Triple Helix Model in Developing Technological Innovation: The Case of Computer Based Interlocking

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ABSTRACT

Computer Based Interlocking (CBI) is the most important part of the electric railway signalingsystem which serves as the "brain" that controls the operation of electrical signaling system thatreplaces the role of the electromagnetic relay which has gradually been abandoned. Developmentof CBI is based on the fact that until recently the signaling system in Indonesia is still reliedheavily on the CBI products from foreign vendors. Therefore, the development of domestic CBIproducts is really necessary in order to decrease the dependence on technology from foreignvendors that at the same time is also be able to support the accelerated development of railwayinfrastructure in Indonesia.The CBI development is conducted in the form of a collaboration involving the government,universities, and industry. This paper explores and analyzes the roles and interactions betweendifferent actors in the triple helix perspective, and identifies how the innovation ecosystemfunctioning with support from the government.Based on the data collected through in-depth interview with the actors involved in the CBI casestudy, this paper gives some key findings. First, government role is very important in establishingan innovation ecosystem for CBI development. Second, the leader in the development of CBItechnological innovation should be the industry supported by governmental R & D institutionsand universities. Third, R & D consortium is an effective vehicle for creating an interactionamong industry, academia, and government.Such findings may provide conceptual direction which is important for the development oftechnological innovation in Indonesia. In addition, in providing support for R&D activities, thegovernment needs to direct its R & D incentives to the industry as a business practitioner with itsown technology roadmap. The possible further research may include some research issues. First,is the pattern occurred in the CBI case also applied in the other cases of technological innovationdevelopment? Second, what obstacles can be identified in the development of CBI technologicalinnovation capabilities? Third, what is the impact of research collaboration in the development ofCBI technological innovation?

Keywords :Indonesia, R & D Consortium, Industrial Research, Government Support

1. Introduction

Computer Based Interlocking (CBI) is the most important part of the electric railway signalingsystem. CBI serves as the "brain" that controls the operation of electrical signaling system thatreplaces the role of the electromagnetic relay which has been abandoned gradually. Because of itsvery important function, the safety and reliability performance of a signaling system is largelydetermined by the CBI.

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Development of CBI is based on the fact that until recently the signaling system in Indonesia isstill relied heavily on the CBI products from foreign vendors. The use of foreign products leads tohigh dependence of foreign vendors that result in high cost of construction, operation, andmaintenance of signaling system, the time length of development realization, and the limitedservice support.

Therefore, the development of domestic CBI products is really necessary in orderto decrease the dependence on technology from foreign vendors that at the same time is also beable to support the accelerated development of railway infrastructure in Indonesia. In addition, thedomestic market opportunities, especially the requirement for a lot of mechanical signalingequipment, the development of double track, and the development of new pathways outside Java,also become a trigger for the development of CBI.

The CBI development is conducted in the form of a collaboration involving the government,universities, and industry. The collaboration is a key for innovation process which can encourageinteractions among firms, universities and R & D institutes (Inzelt, A. 2004).

Leydesdorff and Etzkowitz (1998) propose the triple helix model to describe the dynamicsexisting in the institutional arrangements involving universities, enterprises and governments, andthe relations between them occurred during the process of innovation. Leydesdorff and Meyer(2006) state that within this model, industry has a role as wealth generator, academia as a noveltyproduction and government represents the public control.

Hewitt-Dundas (2006) finds that the ability of the small firm to innovate is related tocollaboration. Not only small and medium sized firms but also large firms get benefit fromcollaboration. The correlation between innovativeness and the collaboration with various actors,such as universities, suppliers, customers, research institutions has been proven to be positive(Becheik et al, 2006).

Evidence suggests that government policies have a positive effect on innovation.Courvisanos (2009) recognizes the strong political focus on public innovation and providesa policy framework that identifies innovation policies formulated by the government.Furthermore, with the emphasis on the triple helix dynamics, Etzkowitz (2008) asserts that therole of government in the triple helix firm is at an embryonic state, and that its effectiveness israther low.

Universities and research institutions have an important role on innovation (Vuola andHameri, 2006). However, Drejer and Jorgensen (2005) argue that traditionally university andresearch institutes focus more on the provision of scientific and technical knowledge, not on thedevelopment of the innovation process of the firms.

Most facts revealed by Etzkowiz (2008), Leydesdorff and Meyer (2006), as well as Drejer and Jorgensen (2005) happen in developed countries. Roles played by industries, academia and government in encouraging innovation process can be different in developing countries including Indonesia. Therefore, this paper tries to verify the roles explained by Etzkowiz (2008); and Leydesdorff and Meyer (2006). This paper also tries to verify the focus of universities and R & D institutes as a provider of scientific and technical knowledge (Drejer and Jorgensen (2005). In other words, this paper explores and analyzes the roles and interactions between different actors in the triple helix perspective, and identifies how the innovation ecosystem works with support of the government.

