STUDIES OF STRATEGIES AND MANAGEMENT

TECHNOLOGY ACQUISITION BY ENTERPRISES- A COMPARISON BETWEEN TECHNOLOGY SELF-MAKING AND BUYING

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Abstract:

Any enterprise, especially productive/manufacturing enterprises, must use at least one technology to develop and maintain its competitive advantage. Technology used in enterprises was acquired through various different modalities. However, each enterprise has different decision in the selection of appropriate modality to acquire technology, whether to create technology at the enterprise by themselves [1] or receive it from outside or take combined action. This article attempts to provide an overview on different modalities being utilized by enterprises to acquire technology, compare the strengths and weaknesses of each modality.

Keywords: *Science and technology enterprise; Technology reception; Technology development.*

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1. Introduction

Any enterprise, especially productive/manufacturing enterprises, must use at least one technology to develop and maintain its competitive advantage. Normally, this issue is interpreted as the need to develop a better, more advanced technology. Most businesses recognize the fact that technological development is a risky and costly process. It is therefore worth to take careful consideration in choosing the modality to acquire technology, whether it should be developed in-house by the enterprise or it should be bought from outside just to ensure that the technology can maintain the competitive advantage of the enterprise.

Enterprises can own technology by creating in-house within enterprises or from acquiring it from external sources. The issue is often called “self-

[1] The author used the concept of "external acquisition" to refer to all the ways by which enterprises could get technology from outside sources (as opposed to the way that technology was created by enterprises at their own facilities or in-house R&D).

making" or "acquisition". The majority of enterprises believed that technology need of business could not only be satisfied by in-house R&D, but also by finding and buying from outside resources.

On the basis of study on the subject of technology acquisition by enterprises [1,2,12,14,16], this paper provides an overview on different technology acquisition modalities by enterprises and makes comparison of the strengths and weaknesses of each modality. However, before taking the analysis into consideration, it should clearly define two basic concepts, such as technology and technology development.

2. Two basic concepts

2.1. Technology

The concepts of technology have so far been suggested by many scholars worldwide. However, the definition by Gaynor launched in 1996 [10] is said the most possible as it contains the basic content in identifying technology:

- Technology covers many other issues rather than machines, processes and discoveries, and can be described in different ways;
- Technology is the solution, process, secret accompanied with or without tools and means to transform resources into products or services;
- Technology includes necessary knowledge and resources to achieve a goal;
- Technology is an important part of scientific knowledge that can be applied in the design of product and/or process or in finding new scientific knowledge.

The key issue here is the flow of technology through: education and training; personal relationship; staff mobility; technical cooperation; conferences and seminars; publications, patent documents; machinery, equipment and tools;... [4].

2.2. Technology development

Concept of "technology development": Technological development covers all stages of "technology development after D"[2], is the main activity in the production of enterprises, in which the concept of "technology development" includes the main content: (i) Planning and implementation of plans to upgrade or expand technology, whereby technology

[2] D in the R&D.

development is understood as "expanding technology"; (ii) Import of technology and technology transfer in order to expand the field of manufacturing technology, extensive and intensively; (iii) Technical and technological management, technology appraisal and technological level assessment. Thus, technology development must be understood as the "expanding of technology" in both terms intensive and extensive [3].

Intensive technology expansion is the upgrading of technology from a low level to a higher level. This content is under the scope of innovation policy[3]. It is the innovation based on the results of research and development (R&D) carried out by enterprises themselves, or obtained from technology transfer contracts signed with other enterprises having a higher level of technology (horizontal transfer), or receive a new technology results from pilot production of research and development organizations (vertical transfer), or even acquire under technology transfer contract with foreign institutions (including both horizontal and vertical transfer).

Expanding technology by extensive term means the replication of technological line of enterprise into two, three or more similar lines with the same function and at the same technology level as the original technology line. This content is under the scope of production policies, beyond the concern of S&T system of some countries, especially in European and North American countries.

