

Model of Technology Commercialization from Government Research Institutions to Private Sector in Indonesia

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ABSTRACT

In general, there are two models of the technology commercialization in Indonesia; First, technology incubator approach; and second, cooperation in the form of direct license or non-technology incubator. In the first approach, the centers of commercialization and management of IPR provide facilities for the tenant. Tenants in general are small and medium-scale enterprises. In the second model, commercialization is performed through license on the cooperation between research institutes and the private sector. In the past, the majority of commercialization used the second model, which is proven to accelerate technology transfer and expand the adoption of technology by the end users. Besides, the second model also produces more royalties and the government allows researchers to receive an amount of the royalties.

Keywords: technology commercialization, Incubator, small and medium-scale enterprises, technology transfer, royalties

INTRODUCTION

In general, government research institutions in Indonesia implement technology transfer of research results through two channels, namely the public domain and commercialization pathways. For technologies that are public domain, the technology transfer is conducted in stages, from research institutions to government agencies that are in charge to disseminate the technology and then to the end users. For example, agricultural technologies from research institutions will be communicated to the extension agency, and then delivered to farmer groups and farmers as end users.

Meanwhile, commercialization generally is cooperated with various parties, especially the private sectors. There are two commercialization models developed in the government research institutions in Indonesia, the first, is through the development of technology incubators, which opens business opportunities for small, micro and medium enterprises in distributing technology to the users. A unit set up by research institutions is responsible for development of the technology incubator in promoting the acquisition of intellectual property rights and technology commercialization. The second approach is to work directly with the

private sector. This cooperation is implemented through various forms, such as research collaborations, where the final results of the study developed jointly, and intellectual property rights belong to those who contribute the most in funding, or governed by a separate agreement.

The dominant cooperation between private sector and government research institutions is in the form of a direct cooperation, in which private sector develops the results from research by government research institutions through cooperation agreement. This cooperation agreement outlined the rights and obligations of each party. Generally, these agreements are set under license cooperation, where the private sector has an obligation to pay royalties from the commercialization of the technology.

Both commercialization models have strengths and weaknesses, which complement each other in accelerating the technology transfer in Indonesia. The paper discusses the model of technology commercialization in Indonesia, which is carried out by government research institutions. The description will begin with the legal basis on the commercialization and the government programs associated with the commercialization. Furthermore, the development of commercialization as well as the various existing variants will be explored. Description of the constraints and the prospects of development is the final part of the discussion.

REGULATIONS CONCERNING COMMERCIALIZATION OF TECHNOLOGIES

Technology transfer is defined as the transfer process of the ability to utilize and master science and technology among institutions, bodies or persons, whether they are in a domestic environment or from abroad into the country, and vice versa.

Based on Government Regulation No. 20 of 2005 concerning Intellectual Property Right and Technology Transfer with Universities and government research institutions, the purpose of technology transfer of intellectual property and the results of research and development activities are:

- (i). Disseminating science and technology; and
- (ii). Improving the ability of communities to utilize and master science and technology for the benefit of society and the state.

Technology transfer can be performed through public domain or commercialization pathways. Commercialization of technology from the government research institutions to the private sectors in Indonesia is conducted under Article 16 of Law No. 18 of 2002 on the National System of Research, Development and Application of Science and Technology, and Article 2 of Government Regulation No. 20 of 2005 concerning Intellectual Property Right and Technology Transfer with universities and government research institutions. The complete contents of Article 2 are as follows:

Universities and R & D institutions have an obligation to transfer the technology of intellectual property and the results of R & D activities generated by research and development activities that are financed fully or partially by the Government and / or Regional Government as long as not in the contrary to public order and legislation.

Both of these regulations encourage government research institutes to collaborate with the private sectors in the technology transfer through commercialization scheme. To facilitate this collaboration, according to Government Regulation No. 20 of 2005 particularly article 16, it is stated that in order to conduct the process of commercialization and management of

intellectual property rights (IPR), government research institutes are required to establish a center for IPR management and technology transfer of IP and the results of R & D activities.

