

Technology Strategy Innovation and National Building Innovation

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Abstract

R & D investment in building technology and innovation is essential for national-building and helps the country to overcome middle income trap effectively.

In theory, technology and innovation are key drivers of economic growth. Robert Solow, 1987 Nobel Prize-winning economist has created the theory of Economic Growth Theory (Growth Theory.) illustrating that the government can support economic development in many ways, for example ; education development, labor training, investment stimulation, resources transfer from low performance industries to high performance industries. But technology and innovation are considered the top priority (Garfield, 1988).

There are empirical evidences suggesting that the development of innovation is correlated to economic development significantly. For example, Solow's study reveals that two-thirds of US economic growth is due to technological advances. And in the research of Das, n.a. (or Chen and Dahlman) (2004) also found that technological development and innovation are correlated with long-term economic growth.

When turning back to consider for Thailand, its economy still lacks of new engines to drive economic growth to a higher level. Thailand's current economic growth has slowed down since the major economic crisis in 1997 (World Bank, 2018).

Although Thai economy has been restructured to higher-tech production level, but that is not sufficiently practical to be released from the middle income trap. Because most key technologies are still imported from abroad, while many industrial sectors are still in the manufacturing stage, the middle section of production chain that can no longer move into the early stage where research and development, branding, and design are taken place, and to the ending stage where product distribution, marketing, and after sale services are taken place which are higher profitable stages in the production chain.

Research and development in creating technology and innovation is essential for economic reconstruction and it is a key factor in creating a new engine for driving the country to be free from middle income trap. This paper, therefore, explores the situation of technology and innovation development in Thailand and provides suggestions that may be beneficial to the development of technology and innovation in Thailand.

1. The situation of technology and innovation in Thailand

Considering the technology and innovation situation in Thailand, our findings reveal that:

1.1 Competitiveness in regard to technology and innovation of Thailand is in lower level

Competitiveness ranking made by the International Institute for Management Development (IMD) reveals that Thailand’s competitiveness is ranked into the middle level in ASEAN group, but the trend is downward.

When considering sub-components of competitiveness index which consists of four main areas (Figure 1): economic performance, government efficiency, business efficiency, and infrastructure index in Thailand, Findings suggest that Thailand infrastructure index, particularly in technology, scientific and education are indexed with low scores which become obstructive to the competitiveness of Thailand. (Rachdawong, 2016)

1.2 Costs of R&D in Thailand are higher than that of similar group of the countries

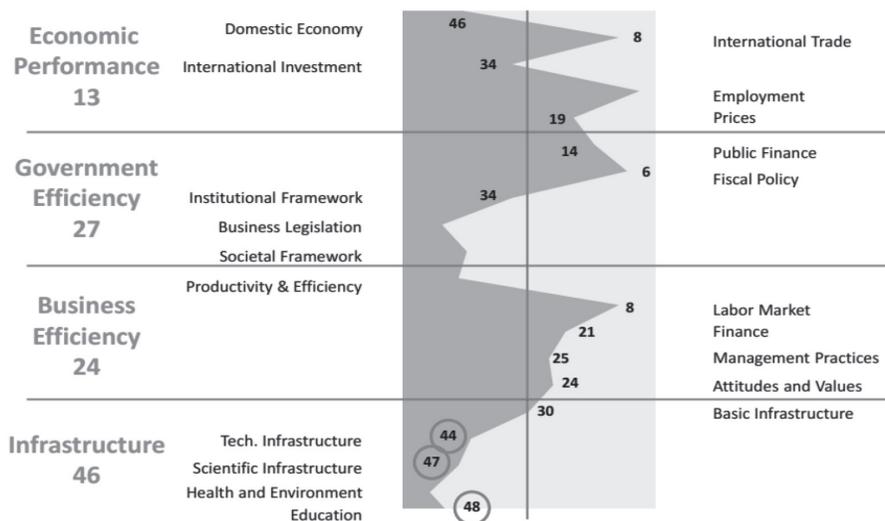
Thailand’s R & D investment has been growing continuously from a static level of 0.21 - 0.26 % of GDP during the year 2000 to 2009, to 0.62 % of the GDP in 2015.

