INDONESIA

S&T Policy: Reform of National R&D Strategic Planning and Government Research Institute in Indonesia

Muhammad Samsuri[1,2]

1. Introduction

Indonesia has faced new challenges to enhance the contribution of science and technology, particularly domestic technology, in economic growth. In 2008, 80% of technology resources to industries came from overseas; only 20% came from domestic research and development. Of overseas technology, 80% came from Japan, 27% from Europe, 9% from the USA and 3% from South Korea. It is imperative for the Indonesian government to foster domestic R&D to increase national competitiveness, and eventually contribute to economic growth.

R&D is a complex activity, whose nature and results can be analyzed by examining five main considerations. Firstly, it contributes to the production and circulation of certified knowledge, by which the quality and importance of new knowledge are determined by the scientific community (peers) and knowledge is mainly spread via publications (scientific journal articles) or embodied in instruments. Secondly, through collaboration with industry, research can contribute to a process of development and can lead to product and process innovation, and thus help to create competitive advantage. Thirdly, R&D can also play a role in the achievement of government objectives. These correspond to what economists call public goods, namely power, prestige, and well-being (such as the environment and health). Fourthly, R&D contributes to the process of embodied knowledge and skill. Training is one method that enables knowledge and skills to be embodied in trainees or students. And fifthly, through providing and disseminating information, R&D contributes to expertise and public understanding. Popularization of science or presentation of R&D results in a simple and widely accessible language or form has always constituted an important part of the work of researchers, including scientist and engineers.

At the core of these phenomena, it has been widely recognized that R&D activities serve as the driving force in complex activity. Hence, R&D policy effectiveness is required to support R&D activities and R&D strategy planning has become one of the principal tools for the management of R&D Policies. Generally, R&D strategic planning assumes two main forms: (1) sectoral strategic policy, which focuses on the competitiveness of a particular branch of activity, such as transport; and (2) dissemination of strategic planning, which is intended to facilitate the penetration of a generic technology, such as automation, material or biotechnology, into an industry. However, the active participation and flexible networking of government, research institutes, industry and society are the key elements for successful R&D planning and program implementation.

In the case of Indonesia, as a developing country with a limited budget for R&D investment, the R&D development mostly emphasizes innovation. Why innovation? With innovation R&D, investment is expected to highly contribute to increasing economic growth in the short-term and enhance competitiveness. According to a report by the World Economic Forum (WEF), Indonesia's competitiveness was ranked 54th of 133 countries in 2009. Consequently, from a policy perspective, intervention needs to be developed in the innovation system framework to satisfy policy criteria and generate significant leveraging effects in enhancing the innovation system and competitiveness and supporting other developmental objectives as well. Government research institutes (GRIs) are key actors in research and development as 80% of R&D budgets is provided by government and only 20% R&D budget provided by the private sector. Thus, reformation of national R&D strategic planning and government research institute activities are unavoidable.

[1]*Senior researcher and senior policy analyst at Ministry of Research and Technology (MoRT), Jakarta, Republic Indonesia*
[2]*Dispatch researcher in Korea Institute Science & Technology Evaluation and Planning (KISTEP), Seoul, Korea*
E-mail: msamsuri@kistep.re.kr, msyamsuri@ristek.go.id

2. National R&D Strategic Planning in Indonesia

2.1 R&D Areas

Reinforcement of the national innovation system and enhancement of research, development and application of science and technology were deemed essential to science and technology development envisioned under national development planning in the mid-term (2010-2014). The frameworks of national S&T development in mid-term national development planning (2010-2014 are illustrated in Figure 1.

The national innovation system was focused to empower science and technology institutions, science and technology resources, and science and technology networks. Research enhancement and development and application of science and technology focused on seven areas: food security, energy security, information and communication technology, transportation technology, defense technology, health and drug technology and development of advanced materials. The goals of the seven focus areas are enhancement of national research, development and application of science and technology, including enhancement of publications, patents, prototypes, technology services and entrepreneurship based on technology. Also included was increased stress on the relevance of research activities to real social needs and social awareness of science and technology.

Against this backdrop, GRIs must make great efforts to implement national development planning to reinforce national innovation systems and enhance science and technology research, development and application. Furthermore, the R&D program at each GRI must stress the seven focus areas. For the innovation system, GRIs should collaborate with universities and industries the Ministry of Research and Technology (MoRT) has a key role to coordinate this collaboration among government research institutes, universities and industries.