Implementation of commercialization can be done by building a technology incubator or working directly with the private sectors. The development of technology incubators is in line with the spirit of building the nation's independence in mastering technology, as shown by the current government by developing Techno Park as an effort to accelerate the dissemination of technology. One of its outputs is to create young entrepreneurs based on technology. Through the concept, it was targeted to build around 100 Techno Parks until the end of 2019 with the technology incubator as the main program.

One factor that could accelerate the technology commercialization process is the provision of rewards for the parties involved. Law No. 13 of 2016 on Patents, particularly Article 12 states that:

- (3) *Inventors referred to paragraph (1) and (2) are entitled to compensation by considering the economic benefit derived from the Invention.*
- (4) *The compensation referred to paragraph (3) may be paid:*
 1. In a lump sum;
 2. A percentage;
 3. A combination of a lump sum together with a gift or bonus;
 4. Other form agreed upon by the parties;

Other regulations on the granting of these benefits are also contained in Law No. 18 of 2002 Article 16 (3) which states that:

- (3) *Universities and government R & D institutions are entitled to use the income generated from the transfer of technology and/or services of science and technology to develop themselves.*

Meanwhile, the provision of royalties to inventors is also made possible by Government Regulation No. 20 of 2005 Article 38 paragraph 2 (b), which states:

- 1) *Universities and government R & D institutions are entitled to use the income generated from the technology intellectual property transfer as well as the results of research and development activities to develop themselves.*
- 2) *Income referred to paragraph (1), can be directly used for:*
 - (i). Increasing the budget for research and development that are required to master the advance of science and technology, and also to develop the invention;
 - (ii). Providing the necessary incentives to increase motivation and the ability of the invention in its environment;
 - (iii). Strengthening the management and technology transfer of intellectual property as well as the results of R & D activities;
 - (iv). Strengthening investments of resources in science and technology;
 - (v). Improving the quality and expanding the range of technology transfer of intellectual property and the results of R & D activities and services of science and technology; and
 - (vi). Expanding its networking with other institutions related to the implementation of its tasks and responsibilities.

Implementation of incentives for researchers is carried out based on the Minister of Finance Regulation No 72 of 2015 and No 6 of 2016, which authorized the distribution of royalties to researchers.

EXISTING COMMERCIALIZATION MODEL

Commercialization Management

In line with the spirit of Government Regulation No. 20 of 2005, in particular article 16, which mandates the establishment of institutions that manage the commercialization process and the management of Intellectual Property Rights (IPR), almost all government research institutes have established a management office which is independent, except the Agency for Health Research and Development which is still *ad hoc* under the Secretariat of this Agency. While other research institutions varies from Echelon 3 to Echelon 2 in the form of technical executing unit, working unit and Public Service Board (See Table 1).

Table 1. Cooperation on Technology Commercialization between Government Research Institutes and Private Sectors in Indonesia, 2011-2015

No.	Institution	Business Commercialization	
		Status	Information
1.	Indonesian Institute of Sciences (LIPI)	Echelon 2	Managing incubator and direct cooperation
2.	Agency for The Assessment and Application of Technology (BPPT)	Public Service Board / Echelon 2	Incubator is managed by a separate unit
3.	National Nuclear Energy Agency of Indonesia (BATAN)	Echelon 2	No information
4.	Agency for Health R & D	IPR Centre non-echelon	There is no incubator management unit
5.	IAARD	Echelon 3	New incubator initiation stage

In BPPT, commercialization is directly managed by the Center for Technology Services or formerly known as BPPT Engineering (BE). This unit is one of working units or Echelon 2 at BPPT formed by Regulation of Head of BPPT No. 170/KP/BPPT/IV/2006 dated April 21, 2006. This unit has tasks to disseminate BPPT's technology through technology services, implementation of project management, and cooperation contracts, as well as general administrative for technology services.

Based on the Minister of Finance Regulation No. 158/KMK.05/2007, dated March 20, 2007, Technology Service Center or BE was established as a government agency that implements the Financial Management of Public Service Board (BLU). It is targeted to obtain IDR 50 Billions from some activities.

