Research Cooperation Between Industry and Research and Development Institutions-Universities in Indonesia with Policy Implications

Erry R. Nurzal[1*] and Asep Husni Y. Rosadi[2]

[1] Directorate of Research, Technology and Innovation Policy Formulation - BRIN
[2] Center for Economic Research in Service and Trade Industry – BRIN

Abstract. *Cooperation between R & D institutions/universities and industry has been carried out a lot. Most of these partnerships have not produced a significant economic impact, as part of fostering national innovation. What is the cause of the unsuccessful cooperation? There are various studies on these failures, including those caused by: unclear reasons for cooperating, improper forms of cooperation, and not yet growing trust between them. This paper discusses research collaboration by paying attention to these three aspects. In addition, it is accompanied by policy implications to improve it. The research used qualitative descriptive analysis with data based on the results of a survey conducted by the Ministry of Research and Technology. The results of the analysis show that: (a) the reason there are still few industries that collaborate with R & D institutions and universities, is because the quality of technology produced by these institutions has not been proven; (a) the form of multi-stakeholder cooperation, involving other than industry and R&D institutions and universities, as well as other parties such as the government, is a form of good cooperation; (c) the industry trusts the performance of imported technology more than the domestic technology. The recommended policies include: (a) improving the quality of human resources, facilities, and infrastructure, as well as publishing research results from R & D institutions and universities in the media or forums, where industry is heavily involved; (b) the government acts as a regulator and facilitator in cooperation between industry and R&D institutions through various policy instruments; (c) technologies produced by R&D institutions and universities whose performance has been technically proven (TRL 6), need serious support.*

Keywords: *Innovation, research cooperation, industry, R&D institutions, universities, trust, multi-stakeholders, policy*

1. Introduction

In practice, cooperation between R&D institutions/universities and industry has been carried out a lot. R&D institutions/universities that collaborate are R&D institutions and established universities such as LIPI - the Indonesian Institute of Sciences - and BPPT – the Agency for the Study and Application of Technology - (now the two institutions have merged into BRIN the National Research and Innovation Agency), PPKS - the Palm Oil Research Center, P3GI - the Indonesian Sugar Plantation Research Center, ITB - Bandung Institute of Technology, UI - University of Indonesia, IPB - Bogor Agricultural University, UGM - Gajah Mada University and others. Meanwhile, industries (companies) are partners in cooperation, especially BUMN (state-owned enterprises) and national private companies. Cooperation between R&D institutions/universities and industry is mostly initiated by R&D institutions/universities. Some of the cooperation programs with government funding through R&D institutions/universities include RUK - Research Excellence Partnership (KRT, 2001), Research Mainstay of Higher Education and Industry (Directorate General of Higher Education, 2012), UIG - University-Industri-Government Partnership and UIPG – University-Industry Partnership Grant (ACDP, 2013), Triple Helix (Moeliodihardjo et al., 2012), SINAS - National Innovation System Research Incentives (KRT, 2014) and PRN - National

Research Program (Kemenristekdikti, 2019). Meanwhile, initiations from the industry are still relatively limited. Policies from the industrial side to encourage industrial cooperation with R&D institutions are not explicitly discussed. The national industrial policy listed in the National Industrial Development Master Plan 2015-2035 (Ministry of Industry, 2015) or in the Ministry of Industry's Strategic Plan 2020-2024 (Ministry of Industry, 2020) does not contain such initiation.

Although the cooperation has long been carried out using a large budget, but most of it has not produced a significant economic impact. Moreover, to foster national innovations that have an economic-production impact. In fact, innovation in the industry with the innovative products and services it produces has high added value and has become the backbone of the economies of many countries (World Bank, 2019; Gherghina et al., 2020). Basically, an industry needs innovation to sustain its life. With the innovation of products and services, the industry strives to meet the needs of its customers, and keep them at the forefront of its competitors. In the industry, product and service innovation is produced by the R&D department of the company. Nonetheless, the industry also needs perspective and progressive innovations produced by other parties.

Prospective and progressive innovations are mostly generated from R&D activities in universities and research institutions as well as technology-based start-up companies. They are an institution full of creativity because they are supported by many young scientists. The products they produce have bright prospects for implementation. But these products are only scientific publications or prototypes. They do not have the ability to realize those products that can be used directly by the market. Therefore, cooperation between industry and research institutions, and universities is a very appropriate synergy for increasing competitiveness. What is the cause of the unsuccessful cooperation between

industry and R&D institutions and universities in increasing the economic impact adequately? In fact, cooperation between R&D institutions and universities with industry can encourage a positive impact on economic performance, by increasing the industry's ability to produce innovative products that are highly competitive. This cooperation also has an impact on social benefits (Brooks, 1994), productivity in R&D activities, absorptive capacity, as well as increased production of science (Carayol, 2003), which can be enjoyed not only by R&D institutions - universities or industries, but also by society in general. Cooperation can also increase regional competitiveness (Morisson and Pattinson, 2020).