Moreover, MoRT and GRIs should focus on the achievement of science and technology development through reinforcement of institutions resources and networks relevant to science and technology. Those include centers of excellence, human resources, budget allocation, equipment and tri-lateral partnerships among research institutes, universities and industries. In

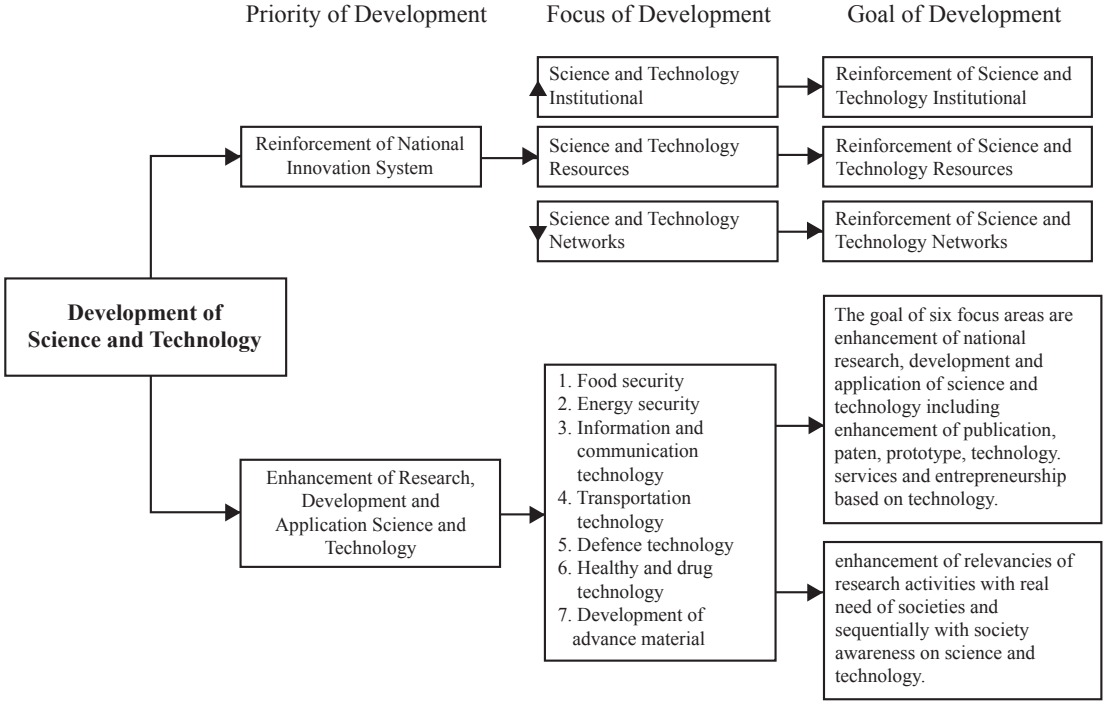

Figure 1 Frameworks of national S&T development in middle term of national development planning 2010-2014

particularly, GRIs should enhance their competitiveness to promote the national program and they should identify areas in which they can compete as a center of excellence.

2.2 R&D Resources

Development of science and technology resources includes human resources development, development and utilization of research facilities, and science and technology budgets. Generically, in Indonesia the current situation for development of science and technology resources are still low in several aspects. The number of bachelor degrees held by Indonesians is lower than that held by nationals of other ASEAN countries, e.g., Thailand, Malaysia, Philippines and naturally Singapore. In 2007, the total number of bachelor degree holders in Indonesia was around 17.5% in contrast to 30.2% in Malaysia, 55.6% in Singapore, 48.3% in Thailand and 28.5% in the Philippines, and nearly as low as that of Vietnam (15.9%).

Furthermore, the number science and technology (S&T) human resources is small compared not only to advance countries but also ASEAN countries except for Vietnam and the Philippines. In 2004, the number of S&T human resources in Indonesia encompassed around 43,779 persons.

Likewise, the government budget for research and development (R&D) is small compared with ASEAN and advanced countries alike. In 2006, the ratio of government R&D budgets per GDP in Indonesia stood around 0.05%, a ratio dwarfed by Korea (3.01%), Japan (3.42%) and other ASEAN countries including even Vietnam (0.2%). Furthermore, the ratio of enterprise R&D funding to total national R&D funding is also small compared with advance countries and several ASEAN countries: 70% from the government and only 30% from companies. This fact contrasts greatly from the case of Japan: 80% from companies and only 20% from government.

