

Received: 25-09-2022 | Revised in Revision: 29-01-2023 | Accepted: 14-02-2023



## Strengthening the process of commercialization of technology inventions

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DOI: <https://doi.org/10.22219/jibe.v6i02.22727>

### Abstract

The crucial factors for enhancing national competitiveness are the technology readiness of research institutions and the level of industry innovation. The triple helix principle of collaboration between academia, businesses, and government is imperative for successful commercialization of technological inventions. However, this process is not well-established in Indonesia, which necessitates strengthening it to support national competitiveness. This study seeks to reinforce the commercialization process, following Randal Gold Smith's theory, which involves investigation, validation, and commercialization stages. The focus is on strengthening the validation stage, specifically through business model, production, market, and price tests.

*Keywords: Strengthening process; commercialization; technology*

### Introduction

The era of disruptive technology, globally marked by the emergence of many technology-based businesses, could compete with conventional businesses that had existed before. South Korea, since the 1960s, has built and involved around 24 research institutions in charge of parsing foreign technology (reverse engineering) and licensing to various domestic industries. So that by 2008, all these efforts have been able to produce technology-based industries and encourage the private sector to help fund their research (Manurung, 2012). This is one of the indicators of South Korea's success in the commercialization of technological inventions, which then has a positive impact on its competitiveness rankings. South Korea's competitiveness reached 27th in 2020, while Indonesia's ranking is 44th, still far below Singapore 3rd, Malaysia 32nd, and Thailand 33rd (IMD World Competitiveness Center, 2022).

Based on a report from the World Economic Forum (WEF), there are 126 indicators to be able to determine the ranking and can consist of 3 main pillars, namely infrastructure, technology readiness in research institutions, and the level of innovation in the industry (World Economic Forum, 2020). In terms of infrastructure development, until now, the Indonesian government has been intensively implementing it, but this technological readiness and innovation pillar has not seen significant development. The pillar of technological readiness is the readiness of technological inventions of research results that can be commercialized. Meanwhile, the pillar of this innovation is the industry's ability to innovate products and market them to generate financial benefits. The two pillars of technology and innovation are very closely related and require collaborative linkages so that they can produce innovative products based on technological inventions that can support the development of the two pillars. Meanwhile, innovative products can be defined as products that make a solution to a problem and are in demand by consumers (Purwono, 2019).

It has been widely carried out in terms of the commercialization of technological inventions resulting from this research. Still, because the processes and methodologies applied have not been used seriously and carefully, it has not been enough to support the development of the pillars of technological readiness and the level of innovation. Even to face competition at the ASEAN level, fundamental improvements must be

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made (Fizzanty, 2014). Therefore, it is necessary to strengthen processes and methodologies to commercialize the technology.

This study aims to strengthen the process of the methodology of commercialization of technological invention products to produce innovative products that are ready to be marketed and in demand by consumers.

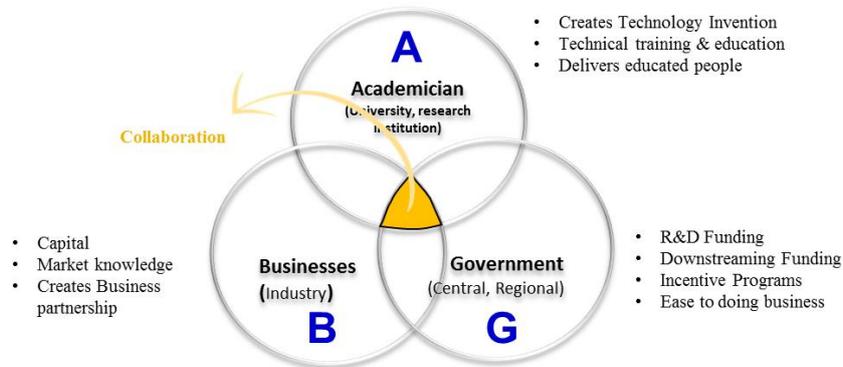


Figure 1. Tripple Helix ABG Collaboration

### Literature Review

Commercialization or downstream of research technology invention products that are ready to be marketed is a globally very important topic in the era of the industrial revolution 4.0, which requires product innovation by utilizing digital technology and big data. Therefore, the involvement from the beginning between the research institutions or academics (A), industry practitioners or business practitioners (B), and government (G) in the form of a triple helix ABG collaboration is significant to pay attention to from the beginning.