There are various analyses to find out the unsuccessful cooperation in increasing the economic impact. The failure was caused, among other things, by the unclear reason for the cooperation (Dan, 2013; Kaymaz and Eryigit, 2011), an inappropriate form of cooperation (Li et al, 2022; Bredikhin et al, 2019), as well as the trust between them (Marinho et al, 2020; Schaefer and Schaefer, 2022; Mark et al, 2014). From an industrial business perspective, the industry's reason for cooperating with universities/R&D institutions is an effort to make profitable investments in the long term, and increase productivity. On the other hand, the industry sees that cooperation with industry has many risks such as coordination and information problems, additional costs incurred, ownership of intellectual property, and commercialization of results and knowledge generated that universities can duplicate and possess (Dan, 2013).

In addition, the industry must also have human resources who have adequate knowledge in the application of knowledge in production systems (Kaymaz and Eryigit, 2011). Obviously, that's a hindrance to the industry. In fact, the partnership relationship should be a long-term relationship (Dooley and Kirk, 2007), to encourage a company-quasi model (Etzkowitz, 2003) and a positive and personal partnership (Pertuze, et al.,

2010), with joint invention efforts (Motohashi and Muramatsu, 2011), a regional cooperation base (Koschatzky, 2014), and a focus on innovation with new actors for new fields (OECD, 2014). The ability to establish reasons that benefit both parties and impacts for regional/national ones that have not grown well.

The form of cooperation is also an obstacle to industry-university cooperation. The determination of the form of cooperation, including the negotiation of intellectual property rights and other forms of contracts is often difficult for them to complete, as well as the process is not transparent and time-consuming (Bredikhin et al, 2019). Based on field research (Li et al, 2022) the form of cooperation in the future, each cooperation between industry and universities does not have to be uniform, but uniquely tailored to their respective characters. However, what must be achieved is that the cooperation must solve the actual problems faced by methods developed for future research. Industry trust in universities / R&D institutions to carry out technological development which is very important in increasing competitive advantage for the industry. There are still difficulties in terms of trust and understanding of operationalization when cooperation between the two parties is carried out (Marinho et al, 2020).

The results of the Schaefer and Schaefer study (2022) show that of the four factors that hinder the success of cooperation, namely: (1) R &D; (2) external support barriers, which are in the form of information barriers and financial support barriers; (3) barriers to collaboration partners, in the form of trust barriers and expertise barriers; and (4) administrative barriers (cost and speed), it turns out that trust barriers have a significant negative impact on cooperation. Meanwhile, another study (Mark et al, 2014) shows that long-term relationships, trust, and a deep understanding of the reasons for differences in determination between universities and industry are very important in cooperation. This paper discusses how efforts to strengthen research cooperation between industry and R&D institutions - universities by paying attention to three aspects, namely: the foundation for cooperation, the form of cooperation, and trust in partners. In addition, it is also accompanied by policy implications

2. Literature Review

Cooperation activities are critical in business activities. The company engages in multiple engagements with stakeholders to create attractiveness in increasing global market share. There are various types of collaboration concepts that can be carried out such as business networks, business clusters, triple helix, keiretsu, business ecosystems, and innovation hubs (Majava et al., 2013). The concept of cooperation has several similarities and differences in terms of membership, goals, coordination, boundaries, dynamics of change, type of relationship, the role of knowledge, and competitors. For companies, the application of this collaboration concept includes the opportunity to interact with various stakeholders to encourage innovation. However, cooperation in addition to allowing for various opportunities to access various resources, it also requires a clear prioritization of relationships and expertise and prepares for changes due to the impact of cooperation.

There are various forms of cooperation between companies (industry) with universities and R&D institutions. The form of cooperation depends on what is to be achieved from the cooperation. From the company side, where the company (industry) plays a role in providing support to R&D institutions/universities, as well as reciprocity in accordance with industry needs. The forms of cooperation include: (1) research support, in the form of financial support and equipment provided by industry to universities; (2) research collaboration, in the form of research contracts involving the expertise of lecturers and university facilities to solve problems in industry, (3) educational programs, student internships, consulting and research; (4) transfer of knowledge, in the

form of interaction activities between industrial personnel and R&D institutions/universities formally and non-formally, educational cooperation, curriculum development, and exchange of human resources to support knowledge and technology to be developed by the company, and (5) transfer of technology, in the form of knowledge transfer interactions, but focused on industry-specific issues involving the expertise of university lecturers or R&D institute researchers and industry experience to produce the technology needed by the market (Santoro and Chakrabarti, 2002; Jonbekova et al, 2020; Hottenrott and Thorwarth, 2011).

In addition, the form of cooperation depends on the mechanism from the R&D institution/university side, such as (1) providing consultancy and technical services, in the form of providing information, technical services, consulting, and other activities provided by the university/R&D institution, (2) R&D cooperation agreement, in the form of cooperation between one or more R&D institutions/universities and one or more companies, where R&D institutions/universities prepare human resources, facilities, and other resources, while industry prepares funds, human resources, facilities, equipment, and other resources in accordance with research and development results. determined by the industry, (3) a license, in the form of a license that is produced by a university and can be utilized by the industry, (4) a research contract, in the form of a contract between an R&D institution/ university and a company/ industry, in which the industry provides funds and time, while an R&D institution/university prepares its HR expertise, (5) spin-off company, in the form of a new company that is feed commercialization of technology produced by research institutes/universities (Rast et al., 2012).