Center of Technology Services has the tasks of marketing management, project management, contract and license management, financial management and administration of Center For Technology Services. The functions of this Center are:

1. Planning and marketing technology services;
2. Implementation of the contract and licensing matters;
3. Implementation services technology maturation efforts and monitoring and evaluation;

4. Implementation of the affairs of the reception, verification, financing and financial reporting; and
5. Implementation of administrative affairs for Center For Technology Services.

Meanwhile, Technology Based Business Incubator (BIT) manages the technology incubator, which is a technical implementation unit at BPPT. This Center is under and responsible to the Director of the Center for Technopreneurship and Industrial Cluster, Deputy for Technology Policy Assessment. BIT has the tasks of service activity in Technology Based Business Incubator. In performing its duty, BIT has the following functions:

1. Facilitation and consulting on business management, legal aspects, and support for business incubation facilities to support the development of cooperatives, small and medium enterprises based on technology or innovation;
2. Facilitation and consulting on entrepreneurial human resource development, development of business networks, access to finance, and cooperation both within and outside the country, as well as the acceleration of services for incubation; and
3. Administrative services in the BIT.

BIT-BPPT was established as a vehicle to create innovative entrepreneurs between partners ABGC (Academic, Business, Government and Community) in order to become a new business unit based on technology or innovation that has competitiveness, tough and independent. It also serves as a guide for Small and Medium Enterprises and Cooperative (SMEC), which is based on technological innovation.

Commercialization process

Generally in all government research institutions, there are two strategies for technology transfer, namely, non-commercial or public domain and through commercialization. Commercialization activities are carried out in two ways: a) the creation of technology-based startup companies through business incubators; and b) the technology transfer to industry through licensing.

Technology incubator

The development of technology incubator essentially has the same fundamental as the development of an entrepreneurial incubator, namely the Indonesian Presidential Regulation No. 27 of 2013 on the Development of Entrepreneurial Incubator. In general, targets of the incubator development (article 3) are:

- a. The emerging of new entrepreneurs and strengthening the capacity of starter entrepreneurs (start-up) which has high competitiveness.
- b. The creation and growth of new businesses that have economic value and high competitiveness;
- c. Increase the value-added on the management of the economic potential through the use of science and technology;
- d. Increase the accessibility for entrepreneurs or potential entrepreneurs to follow incubation program;
- e. Increase the capacity and expertise for strengthening the competence of management of Entrepreneurial Incubator; and
- f. Development of networks to enhance access to human resources, institutional, financing, markets, information, and technology.

The process of technology incubator consists of three stages: pre-incubation, incubation and post-incubation (Fig. 1). Included in the pre-incubation stage is a selection process for prospective tenants. First, the office announces to the public about the opportunity to become tenants with specific criteria and requirements. Based on existing registrants, the selection process will be executed. The selection process includes administration as well as the readiness of tenants following the incubation process. Based on the experiences from various government research institutions showed that there were less than half of them that could pass the selection process. This corresponds to the ability of tenant eligibility as well as the limitations of research institutions in assisting incubation activities.

After the selection process, the elected tenants follow a series of activities that are included in the pre-incubation phase. This activity aims to: (i) give a briefing so that they understand well on the processes/activities of incubation; (ii) develop a business plan that is effective and attractive; and (iii) make the roadmap of implementation activities. At the end, tenants then will be asked to compose a canvas business model. The objective of those activities is to give understanding on the incubation process and how to develop a good business plan, roadmap, and canvas business model. In addition, participants are asked to present their canvas business models and business plans for each product.