However, costs of research and development expenditures in Thailand are regarded as low level comparing to those countries in the same level. Typically, Thailand is categorized to be in the upper middle income countries list with average R & D expenditures of 1.57% of the GDP, while in those high-income countries spend about 2.46% of their GDPs for R&D.

1.3 R&D in private sector grows steadily

In the past, the government solely played a significant role for the investment in research and development, while the proportion of expenditures for R&D in private sector increased slowly during the year 2000 and 2008. Nevertheless, since 2009, R & D investment in private sector has

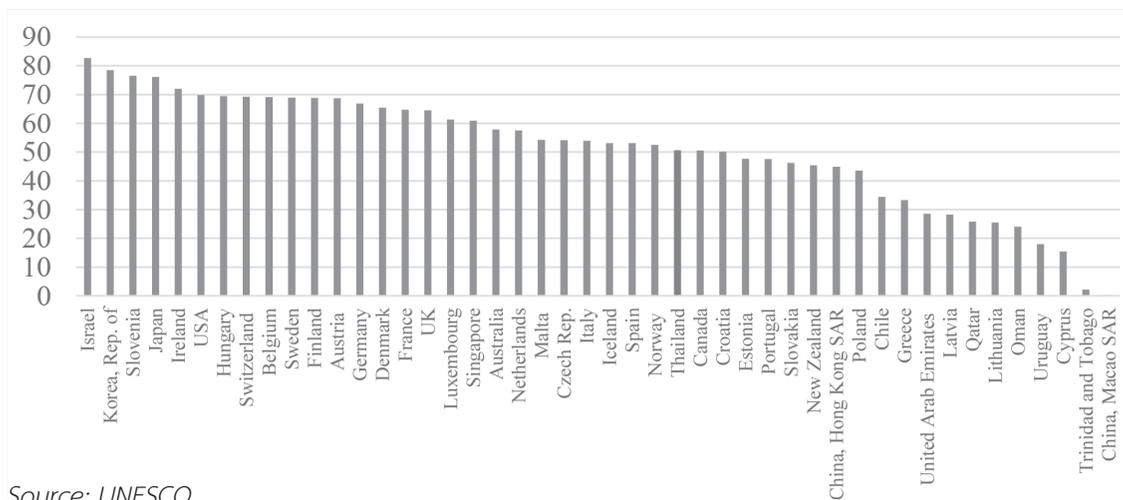
Chart 1 : Thailand’s Competitiveness



Source: IMD

risen drastically from 9,336 Million THB or 41% to 59,442 Million THB or 70% of total R&D expenditures (Chart 2). This is due to the result from changing context in the competitions of economics that turn into the knowledge economy and due to government strategy to promote R&D investment in private sector (UNESCO, 2015).

Chart 2 : Percentage of expenditures dedicated to R&D in private sector in Thailand and in high income countries (% of Gross domestic expenditure on R&D (GERD))



Source: UNESCO

1.4 R & D personnel increase but still remain concentrated in cluster in the public sector.

Thailand has headcount personnel in research and development increased steadily from 55,748 persons in 2002 to 143,187 persons in 2014. Among this, 32,011 of them are full time personnel for the year 2011, and 84,216 persons for the year 2017. This indicates that some of them do not work as fulltime personnel.

Compared to only in term of private researcher, It is found that private sector with higher costs of R%D has less researchers with lower

level of education. By the year 2014, the number of private researchers reached to 28,440 persons a year - consisting of 83% bachelor degree, 15% master degree, and only 2% doctoral degree graduates, while researchers in other sectors consist of 37,525 persons / a year - 6% bachelor degree, 64% master’s degree and 27% doctoral degree graduates.

However, the proportion of research and development personnel in Thailand is relatively lower than that of high-income countries. Thailand

has about 800 full-time researchers/year/one million people in 2013, but in almost all high-income countries, the average numbers of full-time researchers are above 10000 /a year/ one million people.

1.5 Quantity and quality of research and development in Thailand is relatively low.

In 2014, there are merely 94 pieces of research per one million people that are published, while in high-income countries there are over 500 research papers per million people that are published. In addition, most of Thai researches have not been utilized. Of this figure, 40% of total

researches have been utilized for commercial purposes, while in Singapore, China, South Korea and Japan, 48%, 83%, 62% and 65% of total researches have been utilized for commercial, respectively.

