SOME THOUGHTS ABOUT TECHNOLOGY MANAGEMENT

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Abstract:

Technology management plays a very important role in the process of production and realization of the scientific and technological development based industrialization and modernization of the country.

Experience of other newly industrialized countries (NICs) shows that in order to built an economic structure and a modern production based on the development of science and technology (S&T) it should improve the technological level of production. To do that it should improve the efficiency of technological administration and management. This paper discusses basic issues related to technology management.

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1. Technology and technology administration

1.1. Technology

1.1.1. Concept of technology

Technology is understood in many different ways and it is difficult to define a common term for all cases. Therefore, depending on specific purpose of use the definition can be identified accordingly. Below is a quick look at some of the definitions of technology.

a) According to World Bank: Technology means the method of transforming resources into products, including 3 factors: Information on the method, means and tools to use the method to conduct the transformation, the understanding on how the method works and why?

b) According to Law on Technology Transfer 2006 and Law on Science and Technology of Vietnam 2013: Technology means technical

solution, process, know-how with or without tools and means used to transform resources into products.

c) According to the Asia and Pacific Center for Technology Transfer: technology means an important input to produce goods and services, it includes 4 components, namely: Technology (Technoware - T: technology embedded in objects like equipment, machinery,...) Human being (Humanware - H: technology embodied in human: knowledge, skills, creativity,...); Information (Inforware - I: technology contained in the document - data, methods,...), and Organization (Orgaware - O: technology contained in institutions - organization, management,...). The (T) component is called hardware, and the rest of components is called software.

In this paper, the definition (c) was used mainly for analysis, evaluation because it looks detailed, clear and relevant for the study of technology management and administration.

1.1.2. Technology and economic growth

Some economists believed that it could determine long-term economic growth cycles driven by technological change. According to them, during the industrial revolution, the development of steam power made the economies in Europe and United States develop. Electricity and internal combustion engines largely contributed to the economic growth in mid-twentieth century. And so far, new technologies, especially high technologies have created a wave of new economic growth.

1.1.3. Technology development strategy, technology and competition

The important content of technology administration (Management of Technology - MOT) is *to determine the role of technology in business competitiveness and make decision about technology or technology policies to create competitive position in the economy*. Therefore, *administrators need to analyze and understand the relationship between technology and competition strategy, or competitive advantage of their businesses*. According to M. Porter, "technological change is one of the main factors to promote competition. It plays an important role in industrial structure changes and in the creation of new industries".

The Economic and Social Commission for Asia and Pacific of the United Nations had proposed a general strategy for developing countries, i.e, "make some, buy some". The basis of the strategy can be explained from the comparison between technological content of export products and technological content of import products. By implementing this strategy, it

would lead to technology self-reliance, i.e, being autonomous in decision-making, owning the knowledge, skills and having ability to use them to commercialize products. To be technology self-reliant it need to be self-determined in the selection and management of imported technologies, promotion of technology development through mastering, adapting and improving imported technologies; technology management; technology policy formulation and technology development planning.

1.1.4. Technology information

Technology information plays an important role in technology development, it is necessary for the formation of technology policy and technology strategy at the national level as well as in priority areas. At the same time, it is needed for making decision in production activities, especially in technology innovation of enterprises. In reality, many businesses have no condition to use technology information, especially small and medium-sized enterprises. Therefore, many countries have provided support for SMEs in the use of technology information.

1.1.5. Technology environment

Enabling technology environment is the decisive factor for effective technology development. Factors determining technology environment include: the level of socio-economic development; S&T infrastructure, human resources and expenditure for R&D; technological level in the production system: current situation of S&T human resources training in universities; policies at macro level with respect to the development of science and technology...

1.2. Management of technology

Some people think that they can understand the term of personnel management, financial management... but can hardly understand the term of MOT. Is it the management of techniques? Management of information? Management of R&D activities? Management of production? Management of scientists, technicians?... Yes, MOT is a difficult concept to define in a clear, precisely manner for easy understanding because it involves many disciplines such as sociology, economics, psychology, mathematics, political science, statistics, administration, system theory and anthropology. Therefore, the nature of management of technology is the link between science, technology and administration, simultaneously it (implicitly) manages those systems which are capable to create, receive and exploit technology. As such, *MOT is the process of linking different areas to plan,*

develop, implement, monitor and control the technological capability to shaping and implementing strategic goals of the organization.

