

The Technology Assessment Implementation at Science and Technology Research Institute in Defense, Malaysia (Stride)

Siti Norezam Othman¹, Mastora Mustafar¹, Nor Kamariah Kamaruddin¹, Shamsolnizam Karman¹
College of Business, Universiti Utara Malaysia, Kedah, Malaysia

Abstracts--The roles of the technology assessment are to give inputs in terms of not only technical efficiency and economic rationality but also social and ecological consequences of the introduction of a specific technology. The aim of the technology assessment is to determine the risk as early as possible before any decision making in technology purchased is made. Despite the technology assessment basic concept evolution, technology assessment can be applied in various sectors but it is most prevalent in the health, environmental if compared to the defense sector. This is because the defense sector is a country specific whereby security is the main concern of a nation and the information regarding the technology assessments practices are not publish for public knowledge. The purpose of the study was to investigate the extent of STRIDE technology assessment roles in assisting defense ministry in relation to technology acquisition decisions. This study employs case study approach to acquire in depth information on the STRIDE roles in technology assessment using a structured interview to collect the data. The findings indicated that the scope of assessment done was more on development aspect. In addition, STRIDE employed two types of methodologies in determining the priority areas in R&D; brainstorming and Delphi analysis. The implication of the finding would provide clear definitions, scope and guidelines for future technology assessment task.

I. INTRODUCTION

The process of modernization in Malaysia's military is supported by the establishment of credible and well equipped defense force. The total armed forces (excluding paramilitary) in 2005 are expected to reach 120, 000 personnel, which 90,000 troops are in the army. This number is to be reduced over the coming years to between 60,000 to 70,000 soldiers, as the modernization process continues. The modernization initiative of the military is materialized by significant orders on modern and sophisticated technologies such as Scorpene- class submarine, Augusta, Polish PT-91. This major procurement will improve the country's defense capability [1].

II. THE RATIONAL OF TECHNOLOGY ASSESSMENT FOR DEFENSE TECHNOLOGY

The Malaysian armed forces receive high increment in military budget due to its modernization program announced by the government in the late 2005. The aim of this modernization program is to develop a versatile military. Part of the program is to acquire new defense equipment such as Multiple Launch Rocket System (MLRS), submarines, the SU-30K jet fighter and PT-91 battle tank. The investment in

defense technology involves million and billion of dollars [1]. Thus, a mechanism to ensure the purchase is worth for money and for the development of the national armed forces. The acquisition of modern technology should be accompanied with assessment or evaluation not only focusing on the cost effective issue but most importantly, the weight of other factors such as safety, security and others should be equally important before any decision on technology investment is made.

III. OBJECTIVE OF THE RESEARCH

The objective of the study is to investigate the technology assessment implementation undertaken at the defense research institute, which is known as STRIDE.

IV. SCOPE OF THE STUDY

The scope of the study is restricted to the defense research institute, which functions as an advisor to Ministry of Defense. The respondents for the study come from different categories such as the Director, the Deputy Director, the Head of Departments and the Research Officers.

V. THE RESEARCH STRATEGY

This study employs the qualitative approach using case study. The purposes of conducting case study method are:

- By conducting the case study, the researcher has acquired the necessary information and voices that are unable to be detected through survey forms
- To give an in-depth understanding regarding the technology assessment implementation, which is important for the researcher in investigating how STRIDE conducts its technology assessment

VI. DATA COLLECTION METHOD

The data collection methods used in the study included semi structured interview, document review, and company profile. The researcher has visited the organization twice in order to collect data and verify the responses, which are unable to be captured during the first visit

