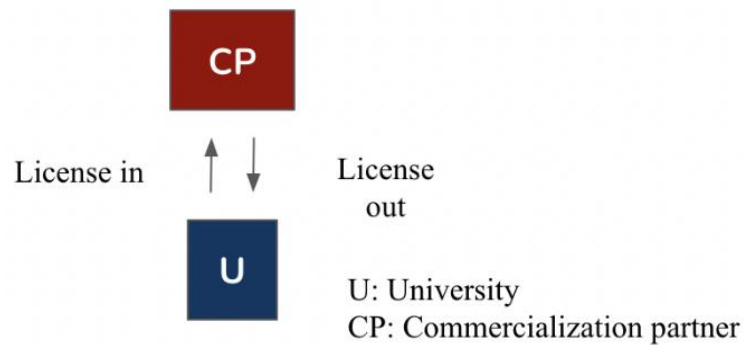


Figure 3. Market driven commercialization.

In the second market driven commercialization strategy, the outsourcing strategy, the industry reaches out to the university for support in research and commercialization. This approach has shown to help companies achieve economies of scale in R&D, manufacturing and marketing. It is also advantageous for the industry players to outsource for support when they lack resources and capabilities (Henttonen & Lehtimäki, 2017). The research and development work would be carried out at the university but with the direction given by the commercialization partner.

In the case of market driven commercialization, the licensing revenue model that is commonly used by the universities would still be relevant to be applied, but the industry partner would be able to give deeper insight and more comprehensive input from the industry point of view in the commercialization process. In contrast to the current framework in open innovation driven commercialization (Figure 1), the open innovation framework tends to be one sided and prioritizes the universities' need to commercialize an innovation that their researcher has produced. Whereas in this framework, the commercialization partner would have the bandwidth to pivot the direction of the research to be done closer to what they need.

#### 4.2. Commercialization with Multiple Partners

Apart from forming a single partnership with a commercialization partner, the universities could also opt to license-out to more than one partner across various markets for a particular research output as depicted in Figure 4. The commercialization partners may come from various regions, different industry backgrounds, various suppliers, various customer bases and even competitors via cross-licensing, grant back and supply of goods compensation. Additionally, universities could also contract out manufacturing, marketing or even license out to a turnkey plant. In this framework, the universities would remain the owner of the IP, but they can give the right to use the IP to several commercialization partners.

In this multi license framework, the commercialization partners are commonly the new technology-based companies (Henttonen & Lehtimäki, 2017) who could not afford the exclusive right to use the IP. For the universities to adopt this model, the TTOs or RMCs would need a coverage team who would function as caretaker of the business model for each commercialization project. The team should have the capability to manage the different commercialization partners covering the different aspects of commercialization.

Reflecting on the case of Malaysian public universities, this collaborative technology commercialization framework could help expand the use of Joint Development Agreements where the universities can maximize the outcome of the collaboration with the partners. This is especially true when the partners also own an IP that they are using to complete their part of the solution (Palfrey, 2011). Furthermore, when compared to the currently

adopted framework in open innovation driven commercialization, the framework assumes that there is only one commercialization partner who would commercialize the research, where in fact there exists a different spectrum of commercialization partners that the university can leverage on. To address these gaps, the TTOs and RMCs would need to have business acumen to manage these different spectrums, to prioritize the relevant markets and commercialization partners to onboard.



Figure 4. Commercialization with multiple partners.

#### 4.3. Equity Type Commercialization

Equity type commercialization is a framework that TTOs and RMCs are familiar with. However, it is found that university spin-offs to researchers driving the business are more common, for example Universiti Malaya's Bioapps Sdn Bhd and Oleopharma Sdn Bhd. In this equity type commercialization framework, the universities can explore equity structure involving the universities and commercialization partners in a new commercial vehicle as shown in Figure 5. The researcher driven spin-offs framework is more common probably due to the control that the university retains indirectly via the employment terms with the researcher. In using the equity type commercialization with commercialization partners, equity investment in the parent company, initial public offerings or divestment of company units are some examples of equity type of commercialization frameworks that can be adopted (Commercialization Strategies, 1998). In the case of divestments, the universities have the option to transfer IP, and the sale of all, or some part of, the rights disposal of a unit of the company, and the divestment could also include physical assets (Henttonen & Lehtimäki, 2017). When compared to the collaboration driven commercialization used by Malaysian public universities (Figure 2), this study finds that in the currently adopted framework, with only the researcher driven spin-offs being recognized, optimization from collaboration partners who are more invested with higher stakes is not maximized. For commercialization partners, recognition of equity-based partnership with the universities would provide them credibility to support their commercialization efforts.

