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 signaling system which serves as the “brain” that controls the operation of electrical signaling system that replaces the role of the electromagnetic relay which has gradually been abandoned. Development of CBI is based on the fact that until recently the signaling system in Indonesia is still relied heavily on the CBI products from foreign vendors. Therefore, the development of domestic CBI products is really necessary in order to decrease the dependence on technology from foreign vendors that at the same time is also able to support the accelerated development of railway infrastructure 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 between different actors in the triple helix perspective, and identifies how the innovation ecosystem functioning 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 establishing an innovation ecosystem for CBI development. Second, the leader in the development of CBI technological innovation should be the industry supported by governmental R & D institutions and universities. Third, R & D consortium is an effective vehicle for creating an interaction among industry, academia, and government. Such findings may provide conceptual direction which is important for the development of technological innovation in Indonesia. In addition, in providing support for R&D activities, the government needs to direct its R & D incentives to the industry as a business practitioner with its own 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 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 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 signaling system. CBI serves as the “brain” that controls the operation of electrical signaling system that replaces the role of the electromagnetic relay which has been abandoned gradually. Because of its very important function, the safety and reliability performance of a signaling system is largely determined by the CBI.

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

Therefore, the development of domestic CBI products is really necessary in order to decrease the dependence on technology from foreign vendors that at the same time is also be able to support the accelerated development of railway infrastructure in Indonesia. In addition, the domestic market opportunities, especially the requirement for a lot of mechanical signaling equipment, 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 encourage interactions among firms, universities and R & D institutes (Inzelt, A. 2004).

Leydesdorff and Etzkowitz (1998) propose the triple helix model to describe the dynamics existing in the institutional arrangements involving universities, enterprises and governments, and the 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 novelty production and government represents the public control.

Hewitt-Dundas (2006) finds that the ability of the small firm to innovate is related to collaboration. Not only small and medium sized firms but also large firms get benefit from collaboration. 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 provides a policy framework that identifies innovation policies formulated by the government. Furthermore, with the emphasis on the triple helix dynamics, Etzkowitz (2008) asserts that the role of government in the triple helix firm is at an embryonic state, and that its effectiveness is rather low.

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

Most facts revealed by Etzkowitz (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 Etzkowitz (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, and government) in Indonesia. The innovation process analysis is a case study related to
the development 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 to Yin, the strength of the case study is that it both covers a contemporary phenomenon and its context (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 uses in-depth interview and discussions with some collaboration members for three years. During that time, interview and discussions were carried out with related parties which consist of industries, academia and government. The interview and discussions were conducted with directors and managers of firms, government officials and researchers from government R & D institute, and universities.

3. Results and Discussions

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

Institutions with the ability to develop the required system and technology are available in Indonesia. One company is engaged in a business of train signaling system with the technology capability of programmable logic controller (PLC) based product. In addition, there are two universities 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 collaboration performed, industry is chosen as the leader. The reason is that industry has more knowledge about the user needs than the governmental research institutions and universities. Another reason for this is that the industry has built its technology innovation capability from the previous programmable logic controller (PLC) based product development which has proven to be successful in the marketplace. The model to develop CBI is presented in Figure 2. The model reflects the triple helix perspective which consists of elements of academia, industry and government. Initially, the collaboration model presented in Figure 1 involves several agencies consisting of Ministry A, Ministry B and company X. Because of limited technical skills, subsequently the collaboration also involves a government 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 (Roelofs et al, 2010).

Figure 1. Initial Model
Table 1 shows the contribution of each member of the collaboration. Ministry A plays a role in providing incentives R & D and program coordinator. Ministry B provides funding for the implementation of the CBI, human resources to verify the CBI technology and user of resulted CBI. 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 to perform technology assessment of CBI. University A and B provide equipment and human resources for technology development.

Table 1. Collaboration Contributions

<table>
<thead>
<tr>
<th>No</th>
<th>Institutions</th>
<th>Funds</th>
<th>HR</th>
<th>Equipment</th>
<th>User</th>
<th>Program Coordinator</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ministry A</td>
<td>√</td>
<td>√</td>
<td></td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>2</td>
<td>Ministry B</td>
<td>√</td>
<td>√</td>
<td></td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>3</td>
<td>Firm X</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Government R&amp;D Institute</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>University A</td>
<td>√</td>
<td></td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>University B</td>
<td>√</td>
<td></td>
<td>√</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The roles of government (Ministry A and B) are not only in the early stages, but also in the stage of implementation and utilization. Without the involvement of Ministry B in the implementation phase, the CBI innovation process will not run smoothly. In terms of funding contribution, the role of government is larger than industry. This fact is very different from the result of the study conducted by Etzkowitz (2008). Based on this fact, the development of CBI will not be able to run smoothly without the support of the government. In the case of CBI, government plays a very important role in creating an ecosystem of innovation. The government role is not only in the provision of funds, but also in the implementation and utilization of CBI.

Time required to finish the technology development is relatively predictable. The development by the company without any collaboration, will take longer time due to
limited research funding and human resources, as well as technological capability. With this collaboration, it can be finished much faster. The program lasts four years starting from 2009 and will end in 2012 with the installation 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 industry had possessed prior knowledge on railway signaling technology. Government research institution and universities gain a lot of technical and practical knowledge from the industry. In the early stage of collaboration, the reality is different from what is revealed by Drejer and Jorgensen (2005). However, at later stage, the industry acquires a lot of knowledge, especially on the methodology of technology development from universities. Meanwhile, the government R & D institute acts as an assessor of CBI technology in which the results of the assessment are very important for the certification of the CBI product.

Collaborative program of CBI development has produced a variety of technological capabilities such as the ability of integration, and development of software and components. The technological capability has resulted in a product output as planned with the domestic component estimated 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 presence of the government is required in the research collaboration to minimize the risk of technology failures which is possible to occur, and to accelerate the development of technological innovation. Moreover, government roles in developing CBI are not only in an early stage, but also in an implementation and utilization stage of CBI. Ministry A has a function as a R & D incentive 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 in R & D activities, provider in funding and human resources for R & D activities. Government R & D institution provides human resources to conduct an assessment on CBI with the aim to standardize CBI product. University A and B provide human resources and equipments to develop CBI.
- Leader in the development of CBI technological innovation should be the industry supported by governmental research institutions and universities. The reason is that the industry has more knowledge about the user needs than the governmental research institutions and universities. Another reason is that because the industry has built its technology innovation capability from the previous programmable logic controller (PLC) based product development which has proven to be successful in the marketplace.
- R & D consortium is an effective vehicle to make interactions among industry, academia and government take place. Technology users, policy makers and researchers can talk together to decide the direction of science and technology to be developed. Dialogue among involved parties in public-private consortia can be an effective way in building collaborations and identifying some problems emerged for innovation.

With the technological capability owned by related parties, collaboration program on the CBI development has produced a product output as planned. Therefore, in providing support for R&D activities, the government needs to direct its R & D incentives to the industry that is engaged directly in the business and has technology roadmap. The reason is that the industry has more knowledge 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 in the 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 technological innovation?

References