VII. LITERATURE REVIEW

A. Status of Technology Assessment (TA) in Developed Country

Since World War II, the developed countries have maintained a technological advantage over adversaries. The US military galvanized the development of technological forecasting. The opening of the nuclear age and the pressure to exploit technology in the Cold War were strong motivations. Fifty years later, the Cold War is history and entirely new threats have emerged. The traditional thinking is no longer helpful. In fact, it may mislead. Today, countries in the world is facing continued threats that require an accelerated pace of technology development amid global proliferation of technologies. Technology assessment, as a general principle and in the broadest sense, is not so new to developed countries, considering the fact that many do have both short- and long-term technology development plans. As rightly pointed out, there are a number of techniques, such as Expert Opinion, Non-Expert Opinion, Monitoring, Trend Extrapolation, Scenarios, Modeling (Qualitative), Modeling (Quantitative), Checklists, and Matrices, that can be gathered up under the term of technology assessment[2]. However, the systematic and structured nature of the technology assessment as well as other combinations of related factors holds key to its effectiveness. Such systematic technology assessment has long been applied in several developed countries. Japan, USA and Germany are well known for their experiences and success with such technology assessment. It is not surprising for technology assessment to be generally perceived as a major tool for identifying opportunities in technologies and markets, thus maintaining or advancing industrial competitiveness.

B. Status of Technology Assessment (TA) in Developing Country

Technology assessment in developing countries is much more difficult to be implemented. Most developing countries have been left behind in technological development. Few if any, sustainable technologies exist in developing countries just to satisfy development needs. So technologies that worked elsewhere under different conditions are chosen and some of these prove unsustainable in developing countries [3]. They added that, no single individual is likely to have adequate technical knowledge to assess thoroughly whether a proposed cultural, economic, experts responsible to recognize, which technology will be compatible with the political, and ecological conditions in this developing countries [3]. Technology assessment in developing countries is more toward

- Emphasize monitoring (keying on what is available from developed countries and the impacts experienced there) more than forecasting or future-oriented impact assessment.
- Needs a favor of a promotional ‘systems approach’

- Needs support and effort from United Nations (UN)
- Technology assessment in developing countries is unable to be separated, freed or escaped from the term of development concerns. The development of technology assessment must deal with three broad concerns: policies to promote the relevant science and technology base; those concern with economic applicability-that is, assessing where resources should be targeted to optimize development; and those concerned with the institutional changes needed for effective adoption (e.g., regulations, venture capital availability) [4].

In general, technology assessment has not yet been developed as an autonomous and systematic process in developing countries. Much of technology assessment elements are found in various policy studies dealing with relevant issues, but are not labeled as technology assessment studies since they follow the wider Science-Technology-Society reference model. Such studies are carried out by different groups and institutions but the possibility for synthesis and creation of a critical mass of knowledge and human resources is quite limited for the time being. Furthermore, another basic reason for not having distinct technology assessment activities reported in developing countries are also the blur definition of technology assessment itself combined with its significant interrelation and connection with technology foresight and technology forecasting. Although, not supported by a systematic process yet, technology assessment activities in developing countries can be found in the form of information and consultation, technology assessment carried out by Public Administration with external expertise and support, Scientific Society, and technology assessment related educational or training activities, seminars and research [3].

Malaysian Ministry of Defense (MOD) has not yet established any formal unit for assessing technology, specifically, but they have had established an entity to handle the research for science and technologies purposes namely Science and Technology Research Institute for Defense (STRIDE). STRIDE role is to provide technical support and scientific expertise to Malaysian Armed Forces (MAF) and actually is one of the departments in MOD. STRIDE involvement with MAF especially in the process of asset and weapon systems procurement but its tasks more toward technical examination and standard, research, trial and evaluation, pre-delivery inspection, investigation, life-extension assessment and R&D. Technology assessment done by STRIDE can be trace in their involvement during the built-up of the concept on assets procurement processes. Based on early interview with MINDEF officer’s, the assets procurement done by MINDEF needs for specifications endorsement by STRIDE, but STRIDE involvement with MAF are not mandatory except for that endorsement and other purposes are based on customer request[1]

VIII. SCIENCE AND TECHNOLOGY RESEARCH
INSTITUTE FOR DEFENSE (STRIDE) MINISTRY OF
DEFENSE

STRIDE is a department in the Ministry of Defense, Malaysia and its role is to provide technical support and scientific expertise to the Malaysian Armed Forces. STRIDE's history began with the formation of the Defense Technical Centre in 1968. At the time, its responsibility was to aid the military in preparing defense specifications for procurement purposes, and running field trials as well as laboratory tests in conjunctions with evaluation requirements. However, by 1972, its work scope has widened to include military operations research activities, and the name was changed to Defense Research Centre. In 1985 its name was again changed to Defense Science and Technology Centre, in line with its new role as the centre for the transfer of defense technology, while still maintaining its technical support services to the Malaysian Armed Forces [5].