With the rapid development of technology, while resources, experience and facilities are limited, it is very difficult for industries to continue to adapt their research activities on their own (Hamel and Prahalad, 1994). Companies (industry) can obtain new knowledge and technology from various external sources, such as competing companies, research institutions (R&D), government research laboratories, industrial research associations, or universities. Cooperation with universities has another impact, besides being able to acquire science and technology, it can also obtain new workers (bachelor), and the expertise of their lecturers as consultants (Santoro and Chakrabarti, 2002).

There are various reasons why the industry wants to collaborate, including: (1) proficiency/ability to develop technology and innovation is closely related to how intensive the relationship between research institutions and industry is, (2) cooperation is a direct exchange of knowledge (face-to-face knowledge exchanges). that takes place between them, and (3) cooperation with universities allows the industry to recruit workers with high productivity (Balconi and Laboranti, 2006). In addition, other reasons are that the industry has limitations in internal R&D activities, short product life cycles, limited R&D budgets, and adjustments to research priorities that are / will develop (Lee and Win, 2004). Industry can also gain access to the resources and expertise needed, opportunities for synergies in advanced research, reduce R&D costs, increase R&D productivity, and stay on track with the latest technology development (Carayol, 2003).

In some countries, the average industry has a high level of technology. However, for industry, R&D institutions/universities are a very attractive external source of technology. Industries seek outside sources of technology to help accelerate their innovation process. Research institutes/universities are interesting sources of technology because they have knowledgeable human resources with sophisticated lab facilities. The industry has the opportunity to conduct research activities at research centers of R&D institutions/ universities, with a high probability of technology transfer success. In this condition,

the cooperation as well as the flow of knowledge and technology takes place in two directions. Cooperation and technology transfer will take place ideally if cooperation with expertise and facilities between them complement each other. With the increasing accumulation of knowledge and experience from collaboration, it will encourage capacity building and help local companies through licensing and collaborative research programs (Lee and Win, 2004).

In cooperation with industry, R&D institutions/universities are more concerned with patents and scientific publications in journals. Meanwhile, the industry is not only concerned with the final results of the research, they also care about the process. Processes such as the codification and protection of certain technical inventions are part of strengthening their portfolio and competitiveness in the future. Cooperation with R&D institutions/ universities for industry is more of a support (complement) to their own research results than as a substitute or main research activity (Adams et al., 2001). The industry realizes that researchers are more concerned with IPR than the output of products that can be sold to the market, so they understand the difficulties they will face when collaborating (Hall et al., 2001).

3. Methodology

The data used in the paper is data from a manufacturing industry survey conducted by the Ministry of Research and Technology (now merged into the National Research and Innovation Agency - BRIN) between 2011 and 2020. Data is also obtained from various sources relevant to research collaborations, both in Indonesia and other countries in the form of survey data as well as reviews and analysis of cooperation conditions. The data is then analyzed descriptively and qualitatively. The purpose of descriptive research is to describe a phenomenon and its features. This research is more concerned with what than how or why something happened (Nassaji,

2015). Qualitative descriptive research studies the relationship or interaction between several research variables with the aim of understanding the event under study. Qualitative descriptive research is a categorical alternative, but less interpretive because it does not require researchers to move away from or into the data; and, it does not require the presentation of data that is conceptual or very abstract, compared to other qualitative designs (Lambert and Lambert, 2012). By using the analysis of the relationship between the available data and the results of the analysis of previous research that is the same or relevant. Furthermore, it is interpreted according to the context that occurs in Indonesia. In addition, it also explained the policies that should be carried out.

4. Findings and Discussions

Analysis of cooperation relationships by paying attention to three things, namely: (1) the reasons for the industry to carry out research cooperation, (2) the form of research cooperation, and (3) industry trust in the performance of R&D institutions - universities.

Industry reasons for conducting research collaborations
In cooperation, at the initial moment, it should be known what is the reason for cooperation. If the cooperation is not due to the urgent need to produce new technologies, the efficiency of production activities, or obtain testing certification, it will become a burden on the industry. Likewise, if the industry cooperates instead of mutually reinforcing synergies, then it only lasts in the short term. When the industry has no reason to cooperate, it shows an indication of a severe obstacle. Based on a survey conducted by KRT (KRT, 2011) several obstacles for the industry to collaborate with R & D institutions/universities include: technology produced by R & D institutions/universities has not proven its quality as the largest obstacle (19.6%). In addition, the industry is also hampered by the bureaucracy that applies

in R & D institutions/universities (15.4%), slow cooperation processes (13.9%), products that are not in accordance with market needs (13.6%), limited facilities and infrastructure (8.6%) and incompetent costs (8.2%). The existing conditions in the R & D institutions/universities are reasons for the industry not to cooperate.

With the rapid development of technology, while resources, experience, and facilities are limited, it is very difficult for industries to continue to adjust their research activities if they are carried out by the industry itself (Hamel and Prahalad, 1994). Companies (industries) can acquire new knowledge and technologies from various outside sources, such as competing companies, research institutes (R&D), government research laboratories, industrial research associations, or universities. Cooperation with universities has another impact, in addition to being able to obtain science and technology, it can also obtain new workers (undergraduates), and the expertise of its lecturers as consultants (Santoro and Chakrabarti, 2002).