3. Technology acquisition activities of enterprises

Two basic modalities which an enterprise can apply to acquire technology are conducting in-house R&D and buying from outside. The following section describes in detail the basic content of these two modalities.

3.1. Self-making technologies in-house

The self-making technologies in-house *(in-house R&D)* is the study of new technology necessary for the organization through research and technology development at the organization. R&D activities are carried out in-house by an entity, may be a research institute/center/division/independent R&D unit, or may be individuals in consortium with research group to conduct R&D activities by specific topic/ project [1, 2]. Some English terms being frequently used and having the same meaning are *in-house development*, "self-making" (*internal technology sourcing*) or *internal R&D*. The choice of enterprises towards technology self-making or not, it depends on the

[3] See more Hoang Van Tuyen. (2007). *Innovation Policy: Some basic issues*. Journal of scientific activity. Number 10/2007.

capacity of individuals and units responsible for R&D of the enterprise. It takes long time and large resources of enterprises to solve many issues of high risk, as well as it will be very difficult for them to foresee the outcomes of technology self-making though this will facilitate the enterprise to have more freedom in operation.

In contrast to the above view, Capon & Glazer (1987) suggested that internal technology development was cheaper than buying from outside. Perhaps the view of these authors was explained by the theory of transaction cost economics. This theory confirmed that when an enterprise decided to invest in special properties without certainty about investment environment, investment opportunities, cost of R&D, the expansion of market became more risky. Thus, the efficiency would be higher when such goods were exchanged internally and the efficiency would be the highest in the case of making technology in-house [16].

Despite the high cost and risk, making technology in-house is still considered as the most important source of technology for most enterprises for some reasons: having core technology is important for enterprises [15]; technology can be customised as per requirement of customers with exact specifications; implicit nature of innovation involved the risk associated with less competitiveness of the technology, it is the main reason leading to the decision to "self-making" technology for the enterprise. Several studies have demonstrated that enterprises having strong internal R&D capacity and resources are less dependent on technology acquisition from outside.

Nagarajan & Mitchell (1998) determined that there were two main advantages of in-house R&D. The first was the mitigation of risk of opportunistic behavior and the second was to build up institutional custom. However, in-house R&D also has certain limitations. An often found drawback was high cost and difficulty to develop innovative capacity with existing internal R&D of enterprises. Furthermore, it should be emphasized that maintaining all in-house R&D activities might lead to isolation and limited business cooperation. Other benefits of the internal technology development by enterprises were that they would be specialized in a special technology [16].

The importance of self-making method compared with the modality of technology acquisition from external sources have been emphasized by many studies. The authors suggested that for new technologies or technologies under development represented a competitive advantage, so enterprises were advised to make such technologies in-house rather than buying from external sources. Chiesa & Mazini (1998) indicated that in-house self-making technology should be concentrated on the core

knowledge part or refreshed business' capacity [13]. Research by Coombs (1996) showed that technological capability of enterprises was an important component of core competency. Therefore, the implementation of R&D is to create and maintain technological capability and core competency of the enterprise. Another study suggested that imported technology from outside could provide short-term financial benefits, but the result would lead to long-term loss of competitiveness [9].

From the above analysis, an important conclusion can be made that the modality of making in-house technology is a very important in acquiring technology for enterprises if their activities require core competency, core technology.

3.2. Receiving technologies from outside enterprise

Many enterprises today increasingly find technology from external sources in parallel with self-making in-house technology. It is obvious that in-house technology has an important role to maintain core competency and core technology of the enterprise, but for many other important technologies that the enterprise cannot create, it is necessary to acquire them from external sources [15]. Research by Narayanan (2001) confirmed this reflection by making a conclusion that enterprises could not only satisfy their technology need by their internal R&D capacity but also had to combine with acquiring technology from outside. The acquisition of technology from outside enterprise can be realized through [14, 16]:

a, Technology inlicensing

Inlicensing is one of the important and the most widely used modalities to acquire technology from outside. It is the reception of technology under the form of technology transfer contract in respect of product, technical process, and design. This method may involve various issues such as cost, commission rate compared with revenue, legal right to technology and commitment of related parties on obligation to maintain their agreement in a certain period of time within an identified territory. Technology inlicensing facilitates enterprises to participate in new markets faster without making major investments in R&D, creates favorable conditions for enterprises to quickly establish a position in the new technology areas, especially in those fields that can complement to the existing core capabilities [3]. Yoshikawa (2003) agreed that technology inlicensing was more appropriate than self-making R&D in cases where the enterprise is under time pressure.