2. Methods

This study analyzes innovation process involving three actors (industry, academia, andgovernment) in Indonesia. The innovation process analysis is a case study related to

thedevelopment of CBI. Case study is the study of the particularity and complexity of a single case,coming to understand its activity within important circumstances (Stake, 1995). According toYin, the strength of the case study is that it both covers a contemporary phenomenon and itscontext (Yin, 1981).

In identifying the roles and interactions between different actors in the triple helix perspective,and identifying how the innovation ecosystem works with the government support, this study usesin-depth interview and discussions with some collaboration members for three years. During thattime, interview and discussions were carried out with related parties which consist of industries,academia and government. The interview and discussions were conducted with directors andmanagers of firms, government officials and researchers from government R & D institute, anduniversities.

3. Results and Discussions

Collaboration program on CBI involving industry, academia and government is initially based ona meeting held in 2008 in Ministry A. In that meeting, Ministry A and B have a vision to reducethe dependency on imported technology especially for computer based train signaling system.

Institutions with the ability to develop the required system and technology are available inIndonesia. One company is engaged in a business of train signaling system with the technologycapability of programmable logic controller (PLC) based product. In addition, there are twouniversities and one government R & D institution which can support the development of CBI.

The development of CBI is carried out collaboratively. In the model of R & D collaborationperformed, industry is chosen as the leader. The reason is that industry has more knowledge aboutthe user needs than the governmental research institutions and universities. Another reason forthis is that the industry has built its technology innovation capability from the previousprogrammable logic controller (PLC) based product development which has proven to besuccessful in the marketplace.The model to develop CBI is presented in figure 2. The model reflects the triple helix perspectivewhich consists of elements of academia, industry and government. Initially, the collaborationmodel presented in figure 1 involves several agencies consisting of Ministry A, Ministry B andcompany X. Because of limited technical skills, subsequently the collaboration also involves agovernment R & D institution and two universities.

Collaboration is carried out in the form of a R & D consortium. The R & D consortium is an effective forum for interaction among industry, academia and government. Technology users, policy makers and scientists can discuss together to decide the direction of science and technology development in the consortium. Dialogue among stakeholders in the public-private consortia may be an effective way to network and identify issues that hamper innovation. In the end, application opportunities are easier to identify when intensive interaction among actors who are also members of R & D consortium takes place (Roelofsen et al, 2010).
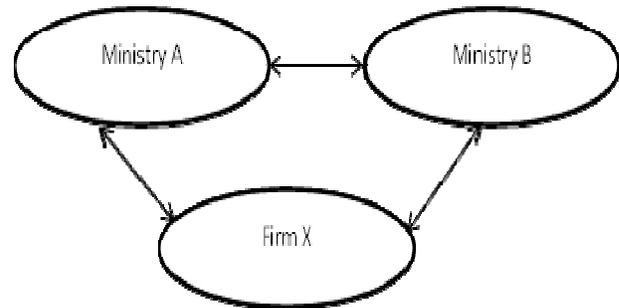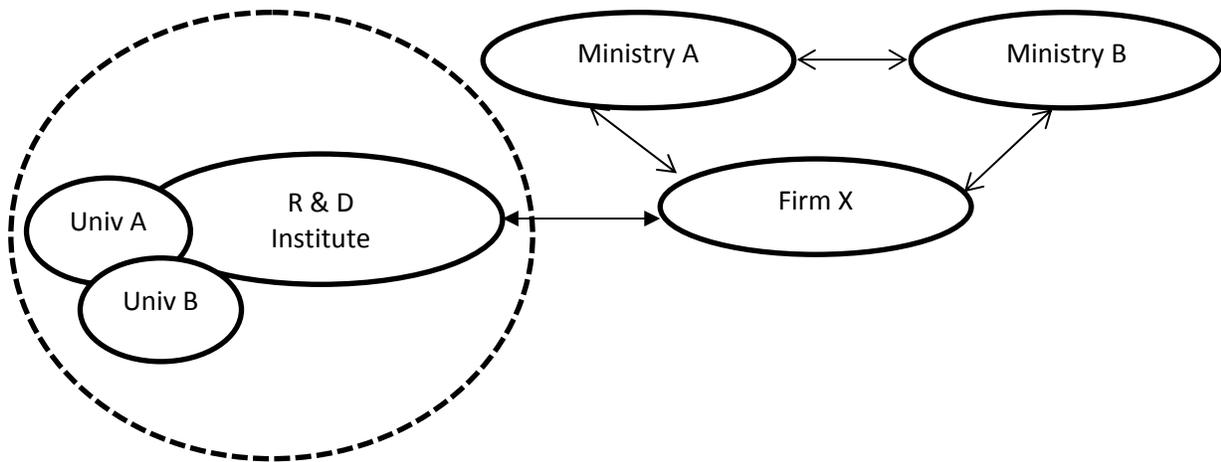