In the past 10 years, Thai researchers have produced over 400,000-500,000 pieces of research, but they have not been commercially exploited since all of them are not kept in the same place, leading to lack of facilities to accommodate further development for commercial applications and while some research are not in consistent with specific needs, and are not of proper quality for practical utilization.

2. Innovation for technological strategy and national-building

Solving research and development issues will certainly support the creation of technology and innovation which will be beneficial for developing the country and bringing Thailand to be free from the middle income trap. For this reason, I would like to present 6 key strategic innovations, namely;

2.1 Enhancing research potential in the country as a whole

1) Defining the creation of commercial innovation as a national agenda

Increasing the potential of research to seriously drive and obtain faster results can be implemented in several approaches, such as development from original research for further utilization, conducting new research to make use of the results with using actual utilization plans, importing new knowledge or technology from abroad, which may be purchased partially, not the whole of it, for developing to apply with existing knowledge and technology in Thailand.

2) Increasing R&D budget of the country.

Government should be committed to stimulating research and development in the country by setting a budget target contributed to research and development in a certain proportion that will definitely make change distinctively. For example, 1% of GDP, and then increase to 3% for a later phase

This will draw the country's resources into the research and development sector bringing significant changes eventually. For example, attracting talented people into the research and development sector can create value for R&D and thus, increase the number of researchers, or help making a better climate of research and development in the country which will encourage private sector to recognize the importance of R&D and turn their investment into this sector more increasingly.

3) Conducting mega project in R&D sector

R&D mega-projects are high-value projects that require extensive period of time to complete. These projects have concrete and desirable outcomes that result in the development in many technologies and in line with the future development of the country. For example, the US Apollo project, which ran between 1959 and 1970, had its clear goal in sending off human to the moon and returning to earth safely. This project has been funded over 25.4 USD billion (500 Trillion THB of today's amount).

Thailand should run R&D mega-projects in the fields that provide opportunity for Thailand to create excellence, such as in medical field, because Thailand has a high potential in medical services and high possibility to become medical hub of Asia and the world as Thailand has high quality medical services with strong private sectors that can support to drive in this field.

For example, the Mega Hospital or Medical City mega-project of Saudi Arabia which created the King Khalid Medical City (KKMC) in Dammam with the investment cost of US \$ 1.27 billion in providing people with accessibility to quality medical services and to develop their medical innovations.

4) Integrating research and development of the country into the same direction

In the past, the investment in research and development of the country is quite scattered. Although the government has a policy framework for supportive industry or technology, such framework is quite broad. As a result, it turns private sector to invest in research and development only to meet the needs of entrepreneurs or executive vision which is often based on the direction of technology and on consumer demand.

While R & D investments in the public sector are usually based on the researcher's proficiency. Thus, government should integrate various research projects and create cooperation between all research and development agencies and people in order to allocate limited budget strategically and in consistent with the development direction of the country.

2.2 Increasing the role of research and development in the private sector

In the past, the government has been a major leader in research and development, but has not yet succeeded in commercializing all the research works. This is due to government does not need to respond to the needs of market as it does not need to consider for profit or loss.

Therefore, research projects implementation often do not meet the needs of the private sector. As a result, to drive the research and development of country to achieve commercial results,

the role of R & D in private sector must be strengthened by the following approaches;

1) Restructuring from the production contract to the design and branding

Many Thai manufacturing sectors are OEMs producer, resulting in low value added of the products. Therefore, in supporting for private investment in research and development, it is necessary to restructure the manufacturing sector to be the original design manufacturer (ODM) and the original brand manufacturer (OBM). Because design and branding are activities that can add value better. But this requires more knowledge and technology obtained from research and development.

In restructuring the industry sector from production sector into design and branding sectors, the following strategies should be taken:

- Development of entrepreneurs to have knowledge and skills that include design and branding.

- Development of marketing capabilities, such as the understanding of marketing needs both of domestic and international markets, or the promotion of business matching activities.

- Marketing support for products that have their own design and branding, such as public relations, supply for demonstration area and product distribution, etc.