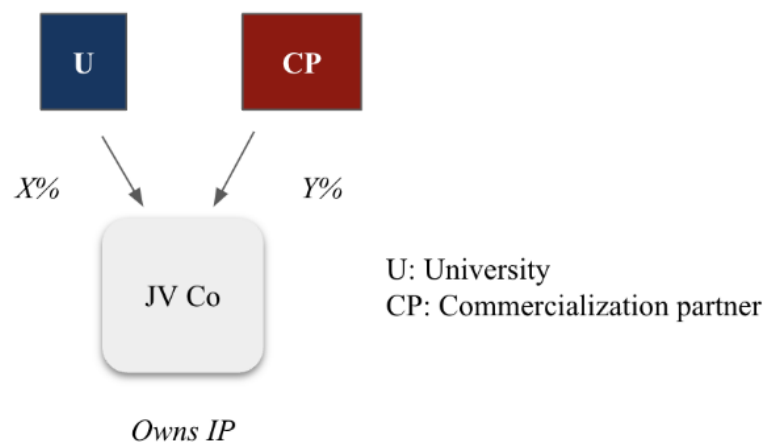


Figure 5. Equity type commercialization.



4.4. IP Right Driven Commercialization

IP right driven commercialization refers to collaborative commercialization based on the various IP rights structure that is adopted by the commercialization partners. There can be three different situations where the commercialization can take place; project based, relationship based and evolving model framework.

In an IP right driven - project based framework as portrayed in Figure 6, the universities could license the research IP to the commercialization partners who sponsor the technology development project financially. In this framework, the universities have the option to negotiate or elect a license, to opt for exclusivity or non-exclusivity of the IP right, and whether the IP right would be a royalty bearing. With these options, more flexibility should be offered to the sponsoring partners as they provide higher financial contributions (Siegel, 2019). The currently adopted open innovation driven commercialization in Figure 1 appears to be rigid and does not provide the commercialization partner who sponsors on a project basis the flexibility to negotiate the terms based on their level of involvement (Siegel, 2019).

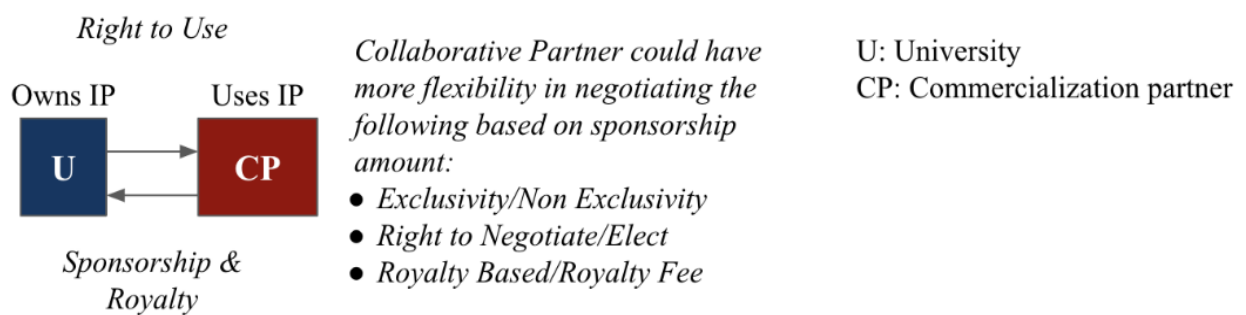


Figure 6. IP right driven commercialization - project based.

When the IP right driven commercialization is relationship based as pictured in Figure 7, the collaboration arrangements can be offered by the universities through different types of relationship agreements to the commercialization partners. For example, corporate memberships, corporate alliances, and master research agreements. These relationship agreements would provide a long-term structure that would foster individual projects underpinned by these agreements. Furthermore, long-term relationship agreement could encourage sponsoring commercialization partners to also lock in their investments for the long run (Siegel, 2019). In comparison to the open innovation driven commercialization (Figure 1), the former does not nurture long-term relationships and in fact does not accord the commercialization partner with a partnership position in the long run.

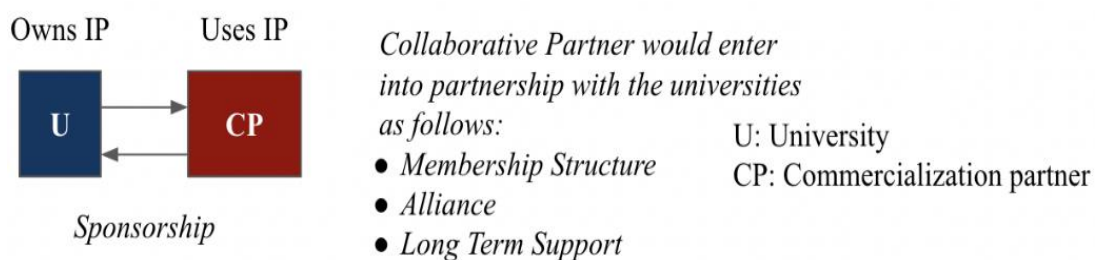


Figure 7. IP right driven commercialization - relationship based.