However, there are some issues that need to be considered when doing inlicensing technology. Abetti (1989) warned that if the technical process

and market development was too fast, inlicensing could lead to acquire outdated, expensive technology [5].

b, Joint venture

Joint venture is a form of alliance of partners. In this arrangement, two or more enterprises form a new business to carry out a certain economic activities. Economic activity could be the development or commercialization of a particular technology or a new business direction.

Relating to joint venture, some issues need to be considered, namely, joint venture could lead to long-term dependence of the enterprise, joint venture could fail if one of the partners does not have enough capacity to receive necessary technology and there are too many conflicts of interest. Other study of Hennart and Reddy (1997) concluded that joint venture was a key method to acquire the resources from other organizations and joint venture with local businesses was also the participation in markets abroad [16].

In the case of developing countries, along with technology inlicensing, joint venture is one of the common modalities to receive new technology, as well as the channel for enterprises to link with multi-transnational corporations. Hobday (1995) was convinced that joint venture was the appropriate way for late comer businesses [8]. However, some studies showed that in developing countries, most of partners in joint venture were reluctant to transfer technological know-how and it was therefore difficult for local enterprises to acquire new technology leading to domestic enterprises become more and more dependent on technology owned by enterprises of developed countries.

c, Research and development contract

R&D contract is a legal transaction to hire or provide fund for other partners to carry out a specific research project. Partners involved may be independent research institutes, universities or even enterprises.

Implementing R&D contract will facilitate enterprises to access to advanced technologies, expand their technology portfolio, provide knowledge for enterprises on technology and potential sample products without having much investment in internal R&D. However, Buckley (1998) commented that the benefits of R&D contract was for R&D institutions, not for enterprises leasing or funding the R&D contract.

d, Cooperation

With R&D institutes, universities and other enterprises

R&D cooperation is simply defined as the cooperation with other organizations (mainly outside R&D institutes and universities) to conduct R&D projects based on formal or informal agreements. In this arrangement, there could be some enterprises and R&D institutes/universities together committed to complete the effort of enterprise to obtain common goals in technology development.

A key advantage of R&D cooperation compared with other methods of receiving technology is that it can lead synergy effect when the parties with different strengths work together. However, R&D cooperation may encounter certain difficulties in finding suitable partners, concluding contract agreements, project management and benefit sharing. In addition, R&D cooperation should be implemented in a cautious manner because enterprises may loose proprietary information into the hands of their partners, so it should ensure information proprietary before entering R&D cooperation.

With customers and/or suppliers of enterprises

In their study, Tidd & Trehella (1997) pointed out that enterprises cooperated with customers to develop technology with a view to winning the trust over the enterprise's products, or jointly develop technology to meet the requirement of other customers, or to gain market share [11]. In some cases, cooperation with suppliers, especially technology providers was very effective because they had certain technological capability and expertise and could quickly detect technology need and make technology change at the request of customers. However, there are some limitations in cooperation with suppliers, namely: enterprises become too dependent on one single supplier; high risk of loosing the core competency of enterprise for suppliers; personal behavior of suppliers; the necessity to adapt to the supplier's technology and some other restrictions.

e, Mergers and acquisitions (M&A)

Research by Chakrabarti, Hauschildt & Suverkrup (1994) pointed out that the principal motivation of mergers and acquisitions was increased market share, increased efficiency, expanded R&D, restructured investment, increased business growth, reduced risk and quick market participation [6]. In the R&D intensive industries, Ruckman (2005) pointed out that mergers and acquisitions was an important and the most popular method for the acquisition of technological know-how from outside. This method was much used when the time pressure required enterprise to conduct in-house R&D activities *(Yoshikawa, 2003)*. Other studies indicated that if it was difficult for the technology to imitate the acquisition will bring about better technology for the enterprise [16].

