FACTORS EFFECTING TECHNOLOGY ACQUISITION DECISIONS IN NATIONAL DEFENSE PROJECTS

Gökhan ASTAN

Turkish Military Academy, Defense Sciences Institute, Ankara, Turkey

"Defense Industry" (DI) not only strengthens the military power of a country, but also effects other fields of technology and economy positively and enables countries to be much more powerful in terms of their competitiveness in technology and knowledge instead of merely being a follower and a continuous customer. If a state seeks to have high-tech and capable DI the only foundation is to create a national environment which is managed based on a systematic "Technology Management" philosophy and well-defined "Acquisition" process. With already reduced resources, it is crucial to spend money for the most needed and right technology. Consequently, the focus of this study is on the "Acquisition" and "Technology Transfer" (TT) concepts and approaches. As such the different TT methods are compared and their advantages and disadvantages discussed. In the last part of the study, DI is described and assessed in terms of the TT methods.

Key words*: Technology Transfer, Defense Industry, Technology Acquisition.*

1. INTRODUCTION

In the 21st century technology is the pushing force of economic, political, military and public welfare of countries. Governments who recognize the vital significance of technology implement strategies, visions, national and/or industrial Technology Road Maps (TRM) to establish a "Technology Management" mindset and philosophy within the country and among all stakeholders such as universities, industry, government entities, for the purpose of acquiring independence and superioriority in knowledge and technology fields. Governments, who are the major facilitating actors in the field, encourage all stakeholders through incentives, laws and some other regulations for innovation, Research and Development (R&D), corporate endeavors and collaboration among each other to create national technological capabilities.

In order to make the right decisions, decision makers need some tools and techniques concerning technological issues. The "Technology Management" discipline plays a significant role as a useful and systematic tool in helping decisions makers manage technological capabilities and assets. The core activities of technology management, namely "Selection, Identification, Acquisition, Protection, Exploitation", show the coarse direction to management, from the phase of searching for a new technology to its disposal from organization.

Limited resources such as time, budget, lack of human resources, lack of encouragement on behalf of governmental authority are some challenging issues in technology management. The most significant problem countries face in technological development issues is the budget. So, governments have to make right decisions and select right technologies and projects in all aspects to gain as much benefit by spending less money. The struggle of "Technology Management" comes into play in this point: Which technology is needed and how to acquire it ?

2. TECHNOLOGY ACQUISITION

"Technology Acquisition" is one of the most important part of the "Technology Management" discipline, and represents a process which has to be managed in a systematic approach from beginning to end. [1]

There are different ways of obtaining and selecting required technology to gain

the necessary technological competence and capabilities, both for countries (at macro level) and companies & organizations (at micro level).

There are also different types and methods of "Technology Acquisition" namely "Internal Technology Acquisition Methods"(ITAM)and"ExternalTechnology Acquisition Methods" (ETAM).

2.1. Internal Technology Acquisition

ITAM are the methodologies which are implemented and employed within an organization whereas ETAM includes external sources or interventions during technology acquisition.

Internal R&D: R&D activities, performed to obtain new technologies and/or knowledge, could be held by organizations in collaboration with some other stakeholders (including universities, laboratories, companies, institutes etc.) or just within their own constitution. Internal R&D is the methodology in which human resources, (scientists, engineers, managers etc.) expenditures, laboratories, knowledge are supported and employed within an organization. Internal R&D is the only comprehensive tool for Internal Technology Acquisiton.

The most important **advantages** of ITAM are:

- Hand tailored requirements are identified by the organization itself, instead of adapting external technological solutions.
- The assimilation and adoption of new technology within an organization becomes much more rapid and modest.
- Organizations could have their own novel technological competency and could thus outdo their rivals.
- Organizations become less dependent on other stakeholders.
- Organizations could have reliable and safe technologies. Especially in Defense Industry it is fundamental to own national defense and security related core technologies to produce some devices independently. For instance Command, Control, Communication, Computer, Intelligence (C4I) devices, crypto metodologies and devices are just a few examples.
- Organizations could benefit from marketing its own technology or using its own technology as a deterrent factor against its enemies or rivals.