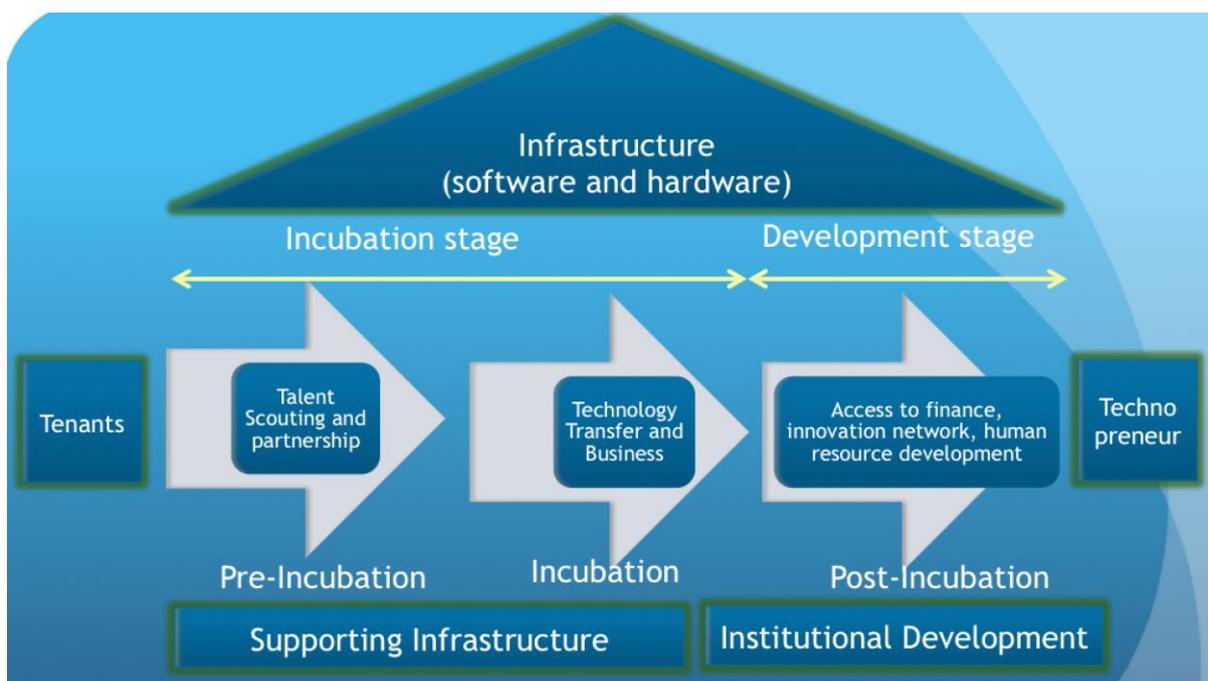


Fig. 1. Stages of Technology Incubation Services

The incubation process can be conducted either in wall or out wall. Generally, government research institutions conduct in wall incubation and provide various facilities and infrastructures known as the 7 S, namely:

1. Space, is office space;
2. Shared office facilities i.e. the provision of office facilities that can be shared. For instance, means of facsimile, telephone, photocopy machine, meeting rooms, computers and others;

3. Service, is an assistance and consultation on management: marketing, finance, production, technology and so on;
4. Support, is an assistance in the form of research and business development and the access to use the technology;
5. Skill Development, consists of training, developing a business plan, management training and others;
6. Seed capital means providing initial funding and an effort to access capital from financial institutions; and
7. Synergy, is the creation of business networks, both local and international businesses.

Based on the experience of various government research institutions, generally, the incubation process varies among tenants, ranging from monthly to yearly. The incubation process includes technology transfer in various approaches and business management in order to penetrate the market. So far, there are some tenants who have been nurtured who could not complete the incubation process for various reasons. The study by Cakrasiwi *et al* (2015) reports that from 2002 to 2014 there are 56 tenants from BIT-BPPT who succeed to join into incubation center at BIT-BPPT. Those tenants come from a wide variety of fields including manufacturing, ICT (Information, Communication, Technology), EES (Energy, Environment, Service), and Agro-industry. Of those numbers, only 16 of them graduate from the process with the survival rate of 29%.

Study by Aurmo (2010) as cited by Cakrasiwi *et al* (2015) illustrated a number of tenants who graduate from incubation centers in Norway, Denmark and Iceland. The study showed that Narvik Science Park, established in 2005, has a percentage of 55% survival rate, Innovation Center Iceland (ICI), established in 1999, has a percentage of 83% survival rate, and Norinnova Northen Innovations, established in 2000, has a percentage of 86% survival rate. Of the three incubations center, the average survival rate is above 50%. Meanwhile, until 2014 BIT-BPPT the percentage survival rate was below 50%.