Figure 1.Intial Model

Figure 2. Triple Helix Model

Table 1 shows the contribution of each member of the collaboration. Ministry A plays a role inproviding incentives R & D and program coordinator. Ministry B provides funding for theimplementation of the CBI, human resources to verify the CBI technology and user of resultedCBI. Firm X acts as a leader in research activities, the provider of funds and human resources(HR) for research. Government R & D institute plays a role in providing human resources toperform technology assessment of CBI. University A and B provide equipment and humanresources for technology development.

Table 1. Collaboration Contributions

No	Institutions	Funds	HR	Equipment	User	Program Coordinator
						Contribution
1	Ministry A	√	√			√
2	Ministry B	√	√		√	
3	Firm X	√	√	√		
4	Government R&D Institute		√			
5	University A		√	√		
6	University B		√	√		

The roles of government (Ministry A and B) are not only in the early stages, but also in the stageof implementation and utilization. Without the involvement of Ministry B in the implementationphase, the CBI innovation process will not run smoothly. In terms of funding contribution, therole of government is larger than industry. This fact is very different from the result of the studyconducted by Etzkowitz (2008).Based on this fact, the development of CBI will not be able to run smoothly without the supportof the government. In the case of CBI, government plays a very important role in creatingan ecosystem of innovation. The government role is not only in the provision of fund, but also inthe implementation and utilization of CBI.

Time required to finish the technology development is relatively predictable. The development bythe company without any collaboration, will take longer time due to

limited research funding andhuman resources, as well as technological capability. With this collaboration, it can be finishedmuch faster. The program lasts four years starting from 2009 and will end in 2012 with theinstallation of this technology at one station in the area of Central Java.

In terms of research development, the role of industry is also very important since the industryhas possessed prior knowledge on railway signaling technology. Government research institutionand universities gain a lot of technical and practical knowledge from the industry. In the earlystage of collaboration, the reality is different from what is revealed by Drejer and Jorgensen(2005). However, at later stage, the industry acquires lot of knowledge, especially on themethodology of technology development from universities. Meanwhile, the government R & Dinstitute acts an assessor of CBI technology in which the results of the assessment are veryimportant for the certification of the CBI product.

Collaborative program of CBI development has produced a variety of technological capabilitiessuch as the ability of integration, and development of software and components. Thetechnological capability has resulted in a product output as planned with the domestic componentestimated above 60%.

4. Conclusions

From the findings in developing CBI, some conclusions drawn are as follows:

- Roles of government are very important in establishing an innovation ecosystem. The presenceof the government is required in the research collaboration to minimize the risk of technologyfailures which is possible to occur, and to accelerate the development of technologicalinnovation. Moreover, government roles in developing CBI are not only in an early stage, butalso in an implementation and utilization stage of CBI. Ministry A has a function as a R & Dincentive provider and program coordinator. Ministry B provides funding to implement CBI,human resources to verify the technology, and user of the CBI. Firm X has a role as a leader inR & D activities, provider in funding and human resources for R & D activities. GovernmentR & D institution provides human resources to conduct an assessment on CBI with the aim tostandardize CBI product. University A and B provide human resources and equipments todevelop CBI.

- Leader in the development of CBI technological innovation should be the industry supportedby governmental research institutions and universities. The reason is that the industry has moreknowledge about the user needs than the governmental research institutions and universities.Another reason is that because the industry has built its technology innovation capability fromthe previous programmable logic controller (PLC) based product development which hasproven to be successful in the marketplace.

- R & D consortium is an effective vehicle to make interactions among industry, academia andgovernment take place. Technology users, policy makers and researchers can talk together todecide the direction of science and technology to be developed. Dialogue among involvedparties in public-private consortia can be an effective way in building collaborations andidentifying some problems emerged for innovation.

With the technological capability owned by related parties, collaboration program on the CBIdevelopment has produced a product output as planned. Therefore, in providing support for R&Dactivities, the government needs to direct its R & D incentives to the industry that is engageddirectly in the business and has technology roadmap. The reason is that the industry has moreknowledge about the user needs than the governmental research institutions and universities.

The possible further research may include some research issues. First, is the pattern occurred inthe CBI case also applied in the other cases of technological innovation development? Second,what obstacles can be identified in the development of CBI technological innovation capabilities?Third, what is the impact of research collaboration in the development of CBI technologicalinnovation?

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