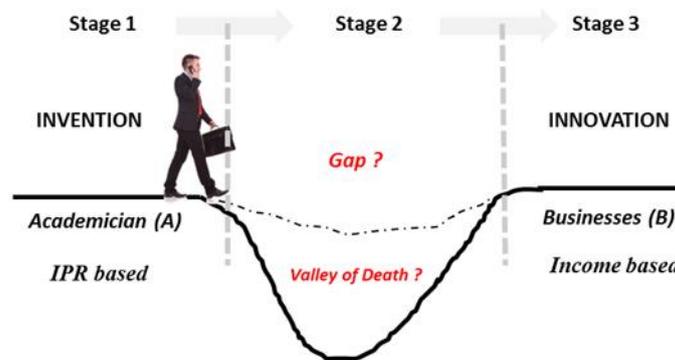


Figure 2. Academian and Business Gap

This ABG triple helix collaboration is essential to be carried out from the beginning, which has been widely used in joint innovations to solve global economic challenges (Ferreira & Steenkamp, 2015). And the collaboration model is a universal model for developing a knowledge-based society through innovation and entrepreneurship (Etzkowitz & Zhou, 2017). Collaborations like this are essential to increase research and innovation activities in research institutions and industry practitioners (Diana & Hakim, 2021). Similarly, it strengthened that in creating synergies in the collaboration, the invention ideas produced by academics should not only be intended for scientific publications but also have a special attraction for business practitioners to collaborate (Handoko F., 2017). Therefore, it can be said that the harmony of collaboration between ABG factors is a determinant for the commercialization of invention products. Collaborations like this can be explained in Figure 1. In this figure, it can be seen that harmonious collaboration will be achieved if academics (A) have technological inventions that can be appropriated with industrial business (B), while the readiness of the government (G) is the readiness to support the

collaboration of academics and practitioners, especially in terms of funding and ease policies for the implementation of these collaborative activities.

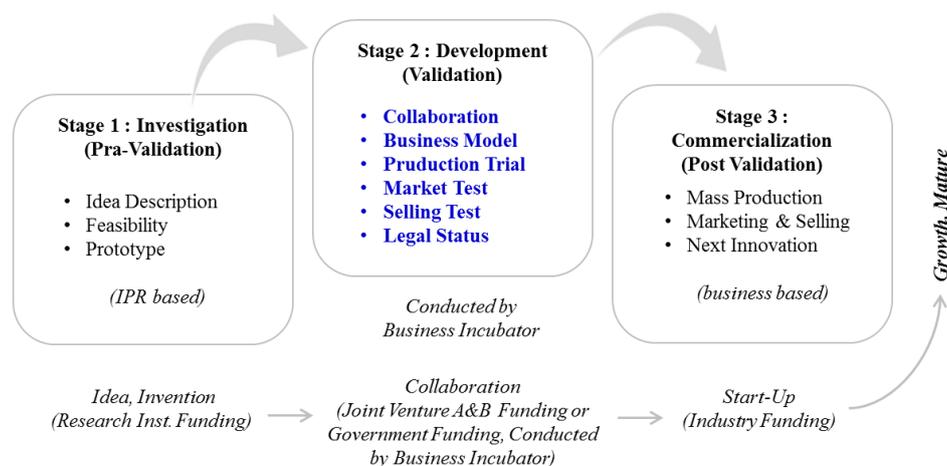
The commercialization of technology involves a complex process consisting of 18 stages, which can be broadly categorized into the investigation, validation, and commercialization stages (Parker & Mainelli, 2001; Randall Goldsmith, 2003). Figure 2 depicts the three stages, with the first stage involving the creation of ideas and inventions, mostly by academics in research institutions (A), followed by the validation stage, commonly known as the valley of death stage. The third stage involves innovation and marketing by business practitioners (B). However, passing the validation stage is often the most challenging due to academic interests prioritizing intellectual property rights (IPR) and businesses focusing on financial gain.

