

A Reflective Study on the Factor Facilitating the Success of the Cooperation between University-industry

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Abstract. The increasing demands of innovation on products, manufacturing processes, and knowledge force industries to build effective collaboration with academic institutes. The reciprocal university-Industry collaboration needs supportive government policies. As a developing country, Indonesia is predicted to be the seventh biggest economy country in the world. Indonesia needs high-functioned vocational education, which successfully bridges schools and industries. The previous studies explained that the developing country with an economy growing needs three significant factors: industries, government, and universities. Currently, Indonesia needs to adopt further and implement the successful factors of cooperation university-industry from understanding the experience of developed countries. It is crucial to analyze the perspectives of industries regarding U-I cooperation, focusing on government policies, financial support, personnel training, and university policies. This study takes a systematic literature review on the previous experiences of the United States of American and Japan to understand these critical issues. Also, this study finally provides some recommendations consisting of (a) Government policies, such as patent regulation, and license certification, (b) Financial support, such as research funding for small companies, and innovative equipment substitutes, and collaboration with universities, (c) Personnel training, such as senior engineers involvement in universities, on-job-training for technology innovation, and student internship in industries, and (d) University policies, providing industries consultant services, long-termed collaboration for technology innovation, faculty members' internship in industries, and alumni retraining.

1 INTRODUCTION

The collaboration Universities and Industries occurred a long time ago. Involved government, university, society pushed by the rule or them self-needs. The phenomenon has related innovation and development activities from the public and private sector increases (Rantala & Ukko, 2019). Public resources are now being direct through different regional-level funding mechanisms to generate innovation, and economic growth used cooperation. These described by Laasonen & Kolehmainen (2017) that the pursuit knowledge-based economy has become an essential goal for economic development (Europe cases), and different types of knowledge-based regional development strategies have been widely adopted to achieve these goals.

Furthermore, the performance of an innovation system depends on the intensity and efficiency of the linkages (Universities, Industries, and Government),

the university tend to play a crucial part in recent years as the country moves to develop knowledge-based economy (Hu & Mathews, 2009). Economy growth some country depend on innovation development, involved universities, industries and government, and other Factor else. (Masarova, 2014) explained are the economic growth of countries depends on various factors; they can include demographic trends, political system, legislation, culture, trade relations, natural conditions.

Present time industries face on revolution industries 4.0 and giving impact each line. Revolution Industry 4.0 will impose new requirements for the education system and applied research while having significant impacts on the labor market, employee skills and knowledge as well as many social consequences (Habanik, Grecikova, & Krajco, 2019). The requirement of industries to establish makes them need about research and continuous innovation. Currently, an increase in

productivity and productive capacity are considered to be the significant factors of economic growth (Masarova, 2014). The key factors that determine productivity include physical capital, human capital, natural wealth, technological change, and innovation (Habanik et al., 2019). Innovations are the ones of should have the industry to keep sustainability production. The way of addressing these, the industry can make cooperate with the university in the research and development innovation field.

One advantage of the cooperation between University-Industry is the form of strong linkage in both. The linkages can be described as a partnership, supporting, and knowledge transfer from industries to universities. The industry also gains from this collaboration since it provides access to new knowledge and technologies necessary for developing new products, improving product quality, or designing solutions for production and service problems (Azman et al., 2019). The collaboration between academia and industry is understood as the transactions between universities and businesses for mutual benefit (Hoc & Trong, 2019). It means cooperation is obtained to benefit improvement each participant. The industry has a sustainable for production, and university has a more reliable link and match.

Each country has a policy about University-Industry Cooperation to create linked better. The experience by several universities to conduct a study, and then published to share with others. Success experience to be a reference to some universities to build cooperation with industries. From both, Universities and Industries have their perspective about the interest related from this journal a focus on cooperation experience between university-industry from the perspective of industries.