In an IP right driven - evolving model framework as shown in Figure 8, the commercialization partners could be given exclusive royalty free commercial rights by the universities. The right is granted provided that the commercialization partners would pay the university royalties or specific lump sums if the revenue generated from the technology commercialization activity exceeds a negotiated threshold. The ownership over the commercialized research IP would vary according to the contributions and responsibilities of the commercialization partner (Siegel, 2019). When compared to the revenue structure in the current framework in open innovation driven

commercialization (Figure 1), this study finds that the current framework requires the commercialization partner to pay royalty without regard for the time required for the research to be known in the market. This would make the current framework less relationship friendly. In the event the market take-up of the technology has not begun, the commercialization partner would be under pressure to deliver the expected monetization.

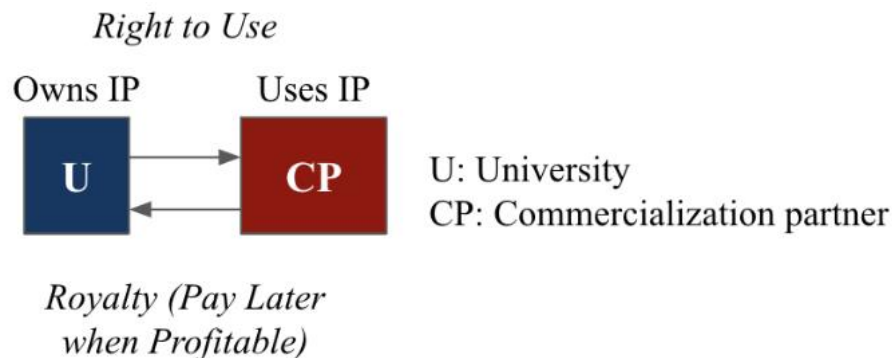


Figure 8. IP right driven - evolving model.

The study finds that the alternative collaborative commercialization frameworks could address issues discovered in the currently adopted frameworks in Figure 1 and Figure 2 by providing for two-sided support for commercialization from ideation to go-to-market phases. The collaborative elements found provides for options to collaborate based on a longer-term basis and with multi parties from various coverage of the market. This will turn the collaboration into a more sustainable launchpad for technology commercialization by Malaysian public universities. With more recognition of risks and investments undertaken by the collaboration partners, the rigidity and need for control by the universities could be more balanced. In any case, it would be pertinent that the solutions sought for Malaysian public universities avoid high knowledge redundancy and increase in coordination costs. This study finds that the alternative frameworks could potentially avoid these issues but adoption of the frameworks itself may not guarantee the said outcome. The next step for this study is to review the collaborative elements in Classical Shariah Frameworks which could provide the solution.

## 5. REVIEW OF CLASSICAL SHARIAH FRAMEWORKS WITH COLLABORATIVE ELEMENTS

Based on the comparison between the current collaborative framework adopted by Malaysian public universities, and the alternative collaborative framework adopted by others, it is clear that the rate of redundancy of university input and coordination cost has affected the decision of TTOs and RMCs. In reviewing the collaborative elements in classical Shariah frameworks, this study assesses the ability of the classical Shariah frameworks to address the said issues. In reviewing classical Shariah frameworks which could be adopted, this study reviews the collaborative elements in Mudarabah and Musharakah which are known collaborative Shariah frameworks. The study also reviews the collaborative elements based on the history of early Muslim scholars and documentation available in the law which was in place during the Ottoman Empire.

### 5.1. Collaborative Elements in Mudarabah

Mudarabah is a framework that involves a capital provider known as *rab al maal* and an investment manager known as *mudareb*. In this structure the *rab al maal* provides the required funding for the labor provider (*mudareb*) to manage professionally and provides his technical know-how in managing the investment activities, and in this case the activities may be of technology commercialization. This framework establishes a profit-sharing partnership and is a trust-based arrangement where the *mudareb* is trusted to carry out the activities in a Sharia-compliant basis and is not liable unless there is misconduct, negligence, or breach of terms where he would be liable for the capital

(AAOIFI, 2022). With this framework, the *mudareb* is responsible to put in their time and effort at risk and does not contribute any capital. Upon entering into the agreement, both parties would have a pre-agreed profit distribution and the fees that the *mudareb* would be entitled to when achieving the set objectives. As such, the *mudareb* would not receive anything for his labor if the partnership objective is not achieved (Bakar, Rosbi, & Uzaki, 2017).

