Technology Foresight – Strategic Use of Science & Technology for Setting Developmental Goals

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In this knowledge based era, harnessing the knowledge from every segment in society is vital to achieve developmental goals set at national, regional and international level. Science & Technology in this context could be utilized in a more pragmatic way to elucidate concrete structure for sustainable economic development and to secure national competitiveness amidst the global changes in the economy and environment. Technology foresight is a vital phenomena practiced by many countries in the world as well as in the region to set up the developmental goals in country's context.

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Though there are many definitions to explain the term **"Technology Foresight (TF)"**, it is best described as a systematic attempt to look into the future of science, technology, society and the economy, and their interactions in order to promote social, economic and environmental benefit.

Nations around the world initiated this versatile subject in many aspects and due to many factors. Especially the cessation of the cold war drove many countries to emerge from their budgetary allocations for war and to invest more on Science & Technology. In addition the ageing population and the enhancing of the global competitiveness brought the nations to face many challenges, so that the technology foresight has been used to exploit the resources with in the S & T framework to successfully orient the future R & D to meet socio economic needs.

Technology Foresight became much more widespread during 1990's though Japan has been engaged in the process since 1970s. Later in 1980's France also entered into the foresight activity, and thereafter in the next decade, 1990s more countries have shown their interest and experimented on foresight. Foresight experience of United Kingdom, Korea, South Africa, is briefly indicated here to provide insight on how the countries in the developed, developing and newly industrialized context, initiate and engage in this process. Moreover Japan's experience in this worthy exercise is simply explained to give insight on Asian contribution.

However, Technology Foresight is not country specific. The findings of foresight study have a greater liability to change with the global changes and therefore need to have better regional as well as international cooperation.

Global Scenario

Many countries across the world entered into this activity to emerge from the economic constraints and to facilitate economic growth. The countries concerned implemented foresight activities mainly for wealth creation, sustainable development, to design policy directives to promote S & T etc. The best case is Japan where the first Science and Technology basic plan based on the Sixth Technology Foresight Study expanded two fold increases in S & T budget to 17 trillion yen.

The United Kingdom, in 1993 initiated its Foresight programme with dual objectives in mind; wealth creation and improving quality of life and subsequently expanded with the inclusion of sustainable development in the agenda. The first foresight study was targeted for five years from 1994-1999 focussing 16 foresight fields. The important point is that the exercise did not collapse with the political changes. The UK foresight exercise encouraged scientists and researchers to conduct risk and innovative ideas into research.

South Korean experience in foresight in the context of newly industrialized nations was initiated in 1994, where Korea has conducted its initial Delphi study by the Ministry of Science & Tehcnology. The foresight exercise is mandated for every five years and envisioned the future of Korean society and technology, linking future needs of society for innovation in research. Korea considered the foresight as a critical tool for policy making, while increasing the governemnt funds for research.

National Research & Foresight Project in South Africa is conducted by the Deaprtment of Arts, Culture, Science & Technology (DACST) and was inaugaraetd in 1996. The main objective of the project was to identify emerging technologies and market opportunities that are expected to be benficial to South Africa. The unique feature of the South African foresight exercise is the inclusive participatory approach, where the stake holders involved, represented the industry, government, labour, civil society deliberately covering every section of a society. Sector identifcation of this was quite unique as the countrywide workshops held guided to get the views of prticiapnts about the future priorities.

In the developing country context, the South African foresight exercise provided worthy results to allocate funds, identify priorities for public funded research, encourage greater R & D investment in industry to improve the technology awareness, and identify skills shortage in science & technology.

Regional Phenomena

Japan played a pioneer role in introducing Technology Foresight to other Asian countries and with the inception of the APEC Centre for Technology Foresight in Thailand many Asian countries geared to foster Technology Foresight Activity in single or multiple fields.

Japan has a legendary history in Technology Foresight. Dating back to 1970s, the Science & Technology Agency undertook the first forecast activity for 30 years of the future Science & Technology. The landmark achievement in this process is the formulation of S &T basic plan to set the policies for investment and resource allocation for the future developments of Science & Technology. The Third basic plan drawn based on the recently held Technology Foresight Study in 2004 envisioned to focus the prospective areas to set the policies for investment and resource allocation for the period of 2006-2010. Key benefits associated with the study is that providing background data for R &D planning including long term technological trends and emerging technologies and support benchmarking R &D activities in Japan. The latter is very useful to recognize the emerging areas that need international collaboration, has identified factors constraining technological development.