The **potential disadvantages** of ITAM are:

- In R&D there is always the risk to fail, and waste time and money. Hence, high risk-high income is not always the final result.
- It requires much more time and budget.
- The internal technology acquisition process should be encouraged by management.
- It requires qualified R&D human source and innovative scientists.
- The complexity and technological structure of systems (especially in Defense Projects) needs the interaction of numerous components, sub-systems, as well as experts, scientists and their knowledge from various different technological fields. The possibility to have all kinds of capabilities for all cases is almost impossible for any one organization.

When assessing the ITAM in relation with Defense and Security Industry Projects, internal R&D solutions and products seem to present the most important advantages and make a country much more reliable, safe and independent in this respect. Also, a country that owns novel products becomes a much better deterrent against its enemies.

On the other hand, a country can have a share of the global defense market, make other countries dependent on itself, as well as finance its own national future R&D efforts by marketing its old or current technologies.

ITAM naturally have some disadvantages. In a field such as "Defense Industry", which is the object of high budgets and complex projects, R&D usually needs long time and huge amounts of budget and qualified researchers, scientist, engineers. However, it presents no guarantee as to the final results.

2.2.External Technology Acquisition

Another series of technology acquisition is External Technology

Acquisition Methodologies (ETAM) which is also called *"Technology Transfer (TT) capabilities by governments or companies which seek to close the technological gaps between other countries/companies or to possess required technological core competences in order to reach strategic targets"*. Technology Transfer management consists of pre-defined activity sets meant to provide the transfer of technology between a transmitter and a receiver [2]. The TT process includes a complex technological environment, complex interactions between stakeholders and teaching and learning capabilities of all stakeholders [3].

Generally, organizations choose external technology transfer when they do not have enough time, core technology or budget to undertake their own R&D. Their common aims are to diversify their products or assets, to avoid the potential risks of failure and to protect knowledge and new technologies [4]. Basically, Technology Transfer is the process employed when organizations face internal incapability and/or unfeasible results when comparing inside solutions with outside solutions. It is also seen as a tool to obtain technologies which prove success and are risk free [5]. The most important reasons for technology transfer between organizations are, as far as the receiver is concerned: to increase its stake on market, to increase benefits, to gain strategic advantage. As for the transmitter these are as follows; to create a market for its old technology and found new R&D efforts for possibly new technologies, to make other organizations dependent on itself. [6]

The technological competences and capability sets needed for this endeavor could be imported by various ways from outside the organization.

ETAM consists of the technology transfer methodologies listed below.

Direct Acquisition: is employed in cases when potential R&D expenditure is higher than the costs incurred by direct purchasing and when the need for technology is urgent and vital. In this kind of TT, the receiver becomes remarkably independent to the owner of technology. Because of rapid TT, the level of technology integration inside an organization could not be fully reached and it causes failure of TT. At the time of the process, the transferred technology usually reaches its saturation phase (base technology) in the technology life cycle and gives less strategic benefits in the long run.

Direct Foreign Investment: It consists of situations when a foreign based organization invests new technologies in another country. It enables a limited technology transfer, but it could be still an effective way of making acquisitions. Therefore, governments usually support and encourage foreign technological investments.

Licensing and/or Know How Contracts: Depending on type of contract intellectual property rights of technology (license, trademark, design, etc.) or technical issues and technology related knowledge could be transferred. If the technology transfer procedure is managed correctly, this methodology enables strengthening the acquisition performance and high adoption of technology within the organization. But the technology object to transfer process would already become a base technology in the saturation phase at the time of TT. The intent and will of the transmitting stakeholder for transferring technology exactly and as soon as possible is also an important factor effecting the success of TT.

Turnkey Solutions: It enables fast solutions for both the transmitter and receiver of TT. However, if not supported by some training, exhibition or some other induction type of activities, it causes ill-defined and flawed TT.

Joint Venture: Joint ventures and strategic alliances occur especially in complex and huge projects which need high budgets and interdisciplinary approaches. In this kind of partnerships the most crucial point is to specify in clear cut terms the boundaries and other related issues in order to prevent future conflicts.