There are various reasons why the industry wants to cooperate, including: (1) the proficiency/ability of technology development and innovation is closely related to how intensive the relationship between research institutions and industry is, (2) cooperation is face-to-face knowledge exchanges that take place between them, and (3) cooperation with universities allows the industry to recruit workers with high productivity (Balconi and Laboranti, 2006). In addition, another reason is that the industry has a lack of reliability in R&D activities internally, a short product life cycle, limited R&D budgets, and adjustments to research priorities that are developing/will develop (Lee and Win, 2004). Industries can also gain access to supporting resources and expertise, have the opportunity to synergize in advanced research, reduce costs, increase R&D productivity, and stay on track with the latest technology development (Carayol, 2003).

In some countries, the average industry has a high level of technology. Nonetheless, for the industry, universities are a very attractive source of external technology. Industries are looking for outside sources of technology to help accelerate their innovation process. The R & D institutions/universities are an interesting source of technology because it has human resources with qualified knowledge (knowledgable) with sophisticated lab facilities. The industry has the opportunity to conduct research activities at research centers of R & D institutions/universities, with the probability of successful technology transfer being large. In this condition, cooperation and the flow of knowledge and technology take place both ways. Cooperation and technology transfer will be ideal if cooperation with expertise and facilities between them complement each other. The increase in accumulated knowledge and experience from cooperation, it will encourage capacity building and help local companies through licensing and research cooperation programs (Lee and Win, 2004).

The collaboration of research institutions with industry is needed as an effort to interact between researchers in solving problems in the industry. Research institutions and universities have experts (professors/researchers) with various bright ideas for solving problems and creating new technologies (technological novelties). The agenda of knowledge and technological challenges in the future is generally deeply felt by the industry so they are at the forefront of mastering technology. The industry wants to gain strong access to new research and discoveries produced by R&D institutions, hoping for significant progress in the development of new products and processes, as well as closer relationships (Lee, 2000). About 50% of the reasons for industrial cooperation projects and R&D institutions/universities are to produce main outcomes in the form of new ideas or solutions to problems faced by the industry, new methods of analysis, and IPR that are beneficial to the company (Pertuze et al., 2010).

Reducing risk, with the risk of being jointly borne or devolved to a guarantor institution when transferring technology, is one of the motivations for the industry and R&D institutions / PT when they cooperate. Risk, including financial risk, is a critical factor in technology transfer that can be mitigated through shared financing and R&D facilities whose failure rates can be measured. In general, R&D institutions/universities have a low risk in carrying out their operational activities, because the output they produce is in the form of consulting services, technical services, training courses, workshops, and seminars (Lee and Win, 2004).

For some R&D institutions, cooperation with industry requires greater resources. The researchers are required to allocate more time and facilities than the research carried out independently. Some research activities must be carried out in industrial locations that are far away. The results of a study conducted by Bozeman and Gaughan (2007) on 1564 researchers from academic researchers indicate that researchers who obtain research funds and contracts work more openly with industry than those who do not obtain them. Grants and contracts from the industry have a significant impact on improving the relationship between the industry and researchers. This is different from the funds and research contracts provided by the government.

Form Of Research Cooperation
The form of cooperation with its various models will affect its role and the benefits it will obtain. Cooperation of two parties (an industry with R&D institutions - universities), will be different from multi-stakeholder cooperation (industry, R&D institutions - universities, governments, funding institutions, and others). Of course, cooperation carries different implications. Cooperation activities are critical in business activities. The company engages in many relationships with outside stakeholders to create an interesting thing in increasing global market share. There are various types of cooperation concepts that can be carried out such as business networks, business clusters, triple helix, keiretsu, business ecosystems, and innovation hubs (Majava et al., 2013). The concept of such cooperation has several similarities and differences in terms of membership, goals, coordination, boundaries, dynamics of change, types of relationships, the role of knowledge, and competitors. For companies, the application of this cooperation concept includes the opportunity to interact with various stakeholders to encourage innovation. However, cooperation, in addition to allowing various opportunities to access various resources, also requires prioritizing clear relationships and expertise and preparing for changes due to the impact of cooperation.

The form of cooperation that is widely carried out is the cooperation of two parties, namely between industry and R&D institutions/universities. The form of cooperation depends on what you want to achieve. From the company side, where the company (industry) plays a role in providing support to R&D institutions/universities, as well as the expectation of reciprocity in accordance with industry needs. Forms of cooperation include: (1) research support, in the form of financial support and equipment provided by the industry to universities; (2) research collaboration, in the form of research contracts involving lecturer expertise and university facilities to solve problems in industry, (3) educational programs, student internships, consulting and research; (4) knowledge transfer, in the form of interaction activities between industry personalities and R&D institutions/universities formally and non-formally, educational cooperation, curriculum development, and human resources exchange to support knowledge and technology to be developed by the company, and (5) technology transfer, in the form of knowledge transfer interactions, but focused on industry-specific issues involving the expertise of university lecturers or researchers of R&D institutions and industry experience to produce technology that the market needs

(Santoro and Chakrabarti, 2002; Jonbekova et al, 2020; Hottenrott and Thorwarth, 2011).