Technology Foresight in South Asian Region

The APEC (Asia Pacific Economic Cooperation) Centre for Technology Foresight was launched in 1998 and established as an independent unit of National Science and Technology Development Agency (NSTDA) in Bangkok. The centre inspires to promote the adoption of technology foresight, and develop technology foresight capabilities through out the APEC region. The centre has established intricate network with other regional economies who engage in Technology Foresight studies.

Methods used in TF

Although many countries embark on technology foresight studies, the objectives, foci and the

approaches basically depends on the economic, institutional and cultural context of the country involved. Further the structure of foresight activities could be elucidated at different levels such as micro-level, meso-level, macro level, and holistic, where each category represent the individual companies and research institutes, group of companies, ministry level participation and acquisition of information at all stages by a coordinating body of the Foresight activities.

The most accepted and common methods are;

- Delphi analysis
- Scenario writing
- Consultation
- Bibliometric analysis
- Socio-economic analysis

Countries in the process of technology foresight invariably employed these methodologies but with certain limitations depending on the country of practice.

Delphi Survey

The method grasp the experts view to identify impending technological developments 20-30 years ahead and to estimate the likelihood of their occurrence and realization time. The method extracts the responses of repeated questionnaires sent to the experts and ultimately consensus of the experts is counted. There are pros and cons with the technique. If speaking on the positive points, acquisition of views of vast majority of experts becomes a prominent feature of the technique.

The Delphi survey is run among a large number of specialists of diverse backgrounds (scientists, government officials, businessmen etc.) to validate several hundreds of specific predictions about the future and collect opinions on the subject (grouped into several fields). Amongst the advantages of the method is the ability to compare the results of such studies in other countries to identify the global trends and its influences at national level. But the method also brings certain disadvantages, as it requires considerable period of time, particpation of large number of experts and due to these facts higher financial investment is necessary.

The Delphi technique is extensvely used in many countries, where Japan is in the fore front. Out of eight foresight studies carried out by Japan so far, former seven studies were based on Delphi study, whereas multi approach has been used in the last and eight study. Except Japan, Korea, UK, Germany, Thailand was engaged in Delphi. But depending on the resources and the infrastructure facilities slight changes have been made to collate the results. The mini Delphi conducted by Korea is such an example in this regard, where instead of carrying out 4-5 repeated questionnaire surveys, mini delphi used only three rounds.

Scenario Writing

This is another widely used method which involves more focussed approach and obtaining the views of the most outstanding individuals in the respective sector. Experts in this instances could predict the likely developemnts in technology in particular field looking 10-20 years ahead. The other important point to realize is, unlike Delphi this technique is not centralised on the technology, instead it addresses the themes in basic science and society.

Almost all countries engaged in the foresight activities widely used this method. It is distinctive as the Scenario could not only be used in technological perspective but the orgaizations, companies could draw their own scenarios to develop future business stratergies and priority settings.

Consultation

Like Delphi the method acquires the views of experts on expected, possible and preferred futures on longer term basis. But its application is limited due to high financial capital needed and the time required for consultancy with the experts. It is dissimilar to the Delphi as the technique is

highly country and culture specific and therefore no provision to compare with the other countries. Netherlands, Australia, South Africa, United Kingdom are few of the countries that experienced this method as one of the technology foresight tools.

Bibliometric Analysis

This involves analysis of databases to identify the recent developments in the world. But employing such a tool is a hard task as it requires huge investment on purchasing necessary software packages.

Socio-Economic Analysis

Social and industrial trend data analysis, views of the non –science experts and society (specially the general public)is mainly counted. To make the process successful candidates should be more conversant of the process.

Advantages of a Foresight Activity for Sri Lanka

Results of foresight exercise will provide insight to strategic allocation of funds to prioritized research and to introduce the needs of research capacity building programmes in the higher education sector.