In December 2001, the Malaysian Cabinet approved the organization's restructuring and raised its status from Division to a Department under the Ministry of Defense. The new name is Science and Technology Research Institute for Defense (STRIDE). In 2002, the construction of STRIDE main laboratory complex was launched. By the year 2004, the main laboratory complex begins its operation.

STRIDE consists of 6 divisions which are: Weapons Technology Division, Instrumentation & Electronics Technology Division, Protection & Biophysical Technology Division, Mechanical & Aerospace Technology Division and Human Resources Management and Support Services Division [5].

STRIDE objectives includes firstly, provide science and technology information and advice in planning and execution of the national defense program. Secondly, conduct scientific and technological support through R&D and evaluation in procurement and utilization of the nation's defense material and system. Thirdly, prepare scientific and technology resources relevant to national defense requirements. Fourthly, develop industrial relations with the intention of providing scientific and technological assistance towards the development of local defense industry. Lastly, develop technical links with external research organization for purposes of increasing defense scientific and technological capabilities [5].

STRIDE plays significant functions in assisting Ministry of Defense. The functions are divided into three, which consists of Research & Development (R&D), Technical Services and Management. R&D is important in developing technical capability to keep abreast with current defense technology. In R&D, STRIDE's assisting Ministry of Defense (MOD) in a few activities, which includes setting the policy for defense science & technology(S&T), determining the priority areas of defense R&D, planning the financial requirements for defense R&D activities, accomplishing

defense R&D projects and lastly, develop strategic alliances and establish networking in the fields of defense S&T [5].

In providing technical services, there are plenty of activities provided by STRIDE's, which include providing support in development and endorsement of defense acquisition specifications, carrying out technical evaluation of defense procurements, conducting operational research and giving advice on development of defense capability, analyze component, material and equipment failures, carrying out laboratory and field tests, measurements and examinations, providing technical consultancy and carrying out calibration and standard measurements.

While in the management functions, STRIDE's provide activities such as, planning and development of infrastructure, equipment and structures, planning and management of the organization's finances, management of the organization's human resource, management of bilateral and co-operation programs, providing support formulation of policies, legalities and administrative matters related to defense S&T and planning and development of Information & Communication Technology (ICT) to support organization's management and defense S&T[5].

IX. TECHNOLOGY ASSESSMENT PROCESS IN STRIDE

The roles of STRIDE in assessing technology are different from the Health Technology Assessment or any other assessment done in a developed country. In the developed countries, the methodologies, process, structure are well defined. The role of technology assessment is extended to forecasting whereas in developing countries, specifically in Malaysia, technology assessment is done for the purpose of procurement. The assessment undertaken limits to the cost effect factor compared to social factor. STRIDE roles are restricted to providing services on technical information of the specific technology but not on the costing aspect. The assessment will be conducted only when there is request from the Armed Force or in other words, it is customer driven. Majority of the jobs performed by STRIDE are only as advisor not as technology proponent to the Malaysian Armed Forces [5].

STRIDE involves during bidding stage. The STRIDE staff involves in a committee and he or she will provide inputs from the perspective of technology. The technical evaluation starts with determining the specification whether the technology products require lab or field testing. For example, to test a vehicle, a field test will be conducted. If the vehicle is going up hill, the vehicle must meet the specifications as stated by military. The evaluation includes people, paper and sometimes physical of the equipment or hardware according to the customer needs. STRIDE and the Armed Forces personnel will meet together and agree whether the test indicated that the technology has complied or failed. In some case, if STRIDE will not be able to run test on the specific technology, the users or the military has to ask

the suppliers to provide validation or certification from manufacturers that their products complied with the military standard. For high technology investment such as aircraft, STRIDE could not do total assessment and normally, it is done only on paper, for instance through rigorous literature. The endorsement from STRIDE is very important before the procurement officers at Ministry of Defense continue with the purchasing [5].

STRIDE also conducts R&D; however the nature of its R&D is more on product modification and extension. Unlike the practices done in health sector in developed countries where technology assessment reports and reviews can be accessed, reports on technology evaluation are disseminated to the party concerned and the reports are treated as confidential. The usage is only for in house to cater the armed forces chief or the Secretary General of the Ministry [5].