Against this backdrop, a huge effort is imperative for MoRT and GRIs to increase their budget allocation for R&D, in particular the seven focus areas of national development. Furthermore, it is imperative that they identify the most effective way to secure highly talented researchers within their limited budgets.

2.3 S&T Networking

S&T Networking can be found not only through internal and institutional networking but more widely including performance of collaboration between government (both central and regional government), research institutes, universities, and industries in term of policy and actual activities. In general, across Indonesia, S&T networking should be reinforced.

In 2009, the World Economic Forum (WEF) rank Indonesia number 43rd in terms of research collaboration performance among government research institutes, universities and industries. Compared to other ASEAN countries, this performance was lower than Singapore (4th) and Malaysia (22nd) but higher than Vietnam, the Philippines and even Thailand (44th). Nonetheless, coordination and collaboration did not sufficient reveal solidity and productivity.

Institutional and functional S&T synergies within the supply side (Government Research Institute under MoRT, R&D agencies under the other ministries, universities), and between the supply side and demand side remain low and should be enhanced. The low institutional and functional S&T synergy results in insignificant revenue from S&T activity in terms of quality and quantity.

Against this backdrop, establishing an integrated policy involving education, science and technology to enhance collaboration in S&T activities is urgent. Equally urgent is erecting collaboration between the supply side and demand side. In term of policy support, MoRT should undertake to enhance S&T networks and it is imperative for GRIs to actively collaboration in demand side R&D (industries and small medium enterprises).

2.4 R&D Outputs

R&D output are based on several indicators: scientific publications, patents, securing & utilization of S&T, embodiment of technology in companies and S&T empowerment. In 2009, the number of scientific

publications included 560 articles in international journals, 2,718 domestic patents and 19 international patents, the last of which was lower than Malaysia (168), Singapore (450), the Philippines (22), and Thailand (40).

Moreover, in the case of securing & utilization of S&T, based on the WEF report, in terms of availability of high technology, Indonesia ranked 54th out of 133 countries in 2009, behind Singapore (3rd), Malaysia (24th), and Thailand (26th) but before Vietnam (75th) and the Philippine (87th). In case of embodiment of technology in companies, Indonesia was ranked 65th after Malaysia (37th), Singapore (13rd), Thailand (61st), Philippine (54th) and Vietnam (51st).

Furthermore, in term of empowering S&T, GRIs have endeavored to develop research. For instance, the National Institute of Aeronautics and Space (LAPAN) succeeded in developing satellites and a Tsunami early warning system, e-government applications to support governance systems, waste recycle technology and R&D in energy and food security. Nonetheless, the scale of S&T empowerment is still insufficient to contribute to economic growth.

Against this backdrop, it is imperative for MoRT to pursue S&T development policies that dramatically increase outputs. In Figure 2, we suggest two purposes for R&D activity with several output models of R&D activities as a functional synergy to improve the performance of S&T actors, including GRIs coordinated by MoRT, private research institutes and R&D agencies in other ministries, universities and industries. That initiative we call the "new strategic policy initiative".

3. Reform in Government Research Institute

GRIs, universities and industry are key actors in any innovation system. GRIs will face new challenges in establishing effective networks with universities and industry that create and promote innovation. Currently the seven existing GRIs are coordinated through MoRT.

The other ministerial R&D Agencies are coordinated by their respective ministries and universities are coordinated and supported by the Ministry of Education (Figure 3).

The current GRI structure has caused a number of functional problems. The following sections will focus on five major aspects: research areas, research resources, networking, R&D outputs, and also MoRT functions and roles.

