EXECUTIVE SUMMARY

Supporting Study: Enhancing Innovation Capability using Local Universities and Public Research Institutes as External Resources

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1. Background and Objective of the Research

Improvement of the innovation capability of firms in the region depends on how successfully they have leveraged their internal and external resources. This supporting study will be focusing on how some of these firms have improved their innovation capabilities through the university – industry linkages locally available to them. Conversely, from the points of view of universities, the role of the university has evolved from the traditional activities of education and basic research to a third mission – technology transfer and commercialization. The study of triple helix has generated a number of important findings already. They are, however, primarily based on the experiences of the advanced economies. It is easy to imagine that the situation for developing countries will be quite different, with less mature technology and a short history of higher education, often constrained by limited resources.

The aim of this supporting study is to highlight the ways which external resources from universities, public research institutes, industrial associations, governmental and private- sector intermediaries and others can help local firms to develop innovative capabilities, through a variety of technology transfer and knowledge sharing activities. The study will also address the question of whether institutional variations have some impact on the ways in which these organizations interact with the local firms, such as the introduction of a Bayh-Dole-Act[3]-like

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[3] The Bayh–Dole Act or University and Small Business Patent Procedures Act is United States legislation dealing with intellectual property arising from federal government-funded research. Adopted in 1980, it gave U.S. universities, small businesses and non-profits intellectual property control of their inventions and other intellectual property that resulted from such funding

arrangement affecting the incentives of academic researchers. The study will illustrate several cases of successful collaboration between these organizations and firms across sectors and countries to provide some room for comparative analyses. In particular, any changes or variations of institutional structure affecting the incentives and R&D environments of university researchers such as the serendipity of research findings and transfer will be analyzed extensively.

The automotive sector has been selected as a case study, since it is economically very important to the ASEAN region, and to a country like India. The sector is undergoing major technological changes, and many countries would like to move up the technological ladder from being just a production base to becoming the base for more sophisticated activities like advanced engineering, design and research development. In order to do so, firms in the sector might need more interaction with local knowledge-producing agencies such as public research institutes and universities. A comparative study on the sector is therefore very timely.

2. Methodology

This research focuses on selected case studies with counterfactual narratives from Thailand, India, Indonesia and Vietnam. These countries were selected based on their having growing automotive industries. They are also in different stages of technological development, and it is therefore interesting to see what type of external players engage in the technological capability development processes of firms at different stages, and how the do it.

A Sectoral Innovation System concept was used as a framework for this research. A sectoral system of innovation and production is a set of new and established products for specific uses, and the set of agents carrying out market and non-market interactions for the creation, production, and sale of those products. Sectoral systems have a knowledge base, technologies, inputs and demand. The agents are individuals and organizations at various levels of aggregation, with specific learning processes, competencies, organizational structures, beliefs, objectives and behaviors. They interact through processes of communication, exchange, cooperation, competition and command, and their interactions are shaped by institutions. A sectoral system undergoes processes of change and transformation through co-evolution of its various elements (Malerba, 2002). Based on this concept, this research paid attention to the

(http://en.wikipedia.org/wiki/Bayh%E2%80%93Dole_Act).

roles of external agents (firm and non-firm), especially universities and research institutes, in the process of development of the capability of firms in the automotive sector.

Turning to the research method, each country team carried out ten case studies of external sources of knowledge and competences (outside the firms) and examined how these knowledge sources interact with intra-firm capabilities. These external sources of knowledge and competences are mainly local universities and research institutes. However, in some countries the roles of intermediary organizations such as industrial associations, professional associations, not-for-profit training organizations and government sectoral development agencies in the process of technological transfer and learning were investigated. Furthermore, secondary data including previous case studies were also included.

3. Main Findings

In terms of level of development of automotive sectoral innovation systems in general and linkages between firms and universities/public research institutes in particular, we can classify the four country case studies into three groups, as follows:

Group A: India and Thailand

The automotive sectoral innovation systems of these two countries are more developed. Firms have relatively higher technological and innovative capabilities, partly due to the longer times the industry has been established. Advanced technological capabilities such as engineering, design and research and development have begun. In India, some local companies began their R&D activities in the 1960s and 1970s. In Thailand, major changes in the investments of transnational companies started in the early 2000s, when they set up 'Technical Centers' performing advanced engineering, testing, product and process design and other development activities. In some cases, their activities go beyond adaptation to fit local and regional (e.g. ASEAN) market conditions.

Linkages between firms and universities/public research institutes are still not strong. Nonetheless, to some extent, they have begun to change from 'personal' relationships to 'institutional' ones. Some universities in Thailand and India have already developed specific degrees on 'automotive engineering', with a certain level of participation from industry (transnational corporations in the case of Thailand and local firms in the case of India). Beyond education, smaller firms (especially parts suppliers) tend to seek cooperation with

universities/public research institutes on testing, calibration, and solving short-term problems. In contrast, larger firms tend to have longer-term and more technologically sophisticated collaborations, including R&D in several cases, through the research projects of postgraduate students. It should be noted that the R&D collaborations with universities and public research institutes are usually limited to issues not critical to the 'present' operation of firms. They tend to focus rather on issues of the 'future', such as new materials and new sources of energy. Some large companies also leverage universities' expertise on the 'fundamental' principles of doing R&D, in terms of training their R&D staff (before in-house training at their headquarters) or outsourcing them to carry out the basic analytical investigation parts of their research projects. Development activities critical for 'today's' competitiveness are mainly conducted 'within' companies or in vertical relationships between automotive assemblers and parts makers.