1.1 The Purpose of the Study

This study was conducted to systematically analyze the significant factors which facilitate the success of cooperation between university and industry, focusing the government policies, university policies and practices, student's preparation, and the contribution in industries based on the perspective industry. Each Factor will be analyzed and gaining with literature reviews from the journal relevant. Before obtaining the significant Factor of facilitating the success factor cooperation between university and industry, we have to know about the based theory about government policy, university policy, financial support, and personnel training based on

industry perspectives. Research framework can be explained as follows,

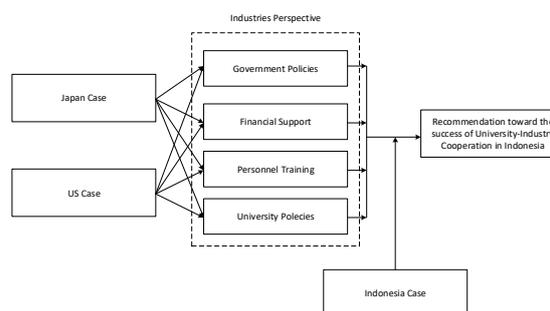


Figure 1: The research framework.

2 METHODOLOGY

A systematic Literature review is the first approach for this study. This method of increasing results being adopts in the social field and science (Sheldon, Bradshaw, Baldwin, Sinclair, & Burrows, 2001). This method reduces subjective bias and risk of overlooking literature in a careful and rigorous process (Kitagawa, 2009). The essential data would come from paper journal related used many synonyms, historical terms, and variants of search terms. They were using the dominant search engine Web of Science (WOS) and Scopus to support other data.

To obtain a literature related used combination process to the literature review process. The four-step process to obtain the literature, that is;

1. Step-one: Major data finding used journal portal of Web of Science (WOS) and consist of two groups. The first group is Web of Science with the last five years, and the second group is with a span of five to ten years. Besides, if there is a lack of data not found on WOS, then use the Scopus Portal as supporting data.
2. Step-two: Eliminate other the journal, if which one selected approves in the topic related. Otherwise, if in the related discussion topic lack, can use another reference from input else.
3. Step-three: To know how many words or sentences related to the primary topic, would be used as a search engine on PDF viewer and then will be recorded each percentage.
4. Step-fourth: The higher percentages explained a journal is related to the primary

topic, and then these a journal will be select to significant references.

3 RESULTS

The literature review is showed Japanese planning for the cooperation between universities and industries starting from a long time ago. Policies for promoting university and industry collaboration in the Japanese started in the 1980s. However, most initiatives were carried out during the 1990s and after (Pittayasophon & Intarakumnerd, 2017). Describe by Perkmann & Walsh (2008) the Japanese had invested considerable effort in University-Industry Cooperation, such as the Haranuma Plan propose in 2001. This plan to preparing and promote the development of enterprises through collaboration with universities, the industrialization of university research achievement, and the relationship between universities and industries. The Japanese government encouraged the universities to set up business ventures through the industrial technology Enhancement Act and Hiranuma Plan star beginning in 2000-2001, and have target 1000 university-originated venture in 3 year (Pittayasophon & Intarakumnerd, 2017). Hiranuma plan is once of the grand plan in Japanese to increase quality and quantity in the University-Industry Cooperation.

Before the Japanese launching the hiranuma plan, the Japanese had established Laws related to science and technology. This Law is called "The Basic Science and Technology Law" in 1995, academia e industry cooperation in Japanese extended to companies, universities, research, national governments, and local government (Tsuruya, Kawashima, Shiozuka, Nakanishi, & Sugiyama, 2018). Further laws are Japanese establish relevant with promoting technology transfer from universities to industries. The both of Law are "*Daigaku-tou Gijutsu Iten Sokushin Ho*" have means the Law for promoting University-Industry Technology Transfer (enacted in 1998) and "*Sangyo Saisei Tokubetsu Sochi Ho*" have meant the Industrial Revitalization Law (enacted in 1999) (Kato & Odagiri, 2012; Vick & Robertson, 2018). Kyoung-Joo (Lee, 2011) and Fumi Kitagawa (Kitagawa, 2009) more detail explained about historical of University-Industry Cooperation constructing in Japanese as following:

Table 1: Historical of UIC constructing in Japanese.