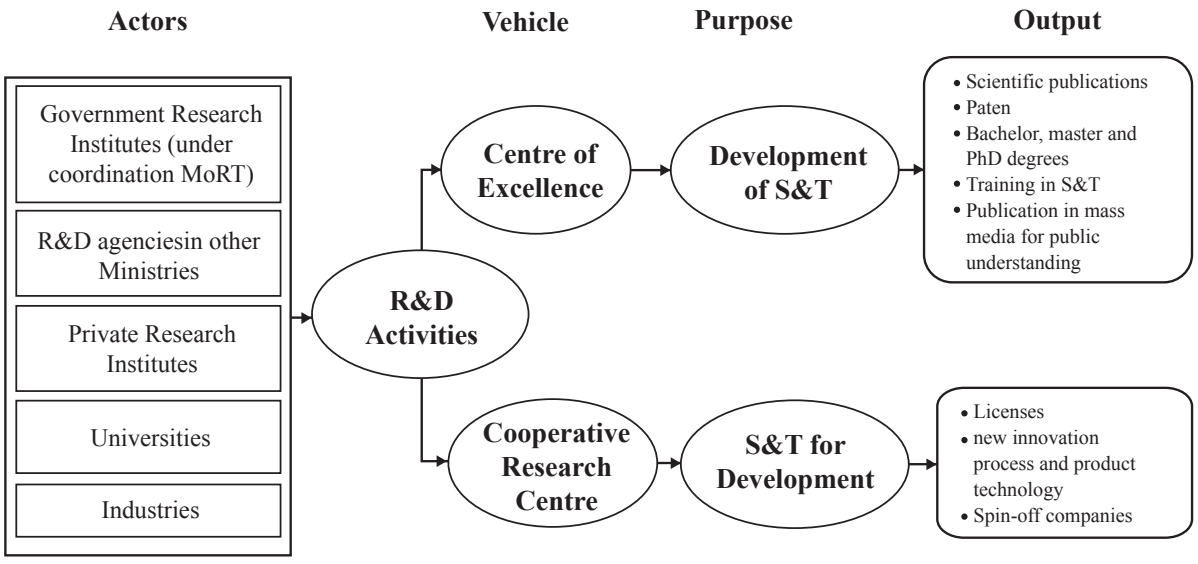

Figure 2 Framework of new strategic policy initiative

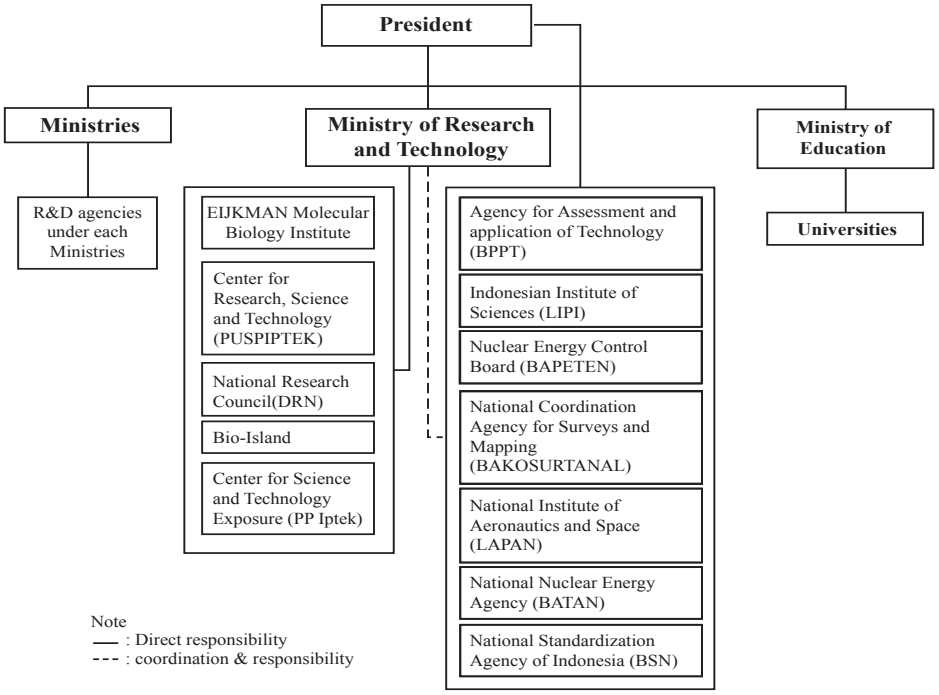

Figure 3 Current organization government research institutes as R&D actors

3.1 R&D Areas

In many cases, the focus of research and development are driven exclusively by the idiosyncratic curiosity of individual researchers and not concerned with market orientation. Not surprisingly, they do not even consider national S&T development planning for 2010-2014.

This lack of coherency and focus should be changed in order to produce useful results. Notably, the focus area of research and development should be conducted based on market orientation.

Most importantly, GRI R&D should be focused on the seven areas outlined in the 2010-2014 mid-term plan: food security, energy security, information and communication technology, transportation technology, defense technology, health and drug technology and development and advanced materials. Moreover, GRIs should strive to become centers of excellence and thus their human resources, budget allocation and equipment procurement should be oriented toward discernable achievement in the seven focus areas.