MOT in high-tech industries faces a number of challenges, namely: reversal relation between technological capability and price of products in some industries, e.g, digital products have very short life cycle, it makes long-term plans less meaningful; initial cost of marketing a product is high, technological change can break the product strategy; difficulty in product pricing.

The constraints making technologies inefficient have been reviewed in operational and strategic aspects. On the operational side, the constraints are expressed through activities, functions and management decision in businesses, it makes the use of resources not optimal. On the strategic side, the drawbacks relate to the strategic goals of the company, strategic thinking, the role of technology in developing corporate strategy, the relationship between R&D, engineering, production and marketing functions.

1.2.1. Strategic and operational aspects of technology management

a) Strategic aspects

Based on the linkage nature of MOT it can determine the scope of it. There are organizations that do not require MOT, for instance, R&D organizations. MOT can be implemented at many different levels such as country, region, sector, company, strategic business unit, project... Technology managers? Depending on the level, maybe the executive board or individual decision makers, who decide on development of technology policy, technology strategy; connecting technology with business strategy, the role of technology in achieving competitive advantage; technology management in changing environment.

b) Operational aspects

The operational aspects of technology administration include: forecasting, assessment, innovation, technology transfer, investment in R&D, linkage of technology with product and market.

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1.2.2. Analysis, assessment on technology capability

In order to develop technology, developing countries including Vietnam mainly choose the modality of technology import. Technology transfer in such a situation causes many problems such as too high cost of technology, unappropriated technology in terms of resources, conditions and objectives... As a result, the country has to use inefficient technologies. From this reality, there is a need to build and *develop the national technology capability*. It is really a complicated issue.

According to Lall, "*national technological capability is the capacity of a country to deploy existing technologies in an effective way to cope with technological changes". Technology capability* of an enterprise is one of decisive factors of its competitive capacity. *Technological capability* of enterprises includes capacity in technology searching and selection for import, absorption and use of foreign technologies; technology adaptation, upgrading/improvement, and innovation. *Technological capability* of a firm is reflected by the comprehensive capacity to perform work tasks in sequence of "buy - use - adapt - improve" activities.

Based on the classifications available, technological capability is composed of 4 categories: operational capacity, technological transaction capacity, innovation capacity and support capacity.

In the evaluation of technological capability, it *needs to assess* the basic elements of it*, i.e, absorptive, adaptive and upgrading capacity of imported technologies and technological innovation capability*. This assessment can be at national sectorial or business level.

Technology assessment capacity at national, sectorial level helps to the strategic planning of technology development and technology policy. The assessment of technology capacity of the industry consists of the following sequential steps: overview of the industry; qualitative assessment of the industry's technology capacity; assessment on natural resources to understand the potential resources relating to the industry, and assessment on human resources of the sector; assessment on infrastructure for technology development, assessment on technology structure of the sector; finally comprehensive assessment on the sector's technology based on the

results of the above steps. Technology capacity assessment at enterprise level will serve as a basis for further improvement of technological capabilities, technology innovation and technology transfer.

2. Technology selection

Appropriateness of technology. Technology is generated from R&D activities. However, R&D activities in different places create different technologies to achieve the same goal, it is influenced by factors such as population, resources, economic systems, technology, environment, socio-culture, legislation - politics. Therefore, any technology is only considered appropriate at the time of its development in specific circumstances and for specific intended objectives. It may be appropriate or inappropriate in other place or other time of application. Persons who are responsible for selecting technology should know the criteria to assess the appropriateness of the technology in question.

The appropriateness of technology shall be considered in four aspects:

- Technology should be adaptive to a range of technologies from traditional, intermediate to modern technology.
- Technology must be relevant to the objectives of each stage of development.
- Technology must be affordable by available resources.
- Technology must conform with local culture, protection of ecological environment, compliant to the local decision-making process.