Year	Legal changes and policies
1995	The Science and Technology Basic Law
1996	The First Science Basic Plan (1996-2000)
1998	Technology Transfer Law (Establishment of Technology Licensing Office)
1999	The Japanese version of the Bay-Dole Act
2000	Law to Strengthen Industrial Technology
2001	The Second Science Basic Plan (2001-2005)
2003	Intellectual Property Headquarters (IPHQs)
2004	National University Incorporation Law
2006	The Third Science Basic Plan (2006-2010)
2008	'Regionally-based innovation Acceleration Plan' (METI)

The history related to University-Industry Cooperation in Japanese from beginning in 1995 until now (2019) makes cooperation was settle. Japanese to be the most important industrial country in the world and have high-quality products. Besides, innovation in Japanese has improved every year, causes collaboration to developing of industrial technology to engage researchers from university. It has shown the cooperation between Universities and Industries function is as well.

The University-Industry have many Factors to be a success in the cooperation established. Based on the literature review and perspective industries, cooperation divided to be four groups. As following is a group of Succes factor from prospective industries:

3.1 Government Policies

The development of Japanese University-industry collaboration since the late 1990s has been characterized by growing cooperation not only between universities and industry but between the two ministries, namely METI (Minister of Economy, Trade, and Industry) and MEXT (Minister of Education, Culture, Sports, Science, and Technology), especially concerning strengthening intellectual property strategies and local industrial-cluster strategies (Kitagawa, 2009). After the cooperation between both of the ministers has established, the Japanese government focused on creating new knowledge, followed by transferring technology, commercializing research outputs, and creating business ventures (MEXT, 2014). However, not enough, Innovators should have legality in innovation and invention activity. Further action of MEXT is established and introduced a policy to

build Intellectual property headquarters (IPHQs) to be placed inside significant research universities in 2003 and provided the universities with financial support for five years (Lee, 2014). IPHQs designed organizational procedures to apply for patents of research achievements and implemented a central management system of IP rights in a university. The primary function of the IPHQs by MEXT looked similar to that of the Approved-TLOs by METI. Still, they have several distinctive aspects of organizational status and the treatment of IP (Lee, 2011).

As a member of the Paris Convention for the Protection of Industrial Property concluded in 1883, the Japanese adopted the treaty's methods for protecting intellectual property, companies with technology holders, or participating in the capital (Tsuruya et al., 2018). Furthermore, the intellectual property rights issue was promoted due to the influence of US government policy (Pittayasophon & Intarakumnerd, 2017). Besides, the Japanese have "the Japanese Bayh-Dole Act," it is like the US Bayh-Dole Act, allowed the state not to acquire patent rights from university inventors researching with government funds. After establishing this Law, the number of university patent applications increased in Japanese after 1999 and, the number jumped to 3756 during 2004 (Kato & Odagiri, 2012; Mowery, 2011; Lee, 2011).

Some technology licensing organizations (TLO) established in 1998 withdrew from the patent application business and began specializing in matching researchers with companies (Tsuruya et al., 2018; Kato & Odagiri, 2012; Lee, 2011; Vick & Robertson, 2018). Patents are more effective as a means of appropriating return to R&D in drugs where innovations are stand-alone (Fukugawa, 2017). At the end of the application process, when patents issue in various countries, over one-third perhaps over half) of patents issued to Japanese universities are co-owned by companies – the overwhelming majority of which are large Japanese manufacturers. Dissatisfaction with university policies preventing companies from automatically owning (or otherwise controlling) collaborative inventions was most acute in the case of narrowly focused (typical) collaborations (Kneller, Mongeon, Cope, Garner, & Ternouth, 2014).

3.2 Financial Support

The Japanese government has policies to increasing and improving university-industry cooperation through two ministries, which have a role in

regulation about financial support to universities and Industries. The university system comes under the jurisdiction of MEXT, while economic and industrial activities become the responsibility of the Ministry of Economy, Trade, and Industry (METI). This has created competition between the two government agencies in an attempt to gain greater administrative control over the UI collaboration policy. In 1998, the METI moved first in introducing a policy of Approved TLO, which was aimed at effectively transferring university generated technologies to industry (Lee, 2014).

The government provides technical infrastructure, such as laboratories and equipment, which is also one of the critical modes of collaboration. Due to government financial support, the technical infrastructure is very advanced and reliable to establish cooperation between universities and industries (Pittayasophon & Intarakumnerd, 2017). The facilities are the one crucial supporting to build and maintain cooperation with each other. Universities need supporting financially to build office and training places, and on the other side, industries need a researcher involved in developing innovative technology. Pittayasophon & Intarakumnerd (2017) describes that Japanese universities prefer to conduct joint research, where university researchers and company researchers work together on equal footing. The Japanese government focus on developing the small firm, Fukugawa (2016) explain that technology diffusion programs to help small local firms enhance absorptive capacity are of high importance particularly in the catching-up economies, and in economies where small firms have a more significant presence in the business ecosystem.