In Indonesia, there are still several obstacles to commercializing technological inventions, as highlighted by some surveys in different regions (Adawiah; et al., 2014; Pujantiyo, 2017). These obstacles include overconfidence by academics in their research results, businesses focusing solely on financial benefits without considering contemporary technology, and insufficient government budget. Furthermore, many research institutions in Indonesia have yet to recognize the importance of commercializing their technological inventions (Nasution A. Reza, 2009). To foster collaboration between the three factors, academics (A), business (B), and government (G), it is crucial to create a collaborative synergy that involves research results that cater to market needs (Awasthy et al., 2020).

Therefore, it can be concluded that there are still weaknesses among each party, resulting in limited collaboration between them. These weaknesses must be addressed to achieve better collaboration and facilitate the commercialization of technological inventions in Indonesia.

### Collaboration Solution Approach

Based on the problems of each of these ABG factors, equalizing perceptions of the entrepreneurial spirit of technology on all ABG factors is very important. This can be achieved by increasing integrated technology business communication between all these factors (Balai Inkubator Teknologi, 2020).



**Figure 3. Commercialization Technology Invention (CTI) Process**

Until now, the role of the Government (G) has been widely realized in the form of several downstream programs for technology products, for example, by the Ministry of Research and Technology since 2016 in the form of an incentive grant program for Prospective Technology-Based Young Entrepreneurs (CPPBT) (Direktorat Jenderal Penguatan Inovasi, 2019). However, the financial grants given are still relatively small per unit of the business proposal but are enough to provide an initiation to prospective entrepreneurs. In addition, a program from the Ministry of Education, Culture, Research, and Technology, since 2020, in the form of a Matching Fund program intended for academics who will commercialize their inventions by collaborating with businesses practitioners (Direktorat Jenderal Pendidikan Tinggi, 2021). This program can provide considerable grant assistance, but because this program is relatively new, no significant results have been seen. Therefore, until now, improvements are still being made in the system and its management.

The most important thing is after the establishment of ABG cooperation, which is a downstream process that can be illustrated as shown in Figure 3, consisting of 3 stages; the first is the investigation

stage, the result of which is the discovery of technology, then the second stage of validation, and third stage of commercialization which is the stage of mass production and marketing oriented towards financial profit. Especially in the second stage, namely, validation, is a test of whether the invention product is feasible and can be in demand by the market in terms of physical and price. At this stage of validation, the protection of Intellectual Property Rights (IPR) will be the first validation (Srivastava & Chandra, 2010). Similarly, research in the agricultural sector suggests that the business model also urgently needs to be validated (Pasaribu et al., 2021). The technology commercialization models focusing on collaborative validation should know the market's challenges (Dehghani, 2015). And that market validation, technology, and funding are essential to avoid future failures (Kim & Shin, 2017).

Thus, this validation stage is the leading alternative solution in addressing the gap/valley of death between academia and industry practitioners; therefore, in this study, especially at this stage, it is proposed that validation be carried out, including: business models, production trials, market tests ( $\alpha$  tests), selling tests ( $\beta$  tests), and management of legal status related to Intellectual Property Rights (IPR) and profit sharing, as well as necessary contracts. Business model validation is an activity that can take the form of improving a mutually agreed business model, including the validation process of production tests on a laboratory scale. Then, the market test and price test is a test of consumers/market desires for the product and its price. This activity can take the form of a survey or discussion with potential consumers (experts, distributors, direct users). At this stage, selecting the right potential consumers for interviews and intensive discussions about the product is necessary. At this stage, it is possible that potential consumers can try to use the product to feel and provide input for improvement so that it can be known with certainty whether the product has indeed met consumer desires.