Although there are certain advantages in the mergers and acquisitions method, as mentioned by some studies, has some limitations such as cultural differences (*Tidd & Trewhella, 1997)*, different technology philosophy between the two organizations *(Chakrabarti, Hauschildt, & Süverkrüp, 1994)* , which were the causes of the failure of mergers and acquisitions of enterprises [6, 11].

f, External investment

External Investment means an enterprise purchases shares of other enterprise which owns an important technology (or has technology capability) that investing enterprise is interested in, but the investing enterprise does not have right to control and manage over the technology of the enterprise from which they have bought shares [15]. Under this form of investment, mainly for large-scale enterprises to invest in innovative enterprises, S&T enterprises or high-tech enterprises. The motivation of large-scale enterprises is to invest in "strategic technology", in which they can ensure their benefits from technology, from there they can participate in the development of new technologies and get access to new technologies with high feasibility without much investment, leading to an opportunity to deploy better technology. Then, investing enterprises can decide to strengthen the position of the enterprise or even to acquire the technology, if it is considered promising in the future.

g, Internal investment

By this way, an enterprise designated unit is formed within on-going activities of the enterprise (like spin-out). This unit is specifically tasked with the development of new technologies or new products. It can implement their tasks by their own ideas, independent from existing procedures and formal systems of the enterprise. This approach is quite effective for large-scale enterprises having strong technology platform and resources to conduct foundation and basic research. However, this approach is less common, rarely brings technology for "mother" company and can lead to the situation that a number of people with entrepreneurial spirit will leave the enterprise with new technologies [16].

h, Staff recruitment

In broadest sense, staff recruitment means enterprises conduct recruitment, acquisition of external professional, technological and managerial qualified personnel in a certain field of technology to work for enterprises for a certain period of time under various different forms. Another form of recruiting is hiring technical advisers to work for the enterprise in a certain period of time.

i, Other modalities to acquire technology from external sources

In addition to the above mentioned modalities, there are many other methods to receive technology from outside. Small and start-up enterprises which established in developing countries can receive technology through *reverse engineering*, duplication, re-labelling, etc. Sometimes there are also authors who refer to the form of external technology acquisition such as copying without acknowledgment of ownership.

Other forms of technology absorption mentioned by OECD (1990), such as through scientific publications, patent documents, workshops, industrial trade demonstrations and many other ways.

4. Comparison between in-house making technology and reception of technology from external sources

It is obvious that a business may not need to perform or meet all the requirements on technology for a necessary product. In some stages, enterprises need to receive technology from outside. The diversity of technology has demonstrated that almost all R&D managers and technological management people said that no business can survive in long-term and be sustainable as a "technology island" [11]. Enterprises must cooperate with other organizations. At the same time, there is a greater appreciation of the important role that external technology sources play. They are considered as the "window" to observe the progress of scientific development. There is no business can be the owner of an unique technology [16].

The need of time saving almost is the most common cause to explain why a company would choose the modality of technology acquisition from external sources in order for achieving their objectives. The global competition makes the product life cycle shorter, therefore enterprises are now competing in reducing the technology development time.

Some enterprises choose the option to acquire technology from outside because of their limited resources (in human, financial, physical facilities, technical respects). Limited resources make enterprises reduce investment with maximum resources for cost savings, using key personnel in other opportunities and allocate their limited resources in a more effective way [11]. Time saving and cost reduction is the main reason why enterprises reduce budget for in-house R&D and focus on securing technology from outside.