Joint Research Efforts or Manufacturing Partnerships: R&D investments, risks and benefits are shared by two or more organizations in order to manufacture a joint product as a result

of technology obtained through R&D efforts. The integration of organizations in a joint aim and mindset is crucial and raises the most challenging risk of this method.

Human resources and Knowledge Transfer: Human resources are intangible assets of organizations. Therefore, people who are experienced and knowledgeable about any field of technology become vulnerable objects of TT. Organizations that seek to transfer this kind of people encourage them through laws, incentives and good working and life conditions. Nonetheless, this circulation could be organized and managed by two or more organizations in order to obtain each other's experiences and knowledge by exchanging some special researchers and scientists.

Conferences, Exhibitions, Symposia, Personal Interactions, etc.: This kind of periodic publications and activities increase the situational awareness of organizations. The recent advancements, applications and regulations could be followed and assessed by actively and/or monitoring open sources. Yet this method does not enable big amount of technological transfer.

Open Source (Web, Books, Journals, Media, etc.): The information and knowledge is limited and already available to everyone. Yet it is still necessary to monitor and participate actively in these kinds sources.

University-Industry Collaborations: These merge the power of universities', laboratories' and institutes' R&D experience and knowledge with the industry's capital support for R&D, high production, manufacturing and market experience. This kind of method is especially encouraged by governments via Technology Transfer Offices and Technoparks. Companies and universities which take a role in Technology Transfer Offices and Technoparks take advantage of flexible tax applications, credit incentives and some other priorities when compared with their peers. Hence, entities such as Technoparks and Technology Transfer Offices are facilitating actors in this kind of TT. The most important point is to create the appropriate atmosphere for industry and university to interact and understand each others' requirements and aims correctly.

Reverse Engineering: It can be described as a single-sided receiver focused TT. The owner of the technology becomes the object of a transfer without its consent. The receiver employs its own capability to adopt technology by imitating or decoding some parts of it. However, the technology is still under ownership rights and the receiver has only limited knowledge about it. As seen this kind of TT is not ethical and could cause legal problems.

Mergers (Purchasing Technology Company): It is the process of completely purchasing an organization with its all technological capabilities. It is the fastest way of transferring complex and high technologies. The cultural differences between organizations could be the biggest challenge to success.

3.TECHNOLOGY ACQUISITION DECISIONS

There are some hot points in the acquisition process. After selecting the desired technology, the management board has to decide to integrate technology through internal or external methods. If external methods are preferred, they have to select the best methodology which presents most benefit and enables most rapid and robust technology adoption. For a successful TT, to collect and analyze needed data for decision makers, to evaluate feasibility studies, to create appropriate transfer environment for all stakeholders, and to establish a well defined management process are vital factors.[7]

However, even if, as it results from the comparison of the 2012 and 2013 fiscal data presented by the SIPRI (Stockholm International Peace Research Institute), national defense budgets have decreased by 1.9% the defense market still presents high profits and opportunities at global scale for countries and companies. [8]

The Defense Industry, includes complex technologies, high budgets and expenditures, big market profits and requires qualified experienced human

resources. Developments in the defense industry, spin off to other technology fields, the increasing market rivalry, and high costs push governments to develop their own national defense industries. The dependency on foreign powers and organizations in defense technologies decreases the reliability and sustainability of armies.

On the other hand, powerful and innovative national defense industries may return pecuniary and non-pecuniary profits, like big market share, becoming an exporter of defense industry instead of a customer, political and military effectiveness on global scale.

In such an important industrial environment with increasing complexity, the choices must be wise and on time. Managers dealing with "Military Defense and Security" projects, should be aware of technology, future paths and trends in defense doctrines and warfare. When selecting a technology acquisition method for any kind of technology, managers have to deal with lots of topics [9]. The main questions awaiting answers concerning Defense & Security projects are as follows:

- Political challenges,
- Budget limitations, the feasibility of both internal and external resources,
- Urgency of required technology,
- Technological Readiness Level (TRL) of desired technology,
- Importance and vulnerability of technology for homeland security,
- The Technological Maturity Level of technology,
- Potential Value Added by having the technology available via internal sources,
- Complexity of Technology and Systems,
- Availability for future developments and incremental enhancements.