### **Role of Intermediator to Commercialize Technology Inventions**

In the process of commercialization of technological inventions in Indonesia, the institutions that do it are still very diverse. Still, they are generally carried out by the research institute or industry. But in its implementation, it is rather difficult to do well since there is an institutional ego, as mentioned above. Therefore, recently there has also been an independent institution in the form of an intermediary that is not under research or industrial institutions. The independence of this intermediary body is very important because it must accommodate the wishes of academics and business collaborators, so the role of neutral institutions with principles of a win-win solution is urgently needed.

The task of this intermediary institution becomes very important since it is the organizer of the validation stage. The initial task begins with making a collaborative agreement between research institutes (A - academia) and industry (B - Businesses). After there is an agreement in this collaboration, a tenant (prospective startup enterprise) will be formed who will follow the validation process. So it can be said that the role of this intermediary institution is very important for the future tenants' success. Intermediator institutions like this generally have the function of business incubation or business acceleration, also called incubator institutions.

Participating in programs in business incubators can give tenants specific skills and abilities for new businesses (Hassan, 2020). Furthermore, intermediary institutions such as incubators are very important and can function properly with adequate regulatory support and funding (Soba et al., 2018).

In Indonesia, there are 83 intermediary institutions in the form of incubators, and almost all of them are intermediary bodies located in university research institutions (AIBI, 2014). And based on a survey of several incubators emphasized that incubators will be more functional when supported by adequate management (Ajie, 2017). Meanwhile, incubators in universities provide more entrepreneurship learning and have not focused much on independent development and achieving rapid growth for tenants. Therefore it is needed to improve (Prasetio et al., 2019).

Therefore, proper management and processing at the time of this incubation is very important thing for tenants. This is very closely related to the methodology of the commercialization process, especially in the validation. The illustration of the roles and duties of this intermediary institution is shown in Figure 3. In this study, to maintain neutrality in collaborating, then the implementer of technology commercialization, especially the validation stage, is an independent Technology Business Incubator, namely Balai Inkubator Teknologi until 2020th, which is part of the Government Agency for the Assessment and Application of Technology but independent in the task force and financial management.

### **Implementation Through a Technology based Business Incubator**

Institutions, including the Technology Incubator Center, Cimahi City Government, Pekalongan City Government, Sebelas Maret University, and other universities from 2003 to 2020. In this period, there were 162 tenants with variations consisting of manufacturing business fields at 27%, food (post-harvest) at 20%,

ICT at 15%, agro-industry at 14%, and the rest were advanced materials, cosmetics, energy, creativity, and animal feed business fields of less than 10% each. As shown in Figure 4, the results describe the tenants who graduated or declared passed based on their independence assessment. The tenant's turnover is the gross income each tenant achieves.