3.3 Personnel Training

The national universities in both (Japanese-US) countries have quality graduate students, famous researchers, and advanced technical infrastructure; therefore, large firms prefer to work with them (industry) (Pittayasophon & Intarakumnerd, 2017). These were achieved a long time ago, starting beginning from government policy. Furthermore, the university continuing engage researcher and teacher to be a participant in the training program in industries. The government was supporting on the financial side and then university preparation of researcher and teacher.

3.4 University Policies

One of the earliest policies to encourage UICs was establishing the UICRC in national universities by MEXT. Since 1994, large national universities in urban areas, such as Kyushu University, began to establish centers for UI collaborations (Lee, 2014). Since 1996, the Japanese government has formulated a basic plan for science and technology every five years, and the current plan is now in its fifth phase (Tsuruya et al., 2018). The activities of local public technology centers have an immediate impact on innovative outputs. The local public technology centers fostered industrial innovations in the region through other routes than the promotion of university-industry joint research (Fukugawa, 2016). Local public universities in Japanese, on the other hand, are under the control of the local government. They aim to provide higher education opportunities to local people and to serve as intellectual and cultural centers within the local community (Pittayasophon & Intarakumnerd, 2017).

Following the declaration of the first Science and Technology Basic Plan in 1996, the government took several policy initiatives to deregulate and encourage UI collaboration. Now professors can join boards of directors of private companies, and universities can accept research funds more easily from industries and accept researchers dispatched from companies at their laboratories (Kato & Odagiri, 2012). University provides consultation on product and process improvement because most collaborating firms are small local firms that do not have R&D capabilities and may not know how to access the universities (Pittayasophon & Intarakumnerd, 2017). The center coordinators respond to a partner firm's requests to find university researchers who can provide technical consultation and conduct joint research (Lee, 2014). The University of Tokyo explicitly encourages and takes advantage of its multidisciplinary knowledge across faculties or departments when it has joint R&D projects with the industry. In the case of Tohoku University, it does not have a specific policy eliminating boundaries of faculties (Pittayasophon & Intarakumnerd, 2017).

In the United States to support commercialization, many universities have established specialized structures, such as technology transfer offices (TTOs), science parks and incubators and created supportive internal rules and procedures (Jensen & Thursby, 1998; Perkmann et al., 2013). The United States established numerous innovative collaboration systems centered

on universities. For example, Silicon Valley successfully linked academia and industry through Stanford University and effectively converted university research and development achievements into applicable industrial technology. (Chang, 2017).

4 DISCUSSIONS

Indonesia has predicted to be the seven biggest economy country in the world. This country needs to improve and build a sustainable economy, with a continuing economy and technology growing up. Japanese is part of ASIA, and have similar characteristic with Indonesia society. Moreover, the Japanese have a big factory in Indonesia and dominate the automotive market as a whole. Indonesia given big impact economy to the Japanese industry has established victory in this country. It should easy to implementation of transfer knowledge from Industries to universities or established cooperation between Japanese factories with university.

The four factors, as described in the finding on literature review, if at duplicate and implement in the Indonesia system given a significant impact on universities and industries. Implementation should consider about society, government-supported, and local wisdom from Indonesia. The four factors included government policies, university policies, financial support, and personnel training that have the representation of the desires of industries. All this time, industries have little contribution and cooperation with universities and the government. They were only limited to internship places and worker recruitment as an employee in industries. The cooperation as established have equal foot each other had explained by Pittayasophon & Intarakumnerd (2017), where university researchers and company researchers on the collaboration has a principle as work together on equal footing.