R&D development in enterprises takes a major risk for many reasons: the technology can be developed, completed or failed. In order to minimize or

share risks and reduce R&D costs, many companies try to cooperate with outsider institutions. Some businesses turn risk back to the technology provider as it is more capable in risk management; some firms avoid spending a large amount money for R&D by cooperating with other businesses for joint technology development and application [16]. Besides the reason of risky operation, another reason is that many enterprises are lack of internal R&D capabilities to carry out complex technology development projects.

Complexity in the process of technology development, complexity of the technology itself and the rapid change of technology are also other causes to explain the reason why enterprises would prefer the modality of outsourcing technology from external sources with a view to supplementing in-house R&D capacity or filing gaps of technology capability within the enterprise [4].

In addition, engaged in R&D cooperation enterprises can enjoy external technical resources, technology opportunities for achieving the business goals [13]. The power and potential of seizing technology opportunities are important factors to explain the changes in the intensity and productivity of R&D among firms and between industries. The benefit of working together to conduct R&D activities can be explained as follows [1, 2]:

- Sharing resources, especially in funding for R&D projects;
- Avoiding repetition in R&D;
- Reduced risks;
- Cost saving;
- There are synergies in R&D activities, and many other benefits.

The limitation of collaborative R&D includes transaction costs particularly in the coordination, management and control of R&D activities between various different partners. Transaction costs relate primarily to the following issues:

- Unification of organizational structure, decision making process,...
- Operational coordination between different organizations,...
- Coordinate the use of assets, resources,...
- Exchange of intangible assets, for example, information or know-how.
- Exploitation and use of the results from R&D cooperation.

Table 1 below summarizes the strengths and weaknesses of the technology acquisition by enterprises through different acquisition modalities.

Table 1. Comparison of the strengths and weaknesses of different technology acquisition modalities

IN-HOUSE R&D*	BUYING FROM OUTSIDE
Strengths	**Strengths**
Strengthened R&D capacity particularly core competence for the enterprise	Low level of risk
Increased the enterprise's position (especially in negotiation, purchase, sale or transfer of technology, etc.), increased competitive advantage	Cost and time savings
Possible self-adjustment	Supplement missing technological capability of the enterprise
Reduced risk of opportunistic behavior	Suitable for enterprises with limited resources, low R&D capacity
Experience and competence obtained, especially R&D capability strengthened	Suitable for low complexity technologies
NIH syndrome[4] avoided	Suitable for enterprises having rapid change in products and technology process
Suitable for areas of new and high technology	
To protect the commercial value of the enterprise's products, prevent competitors to access to information, technical know-how and important skills.	
Can meet the needs of the market, customers	
Weaknesses	**Weaknesses**
It requires strong enough R&D capacity and certain resources (human and financial, etc.)	Depend on outside technology sources
Time consuming and high risks	Problems in managing the process of receiving outside technology
Impossible to take advantage of external resources, power	It may bring about backward, expensive technology for enterprises
	It should have a certain capacity to adjust and adapt imported technology
	Short-term financial benefit, but long-term loss of competitiveness

Source: Compiled by the Author

** See detailed factors affecting R&D activities by the enterprise [8]*

[4] NIH syndrome (Not-invented-here - it was not invented here) is just a slang meaning an individual/organization resolutely refuse to use the results of the work done by others, despite it can help them. This expression usually going with "re-invent the wheel", to indicate that a person/organization spent a lot of time and effort on doing the same work that others has done before.

5. Conclusion

In order to maintain and develop the competitiveness, every business has different strategies to acquire technology from outside or create it in-house. Each modality of technology acquisition has certain strengths and weaknesses. However, the decision of enterprises to choose which of the two modalities or both depends on many different factors: internal and external factors (policy and institutional environment), particularly during the stage of enterprise development. The above analysis indicated that during development, enterprises needed to carefully consider the strengths and weaknesses involved before making decision to select suitable technologies for maintaining competitive advantage of the enterprise in each stage of development. The issue of how to make decision to select right modality to acquire appropriate technology for the business will be discussed by the author in his upcoming article./.

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