In addition, the form of cooperation depends on the mechanism from the side of R&D institutions/universities, such as: (1) provision of consulting and technical services, in the form of providing information, technical services, consulting and other activities provided by universities / R&D institutions, (2) understanding of R&D cooperation, in the form of cooperation between one or more R&D institutions/universities with one or more companies, where R&D institutions/universities prepares human resources, facilities, and other resources, while the industry prepares funds, human resources, facilities, equipment and other resources in accordance with the results of research and development determined by the industry, (3) licenses, in the form of licenses produced by universities and can be utilized by industry, (4) research contracts, in the form of contracts between R&D institutions/universities and companies industries, where the industry provides funds and time, while libang institutions / universities prepare their SDM expertise, (5) spin-off companies, in the form of new companies that are the result of commercialization of technology produced by institutions / universities (Rast et al., 2012).

The form of cooperation can be in the form of two parties or multi-stakeholder cooperation. In Indonesia, the cooperation between the two parties is in the form of direct cooperation between industry and R&D institutions/universities with initiatives from industry (KRT, 2011) as well as cooperation due to incentives from the Ministry of Research and Technology/ Ministry of Education such as Research Excellence Partnership - RUK (KRT, 2001), University-Industry Partnership Grant (ACDP, 2013). Meanwhile, multi-stakeholder collaborations that have been carried out include the National Innovation System Research Incentive Program or SINAS (KRT, 2014) and the National Research Priority Program or PRN (KRT / BRIN, 2020).

The collaboration between the two parties with initiatives from the industry, in general, is in the form of research contracts involving the expertise of lecturers and university facilities to solve problems in the industry and technology transfer, in the form of interactions such as knowledge transfer, but focused on industry-specific issues involving the expertise of PT lecturers or researchers of R&D institutions and industry experience to produce technology needed by the market (KRT, 2011).

The cooperation of two parties due to incentives is carried out with the initiative of the R&D institutions/universities. The R&D institutions/universities submit a research proposal to the Ministry of Research and Technology/Ministry of Education by including its partner industries. The partner industry is determined by the institution/ university. The funding is obtained from the Ministry of Research and Technology/ Ministry of Education which is directly given to R&D institutions/universities, while the contribution of the industry as a partner is in the form of in-kind (human resources, facilities, and other non-cash).

Multi-stakeholder cooperation is carried out through PRN (National Research Priority) with SINAS (National Innovation System). There is little difference between PRN and SINAS. PRN emphasizes cooperation between R&D institutions and industry to produce one particular product that becomes a commercial product. This product is carried out jointly between various R&D institutions and the industry. PRN is grouped based on research focus. There are nine research focuses, namely: food, energy, health, transportation, engineering, defense and security, maritime, social humanities arts and culture education as well as multidisciplinary and cross-sectoral (KRT / BRIN, 2020).

For example, PRN with a focus on health research with Insulin Biosimilar Product Development activities. As the coordinator is the LIPI Biotechnology Research Center (R&D institution), involving other R&D

institutions/universities, such as BPPT, School of Biological Sciences and Technology ITB, Faculty of Pharmacy UGM, and Faculty of Medicine, Universitas Airlangga. The industry involved is PT. Biopharma. In addition, it also involves regulators and supervisors, namely the Food and Drug Supervisory Agency (BPOM) and the Food, Medicines, and Cosmetics Assessment Institute of the Indonesian Ulema Council (LPPOM MUI) (LIPI Biotechnology Research Center, 2020). Research collaboration is a collaboration with all involved, and each contributes according to their competence and budget. KRT / BRIN functions to monitor output and coordination between the parties involved.

Meanwhile, SINAS is a program to increase productivity and utilization of national research and development results. The expected achievements are scientific papers in international journals, intellectual property rights (IPR), and start-up companies. Types of funding in the form of incentives: basic research, applied research, research on increasing the capacity of science and technology production systems, and accelerating the diffusion and utilization of science and technology. Research topics according to the priority areas of science and technology are food, health, and medicine, energy, transportation, information and communication technology, defense and security, and materials. The implementation is carried out in a consortium, although there are also non-consortia. For a consortium, it must consist of three or more institutions consisting of government R&D institutions, and government and industry that synergize and contribute (KRT, 2014).

PRN and SINAS involve three institutions: R&D institutions/universities, industry, and government (represented by the Ministry of Research and Technology). The cooperation of the three institutions is known as the triple helix. In the development of the triple helix model, there are efforts to increase the priority of the role of R&D institutions/universities in the innovation process and perspective of

their research activities (Etzkowitz, 2002; Leydesdorff and Meyer, 2003; Majava et al., 2013; Andersen and Hutton, 2013). R&D institutions/universities must adjust to the demands of funders (government and industry) to be more active in the innovation process and foster closer relationships with industry and understand what they expect. In the triple helix mode 1 model, where the government acts as a funder, while R&D institutions/universities conduct research that can be utilized by the public (including industry), the direction of research activities is more determined by the researchers themselves. Research success is determined by success in scientific publications in well-known journals and exposure in seminars and IPR publications. The relationship between R&D institutions/universities and industry is more of an application of IPR produced by R&D institutions/universities.

The relationship is now shifting, in triple helix mode 2, where R&D institutions/universities are required to also invest their capabilities and resources to adapt to the needs of the industry. As a basic obligation, the R&D institutions/universities are required to produce new discoveries and conduct testing and verification of their lab capabilities. This obligation can also be enjoyed by the industry so that the R&D activities seem to be part of the product development process carried out by the industry. Meanwhile, R&D institutions/universities have gained a new understanding of the development of products for markets that have only been in the realm of industry (Dooley and Kirk, 2007).