The issue of linkages between firms and universities/ public research institutes has a high priority in the agenda of science, technology and innovation policies of these two countries. Policy makers have already recognized the importance of this issue for the future competitiveness of countries. For example, there are projects at national levels trying to promote such linkages, though the results might not be fully satisfactory. Further there are 'intermediary' organizations, either public or private, trying to promote linkages between actors in automotive sectoral innovation systems. These intermediaries are important in bringing together the different demands and expectation of different actors, especially between firms and universities/public research institutes.

Group B: Indonesia

Indonesia is a middle case. Their automotive industry started later than those of India and Thailand and it is relatively smaller in terms of production and sales. More importantly, actors in its automotive sectoral innovation system are weaker in terms of technological capabilities, and linkages among them are much more fragmented and limited to physical transactions (versus critical knowledge and information flow).

In particular, 'institutional' linkages between firms and universities/public research institutes beyond basic education and testing services are almost none. Even though Indonesia has excellent research and educational institutes such as the Indonesian Institute of Sciences (LIPI) and the Bandung Institute of Technology, they are doing research not relevant to the 'present' activities of automotive firms. The weakness of the linkages has been recognized by Indonesian government agencies. This is very much paper recognition, however, and no serious

action has been taken. In addition, unlike Thailand, there are no 'sector-specific' agencies which can perform the roles of intermediaries linking actors in the automotive innovation system.

Group C: Vietnam

Vietnam's automotive sector started up in the middle 1990s. Though it has high potential, and some sub-sectors such as motorcycles have grown impressively in terms of production volume, its sectoral innovation system is still in its infancy. Passenger car production is very small. Firms are generally weak in term of technological capabilities. Transnational corporations use Vietnam only as a production base. Development activities are carried out in other countries, including Thailand, even for motorcycles. Many local parts makers are not qualified in terms of quality, cost and delivery to enter the global value chains of transnational corporations. Those that can enter such chains are generally original equipment manufacturers (OEMs) which produce according to specifications given by the automotive assemblers.

University-industry collaborations at 'institutional level' are almost non-existent. There are' however, researchers and professors working for the industry on a 'personal' basis. Most of the work is problem solving in nature. The issue of linkages between firms and universities and public research institutes in the automotive sector has not yet been put high on the government's science, technology and innovation policy agenda. There are no major government initiatives on this matter and no sector-specific agencies acting as intermediaries.

Nonetheless, Vietnam has high potential to develop its automotive industry. It has a large stock of engineers. The state is strong enough to enforce regulations relatively well. For example, pollution emission control regulations enforced by the government have pressured local firms to upgrade their production standards to meet such requirements. A few universities have now also started to offer training programs for building up the competencies of local firms.

4. Lesson Learnt: Critical Success Factors for Collaboration between Firms and Universities/Public Research Institutes

From the four case studies, we can draw lessons learnt in terms of critical success factors for collaboration between firms and universities/public research institutes, as follows:

- *Phase of development of the technological capability of firms and the sectoral innovation system*. Effective collaboration depends very much on what phase firms in the industry are at in terms of their level of technological capability, and how the sectoral innovation system works, in terms of roles of the actors and their linkages. Universities and public research institutes are expected to play more roles when firms have higher technological capabilities, and their sectoral innovation system is more coherent. This is because on the one hand, firms at that level have a clearer 'technological development strategy' and deeper 'absorptive capacity', enabling them to work with counterparts from universities and public research institutes. On the other hand, most universities and public research institutes are conducting technologically sophisticated activities such as, R&D which is easier to match with the interests of higher-capability firms. Nonetheless, there are institutes focusing on enhancing the capability of firms at the lower level (e.g. production, basic engineering, quality control and so on). It depends, therefore, on the division of roles and missions among higher education and public research institutes in a country, which is also a critical policy issue.
- *Incentives*. Incentives, both in terms of monetary rewards and recognition and promotion are essential for the university professors and researchers who work with the industry. Without correct and sufficient incentives, most will be less willing to work with the industry.
- *Enabling laws and regulations*. This is also a crucial issue. Laws and regulations must provide flexibility and an encouraging environment for professors and researchers to work with the industry, in areas ranging from joint education, training, research and consultancy, to service providing and others.
- *Trust*. Trust between the two sides is critical. As social capital, it varies from one country to another. It can nonetheless be improved if the right environment, incentives and good demonstrating examples are provided.
- *Information gap*. In many circumstances, firms do not really know what universities are specialized in and where the experts are. On the other hand, in many cases, universities and public research institutes do not really know the demands of industry.
- *Roles of intermediaries*. In many cases, 'the invisible hand' of market mechanisms cannot deliver effective collaboration, and the 'visible hand' of intermediary organizations is needed. Universities/public research institutes have different expectations and mindsets from those of firms. The level of distrust and unfamiliarity

between the two sides can be high. They might not have prior experience in working together and do not really know what the other is doing or expecting. There are also difficult issues of contracts and the ownership of intellectual property rights, which can be obstacles for cooperation. Competent public, private or semi public intermediary organizations can step in and bridge these differences.