After assessing the object technology (technology desired to be obtained by acquisition process), if it is decided to be transferred, the proper methodology must be chosen. In this process, Defense & Industry project managers have to choose the best TT tool to gain maximum benefit. After searching for all potential stakeholders, opportunities and bids the best fit option should be employed. At this phase, any manager must take into account the factors below.

- The scope of the defense project,
- National industry capability concerning personnel and technological aspects,
- The budget allocated for the project,
- Feasibility of the project,
- Potential risk of failure,
- Potential stakeholders, technological and communication capabilities,
- Geopolitical distance between potential stakeholders, sources, etc.,
- The complexity of a given project,
- International strategic alliances and political circumstances,
- International agreements and contracts,
- Technology possession level of stakeholders,
- The willingness of potential stakeholders to share technology and knowledge.

4. CONCLUSIONS

Defense industry and technology are very important fields for all countries because of various reasons. As a triggering factor and positive facilitator of economic growth and technological spin offs to other fields within the country and as a political, military and strategic source of power, defense industry and technology presents remarkable effectiveness to the organizations and countries which put emphasis on technological and industrial growth in the military defense field.

The increasing costs and complexity of defense projects and the decreasing budgets force project managers to choose the best technology by using best acquisition process. The "Technology Management" discipline plays a significant role and helps decision makers as a useful and systematic tool in managing this kind of challenging projects.

As a part of technology management 'Technology Acquisition' can be divided into 2 parts: Internal Technology Acquisition and External Technology Acquisition.

The importance and vulnerability of desired technology to national security, budget limitations, technology readiness

level, technology maturity level, stakeholders interaction, feasibility, internal human resources qualification, time limitations, the necessity of being a national solution and the risk of failure are some important factors which can affect decision makers when choosing internal or external technology acquisition methods in defense projects.

If decision makers select external acquisition (technology transfer), another decision point occurs. Which technology transfer method is the best? Decision makers have to deal with some challenges and think about some issues such as scope, budget, complexity level and feasibility of defense projects, international agreements and contracts signed by the country about defense sources limitations, TRL and TML of the object technology, internal human resources and technological capabilities, potential stakeholders technological capabilities, and potential stakeholders willingness to share technology and knowledge, geopolitical position of a country (distance to technological areas, stakeholders and other resources), international strategic alliances with other countries and risk of failure are factors which affect defense project managers when choosing technology transfer type and method.

To select and invest into the right technologies by implementing appropriate processes is vital for effective defense management. Balancing the diversification of technological projects, identifying vulnerable and critical technologies for national security and to make feasible decisions is important especially considering the global trends in decreasing defense budgets. The tradeoffs made by governments in the acquisition of defense technology projects must be realistic, optimized and technological processes must be run and managed systematically from beginning to end.

REFERENCES

[1] Mannke F., (2012). Fostering International Technology Transfer Through Climate Technology Networks Between European and Latin American Universities. Latin American Business Review, 13:171–197.

[2] MADANI H. (2009). Technology Transfer: Biotechnology Industry. Indian Management Journal .

[3] LEE, A. W. (2010). “An Evaluation Framework for Technology Transfer of New Equipment in High Technology Industry”. Technology Forecasting and Social Change .

[4] Çetindamar D., Phaal R. (2013). Teknoloji Yönetimi Faaliyetleri ve Araçları. Ankara: Elif Yayınevi.

[5] Cohen G.,(2004). Technology Transfer: Strategic Management in Developing Countries. Sage Publications.

[6] Graebner E., Kathleen M., Eisenhardt, Roundy T., (2010). Success and Failure in Technology Acquisitions: Lessons for Buyers and Sellers. Academy of Management Perspectives.

[7] Ramanatahan K. (2005). An Overwiew of Technology Transfer and Technology Transfer Models. Guidebook on Technology Transfer Mechanisms.

[8] Stanczyk K., (2010). Current trends in The World Defense Expenditure. Management of Economics,313.

[9] Cui, A.S., David A. Griffith, Cavusgil S. Tamer and Dabic M. (2006). “The Influence of Market and Cultural Environmental Factors on Technology Transfer Between Foreign MNCs and Local Subsidiaries: A Croatian Illustration”, Journal of World Business.