To adopt the Mudarabah framework for collaborative technology commercialization, Malaysian public universities and their commercialization partners can be either the capital provider (*rab al maal*) or the labor provider (*mudareb*). This would depend on which commercialization framework is adopted that determines the contributions of both parties. There is a requirement in Mudarabah however that the capital must be provided in cash or tangible assets. If the capital is in the form of tangible assets, it should be an asset that is clearly known to the contracting parties and defined in terms of quality and quantity. The capital must be placed at the disposal of the *mudareb* with free access to it (AAOIFI (2022)). Notably, when there is a requirement for the capital to be in cash or tangible assets, it provides for the partners' needs for growth or optimization which addresses the gap found in the current framework. The flexibility of the *mudareb* in managing the funds depends on the type of Mudarabah structure adopted in the agreement:

#### *i. Unrestricted Mudarabah*

The first type of Mudarabah is Unrestricted Mudarabah, where the capital provider permits the *mudareb* to administer a Mudarabah fund without any restrictions and with his expertise. However, it must be exercised only in accordance with the interests of the parties and the objectives of the Mudarabah contract, which is for profit generation. When the capital provider provides the above permission, the capital provider is giving the *mudareb* funds as well as opportunity to grow and optimize the collaborative arrangement. This would address the gap in the current framework where the current framework does not cater for the commercialization partners' needs for the said growth or optimization. Furthermore, the arrangement in the current practice of the adopted framework is rigid and does not provide the sponsoring partners flexibility to negotiate the terms based on their level of involvement.

#### *ii. Restricted Mudarabah*

The second type of Mudarabah is the Restricted Mudarabah, where the capital provider restricts the actions of the *mudareb* to a particular location or type of investment as the capital provider considers appropriate. However, the capital provider is not allowed to unduly constrain the *mudareb* in his operations although they may require a guarantee from the *mudareb* (AAOIFI, 2022; Bakar et al., 2017). By specifying a suitable location for the respective *mudareb*, the capital provider would be able to identify several *mudarebs* who could achieve the objective based on their capacity and potential. This framework could be adopted by the TTOs and RMCs, together with the commercialization partners, where the university takes on the capital provider role and they could expand the commercialization coverage with multiple *mudarebs* (commercialization partners). Notably, the restriction on the capital provider to unduly constrain the *mudareb* in his operations is ironically addressing the issue with the current framework that does not support the commercialization partner's need for growth or optimisation as the *mudareb* is guided on where to focus on the business.

The Mudarabah framework already provides for inclusion of profit distribution based on an agreed percentage. For a fixed fee to be in place in the collaboration arrangement, a separate non Mudarabah arrangement needs to be executed in tandem. The percentage of profit can be adjusted to customary practice. Conversely, if no fixed customary practice applies, the percentage would be considered as void (Bakar et al., 2017). In the case of technology commercialization, technology normally relies on funding to gain traction prior to the revenue generation stage. Therefore, the TTOs and RMCs and collaboration partners may need a separate non Mudarabah arrangement to cover the fixed fee for the *mudareb*. Ensuring that the *mudareb* is financially provided for, is an

element in a collaborative commercialization partnership that is important. The allowance for profit adjustment will also address gaps in the current commercialization framework that is rigid and does not provide for the sponsoring partners on a project basis and flexibility to negotiate the terms based on their level of involvement.

### 5.2. Collaborative Elements in Musharakah

Musharakah is traditionally known as *Sharikat al-'Aqd* (contractual partnership) which means an agreement between two or more parties to combine their assets, labor or liabilities for the purpose of making profits. *Sharikat al-'Aqd* can be classified into two; the Traditional Fiqh-Nominate Partnerships, and Modern Corporations (AAOIFI, 2022).

#### i. Traditional Fiqh-Nominate Partnerships

There are several partnership arrangements under Traditional Fiqh-Nominate Partnerships: contractual partnership, liability partnership, and vocational partnerships. In contractual partnership or known as *Sharikat al-'Inan*, each party in the collaboration contributes a certain amount of capital. The profit outcome is then distributed based on the agreement between the parties while loss then is based on capital contributions. The capital contributions could include commodities or if the capital is in other currencies, it would be translated to a common value, debts, or funds of a current account.

In liability partnership or known as *Sharikat al-Wujuh* or *Al-Dhimam*, the partnership is based on creditworthiness or reputation of the involving parties where a bilateral agreement between two or more parties allows them to buy assets on credit, appertaining to their credibility in making profit. Profit then is shared based on an agreed ratio while loss is based on the undertaking by each party of the purchased asset. This partnership requires no monetary capital.

Thirdly, vocational partnerships and partnerships for undertaking difficult work or accepting jobs is known as *Sharikat al-'A'mal*. This is also known as service partnerships in skilled trades involving an agreement between two or more parties to provide services pertaining to a professional, vocation or skilled trade, or to render some services or professional advice, or to manufacture goods. In this partnership structure, the profit is shared based on an agreed ratio and no monetary capital is required where each partner may distribute different types of services. If the service partnership requires capital goods, it is permissible for each party to acquire them and partners may contribute funds for the purpose. It is also permissible for a party to provide services to the partnership in return for a fee.