Reviewing the trend of fund allocation on the nature of research in Sri Lanka, there exists a dramatic change in R & D expenditure in 1996 and 2000. In the year 1996, percentage R & D expenditure accounts for 7% for experimental development, whereas in 2000 it has reached to a level of 26.0%. Though the trend is positive it is obligatory to direct the investment to recapture the investment through better research outputs. Foresight study in this perspective is vital to adjust the R & D budgets as well as to identify the important technologies for future developments.

Raising the level of technology would not be sufficient if the impact on the society and the economic benefits are neglected. Therefore technology foresight study is a useful tool to direct S & T activities and allocate more funds to gear the socio- economic development of the country. Another significant advantage is the results could be used in the decision making process at the policy level to draw concrete proposals for the future developments in the S & T sector.

Why it is Important to Sri Lanka

During the past few decades remarkable change has been shown in the Sri Lankan economy as the contribution from Agriculture sector for the economic growth is capitalized by the industrial and service sectors reaching the values of 36.3% and 59.3% respectively as indicated in the Central Bank Report 2005. The present figure of economic growth rate of 6% needs to be shifted to a value of 8% in order to alleviate poverty, and to raise the level of living standards.

As articulated in many government policy documents improving technology and research development has been strongly regarded as one aspect of achieving economic growth. In this sense technology foresight could be used as a strong mechanism to promote application of modern technology.

The need for such a breaking mechanism is well understood when compared with global situation. The Global Competitiveness report 2004/2005, places Sri Lanka at 98th position. Global Competitiveness Index (GCI) ranking was based on the indicators such as, macroeconomic environment, the state of a country's public institutions and the importance of technology for development process. Further penetrating to the sub index rank, the corresponding value for technology index Sri Lanka occupies 88th position, categorizing the country under lower position in the GCI scale.

Further the present level of GERD/GDP of 0.19%, as estimated by the R &D survey done in 2000, is not satisfactory. This is far behind the recommended level of 1%, given for developing country.

Rectifying this present status is a difficult task unless developing a strong network for collaborative research among public and private sector organizations. Technology Foresight is one of the best ways to bring the views of both sectors to achieving common goal.

At a stage where the attempts are being made to shift the GERD/GDP value to a favorable figure, Technology foresight study would be a guided pathway to identify the future technologies for a flourishing future in economic perspective and to reap the benefits of Science and Technology.

Stake Holders

Usually the major stake holders in such a study are the experts in the relevant field irrespective of the locality, as there is a flexibility of getting the views of the local as well as international experts. Another important aspect is the ability to gain and share the knowledge and experience of expatriate scientists, specially when performing Delphi process. In Sri Lankan point of view, at a situation where the country is deprived of the expertise due to continuous migration, employing techniques such as Delphi process would help assist to bring the local brains to set future developmental goals.

Apart from this, the methodologies such as Delphi involves the synthesizing the views of non experts in the anticipated field, but who are experts in another field. Most important is the inputs obtained from the society which covers the general public and other organizations such as Small and Medium industries etc. Actually Japan with its robust position in conducting foresight studies in their last survey included the socio economic analysis as another tool to gather views from the society.

Limitations and Strengths Sri Lanka Could Encounter

In the wake of limited facilities and within the feeble framework of National Innovation System hard attempts have to be made to collate the needful information.

But it is worth mentioning that the scientific community spread out in 15 Universities, 32 Science & Technology based organizations and in industrial sector would be valued resources in this exercise.

In addition there are many professional scientific bodies in Sri Lanka where the valued inputs could be obtained. From the industry point of view the trade associations, industry chambers could also play a dominant role in such a study. Hence despite the limited human and financial constraints there exist some hidden strengths which could be utilized to attain benefits.

However, realizing the importance over the other limitations of such an activity to Sri Lanka, National Science Foundation is to commence a Technology Foresight study shortly, focusing the Rubber and Aquaculture industry. The National Science Foundation expects the stringent cooperation of all responsible stake holders to make this attempt a success.

These foresight studies would no doubt identify the emerging global trends in those industrial sectors and simultaneously assist prioritize research at national level for future prosperity. Accordingly, strategic prioritization of research brings an indispensable advantage in allocating S & T budget for research & development in rapidly developing and priority areas.

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