Post-incubation activities is generally associated with assistance in business development, as well as connecting tenants with various facilities provided by the government, such as financing and access to other information. This mentoring process also varies among tenants and their readiness for self-dependent. It can be observed from the experiences that there is tenants' dependence on the assistance given by research institutions, particularly in market penetration. Some tenants even expect that the market of their products will be guaranteed in various government projects and activities.

Commercialization through License

Commercialization via licensing process begins with the selection process on the technology that is ready to be promoted to the private sector. To calculate the technology readiness, BPPT uses analysis tools known as Technology Readiness Level (TRL), which is adopted from NASA. Meanwhile, LIPI has developed their own criteria, the so-called innovation readiness level (IRL), with easier indicators in the form of various intermediate products of the research results. On the other hand, the other government research institutions apply more subjective approaches based on the calculation by researchers and leaders on technology readiness for commercialization.

Once the technology has been ready for commercialization, it is then promoted to the private sectors. Or there is another form of this process, that is the private sector has already known the forerunner of technology, and then they approach to the research institutions to gain the rights for licensing. Efforts to be closely linked with private sectors have been

conducted in several ways. In the past, IAARD organized a Round Table Meeting (RTM) to invite people from the private sector who are prospective to be partners in the business cooperation. However, this practice is not effective since there is no follow up action after the meeting. Therefore, the current approach is replaced by visiting potential of people from the private sector to perform a technology promotion. This latter approach is proven to be more effective to attract the attention of the private sector in licensing IAARD's technologies since it could generate more license agreements.

Other promotion strategy is the existence of good relationship between technology producers and private sector association, as well as informal communication that is a foundation in the collaboration. LIPI and Health R&D Agency mostly do this pattern.

Based on the interest of the private sector, the cooperation then will be processed in the form of Memorandum of Understanding (MoU) between parties. Government research institutions, as the owner of technologies, will evaluate the feasibility of the private sector as the licensee, which will be assessed based on the appropriateness and seriousness of the company and the network of the market distribution.

The MoU outlined the rights and obligations of each party. Obligation of licensee is helping research institutions to deliver research results to the end users through its distribution channels at affordable price. In this process, the amount of royalty will also be agreed. The government research institutions have set the amount of royalty for each type of technology. For instance, the Minister of Agriculture regulation has set the amount of royalty for seven clusters of agricultural technologies ranging from 1- 5 % of the cost of sales.

The company has an obligation to meet all of the requirements so that the technology can be marketed. In addition, they are audited regularly on a yearly basis to implement the cooperation. In this audit process, government research institutions will examine the official report from the company related to the amount of the sales of the technology, and followed by field checking which involves the auditor officers.

From the results of the annual audit it is then agreed upon that the amount of royalty is to be paid as well as the follow-up action based on the evaluations of the implementation of the cooperation. After sales service is the most complained issue by the private sector. Generally, government research institutions have not been well provided by after sales services according to the agreement.

The cooperation agreement has a timeframe and varies among different technologies. Royalty received by government research institutions is perceived as not belonging to the government's tax revenues. Government research institutions as regulated by the government can utilize 95% from the total of government's not tax revenues, with the following distribution: 40% for research institutions to purchase research equipment, capacity building, and laboratory or experimental station renovation; 40% for the inventors; and 20% for technology transfer office.

After the termination of cooperation, normally the same company will extend the agreement or the technology will be offered to other companies for new cooperation.

Achievement

Table 2 shows that in general commercialization through direct cooperation or license is still dominating the pattern of cooperation between government research institutions and the private sector (>75%). It is because the direct cooperation generally shows quick results and wide area coverage. The incubation process generally incubates the startups and small-scale industry but takes time and has a limited market. But in terms of business development and equitable aspect, the incubation activities could involve more tenants.