There are several collaborative elements found in this Traditional Fiqh-Nominate Partnerships framework that would be applicable for the purpose of universities' commercialization. Firstly, the structure of capital contribution and profit distribution in this framework would help to cover the universities' need to monetize and commercialize an innovation that its researcher has produced. It would also acknowledge that the commercialization partner could be a demand driver as the partner could also negotiate based on what they require and based on what they are able to contribute. Therefore, Malaysian public universities could enter into a partnership with their commercialization partners based on creditworthiness or reputation (liability partnership) for the purpose of making profit. This framework provides flexibility to the partners with the ability for parties to agree on different arrangements on inclusion of commodities, profit distribution and assets for purchase.

#### ii. Modern Corporations

Modern corporations and their well-known forms include several types; the Stock Company, a joint-liability company, Partnership in Commendum. Company Limited by Shares, Muhassah partnership and diminishing partnership. Firstly, Stock Company, which is a company in which the capital is partitioned into equal units of tradable shares and each shareholder's (co-owner's) liability is limited to his share in the capital. Rules of *Sharikat*

al-'Inan apply except for the issue of limited liability of the shareholders. This type of company cannot be unilaterally terminated by one party or minority shareholders. It requires a separate legal entity that can issue new shares including preference shares (AAOIFI, 2022). This study finds limiting the liability to the shares allocated as well as restriction on unilaterally terminating the shareholders as collaborative. The ability for partners to retain and change their shares also allows flexibility. Furthermore, Malaysian public universities and their commercialization partners could also set-up spin-offs to leverage on this type of Shariah framework.

Secondly, a joint-liability company, which is a form of personal partnership. There is a requirement for it to be publicly declared as a registered company with a trademark with its own legal identity. Partners could withdraw later on (AAOIFI, 2022). Due to the higher cost of incorporating a company, providing for partnerships allows smaller entities and individual commercialization partners to enter into partnership with Malaysian public universities.

Thirdly, Partnership in Commendum which is a form of financing partnership. The personality of the operating partner matters to the sleeping partner and ownership is disproportionate. The managing partners are jointly liable from their personal wealth on the basis of joint liability. The liability of each sleeping partner is limited to the number of lots he owns and does not extend to his personal assets. Profit is distributed by ratio of lots or agreements while losses are borne by the managing and sleeping partners based on their shares in the capital (AAOIFI, 2022). This study finds the differentiation between the operating and sleeping partner as collaborative. It would address the gap in the current framework being one sided and prioritizes the universities' need to commercialize an innovation that its researcher has produced.

Fourthly, Company Limited by Shares, which is a form of personal partnership. Share subscription is in accordance with an equal number of shares and comprises managing partners and sleeping partners. The liability of managing partners is from their personal assets on the basis of joint liability. They work as *mudareb* and simultaneously participate in a partnership. The sleeping partners' liability is limited to the number of shares each partner owns. Profit is distributed according to the ratio of participation or agreement. Losses are borne by the managing and sleeping partners based on their shares in the capital (AAOIFI, 2022). This study also finds the differentiation between the operating and sleeping partner as collaborative. It would address the gap in the current framework being one sided and prioritizing the universities' need to commercialize an innovation that its researcher has produced.

Fifthly, allotment (Muhassah) partnership, where the definition of *Sharikat al-'Inan* is applicable. It does not require a separate legal entity and accounts for each partners' financial strength and ability to meet financial obligations. The rules are similar to *'Inan* partnership (AAOIFI, 2022). Similar to joint-liability, removing the requirement for a separate legal entity allows smaller entities and individual commercialization partners to enter into partnership with Malaysian public universities more easily. Malaysian public universities and their commercialization partners could also set-up spin-offs to leverage on this type of Shariah framework without having to set-up a separate legal entity.

Sixthly, diminishing partnership (this partnership originates from *Sharikat al-'Inan*). In this partnership, one of the partners promises to buy the equity share of the other partner gradually until the title to the equity is completely transferred to him. As the buying and selling of shares is stipulated in another agreement, the partnership agreement needs to stipulate the contribution from all parties although disproportionately. Profit could be disproportionate to equity (to be agreed) and partners could also agree to retain or change when the shares change. Losses shared are in accordance with the ratio of equity shared (AAOIFI, 2022). This type of arrangement would be useful for short term collaborations where there are parties who plan to exit the venture as per the agreement.