- *The vision and will of an entrepreneur*. This is a prerequisite for any collaboration. The mindset of entrepreneurs in exploring opportunities to collaborate with others outside their companies and usual networks is a starting point. They must then have a strong will to carry out the collaboration and overcome obstacles that might crop up.

5. Policy Recommendations

From this research project, we can derive policy recommendations at two levels: country and ASEAN Plus Six

Recommendations for Member Countries

- Collaborations between firms and universities/public research institutes should be placed on the key agenda of national science, technology and innovation policy

- *Human resource development.* It is very important to prepare enough qualified people very much in advance, as it takes many years to build a stock of qualified manpower.
    - ✓ For countries whose automotive industry is in the production (assembling) phase, vocational education to prepare competent and skillful technicians and production engineers should be given high priority. For countries whose automotive industry has begun to include development activities, design engineers and industrial designers should be a major focus.
    - ✓ It is also worth studying the necessity of having specific educational programs on 'automotive engineering', which might lead to educating engineers tailor-made for the industry.

- *Clearer division of roles and missions among educational and research institutes*. Some level of specialization might be needed. The first group of universities and research institutes may focus on advanced research for the 'future' of the industry both in terms of automotive technologies (*e.g.* hybrid engines, electrical vehicles, new materials) and

related infrastructure (*e.g*. clean energy, logistics and transportation systems). The second group might focus on helping firms develop indigenous technological capabilities by providing consultancy, research and services to meet 'today's' demand. This also depends on phase of technological capability development of local firms. If local firms, at large, have low level of capabilities and are struggling to solve problems at the production and engineering level, the second group of universities and public research institutes should be a major policy focus. On the other hand, if most local firms have rather high level of capabilities, the first group of universities and public research institutes should be given higher attention. Under budget constraints, especially in some ASEAN countries, prioritization in this regard is very important for making effective use of universities and public research institutes as catalysts for development of indigenous technological capabilities.

- *Organizational setting of universities and public research institutes.* It is very important to design an organizational setting for universities and public research institutes which will help them complete their aforementioned missions. Basically the organizational setting in terms of sources of funding, human resource management, and others should try to reach a balance between achieving the role of "public good" providers (which requires some state subsidies) and encouraging and pressuring them to work with and for industry (which might require linking government funding to performance-based criteria, especially in terms of impacts on industry).

- *Law and Regulations*
  - ✓ More flexibility in curriculum development to fit the fast-changing nature of automotive technologies, and the future requirements for multi-disciplinary studies is needed. In this regard, educational and professional standards authorities should provide more freedom to universities to design new courses. They should focus on being promoters rather than simply regulators.
  - ✓ More flexibility should be granted for university professors and researchers during office hours to work with the industry.

- *Incentives for encouraging collaboration*
    - ✓ Tax incentives and/ or matching grants for R&D/innovation consortia between groups of firms and universities/R&D institutes should be considered
    - ✓ Rewards and additional career paths for professors and researchers, for example, professor of practice, should be given to those who want to focus on working with and for industry
    - ✓ Tax incentives for private universities achieving excellence in university-industry collaborations
- *Trust Building.* It is important to have a means of bringing both sides together and understanding each other better.
    - ✓ Sabbatical leave should be allowed for professors and researchers to work for industry for a certain amount of time.
    - ✓ Industry-Academia exchange programs in various forms such as guest researchers and professors should be encouraged.

- *Roles of Intermediaries*
    - ✓ Capacity building programs for intermediary organizations are needed, since not all of them can perform the role they are supposed to play effectively.
    - ✓ Authorizing and encouraging the development of 'private' intermediary organizations. Some of them know the industry better than governmental ones and are more flexible. This will also reduce the burden on government authorities.

Recommendations for ASEAN Plus Six

- As the ASEAN Community becomes realized, and collaborations in the ASEAN plus Six will be very much strengthened, joint studies on future demand on human resources for the automotive sector should be conducted. This is necessary for ensuring this region remains attractive for future investment in this sector, and for upgrading its position in the global value chain.
- Human resource mobility across member states should be encouraged. The tacit knowledge embodied in engineers and technicians will become more flexibly available. Since the automotive sector is a key sector in most member states, it should be a 'pilot sector' for cross-country human resource mobility.

- Mapping and locating talent and specializations of automotive technologies and knowledge in universities and public research institutes across the region. This sort of database is a fundamental basis for future collaboration across countries
- Encouraging collaborations between firms, and universities and public research institutes across member states. In some cases, better international matches between the two sides might be achieved easier and more effectively than domestic collaborations.
- A joint study and meetings to share good practices *of intermediary organizations* in the member states should be organized.

References

Malerba, F. (2002), "Sectoral systems of innovation and production", *Research Policy* 31: 247-264.