The first Factor is government policies; Indonesia has a source for all the Law, called UUD45. The whole of the Law which developed from this source, and have reference to being a prosperous society. The Japanese government policies can be implemented in the Indonesia situation should in line with UUD45. The government policies that can be implemented to improve and develop University-Industry Cooperation are; The Cooperation between two ministries, that is the Ministry of Research and Technology and the Ministry of Industry; and Focused on creating new knowledge, followed by

transferring technology, commercializing research outputs, and creating business ventures. Besides, the government established Law for protecting intellectual property and made it easy to create of patent certificate.

The second Factor is financial support; each University in Indonesia has a barrier to establish cooperation between universities and industries; it caused limited financial support as a government institution. Even though in the cooperation, university and industry needed much financial support to be running success. As following is the Japanese government supporting of financial in the University-Industry Cooperation; Provides technical infrastructure, such as laboratories and equipment, is also one of the essential modes of collaboration; Focus on developing the new or small company, and engaged in developing substituted technology for a small company.

The third Factor is personnel training; the teacher and researcher at the university have the competency to share with the student. However, Indonesia's teacher and researcher need to continue to improve competency and knowledge in applying technology in industries. The Japanese government entered the program, such as student and teacher internship and on-job training in industries. It is an influence on updating student and teacher skills and knowledge. This line is compacted with student and teacher conditions in university whole in Indonesia.

The last Factor is university policies; the universities in Indonesia have the power to creating policy in the private institution. However, the government to encourage the university to establish policies related to increasing cooperation between the university and industry. Several policies from Japanese university experiences such as; University providing industries consultant services for small industries; and have long-termed collaboration policies for technology innovation and future technology. Besides, faculty members' should involve in the internship program in industries, and alumni can take a retraining program in industries.

5 CONCLUSIONS

Experience of University-Industry based on respective Industries recommending to establish mutualism cooperation for each party. Several recommendations starting beginning from Government policies have established patent regulation supporting both parties, and the government should provide license certifications

which easy to access and step of the licensing process. Besides, the government has supported companies and universities financially, such as research funding focus on small companies or startup entrepreneurs. The government should have the program to substitutes innovative equipment needed for industries. To supporting innovative equipment, the government can involve universities to collaborate on developing the technologies.

Other side, universities have involved senior engineers in engaging in collaboration with industries. Also, the university sending students and teachers to participate in the program of on-job-training for technology innovation to improve skill and technology knowledge. Besides, student engagements in an internship program in industries to applying and improving skills. To supporting University-Industry Cooperation, the university should have several policies in the internal organization. The form of policies, such as providing industries consultant services for small industries and have long-termed collaboration policies for technology innovation. For faculty members' should involve in the internship program in industries, and alumni can take a retraining program in industries.

REFERENCES

- Azman, N., Sirat, M., Pang, V., Lai, Y. M., Govindasamy, A. R., & Din, W. A. (2019). Promoting university-industry collaboration in Malaysia: stakeholders' perspectives on expectations and impediments. *Journal of Higher Education Policy and Management*, *41*(1), 86–103. <https://doi.org/10.1080/1360080X.2018.1538546>
- Chang, S. H. (2017). The technology networks and development trends of university-industry collaborative patents. *Technological Forecasting and Social Change*, *118*, 107–113. <https://doi.org/10.1016/j.techfore.2017.02.006>
- Fukugawa, N. (2016). Knowledge spillover from university research before the national innovation system reform in Japan: localization, mechanisms, and intermediaries. *Asian Journal of Technology Innovation*, *24*(1), 100–122. <https://doi.org/10.1080/19761597.2016.1141058>
- Fukugawa, N. (2017). University spillover before the national innovation system reform in Japan. *International Journal of Technology Management*, *73*(4), 206–234. <https://doi.org/10.1504/IJTM.2017.083079>
- Habanik, J., Grecikova, A., & Krajco, K. (2019). The impact of new technology on sustainable development. *Engineering Economics*, *30*(1), 41–49. <https://doi.org/10.5755/j01.ee.30.1.20776>