Industry Confidence In The Performance Of R&D Institutions/Universities
The results of a survey conducted by the Ministry of Research and Technology (KRT, 2011) to determine industry perceptions, showed that technology that comes from outside (imported) has a better performance compared to technology produced by domestic R&D institutions/universities (value 2.92 on a scale of 4.0) followed by technology from principal companies (2.45) and R&D companies themselves (2.43). Meanwhile, a

technology derived from government R&D institutions is relatively low (1.98). Likewise with technology from private R&D institutions (1.83) and universities (1.79). With conditions like this, building industry trust in the technology produced by domestic R&D institutions/universities faces tough challenges.

The survey above shows that the cooperation between industry and R & D institutions will take place well if there is trust between them, especially industry confidence in the performance of R&D institutions. In cooperation, the one that issues the budget in real terms is the industry. Therefore, as a business entity with a financial statement base, the industry must believe that its investments should provide a decent future profit. Industrial research cooperation with R&D institutions is a long-term investment to produce products that become the mainstay of the industry in the future. Understanding each party's reasons and beliefs is difficult.

In cooperation with industry, R&D institutions/universities are more concerned with patents and scientific publications in journals. Meanwhile, the industry is not only concerned with the final result of the research, they also care about the process. Processes such as the codification and protection of certain technical inventions are part of strengthening their portfolios and competitiveness in the future. Cooperation with R&D institutions/universities for the industry is more as a support (complement) to their own research results than as a substitute or main research activity (Adams et al., 2001). The industry realizes that researchers are more concerned about IPR than the output of products that can be sold to the market, so they understand the difficulties they will face when cooperating (Hall et al., 2001).

Most companies (77%) realize that the capabilities of R&D institutions are very limited. R&D institutions/universities provide a contribution that is not too significant and even tends to be categorized as moderate in improving the quality of

industrial products. The contribution of research institutions to the industrial research agenda is very small (Lee, 2000). Of the cooperation projects carried out, around 60% gave below the expected results (underachieved), with the outcome not producing products, processes, or influencing company decisions (Pertuze et al., 2010).

Not all companies feel pessimistic about the performance of R&D institutions/universities when cooperating. Siemens, for example, has cooperated with one of its best strategic assets. They include their global innovation strategies to strengthen their presence in developing countries, as well as their competitive advantage in HR and technology resources. Siemens integrates its scientific knowledge from its various global networks through collaborations with top universities such as MIT and the University of Berkeley. Such cooperation is indispensable for Siemens in its R&D activities to develop strategically important new technologies (Piacentini, 2013). In Indonesia, industries that adopt a lot of technology from domestic R&D results are SOEs, while FDI brings more technology from abroad (Rosadi, 2014).

Policy Implication

By paying attention to the above exposure, industrial cooperation with R&D institutions/universities faces quite severe challenges. The challenge requires policies to make cooperation more possible. The challenges and some of these policy proposals include:

1. The first challenge: the technology produced by the R&D institutions/universities has not been proven, bureaucratic problems, and limited facilities and infrastructure, and incompetent costs. Policies that can be done include:
   a. Improving the quality of human resources, facilities, and infrastructure as well as the publication of research results in media/forums where the industry is heavily involved.
   b. Preparing service work units at R&D institutions/universities as BLU

(Public Service Agency). The BLU task force allows financial management patterns to be carried out flexibly with sound business practices to improve services to the community and industry. BLU allows for bureaucratic cuts with affordable service costs.

c. Preparing human resources management work unit managers at R&D institutions/universities that are professional, not bureaucratic, the service process can work quickly, according to market needs, and at the most optimal cost.

2. The second challenge: there is still little and limited research cooperation between industry and institutions/ universities. For this reason, it is necessary to pursue policies:

   a. Equipping R&D institutions/ universities with good marketing skills, so that the industry obtains the right, feasible and easy information. The R&D institution must polish itself with good packaging. This will encourage the industry to assess institutions as rigid and self-oriented institutions.

   b. Build professionalism for institutions and human resources in R&D institutions/universities. We recommend that units of R&D institutions/universities that have the potential for cooperation with the industry obtain accreditation from competent institutions and have the ability to certify. In addition, every human resource, both technical and supporting, must have certification in accordance with their fields.

3. The third challenge: perceptions that are still oriented towards imported technology, and the low performance of domestic technology. Policies that can be proposed include:

   a. Preparing consortium research by involving R&D institutions/ universities and industries as well as potential foreign partners to focus on developing Indonesia's flagship

technology in the future and or have a broad impact on society. The research is mainly in fields that have not been carried out by many other state companies and take advantage of the abundant raw material potential in Indonesia.

b. Selecting and preparing potential research results from R&D institutions/universities to be specially developed by the consortium. Research results that have a TRL (Technology Readiness Level) value of more than 6 are developed to become commercially viable products.

c. Growing technology-based start-up businesses as a result of spin-offs from R&D institutions/universities.