Technology selection method

At present, there exist some efficient methods of technology selection based on project evaluation methods that many Western countries are using, namely:

- *Based on the net present value of the technology plan*. Accordingly, if the plan has no negative net present value, it may be acceptable.
- *Based on the ratio of the present benefit value of the plan* and the current value of its cost. If the ratio is not less than 1, then it can be accepted.
- *Based on the internal rate of return k,* whereby if the value of k is found large, then the plan can be acceptable.
- *Quick capital recovery,* whereby a plan is selected as the one capable to obtain most rapidly the return.

All the above methods are based on the estimation of benefits, costs, interest, internal rate of return... The selector of technology needs to understand these concepts before making analysis of each criterion.

To acquire effectively technology we have to answer the following questions: Which appropriate technology to purchase? How much is it reasonable? From which country we should import? How a technology transfer contract is considered sound document without losses?... To receive and use technology effectively, the role of consultants is very essential. Consulting personnel must be highly qualified persons who have been formally and systematically trained in the areas of concern and should be paid accordingly for their contributions.

3. State management in technology transfer

3.1. Technology development planning

Republic of Korea has been very successful in managing technology transfer activities, the secret of the success was technology development planning. The Korean plan consists of 3 stages of industrial development, and in each stage S&T development is a must along with the industrial development.

Priority setting. In reality, if this goal is achieved other goals may not. The Korea's goal was rapid industrialization, thanks to efficient use of resources.

Controlling technology transfer activities in the following ways: control by rules and regulations, it means that to control the approval of technology transfer contracts; Control is of advisory, supportive natures by providing assistance or advice to private companies in the search for appropriate technologies with reasonable price; control is also of promotion and encouragement nature by providing financial stimulation or incentives to promote companies operating for the national objectives.

3.2. Building national technology strategy

Import source technologies, advanced technologies of national significance. Large, important projects developed, hold, operated by foreigners often get most of the profits, less contribution to the national technology independence and the external exposure of modernization does not always mean the country has reached a high level of technology. However, it is still significant if in the long run, foreigners when return to their home countries, projects will belong to the country.

Using endogenous technologies. Many small projects using endogenous technology will improve the quality for many people. For example, in 1985, in Philippines there were projects: train villagers how to produce soap from coconut oil. The project was successful, but hundreds of such projects together would not make Philippines technology self-reliant. Korea has two options: to develop domestically or import technology. If it costs higher or time consuming to develop technologies in the country, then import is preferred by the rules: If time and resources is limited, import of technology shall be more efficient than self-creation.

Providing guidelines for technology import to achieve specific goals. Normally, this implies the introduction of technology into the most underdeveloped areas.

Improvement of imported technology. Conducting research on imported technologies to firmly master, improve technology to adapt to local conditions.

3.3. Technology appraisal

Technological innovation can be done by importing technology or conducting self-research to generate new technologies... and it is often carried out via technology transfer, whether direct or indirectly. But technology transfer also contains a lot of risks if we are not fully aware of characteristics and impacts of the transferred technology to economy, environment, society and ethics. Because the impacts of new technologies are not easily predictable, as long as the technology is used widely in practice. Technology appraisal is to provide organizations and individuals with information on the benefits of the technology as well as the benefit of application of a new technology; for ineffective technology, it needs to be upgraded or replaced to create quality products and better service, minimizing negative effects that it can bring about. In brief, *the objective of technology appraisal is to examine technology in its full panorama, with all opportunities, possibilities and positive or negative effects it may bring.*

We consider technology appraisal - in the context of technology management - as a systematic attempt to foresee the consequences of introducing a particular technology into all areas of possible interactive with it. The major significance of technology appraisal is the one-step-ahead selection of choices by a comprehensive analysis of all possible consequences of the choice, not just the immediate effects but also the long-term impacts.

Bottom line: technological innovation can be done in various ways such as import of technology, self-research to generate new technologies... and it is

often realized by via technology transfer, whether direct or indirectly. But technology transfer also contains a lot of risks if we are not fully aware of characteristics and impacts of the transferred technology to economy, environment, society and ethics. This shows the need for better administration and management of technology to promote advantages, minimize negative impacts of technology. Hopefully, Vietnam will quickly become an industrialized - modernized country based on S&T development./.

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