X. THE SCOPE OF THE TECHNOLOGY ASSESSMENT (TA) FUNCTION UNDERTAKEN BY STRIDE

The TA undertaken by STRIDE depends on customer or user request. Unlike other TA, the TA undertaken by STRIDE is not done for policy making purpose. The TA serves as an input for the Technology procurement and assessment Unit in the Ministry whether to consider the technology for purchase or not. Despite this function, STRIDE presumes the advisor roles, which do not have veto power. Before any purchase is processed and made, it is important to get an endorsement by STRIDE. In some cases, the endorsement from STRIDE is overruled by the Tender Board for urgent and immediate case. However, not every time the representatives from STRIDE participate in the committee, which are made of representatives from military as well. Sometimes STRIDE is not included in the committee meeting before a technology or military requirements are purchased.

XI. THE EVALUATION CRITERIA IN TECHNOLOGY ASSESSMENT

In assessing the defense technology, there are a number of main considerations need to be taken by STRIDE. These factors include cost, net centric, giant leap, state of the art, modernization, automation, force expansion and number of personnel employed. These are important determinants considered by STRIDE before a consensus agreement is reached in recommending the purchasing of the technology. The technical criteria looked into by STRIDE are performance in the tropics, ergonomics, user friendliness, life cycle cost, science and technology support or analysis capability, and finally the industry support for maintenance.

The assessment needs to consider the criteria mentioned before any endorsement is made. Performance in tropics

means whether the technology, which comes in the forms of equipment, machineries or software. Most of the defense technologies are purchased from the advanced or industrialized countries, which experience the temperate climate. Due to the climate aspect, sometimes the technology, which is considered to be purchased fail to perform as expected. Another criteria used to evaluate technology is in terms of its ergonomic, for instance, the size of the seat in land vehicles, which are built for the European size or other example such as the force to trigger machine gun, which fits the European soldiers.

The evaluation takes into consideration whether it is user friendly, for instance the instruction manual in terms of the sequence of set up must be put differently to adapt to the culture. In addition, the assessment will be based on the life cycle cost of the technology to be purchased. The technology is evaluated in terms of its optimal usage and the length of its operations. Moreover, the assessment also considers whether the buying of technology is accompanied with S&T support or whether the local personnel have the analysis capability. Finally, whether the purchase of the technology will generate the business of the local defense industry is another important criterion. The purchase of submarine, which has the lifetime of thirty years and with the length of its lifetime, the local defense industry could learn to produce components for the submarines as time passed.

XII. METHODOLOGIES IN TECHNOLOGY ASSESSMENT

In identifying the priority areas in defense research and technology, STRIDE uses brainstorming to attain the objective in determining the priority areas for R&D in MOD. Through brainstorming, the participants, who are experts in the area, will be given the opportunity to discuss relevant and significant fields or areas to be introduced in the army. There are seven categories for R&D in defense. The categories are weaponry; aeronautical, maritime, transportation, ICT, Support services and Operations research. Based from the discussion results, every group will highlight the R&D topics considering the current issues, which are appropriate to military. Then, the topics will be studied based upon strategic importance and management capability.

Other than brainstorming, another TA tool used by STRIDE is Delphi analysis. The analysis scale used in the survey on each R&D topics priority, derived from the brainstorming session. There are two important aspects considered in the Delphi analysis; the strategic importance and the capability. The Delphi technique is a methodology to forecast opinion using qualitative approach. The qualitative approach means the panels, who are the army personnel from the Air Force, Army and Navy as well as the STRIDE officers, express their opinion subjectively [6]. The criteria used in the Delphi analysis can be referred in Figure 1