5. Conclusion

Industrial cooperation and R&D institutions/universities show: (1) only a few industries cooperate with R&D institutions/ universities, the main reason is that the quality of technology produced by R&D institutions/universities has not been proven. This should be an impetus to improve the quality of human resources, facilities, and infrastructure as well as the publication of research results in media/forums where the industry is heavily involved; (2) there are two forms of cooperation that are generally carried out: two-party cooperation and multi-stakeholder cooperation. The cooperation of the two parties only involves industry and R&D institutions/universities, while multi-stakeholder cooperation in addition to including the two parties also involves other parties, namely the government and other institutions. Of these various forms, multi-stakeholder cooperation, involving many stakeholders is an option that tends to be widely used; (3) the industry believes more in the performance of imported technology compared to domestic technology. This condition is because there are still few domestic technologies that have succeeded in becoming commercial products that are in demand. Hence the technically proven

technology (TRL 6), needs to get serious support.

References

ACDP [*Analytical and Capacity Development Partnership*], (2013). Developing Strategies for University, Industry and Government Partnership in Indonesia. Jakarta: Agency for Research and Development, Ministry of Education and Culture

Adams, J.D, B.P. Chiang and K. Stankey (2001). Industry University Cooperation Research Centers, *Journal of Technology Transfer*, 26, 73-86

Andersen, B. and W. Hutton (2013). Raising the Potential of the Triple Helix: Co-Innovation to Drive the World Forward. Lancester: Big Innovation Center – Lancester University

Balconi, M and A. Laboranti (2006). University-Industry Interactions in Applied Research: The Case Of Microelectronics, *Research Policy*, 35, 1616-1630

Boardman, P. C. and E. A. Corley (2008). University Research Centers and The Composition of Research Collaborations, *Research Policy*, 37, 900-913

Bozeman, B. and M. Gaughan (2007). Impacts of Grants and Contracts on Academic Researchers' Interactions with Industry, *Policy Research*, 36, 694-707

Bredikhin, V., N.E. Ovchinnikova, O.P. Ovchinnikova, and Tatiana Kolmykova, (2019), Problems and prospects of university-industry interaction, Journal of Applied Engineering Science, 17(2): 224-232

Brooks, H. (1994). The Relationship Between Science and Technology, *Research Policy*, 23, 477–486

Corayol, N. (2003). Objectives, Agreements And Matching in Science-Industry Collaborations: Reassembling The Pieces of The Puzzle, *Research Policy*, 32, 887-908

Dan, M.C, (2013), Why Should University and Business Cooperate? A Discussion of Advantages and Disadvantages, International Journal of Economic Practices and Theories, 3(1): 67-74

Direktorat Jenderal Pendidikan Tinggi (2012). Panduan Pelaksanaan Penelitian di Perguruan Tinggi. Jakarta: Direktorat Penelitian dan Pengabdian Kepada Masyarakat, Ditjen Pendidikan Tinggi, Kementerian Pendidikan Nasional.

Dooley, L. and D. Kirk (2007). University-Industry Collaboration: Grafting The Entrepreneurial Paradigm Onto Academic Structures, *European Journal of Innovation Management*, 10 (3), 316-332

Edmondson, G., L. Valigra, and M. Kenward, (2012), Making Industy-University Partnership Work: Lessons from Successful Collaborations. Science Business Innovation Board AISBL. [www.sciecebusiness.net]

Etzkowitz, H. (2003). Research Groups as 'Quasi-Firms': The Invention of The Entrepreneurial University, *Research Policy*, 32, 109-121

Etzkowitz, H. (2002). The Triple Helix of University-Industry-Government Implications for Policy and Evaluation, *Working Paper 2002-11.* Stockholm: Institutet for Studier av Utbildning Och Forskning.

Gherghina, S.C, M.A. Botezatu, A. Hosszu and L.N. Simionescu, (2020), Small and Medium-Sized Enterprises (SMEs): The Engine of Economic Growth through Investments and Innovation, *Sustainability*, 12 (1),347; doi: 10.3390/su12010347

Halls, B.H., A.N. Link and J.T. Scott. (2001). Barriers Inhibiting Industry from Partnership with Universities: Evidence From The Advanced Technology Program, *Journal of Technology Transfer*, 26, 87-98

Hamel, G. and C.K. Prahalad. 1994. Competing for the Future. Boston: Harvard Business School.

Hottenrott, H. dan S. Thorwarth (2011), Industry Funding of University Research and Scientific Productivity, *KYKLOS,* 64 (4), 534–555,

Jonbekova, D. J. Sparks, M. Hartley and G. Kuchumova, (2020), Development of University–Industry Partnerships in

Kazakhstan: Innovation Under Constraint, *International Journal of Educational Development*, 79, 1-10

Kemenristekdikti (2019), Peraturan Menteri Riset, Teknologi Dan Pendidikan Tinggi Republic Indonesia, Nomor 38 Tahun 2019 Tentang Prioritas Riset Nasional 2020-2024

Kementerian Perindustrian (2015). Rencana Induk Pengembangan Industri Nasional 2015-2035. Jakarta: Pusat Komunikasi Publik Kementerian Perindustrian

Kementerian Perindustrian (2020), Rencana Strategis Kementerian Perindustrian Tahun 2020-2024. Jakarta: Kementerian Perindustrian