3.2 R&D Resources

Development of science and technology resources includes human resources development, development and utilization of research facilities, and R&D budget allocation. Generally in Indonesia, development of S&T resources is still low, as suggested by several indicators.

The ratio of researchers in research institutes per million people in Indonesia is around 207, a number lower than that prevailing in other ASEAN countries, e.g., Thailand (600 researchers) and Singapore (7,000 researchers) although higher than that in Vietnam (115 researchers) and the Philippines (48 researchers).

Government R&D funding in Indonesia is corresponding miniscule. In 2006, the ratio of government R&D budgets to GDP around 0.05% and, of that, 70% derives from government and only 30% from companies.

Accordingly, GRIs should actively pursue increasing the quantity of researchers and the quality of performance by increasing budget allocation for R&D, particularly in the seven focus of national development.

3.3 S&T Networking

S&T Networking is a real problem for GRIs in Indonesia. In advanced economies, S&T networking should be found not only internally through institutional networking but more widely and intricately through collaboration among government (both central and regional), universities and industries in terms of policy and activities.

Hence, S&T institutional and functional synergies between internal suppliers (GRIs under MoRT, and R&D agencies under other ministries) are important to increase effectiveness and mitigate areas of overlapping redundancies. Beyond that, institutional and functional synergies among GRIs, universities and industries should be pursued to increase the effectiveness of R&D and ensure utilization of research results. Given this, it is imperative that GRIs actively seek R&D collaboration with industry and small medium enterprises (SMEs), especially in terms of market requirements.

3.4 R&D Output

R&D output in Indonesia low compared with other countries. As mentioned above, in 2009, R&D output could be attested to by the publication of 560 articles in international journals and attainment of 2,718 domestic patents and 19 international patents, the last of which was lower than Malaysia (168), Singapore (450), Philippines (22), and Thailand (40). Moreover, Indonesia ranked 54th of 133 countries in 2009 (according to the WEF in terms of securing & utilizing S&T, after Singapore (3rd), Malaysia (24th), and Thailand (26th) but higher than Vietnam (75th) and the Philippines (87th).

Thus, the GRI system must be dramatically reformed to focus on output and that output must not be measured only in terms of scientific publications and number of patents but also in terms of the number of bachelor, master and PhD degrees, quality of training and publicizing S&T in the mass media to enhance public understanding. In case of S&T for development, output should also be measured in terms of technology licenses, new developments in process and product technology and the number of commercially viable spin-offs. Above all is the attainment of functional synergies in terms of discernable output between actors of S&T through cooperative research centers and developing centers of excellence as a vehicle.

3.5 Role and function ministry of research and technology

MoRT is responsible for assisting the President of the Republic of Indonesia in formulating national policies and implementing coordination in the field of research, science and technology. The following is the main functions of MoRT in the field of science and technology: formulating government policies, coordinating and synchronizing the implementation of those policies and evaluating programs arising from those policies.

Given its role and function, MoRT has been guiding national direction in fostering, cultivating, stimulating, facilitating and creating conducive surroundings for developing national systems for research, development and applications of S&T, through diverse programs that empower S&T institutions, reinforce S&T resources and networks, enhance S&T productivity and utilize S&T based on external demand.

However, MoRT should do more to ensure direct coordination and networking among the seven national GRIs: Indonesian Institute of Science (LIPI), Agency for Assessment and Application Technology (BPPT), National Institute of Aeronautics and Space (LAPAN), National Coordinating Agency of Surveys and Mapping (BAKOSURTANAL), National Standardization Agency (BSN), National Nuclear Energy Agency (BATAN) and National Nuclear Energy Control Board (BAPETEN).

Internationally, S&T coordination, including GRI coor-dination, assume diverse forms. In Korea, all coordination in the field of S&T, particularly S&T policy, falls under the National Science and Technology Council, but several GRIs fall under the Ministry of Education, Science and Technology (MEST) and several others fall under the Ministry of Knowledge and Economy (MKE). In Germany, overall responsibility for S&T falls within the purview of the Federal Ministry of Education and Research.

Moreover, S&T policy in Indonesia has been characterized by parallel research policy objectives in different ministries. To avoid unnecessary duplication of research policy activities, MoRT has initiated and maintained closer interactive dialogues with those institutions. In addition, MoRT has also sought to reinforce ties between public R&D institutes, universities and private business organizations. In the design and implementation of national cross-ministerial programs in the field of research and technology, MoRT has played an important coordinating role, and the major challenge is maintaining close coordination with ministries engaged in parallel S&T sectors.