- Offering funding and incentives for industrial restructuring such as, the Manufacturing Restructuring Fund, tax measures to production restructuring, the promotion of joint venture funds for new entrepreneurs having design and branding.

- Development of research and development infrastructure and product design.

2) Creating alliance with global research agencies

As an example, the Chinese government

encourages Chinese private sectors to form a coalition with global research agencies in order to access the latest technology of the world.

For example, Hisense, an electronics giant of China, has partnered with MIT (the world's leading universities in the US) to train its personnel and collaborate on the Smart Technology, Artificial Intelligence, and Human-computer dialogue projects.

3) Establishing research partnerships between public and private sectors.

There are many forms of cohesion between public and private sectors. Collaboration in research partnerships is a high level cohesion (Guimón, 2013) because there is mutual agreement made in the research projects. The government should initiate to be research partnership with private sector by surveying the demands for innovation of business sector in the whole country. Then match that needs with appropriate governmental organization that have a consistent mission.

Biomarkers Consortium is an example of partnership between the public, business and public sectors in the United States consisting of public sectors from the National Institutes of Health (NIH), and the US Food and Drug Administration. (FDA). The business sector is the National Health Insurance Center (CMS), which includes the pharmaceutical, biotechnology, diagnosis, and medical equipment industries. As for public sector, it includes non-profit organizations, associations and various right protection groups. Such the cooperation is established to promote the discovery, development, adoption, regulations of bio-markers, and acceleration in the creations of new technologies, new drugs, successful methods of prevention, diagnosis and treatment (Hoffmann, 2013).

2.3 Quality enhancement for innovation ecosystem

Innovation often takes place in the right environment. In enhancing innovation capability of the country, it is necessary to develop innovative ecosystem with the following approaches.

1) Developing technology centers in various industrial clusters

The government has a policy in encouraging entrepreneurs to join together as industrial clusters. However, further measures and strategies that should be implemented are; encourage these clusters to establish research institutes or to collaborate with universities to continue research and development in relation to the industry of that cluster. Institutional funding may come from contributions of entrepreneurs in that industry. The results obtained from the research and development will be considered as knowledge that all operators in the industry can share. This will raise the competitiveness and further develop the industry consistently.

2) Supporting undergraduate / doctoral students to conduct research based on the needs of business sector.

Universities should encourage students to designate research topics that are in consistent with the needs of business sector. Each university may establish a data center that aggregates research topics contributing to the needs of individual businesses so as students can choose desired topics for developing as their own research projects. Universities may also request research funding from the business sector for their students.

3) Developing business Incubator center in the university to turn a concept into a business

The University Business Incubator center will create a strong connection between knowledge

builders and the business sector helping new graduates in the community to create businesses and make new businesses become more successful as compared to the new business that occurs in stand-alone business incubators. Because the new business occurs in the center is much closer to its business mentor. However, in the establishment of the incubator center, required indicators should be clearly defined in order to drive, follow up and control to make potential business ideas become reality.

4) Taxes exemption on activities related to the transfer of production technology

Such tax exemption will encourage the transfer of production technology to Thai entrepreneurs. In some countries, the government offers tax exemption for incomes derived from a commercialization of intellectual property which will help encourage the transfer of technology from technology producers to technology users more increasingly. For example, in Malaysia where 50% tax exemption is applied for revenue generated from commercial research application within 5 years.

5) Law amendment to facilitate the innovation

Thailand has some laws that may hinder the development of innovative products. For example, the application of Thailand Industrial Standards (TIS) to the first innovative products in the world. In such case, as there are no equivalent standards for new innovative products to comply, applying a law to such TIS non-compliant product may prevent them from being manufactured.

For example, in case of new innovative polymer gas tank that cannot be certified by TIS for the first time due to no comparable standards to apply with, or in case of Uber Taxi Service that cannot operate in Thailand due to legal obstacles.

Or in case of Trade Competition Act of Thailand that allows business mergers and acquisitions to occur from starting to ending of the processes resulting business sector to implement consolidation strategies to occupy and monopolize the market, instead of investing to create innovation.

2.4 Increasing the demand of R&D

In the past, Thailand primarily focused on solving the problems of R & D supply, such as by infrastructure development, funding for research agencies, development of research personnel, etc. Although these approaches are necessary but they not still adequate. Thus, increasing the demand for research and development should be also implemented.