KRT [Kementerian Riset dan Teknologi] (2001). Program Riset Unggulan Kemitraan antara Lembaga Litbangyasa dan Industri untuk Tahun 2002, [http://202.46.15.98/index.php?module=News%20News&id=267]

KRT [Kementerian Riset dan Teknologi] (2011). Laporan Akhir Survey Industri Manufaktur 2010. Jakarta: Kementerian Riset dan Teknologi

KRT [Kementerian Riset dan Teknologi] (2014). Pedoman Insentif Riset Sistem Inovasi Nasional. Jakarta: Kementerian Riset dan Teknologi

KRT/ BRIN (2020), Panduan Program Flagship Prioritas Riset Nasional 2020. Jakarta: Kementerian Riset dan Teknologi

Koschatzky, K. (2014). New Forms of Regional Interaction Between University and Industry Evidence from Germany. *Working Paper Firms and Region No. R3/2014.* Karlsruhe: Fraunhofer Institute for Systems and Innovation Research ISI.

Kuhlmann, S., and E. Arnold (2001). RCN in the Norwegian Research and Innovation System. *Background Report No. 12 in the Evaluation of the Research Council of Norway.* Brighton: Technopolis

Lambert, V.A. and C.E. Lambert, (2012), Editorial: Qualitative Descriptive Research: An Acceptable Design, Pacific Rim *International Journal of Nursing Research,* 16(4): 255-256

Lee, J. and H.N Win (2004). Technology Transfer Between University Research Centers and Industry in Singapore, *Technovation*, 24, 433-442

Lee, Y.S., (2000). The Sustainability of University-Industry Research Collaboration: An Empirical Assessment, *Journal of Technology Transfer*, 25, 111-133

Leydesdorff, L. and M. Meyer (2003). The Triple Helix of University-Industry-Government Relations, *Scientometrics*, 58 (2), 191-203

Li, J., X. Sun. X. Dai, J. Zhang dan B. Liu (2022). Knowledge map analysis of industry-university research cooperation policy research based on CNKI and WOS visualization in China, *Sustainability,* 14, 7862: 1-26

Majava, J., V. Isoherranen, and P. Kess, (2013). Business Collaboration Concepst and Implications for Companies, *International Journal of Synergy and Research*, 2 (1), 23-40

Marinho, A., R.G. Silva and G. Santos, (2020), Why Most University-Industry Partnerships Fail to Endure and How to Create Value and Gain Competitive Advantage through Collaboration – A Systematic Review. *Quality Innovation Prosperity / Kvalita Inovácia Prosperita,* 24(2): 34-48

Mark, M., R.L. Jensen, and M.T. Norn, (2014), Estimating the economic effects of university-industry collaboration. *Int. J. Technology Transfer and Commercialisation*, 13 (1/2): 80-106

Moeliodihardjo, B. Y, and B. W. Soemardi, S.S. Brodjonegoro dan S. Hatakenaka, (2012), University, Industry, and Government Partnership: Its Present and Future Challenges in Indonesia, *Procedia Social and Behavioral Sciences*, 52, 307-316

Morisson, A. and M. Pattinson, (2020), *University-Industry Collaboration: A Policy Brief from the Policy Learning Platform on Research and innovation.* Lille: Interreg Europe Policy Learning Platform.

Motohashi, K. and S. Muramatsu, (2011). Examining the University Industry Collaboration Policy in Japan: Paten Analysis, *RIETRI Discusiion Paper Series* 11-E-08. Tokyo: The research Institute

of Economy, Trade and Industry. [www.rietri.go.jp/en]

Nassaji, H., (2015), Qualitative and descriptive research: Data type versus data analysis, Language Teaching Research, 19(2) 129–132

OECD [The Organisation for Economic Co-operation and Development] (2014). OECD Economic Survey: Korea. [*www.oecd.org/sti/ind/2759012.pdf*]

Pertuze, J.A., E.S. Calder, E.M. Greitzer and W.A. Lucas, (2010). Best Practices for Industry-University Collaboration, *MITSloan Management Review*, 51(4), 82-90

Piacentini, A. (2013). The University–Industry Partnership: A New Format to Promote Innovation. Department of the Premier and Cabinet, Government of South Australia

Pusat Penelitian Bioteknologi LIPI (2020), *Proposal Riset Prioritas Riset Nasional: Pengembangan Produk Biosimilar Insulin,* Jakarta: Kementerian Riset dan Teknologi

Rast, S., N. Khabiri and A.A. Senin (2012). Evaluation Framework for Assessing University-Industry Collaborative Research and Technology Initiative, *Procesia- Social and Behavioral Sciences*, 40, 410-416

Rosadi, A H Y. (2014), Technology Adoption in Manufacturing Industry and Its Policy Implication, *Journal of S&T Policy and R&D Management*, 12 (1), 33-44

Santoro, M.D. and A.K. Chakrabarti (2002). Firm Size and Technology Centrality in Industry-University Interactions, *Research Policy*, 31, 1163-1180

Schaefer, T.K. and K.J. Schaefer, (2022), Barriers to university-industry collaboration in an emerging market: Firm-level evidence from Turkey, *The Journal of Technology Transfer*, 47:872–905,

World Bank (2019), Innovative China: New Drivers of Growth. Washington DC: World Bank Group and DRC