Furthermore, for the 2010-2014 term, the role and function of MoRT should be directed to enforce intermediation in the development of the national innovation system by coordinating convergent research institutes in policy formulation and policy implementation in S&T field research and development (supply-push technology), promoting R&D results and encouraging a demand driven approach. Achieving functional synergy offers a strategic approach for intermediation, coordination and synchronization of research institutes (GRIs coordinated by MoRT, R&D agencies under other ministries, universities, regional government institutes and industries).

Starting in 2004 MoRT has been promoting R&D incentive system as a tool and stimulant to conduct functional synergy to enhance R&D capabilities. The R&D incentive system must encompass basic research, applied research, enhancement of S&T capacity in production systems and acceleration of S&T diffusion and utilization.

4. Policy Implication

Considering national S&T planning in the mid-term (2010-2014), we have analyzed the R&D output, role and function of MoRT and R&D actors (GRIs, universities and industries). Based on our findings, we can summarize the major policy reform issues and future tasks as follows.

First, in order to realize national S&T development planning, deriving a strategic policy encompassing the entire systemic range from planning and implementation to evaluation, including budgeting, is necessary. Also, the strategic policy must expand its concept of output from not only the number of scientific publications and patents or even the number of higher education degrees but also technology licenses, process and product technology development, enterprise spin-offs, training and propagation of S&T in mass media for public understanding.

Second, S&T development should be consistent in order to nurture and foster the seven focus areas: food security, energy security, information and communication technology, transportation technology, defense technology, health and drug technology and advanced materials.

Third, in order to empower S&T institutions, GRIs should be reformed into centers of excellence and pursue world-class competencies operating under effective management. GRIs should focus in the specific areas in which they have high capabilities performance in enhancing S&T productivity based on customer-orientation. S&T agencies in other ministries should continuously support and assist research institutes through direct policy and research incentives to encourage centers of excellence in their respective GRIs.

Fourth, in order to reinforce S&T resources, GRIs should focus on systemic reform in software and hardware. With regard to software they should enhance human resources (researchers with high qualified education and high performance). As to hardware, they should increase the number of internationally recognized R&D facilities through facility accreditation. MoRT should encourage and foster reforms through policy instruments and research incentives that increase human resources in GRIs, e.g., establish scholarship system and reward system

Fifth, Since S&T is broad and synergistic, GRIs should establish effective networking with universities and industries to realize R&D activities based on external demand. Collaborative research centers offer an alternative to tripartite collaboration among GRIs, universities and industries. The collaboration research system should not be restricted solely to domestic entities but rather include networking with foreign research institutes, universities and industries. MoRT should support these endeavors through policy

and financial instruments to realize this tripartite collaboration.

Sixth, in order to enhance R&D productivity, reforming the GRI system in terms of dramatically increasing output is necessary. In term of S&T development, the definition of output should be expanded beyond the number of scientific publications and patents and higher education degrees to include technology licenses, process and product technology development, enterprise spin-offs, training and popularization of S&T in mass media. MoRT should offer support via policy and R&D incentives in basic and applied research, enhancement of production system S&T capacity and acceleration of S&T diffusion and utilization. To achieve dramatic results in these strategic goals, direct policy incentives through a top-down approach is imperative.

Seventh, in order to enhance S&T utilization through technology transfer and establish new technology enterprises, GRIs should reform R&D activities to be market driven rather than researcher driven.

Outputs that include technology licenses, process and product technology development and commercial spin-offs should be emphasized with the MoRT supporting through direct policy and R&D incentives. Systematic R&D incentive systems to enhance S&T production capacity, diffusion and utilization should be implemented.

Moreover, “political will and leadership” are most important to boost and foster S&T policy and activities and reform GRIs. Without those, it will be very difficult to realize coherent S&T planning, implementation and evaluation and also impossible as well as the goal of enhancing national competitiveness through S&T. Political will must extend beyond budget allocation to encompass support and understanding that S&T development offers long term advantages.

References

Callon Michel, Laredo Philippe and Mustar Philippe (1997). The strategic management of research and technology. Economica International.

Coldric Simon, Philip Longhurstb, Paul Iveya, John Hannis (2005). An R&D options selection model for investment decisions. Technovation, (25): 185–193.

Ministry of Research and Technology (2010). Strategic Planning of Science and Technology 2010-2014; Ministry of Research and Technology. (in Indonesian)