### *5.3. Collaborative Elements Present in the Key Success Factors of Early Muslim Scholars*

Apart from studying the Mudarabah and Musharakah frameworks, this study also analyses the collaborative elements which were part of the key success factors of the early Muslim scholars. They could be found in the historical accounts by Ibn Khaldun in *The Muqaddimah* (1967) and the laws on partnerships in place during the Ottoman Empire as per the Al-Majalla (Al-Majalla et al., 2022). In reviewing the said accounts and laws in the context of collaborative commercialization, it is pertinent to consider how the collaborative elements would solve the issues related to the current framework.

#### *i. Historical Accounts on the success of Muslim scholars in the Muqaddimah*

Apart from studying the Mudarabah and Musharakah frameworks, this study also analyses the collaborative elements which were part of the key success factors of the early Muslim scholars. Firstly, there is a great extent of civilization in cities because of the continuity of abundant civilizations that is demanding for scientific research (Chapter 6, *The Muqaddimah* (1967)). With this, the TTOs and RMCs would need to acquire the skills to explore industries, economies, cities or countries where the patented research is in demand and identify collaborative partners with the resources needed to reach out to those places.

Secondly, that the scholar (in this case the university as well as researcher) as well as the collaborative commercialization partner are in a state of beyond subsistence (Chapter 2, *The Muqaddimah* (1967)). With this, they are able to focus on the effort of commercializing the university research. As such, the TTOs and RMCs would need to ensure that both the researchers and the commercialization partners are able to sustain financially during the period of research and commercialization. Ibn Khaldun recognizes such people as having a sedentary culture and having additional intelligence. Notably, the early Muslim scholars had developed a sedentary culture unlike other nations. They became well versed in many different crafts (innovation) and sciences. This study also notes that those mentioned by Ibn Khaldun in *The Muqaddimah* are either jurists or from families of the Caliphate or with authority. As such, the scientific research and application thereof is not what they had to rely on to sustain. With this, the TTOs and RMCs would need to ensure that both the researchers and the commercialization partners are able to sustain financially during the period of research and commercialization.

Thirdly, man (in this case the university as well as researcher) are to obtain some profits through no efforts of his own and could make money from his labor, craft thinking, speculation & commerce (Chapter 5, *The Muqaddimah* (1967)). With this, TTOs and RMCs would need to ensure that the collaborative commercialization is based on a sound business plan that would generate revenue that would sustain both the university and the commercialization partner. Monitoring of the execution of that plan by the commercialization partner and intervention and support by the university would be necessary.

Fourthly, a knowledge database consisting of books & scientific papers are available. Like those retained or appropriated by the Persians, Greeks, Byzantine Dynasty and Greek Dynasty when they were seized by the Roman Emperors (Chapter 6, *The Muqaddimah* (1967)). With this, the TTOs and RMCs should provide such knowledge database to the commercialization partners as well.

Lastly, the scholars conducted their study in a manner according to a method with credibility. Namely, benchmarked against a well-known and decisive authority (during Ibn Khaldun's time was Aristotle). They also have ready knowledge of the great number of works available, all the relevant technical terminology & numerous methods of the works. The scholars also have knowledge of words and the way in which they indicate ideas in the mind by writing or verbal articulation (Chapter 6, *The Muqaddimah* (1967)). With this, the TTOs and RMCs must ensure the credibility of the research and also the commercialization process. They will need to ensure that the researchers are able to convey and explain their research to their commercialization partners.

*ii. The Laws on Partnerships in Place during the Ottoman Empire*

This study also reviews the collaborative approach of the Ottoman Empire as per the law being practised at the time (Al-Majalla et al., 2022). The study was based on the types of partnerships during that time, which suggests the types of collaborative commercialization available.

Firstly, joint ownership over something that provides a person's special position in relation to such a thing. The ownership could either be via acquisition, offer and acceptance as well as gratuitous joint ownership (No. 1045, (Al-Majalla et al., 2022)). As such, the Muslim scholar and commercialization partner was able to enter into joint ownership via buying and selling, and contract of ownership of the research.

Secondly, that the Muslim scholar and commercialization partner was able to enter into a contract of partnership that consists of a contract for joint ownership of equal and unequal shares. In this framework, two or more persons could jointly share in capital and profit (No. 1329 and 1331, (Al-Majalla et al., 2022)).

Thirdly, the Muslim scholar and its partner could also enter into partnership in property, or a partnership in work or a partnership on credit. The partners could agree that their labor shall be their capital and that they shall undertake to do work for some other person, and that the remuneration they receive shall be divided between them and form a partnership to that effect, such partnership is a partnership of work. (No. 1332, (Al-Majalla et al., 2022)).

## 6. RESULTS

In order to address the low rate of commercialization, based on the gaps identified from existing collaborative frameworks, the TTOs and RMCs of Malaysian public universities could explore the alternative collaboration frameworks adopted by others. However, this study finds that there are remaining gaps that could be resolved by the collaborative classical Shariah frameworks.