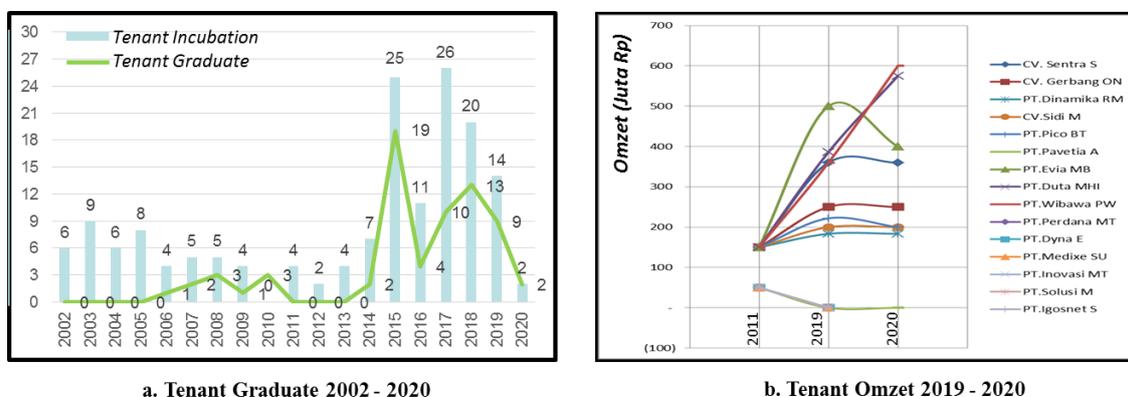


Figure 4. Tenants Graduated and Turnover in 2004-2020

Figure 4a shows tenants graduating from 2002 to 2020. When viewed from 2003 to 2012 (funding < 100 million Rupiah per tenant), several incubation tenants have been declared passed, but some tenants have not been able to graduate. During this period, the facilities provided to tenants are a workspace, meeting rooms, entrepreneurship training activities, the preparation of a business plan, and access to promotion and marketing. Currently, the use of the Commercialization Technology Inventions (CTI) process has not yet begun. In the same picture, in 2012, after the CTI process was applied, the number of incubation tenants and pass tenants appeared to increase sharply. Facilities provided in addition to workspaces, meeting rooms, several entrepreneurship training, considerable funding (IDR 150-250 million per business), as well as the application of the CTI process.

Figure 4b shows the 2019-2020 Tenant Turnover, which is the result of a survey of tenants who passed before and after using the CTI process, to find out the sustainability of their business, especially to find out the turnover (gross income) of 15 tenants (as representatives) who had passed before. Due to the pandemic, the survey was conducted with online interviews, so only a few tenants could be contacted. These 15 tenants have varied business fields, including post-harvest agriculture, informatics, and digital. In this picture, it can be seen that the tenants before using the CTI process, almost all of them are no longer operating, and those who are still operating are seen to have decreased turnover (under IDR 100 million) and even lost money. Meanwhile, the tenants passed after using this CTI process, and almost all of them increased (upper IDR 100 million). However, there was a decrease in the pandemic era a significant increase.

From the survey results, it can be said that using the CTI process, which specializes in strengthened validation, has a very positive impact, adding past tenants and generating a much higher turnover than not using the CTI process. This proves that this validation stage is very important and determines the sustainability of the business, especially from the amount of turnover generated by tenants.

## Conclusion, Suggestions and Limitations

The results of this study demonstrate the effectiveness of the commercialization of technological inventions (CTI) process in producing positive outcomes in several institutions. The process, which focuses on the validation stage, has helped many tenants successfully commercialize their technology invention products. This is evident in the increased turnover and favorable survey results. The authors believe that the CTI process would be most effective when executed through independent intermediary institutions. This is because these institutions can ensure neutrality in accommodating the needs of various stakeholders, such as entrepreneurs, researchers, and investors. Moreover, the CTI process can be applied to many tenant businesses, making it a flexible and adaptable solution for technology commercialization.

The study's authors suggest that the CTI process, particularly the validation stage, should be widely adopted to improve collaboration among the three key pillars of academic technology readiness: researchers, entrepreneurs, and investors. By providing a structured and systematic approach to

commercializing technology inventions, the CTI process can help increase innovation in the industry and boost Indonesia's competitiveness on the global stage. Furthermore, although based on small sample size, the study's results are strong enough to support the conclusion that the CTI process is a valuable tool for technology commercialization.

In conclusion, this study highlights the importance of the CTI process in commercializing technology inventions. Focusing on the validation stage has produced positive outcomes and can be effectively executed through independent intermediary institutions. The authors suggest that the widespread adoption of the CTI process could help improve collaboration and increase innovation in the industry, ultimately contributing to an increase in Indonesia's competitiveness on the global stage.

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