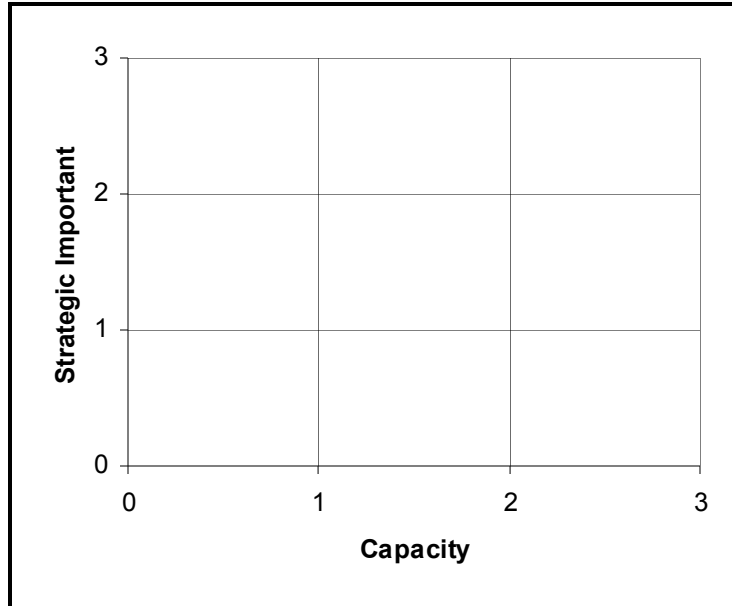


Figure 1 : Ranking Criteria for Delphi Analysis

The steps in the Delphi analysis are similar to what have been practised in the developed country. However, the objectives and the scopes of analysis are different. In developed countries, the objectives of the analysis are to identify the effect of any introduction of technology on the country, by taking into consideration its impact on social, security, legal, safety and others. The scope of the analysis is expanded to identifying the level of risk of the technology whereas in STRIDE, the analysis is more on identification of priority area in R&D.

XIII. DISCUSSION

After nearly 40 years, STRIDE has restricted its role as science and technology advisor on national defense program, and conduct scientific and technological support through R&D for MOD. Even though, they had developed technical links with external research organizations for the purpose of increasing defense scientific and technological capabilities they were lack in aiding MOD in identification and consideration of existing and probable impacts of technological application. Office of Technology Assessment (OTA) in USA in its practices did the assessment, including information, surveys, studies, reports, and findings, which shall be made available to the initiating committee or other appropriate committees of the Congress. In addition, any such information, surveys, studies, reports, and findings produced by the OTA may be made available to the public except where: To do so would violate security statutes; or, the Board considers it necessary or advisable to withhold such information in accordance with one or more of the numbered paragraphs in Section 552(b) of title 5, United States Code. Compared to the OTA or TA Agency in the developed

countries, STRIDE functions on technology assessment are far from technology assessment practices and requirement. Their assessment role is limited to technology per se and the evaluation done is more on whether the technology can be practically implemented by the military. Their recommendations from assessment are for the purpose of technology procurement. The recommendations are not strongly enough to influence the direction of the national defense policy.

The findings from the case study supported research on technology assessment implementation at developing countries where TA definition is a kind of blur to them. The scope of TA for most of the developing countries is to focus or look into the development aspect such as in STRIDE case, whether the technology purchased will bring benefits in terms of technology transfer to the country or in return, there is a spill-over benefit on the local defense industry. From the result, we can conclude that TA role as an input provider to improve decisions in policy making has a long way to go. Thus, there are a lot of improvement can be done in regards to the TA practices such as formulating a clear definition, roles as well as guidelines in undertaking technology assessment so that the assessment can be used whenever important policy or decisions are to made by the authority.

XIV. CONCLUSION

STRIDE was established in 1968 and responsible to aid the military in preparing defense specifications for procurement purposes, and running field trials as well as laboratory test in conjunction with the evaluation requirements. In 1972, its work scope widened to include military operations research activities. STRIDE has been the

advisor on technical matter related to defense technology quite for some times. The scope of technology assessment is highlighted in this study as well as the main considerations for technology investment and the methodologies used in identifying the priority areas in defense technology. In terms of the scope, the organization is included in a committee with members from the Ministry, the Army and also the STRIDE research Directors whenever there is a demand to evaluate and assess the technology from customer. The evaluation done is for the purpose of procurement or purchasing. Their roles and functions are quite different from the OTA or Technology Assessment Agency in the developed countries. The assessment on technology is done for development aspect such as technology transfer from advanced nation to

Malaysia. In regards to the methodologies used in identifying the priority areas, STRIDE uses two types of methodologies; the brainstorming and the Delphi analysis.

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