The study finds that the gaps relate mainly to the IP strategy of the university which continuously seeks to protect and monetize its research from licensing. With this, Malaysian public universities need to be open to adopting a different approach towards their IP strategy for example by considering IP to be an asset class rather than for protection of its wealth. Universities need to also be more open to the targeted customers, competitors and others who could offer their IP for collaboration. Open innovation is at the moment very one sided where the university would showcase the solutions when the research has been completed without prior validation. IP should provide the university and its collaboration partner the freedom of action for growth of the brand. IP of the research should help the university establish the strategy that enables the university and its collaborative partners to be creative and flexible. In the open innovation framework currently used, it might allow universities to efficiently convert from research ideas to patented research output. However, without the feedback from the collaboration partners who understand the industry needs or who could drive the demand themselves, universities would risk rejection or an extended period of having to make the necessary adjustments post feedback. As for the existing collaborative commercialization frameworks which have been identified by this study, the gaps found so far relate to the implication of Malaysian public universities initiating innovation, the extent of risk and commitment of both parties. In collaboration driven commercialization, it is important that the knowledge transferred to the collaboration partners by Malaysian public universities are in industry ready form in order to avoid high knowledge redundancy. Also, the issues related to coordination between Malaysian public universities and their collaboration partners need to be addressed in order to manage the increased coordination costs.

Adoption of alternative collaborative frameworks could to some extent resolve the gaps found in the existing collaborative frameworks adopted by Malaysian public universities. There are however remaining gaps that need to be addressed by the TTOs and RMCs. For example, in market driven commercialization commonly with a licensing revenue model, the industry partner would be able to give deeper insight and more comprehensive input from the industry point of view during the commercialization process. Whilst the process would be two-sided, which would

minimize the risk of high redundancy, the process of procuring the partner's input as well as verifying the partner's input could in itself attract a high coordination cost.

In commercialization with multiple partners, a collaborative technology commercialization framework with the use of Joint Development Agreements with multiple partners covering various spectrums could allow the universities to reach out to a wider market. The TTOs and RMCs would need to have business acumen to manage these different spectrums, to prioritize the relevant markets and commercialization partners to onboard. Otherwise, the high redundancy and coordination cost would still ensue. In an equity type commercialization, by entering into spin-offs with their collaboration partners, Malaysian public universities could optimize the relationship with their collaboration partners more as they would be more invested with higher stakes. For commercialization partners, recognition of equity-based partnerships with the universities would provide them credibility to support their commercialization efforts. However, with the commitment as an equity partner, Malaysian public universities are likely to take a substantial amount of time for the onboarding of such partners. And finally, in IP rights driven commercialization, the study finds that the alternative collaborative commercialization frameworks could address issues discovered in the currently adopted frameworks in [Figure 1](#) and [Figure 2](#) by providing for two-sided support for commercialization from the ideation to go-to-market phases. The collaborative elements found provides for options to collaborate based on a longer-term basis and with multi parties from various coverage of the market. This could turn the collaboration into a more sustainable launchpad for technology commercialization by Malaysian public universities. With more recognition of risks and investments undertaken by the collaboration partners, the rigidity and need for control by the universities could be more balanced. This is, however, still subject to the capability of the TTOs and RMCs and not taking into account the Technology Readiness Level for commercialization. In any case, it would be pertinent that the solutions sought for Malaysian public universities avoid high knowledge redundancy and increase in coordination costs. This study finds that the alternative frameworks could potentially avoid these issues but adoption of the frameworks itself may not lead to the said outcome.

With the remaining gaps, the TTOs and RMCs should explore the adoption of the classical Shariah framework, particularly the structured frameworks, namely Mudarabah and Musharakah. Reason being, each type of framework already has a set mode of partnership for Malaysian public universities to opt for. To adopt the Mudarabah framework for collaborative technology commercialization, Malaysian public universities and their commercialization partners can either be the capital provider (*rab al maal*) or the labor provider (*mudareb*), and this would determine the contributions of both parties. If Unrestricted Mudarabah is chosen, the capital provider will not restrict the *mudareb* and will give the *mudareb* funds as well as the opportunity to grow and optimize the collaborative arrangement. In Restricted Mudarabah, if the capital provider unduly constrains the *mudareb* in his operations it is ironically to guide the *mudareb* on where to focus on the business or research, if the capital provider is the commercialization partner who commissions the research. Ensuring that the *mudareb* is financially provided for, is an element in collaborative commercialization partnership that is important.

This study finds that this works the same for Traditional Fiqh-Nominate Partnerships as the structure of capital contribution and profit distribution in this framework would help to cover the universities' need to monetize and commercialize an innovation that their researchers have produced. It would also acknowledge that the commercialization partner could be a demand driver as the partner could also negotiate based on what they require and based on what they are able to contribute. This study also finds that Malaysian public universities could enter into partnership with commercialization partners based on creditworthiness or reputation (liability partnership) for the purpose of making profit. Classical Shariah frameworks also provide flexibility to the partners with the ability for parties to agree on different arrangements for inclusion of commodities, profit distribution and assets for purchase.