- Hoc, L. H., & Trong, N. D. (2019). University-Industry Linkages in Promoting Technology Transfer: A Study of Vietnamese Technical and Engineering Universities. *Science, Technology and Society*, 24(1), 73–100. <https://doi.org/10.1177/0971721818821796>
- Hu, M.-C., & Mathews, J. A. (2009). Estimating the innovation effects of university-industry-government linkages: The case of Taiwan. *Journal of Management & Organization*, 15(2), 138–154. <https://doi.org/10.1017/s1833367200002753>
- Jensen, R., & Thursby, M. (1998). Proofs and Prototypes for Sale: The Tale of University Licensing. *National Bureau of Economic Research*. <https://doi.org/10.3386/w6698>
- Kato, M., & Odagiri, H. (2012). Development of university life-science programs and university-industry joint research in Japan. *Research Policy*, 41(5), 939–952. <https://doi.org/10.1016/j.respol.2012.02.011>
- Kitagawa, F. (2009). Universities-industry links and regional development in Japan: Connecting excellence and relevance? *Science, Technology and Society*, 14(1), 1–33. <https://doi.org/10.1177/097172180801400101>
- Kneller, R., Mongeon, M., Cope, J., Garner, C., & Ternouth, P. (2014). Industry-university collaborations in Canada, Japan, the UK and USA - With the emphasis on publication freedom and managing the intellectual property lock-up problem. *PLoS ONE*, 9(3). <https://doi.org/10.1371/journal.pone.0090302>
- Laasonen, V., & Kolehmainen, J. (2017). Capabilities in knowledge-based regional development-towards a dynamic framework. *European Planning Studies*, 25(10), 1673–1692. <https://doi.org/10.1080/09654313.2017.1337727>
- Lee, K. J. (2011). From interpersonal networks to inter-organizational alliances for university-industry collaborations in Japan: The case of the Tokyo Institute of Technology. *R and D Management*, 41(2), 190–201. <https://doi.org/10.1111/j.1467-9310.2011.00633.x>
- Lee, K. J. (2014). Development of boundary-spanning organizations in Japanese universities for different types of University-industry collaborations: a resource dependence perspective. *Asian Journal of Technology Innovation*, 22(2), 204–218. <https://doi.org/10.1080/19761597.2014.973164>
- Masarova, J. (2014). Differences in the Performance of the Visegrad Group Regions. *SGEM 2014 Scientific SubConference on POLITICAL SCIENCES, LAW, FINANCE, ECONOMICS AND TOURISM*, 4, 195–202. <https://doi.org/10.5593/sgemsocial2014/b24/s7.025>
- Mowery, D. C. (2011). Learning from one another? International policy "emulation" and university-industry technology transfer. *Industrial and Corporate Change*, 20(6), 1827–1853. <https://doi.org/10.1093/icc/dtr063>
- Perkmann, M., Tartari, V., McKelvey, M., Autio, E., Broström, A., D'Este, P., ... Sobrero, M. (2013). Academic engagement and commercialization: A review of the literature on university-industry relations. *Research Policy*, 42(2), 423–442. <https://doi.org/10.1016/j.respol.2012.09.007>
- Perkmann, M., & Walsh, K. (2008). Engaging the scholar: Three types of academic consulting and their impact on universities and industry. *Research Policy*, 37(10), 1884–1891. <https://doi.org/10.1016/j.respol.2008.07.009>
- Pittayasophon, S., & Intarakumnerd, P. (2017). University and industry collaboration in Japan and Thailand: influence of university type. *Asian Journal of Technology Innovation*, 25(1), 23–40. <https://doi.org/10.1080/19761597.2017.1302399>
- Rantala, T., & Ukko, J. (2019). Performance evaluation to support European regional development—A university-industry perspective. *European Planning Studies*, 27(5), 974–994. <https://doi.org/10.1080/09654313.2019.1581728>
- Sheldon, T., Bradshaw, J., Baldwin, S., Sinclair, I., & Burrows, R. (2001). *Methodologies for socially useful systematic reviews in social policy: ESRC End of Award Report*.
- Tsuruya, N., Kawashima, T., Shiozuka, M., Nakanishi, Y., & Sugiyama, D. (2018). Academia-industry Cooperation in the Medical Field: Matching Opportunities in Japan. *Clinical Therapeutics*, 40(11), 1807–1812. <https://doi.org/10.1016/j.clinthera.2018.10.010>
- Vick, T. E., & Robertson, M. (2018). A systematic literature review of UK university-industry collaboration for knowledge transfer: A future research agenda. *Science and Public Policy*, 45(4), 579–590. <https://doi.org/10.1093/SCIPOL/SCX086>