Incubation activities in several government research institutions are not yet developed as it should be, because incubation is not yet defined in the tasks and function of the organizations as well as limited facilities and budget.

Table 2. Commercialization cooperation between Government Research Institutions and Private Sector, 2011-2015

No.	Institution	Number of cooperation	
		Technology Incubator	Direct Cooperation
1.	Indonesian Institute of Sciences (LIPI)	18	92
2.	Agency for The Assessment and Application of Technology (BPPT)	16 ¹	250
3.	National Nuclear Energy Agency of Indonesia (BATAN)	NA	32
4.	Agency for Health R & D	0	8
5.	IAARD	6	137

¹ These are elected tenants from 56 candidates (Cakrasiwi, *et al*, 2015)

CHALLENGES AND SOLUTIONS

Commercialization Through Technology Incubator

Commercialization through technology incubator has not yet developed as it should be due to several internal and external factors. The external factors are (a) the limitation of operational facilities that affected the ability to incubate more tenants, (b) lack of seed capital so that the incubator has not yet handled professionally and many tenants could not get the seed capital despite proper funds, (c) low commitment and government support and inconsistent for incubator development.

Meanwhile the internal factor is 73.33% tenants experienced technical problems as reported by Cakrasiwi *et al* (2015), such as the problem related to the equipment. For example, most of the machines used to manufacture the products are damaged or are too old, so it cannot work optimally as a result. Another internal factors are marketing of the products. The companies that developed technology-based products require a market survey beforehand to recognize whether the product is really needed by the consumers or not, or commonly called the Lean Start Up survey.

Another factor that leads to successful technology incubator is determined by the role of mentor. The mentor not only must have the appropriate background, he/she also must have to acquire deep experience and knowledge on the business field of tenants. Therefore, the mentor can assist the tenants in finding solutions when experiencing problems, and can speed up the way tenants graduate from incubation centers and become successful in running the business after the incubation period.

To overcome the problems related to commercialization through technology incubator, therefore currently government research institutions collaborate with well-experienced members of the private sector as mentors. Through this approach, startups or tenants can learn from the mentors and gain practical solutions to any problems. Regarding the facility, the government, through development of 100 techno-parks, will complete the facilities that is required in the incubation process.

Direct Commercialization or Non-Incubator

One of the main problems from the direct commercialization to private sectors is the technology readiness. Generally, government research institutions have not yet developed the tool to assess technology readiness. In addition, some of the government research institutions have not yet provided sufficient funding for the development of scientific inventions, so that the technology is completely ready for cooperation with the private sector.

Besides the issue of technology readiness, another problem is the company readiness to cooperate in the development of products. Some companies do not fully cooperate to develop the products and compete fairly with similar products in the market. Some companies are waiting for government projects that supports the result technologies from government research institutions.

Regarding IAARD technologies, a study conducted in early 2015 (IIATT, 2015) shows that from 108 license agreements between IAARD with 57 private sectors, only 55 agreements have been well implemented, while the other 35 agreements were not going well, and 18 agreements have been completed.

From 35 agreements that are not running as they should be, 20 agreements are facing problems related to the quality of the technologies (20%), licensing issues (40%) and cannot compete with similar products in the market (40%). Moreover, 15 other agreements are facing problems related to the low quality of the partner companies, such as companies which only rely on government projects and have no efforts to penetrate the public market (67%), and have internal management issues (33%).

In response to the issue of technology readiness, IAARD has developed Technology Readiness Level (TRL) tool to assess the readiness of the technology. TRL, which consists of nine levels is currently being developed for seven technology clusters that include: variety; strain of livestock; veterinary and other medications; postharvest processing; test kits and agricultural machineries; pesticides; and fertilizers.

In addition, IAARD through SMARTD (Sustainable Management of Agricultural Research and Technology Dissemination) fund also provides a variety of financing schemes for technology development activities, in an effort to prepare the technology to be ready for adoption by end users. From the results of the initial analysis using this tool, some IAARD technology remained at levels 5 and 6. Therefore, further development is needed in the form of prototype development, prototype testing, including analyzing the economy of scale in order to make the technology ready for adoption by end users.