With the Modern Corporations framework, Malaysian public universities would be adopting a collaboration mode that is built in the stakes or shares in a company. With the stock company, Malaysian public universities could limit the liability to the shares allocated as well as put a restriction on unilaterally terminating the shareholders. The ability for partners to retain and change their shares also allows flexibility. If they opt for a joint-liability company or company limited by shares, due to the higher cost of incorporating a company, Malaysian public universities could allow smaller entities and individual commercialization partners to enter into partnership with them. In a Partnership in Commendum or allotment (Muhassah) partnership, Malaysian public universities could differentiate between the operating and sleeping partner. It would address the gap in the current framework being one sided and prioritizes the universities' need to commercialize an innovation that their researchers have produced by assigning to the *mudareb* the appropriate remunerations relative the sleeping partner. If Malaysian public universities opt for a diminishing partnership, partners could also agree to retain or agree on when the shares would change. Losses shared are in accordance with the ratio of equity shared. This type of arrangement would be useful for short term collaborations where there are parties who plan to exit the venture as per the agreement. The TTOs and RMCs could also utilize the laws which was applied during the Ottoman Empire as a guide for the rules based on the types of partnerships and joint ownerships that they prefer.

Based on the historical accounts of the early Muslim scholars, TTOs and RMCs would need to acquire the skills to explore industries, economies, cities or countries where the patented research is in demand and identify collaborative partners with the resources needed to reach out to those places. The TTOs and RMCs would need to ensure that both the researchers and the commercialization partners are able to sustain financially during the period of research and commercialization. Sufficient understanding of how to manage a business would be pertinent in order to ensure that the collaborative commercialization is based on a sound business plan that would generate revenue that would sustain both the university and the commercialization partner. Monitoring of the execution of that plan by the commercialization partner and intervention with support by the university would be necessary.

To increase the technology commercialization rate, TTOs and RMCs could explore the alternative commercialization structures which are available. To address the concerns that the collaborative framework sought for would result in high level of knowledge redundancy and coordination cost, the TTOs and RMCs could explore the various types of classical collaborative Shariah frameworks available based on the outcome that would suit their IP Strategy. In this regard, Malaysian public universities should adopt an IP Strategy that is based on openness and connectedness so that the classical collaborative Shariah frameworks do not result in them becoming even more rigid. Furthermore, based on the experience of the successful Muslim scholars, the talents in the TTOs and RMCs must procure the skills and experience required in order to grow the potential of Malaysian public universities' technology commercialization via collaboration. This goes beyond business acumen and covers the ability to connect and explore industries which are known and unknown.

## 7. CONCLUSION

To improve the commercialization rate of Malaysian public universities, the objective of this study is to explore collaborative elements found in classical Shariah Frameworks that can be adopted to develop a more dynamic collaborative technology commercialization framework for Malaysian public universities. Based on the literary analysis and gaps identified in the existing collaborative technology commercialization frameworks, the study finds that the key issues relate to the protective approach in the IP strategy of Malaysian public universities. Theoretically, the issues affecting the commercialization rate of Malaysian public universities would be resolved, if the TTOs and RMCs were to explore alternative collaborative frameworks with willingness to adopt an IP strategy based on openness and connectedness. However, this study finds that there are remaining concerns of high knowledge redundancy and coordination cost of collaboration among Malaysian public universities even with the adoption of these structures. To address these remaining issues, the study reviews the collaborative elements

present in structured and unstructured collaborative classical Shariah frameworks as a possible solution. Based on the literary analysis, this study finds that there are collaborative frameworks in Mudarabah, Musharakah and partnership structures which were in place during the Ottoman Empire with a clear outcome wanted by the universities that they could choose from. For example, if they wanted a capital provider who would provide them clear direction on the jurisdiction to commercialize in, they could adopt the Restricted Mudarabah framework. Based on the review of the collaborative elements in the key success factors of the early Muslim scholars, this study also finds that the TTOs and RMCs need to upskill themselves in ways that would allow them the opportunity to discover the right collaboration partners and market for commercialization. They also need to upskill themselves on how to monitor and manage the commercialization in the best and most efficient way. This includes providing both the researchers and collaboration partners with what they need in order to fulfill the commercialization objectives.

With this, the next step for this study is to validate the findings with a sample of Malaysian public universities. The validation would involve a review of sample collaboration legal agreements as well as discussions with sample TTOs and RMCs. In the review, this study will seek to understand the applicability of the collaborative classic Shariah frameworks at the different stages of Technology Readiness Levels (TRLs) for commercialization.

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