1) The state functions as a purchaser of innovation through the procurement process

Innovative products launched to market for the first time require a special market. Because new launching products, their quality may not be good enough and may not be ready to compete in a global scale immediately. If these products cannot be sold in the country, then they cannot be developed to compete in the global market. Therefore, the government should serve as a buyer of innovation. Since the government has a large number of budgets for procurement in each year, the budget may be used to support innovative products of the country. As for an example, cars used in the South Korean government authorities, they mainly are Hyundai cars. This is due the policy of the government that supports the automotive industry in the country.

Thailand used to apply such approach. For example, the Police Department purchases a Tiger brand motorbike. Without support from the government, these motorcycles may not compete with Japanese motorcycles. However, although

this approach may be reasonable in term of concept, it is very sensitive to be applied in Thailand because it may be seen as benefits that government offers to some private sectors. And since the government procurement process may lack of transparency, this approach will not allow continuity in the development of innovative products to be competitive. Thus, government needs to determine precisely that what innovation it should support and the procurement process must be transparent with explicit timing.

2) Motivating to buy innovative products through tax policy

For example, people buying innovative products or parts will be offered taxes reduction to encourage increasing demands which will help to expand innovation market to a larger scale. This will make the investment in R & D become more cost-effective and induce the private sector to increase the demand for their research and development.

2.5 Increasing utilization of research

1) Setting the goal of research utilization for 100%

This can be done by surveying all non utilized governmental research and selecting potential research to encourage the private sector to develop the research for commercial, such as, surveying of rubber products for the demand and marketing such products globally.

2) Government provides research product licenses of public sector to private sectors

Since a viewpoint of some government officials is that the research is not rotten and can be kept longer. Therefore, its license price is kept unchanged. Although the right of the research is not sold, the research in fact is like other goods and services that can be devalued over time. A

research can expire. If it is not used at the right time, It will become obsolete and unusable.

Thus, the government should collect all government research that has not yet been utilized for proposing to the private sector to select for further development and utilization. This may be implemented by making profit sharing agreement that if a private sector gains a profit from the development of a research, it must share the profits to the state. But if the private sector lost the profit, the state will not charge for the license. And state-owned banks may consider business plans and provide funding to private sectors that utilize state-funded research.

2.6 Increasing the research personnel

1) Reverse brain drain

In attracting those Thais and foreigners who have world-class capabilities in various fields to be back to work for the country, in the fields that lack of such talented personnel or in the fields that are consistent to long-term needs of the country, the government needs to use some resources to motivate these people, such as, compensation, benefits that can motivate these professionals to work in the country. An example of this goes with the Chinese government that has agencies in seeking for the best and most intelligent Chinese people worldwide to be back to China by attracting these people with incentive with high financial return or by offering high status and position in organizations or universities.

2) Jump strategy

The jump strategy is to provide scholarship strategically by surveying which professors or universities are the best in the world in the field, technology or industry that Thailand lacks of. And this is a strategy for future development of the country to allocate potential person to study with

those excellent professors and universities in order to gain access to knowledge frontiers and this can bring knowledge back to the country rapidly

Scholarship holders of jumping strategy should be given problems for solution finding before continuing education to conduct research with certain target. And when these people graduate, they must be offered with supporting projects to develop their research as new industries and to support the creation of innovative hi-tech products and new entrepreneurs.

This approach is the way that Brazilian government uses for science and technology development. Brazil has the “Science without Borders” program, which sends off 75,000 students in 2014 to study abroad in famous institutions such as 26,300 students to the United States, 9,500 to the United Kingdom, 7,000 to Canada, 6,400 to France, 5,900 to Germany, etc.

“Innovation distinguishes between a leader and follower” says Steve Jobs, the world’s most important innovator, demonstrating the importance of innovation for the future competitiveness and for survival of the nation.

If Thailand desires to stand out on the global stage rapidly, to be a regional or continental leader. All sectors including firms, entrepreneurship, foundation, nonprofit Organization, university, institute of science, government agencies, all citizens and consumers, must recognize the importance of innovation and collaborate to create new innovation and development to be the top of the world, both in term of quantity and quality.

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