Aside from the internal fund from government research institutions, currently government through Productive Innovative Research (RISPRO) scheme provides funds for the development of research results to be ready for adoption by end users. RISPRO has a competitive nature, and it will be given to the research proposals that meet the requirements, and implemented by researchers who have a good track record and the results have an impact on the nation's progress.

There are two types of funds, commercial and implementative. The commercial type includes the development of research results for Food, Energy, Health and Medicine, Defense and Security, Transportation, Information and Communications, and Advanced Materials. Funds provided for each research topic costs a maximum of US \$ 151.515, or one billion rupiah for a maximum period of three years. The implementative type includes field studies of Eco-Growth, Governance, Social, spiritual and Cultural Affairs. Funds provided for each research topic costs a maximum of US \$ 37.878 or 500 million rupiah for a maximum period of two years.

Research development that are funded by RISPRO has the following requirements:

1. Research must have business feasibility;
2. Research should involve partners, so that the research results can be applied directly/commercialized by the partners that supported by cooperative agreement (memorandum of understanding);
3. Partners should come from central/regional government and/or corporate/Indonesian citizen; cooperative; and/or the micro, small and medium enterprises that are legal entities; and
4. Partners must have a commitment to contribute to the research at least 10% of the proposed research funding in the form of shares of funds and/or other forms that can be measured with money (cash / in kind)

Outcomes of the research results for Commercial RISPRO are:

1. New products that are feasible to be commercialized;
2. New invention to produce new products that have commercial value;
3. Development of existing products;
4. Improvement of the production process; and
5. Application of new technologies that have economic value in order to improve the competitiveness of national industries.

Outcomes of the research results for Implementative RISPRO are:

1. Implementation of policies/model to strengthen the public sector's governance and corporate;
2. Implementation of policy/model of a sustainable economic development and improvement and environmentally friendly;
3. Implementation of policy/model of embodiment and increased harmony in the social and spiritual aspects; and
4. Implementation of policy/model of development and preservation of Indonesian culture.

CHALLENGES

The main challenge in this commercialization is how the government research institutions can produce an interesting result for the private sector, which plays role to in technology dissemination, as well as how to raise researcher's awareness for generating research results that meet the needs of the users. As discussed in previous section, one of the complaints from the private sector is that the research results have not been fully required by the users, as well as the quality of the technology that does not meet its specification.

To respond to this problem, therefore an intensive communication between government research institutions with the private sector is absolutely necessary. For example, IAARD research institution has signed an agreement (MoU) with business associations. One of the things to be implemented is to conduct a regular meeting between researchers and the private sector to share market information, as an input for the researchers in planning their next research that is responding to the market needs.

The government permits researchers to receive royalty as a result of cooperation. This is expected to attract the researchers to generate more technologies in accordance with market needs. Government policies in the protection of intellectual property rights, such as zero maintenance cost for the first 5 years maintenance is another thing that is expected to further encourage researchers to register the results of their research for IPR protection and, later, cooperate with the private sector for dissemination.

CONCLUSION

Cooperation between government research institutions with the private sector principally is intended as an effort to accelerate the delivery of innovation to the end users. The private sector with their networks are expected to assist the government's research institutions in delivering effective research results to potential users in a massive scale. It is expected to answer one of the issues relating to the acceleration of the adoption by end users.

At the beginning, the cooperation is limited to a few companies that have already collaborated with government research institutes. Later, this cooperation is growing with the increasing number of government research products that are potential to be marketed through commercial lines and more open information on research products through various media. Commercialization cooperation grows and involves a lot of members of the private sector. Then the government sees another potential from small, micro and medium enterprises to get involved in this cooperation and expand it through incubation pattern.

Currently, direct cooperation with the private sector is still dominating the commercialization cooperation between the private sector and government research institutions. This relates to the marketing networks and the speed of market penetration. While the incubation pattern is still developing in a variety of patterns and requires a strong commitment and support from the government.

Onwards, both cooperation still needs to be synergized to accelerate the innovation transfer from government research institutions by overcoming the existing issues.

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