

SOME ANALYSIS AND EVALUATION REMARKS ON VIETNAM SCIENCE AND TECHNOLOGY

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Abstract:

During recent decades, Vietnam science and technology (S&T) has gained considerable results of development and given contributions to socio-economic development and national defense. From one side Vietnam S&T has got many achievements in enhancing highly S&T potentials, innovating and improving institutional structures of the country, and establishing initial backgrounds of S&T market. From another side, however, Vietnam S&T did not really become driving forces for socio-economic development. In this paper, we provide a summary of analysis and evaluation remarks on S&T development of Vietnam through stages as well as its actual situation. These considerations would permit to make some proposals for directions of S&T development of Vietnam in next stage.

Keywords: Science and technology; Innovation; Research & Development.

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1. Introduction

Vietnam S&T, in process of implementation of the Doi-Moi reforms, gained considerable achievements and gave contributions to socio-economic development and national defense. Social sciences and humanities provided conceptual arguments for planning strategies and policies and building legal backgrounds and laws, and gave contributions to development of the systems of key concepts for development of the country. Natural sciences gave contributions to enhance the level and capabilities of fundamental sciences and created backgrounds for establishment of some multi-discipline S&T sectors. Technical and technological sciences gave certain contributions to enhance labor productivity and quality of products and services, and to improve competitive capabilities of enterprises and national economy. Produced great efforts have enhanced S&T potentials, innovated and improved institutional structures, and established initial backgrounds for S&T market. However, Vietnam S&T activities did not enter deeply and

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largely in all the sectors of national economy and did not become driving forces for socio-economic development.

In this paper, we provide a summary of analysis and evaluation remarks on S&T development of Vietnam through stages, comparing them to development stages of some other nations. We also provide some analysis and evaluation remarks on actual situation of Vietnam S&T development of and then we make some proposals for directions of S&T development of Vietnam in next stage.

2. Comparison of S&T development of Vietnam through stages to the ones of some other nations

Vietnam gained impressive development steps during the two decades 80s and 90s of the XX-th century. After initiating, the Doi-Moi reforms Vietnam started the shift of economic management from the centrally-planned economy to the socialist oriented market economy driven one. Remarkable progresses in building and re-structuring institutional systems and opening the national economy have provided new opportunities for Vietnam to develop economic activities, to intensify integration moves to the world's economic markets. During this period, Vietnam advanced forwards with a growth rate faster than almost all the East Asian countries, except China. The annual average growth rate was 7.26% during 10 years, from 2001 to 2010, which made Vietnam reduce poverty rate and enhance living quality of population. However, during the late years of the decade, Vietnam experienced a decline of growth rate from 7.5% by 2005 to 5.4% by 2009 which was the signal of successive decline trends during the following years.

During early years of 1980s, the economic system of Vietnam was governed on basis of central control principles where research and development (R&D) activities were relatively separated from production and education activities. A series of reforms was implemented and led to a more flexible state of the system. The series of reforms permitted to establish pre-conditions to create knowledge markets, particularly the intellectual property (IP) one. From theoretical points of view, reforms offer conditions for R&D activities to be driven by market principles. In practice, however, the S&T system continued to be dominated by public R&D actors and then R&D activities remained relatively separated from production sectors.

Vietnam has a big number of universities and a long list of public S&T organizations of various small and large sizes. But, here only a very few number of enterprises participates in R&D activities. Standard principles would mind that a “following and catching up” economy, as the one

Vietnam has now, would lead to existence of a bigger number of enterprises to participate in innovation activities in expectation to produce superior quality products for markets. In global conditions, when the institutional systems and support tools remain limited, undeveloped and improperly coordinated, the most recent institutional reforms play roles of catalysts for development of Vietnam. Vietnam has managed to put down the first foundation stones to build up a complete innovation system. However, this system did not really develop due to restrictions in resources which should be mobilized for development as well as lacks of attentions to be paid for practical use and economic profits.

When dealing with Vietnam as we have during the three decades of the Doi-Moi reforms, and gradual shifts to socialist oriented market economy, we do not see the involvement of large scaled private enterprises similarly to the case of Russia. Instead of that, Vietnam has developed many features similar to the ones of China in this process, namely joint ventures of multinational companies with local State owned enterprises and appearance of small scaled private enterprises. In this process, China conducted radical reforms of micro economic structure during short period, particularly in areas related to S&T sectors and S&T activities. Contrarily, in Vietnam, the reforms were not conducted so definitively in institutional aspects and, as results, led Vietnam to another orbit where Vietnam remains far behind China in numerous aspects of development of an innovation system.

Another country worth for learning lessons in aspects of S&T development is South Korea. This country has been transferred from an agricultural society with many stagnation problems to one of the most dynamic industrial societies of the world during the last 4 decades. During 1960s, the development level of South Korea, being in starting points of initial efforts for industrialization, was similar to the one of Vietnam. South Korea was as typical underdeveloped country with limited natural resources, low production capabilities and high population. South Korea GDP by 1961 was only USD1.3 billion (1980 value rates) or USD87 per capita. International trade ties were in pre-development stage. But actually South Korea is 13th ranked among the world's strongest economies with leading positions in some technological sectors such as semi-conductors, LCD displays, communication equipment, car manufacturing and ship building.

A retro vision to 1960s shows that South Korea did not pay much attention to S&T roles. The country had only two public S&T organizations: Military R&D Institute and South Korea Research Institute of Nuclear Energy with less than 5,000 researchers and engineers. By 1963, South Korea expenditures for R&D activities was USD9.5 million. But a notable

difference from Vietnam is that South Korea had well trained labor forces. From this point, in 1962, South Korea set up its first 5 year plan which required a huge source of new technologies. Since South Korea lacked technological capabilities, it needed to base the implementation of plans on external sources of technologies. South Korea adopted a strategy to promote technology transfer from foreign countries and, at the same time, to develop domestic capabilities of technology absorption for application and improvement of transferred technologies. During this period, South Korea issued a very tough policy to FDI sources and, because of that, FDI sources did not play big roles in technology transfer. Instead of that, the South Korea Government focused efforts on external capital loans to buy technologies and attached training packages for purpose to set up big scale State owned industrial corporations. Regarding the private sector, the development of small and medium enterprises (SME) followed a similar way for get technologies. Public research institutes were established to assist private enterprises to absorb transferred technologies. In parallel to technology absorption, South Korea started to build its own R&D capabilities through establishment of two institutes KIST and KAIS on basis of the US model, two laws being specially promulgated for these two institutes.

For the decade of 1980s, efforts for technology transfer through purchase of external technologies and FDI investment sources did not help South Korea make further break-through advances. Therefore, the South Korea Government decided to shift efforts to build up its own R&D capabilities, particularly to encourage R&D activities in private sectors. Expenditures of South Korea for R&D activities experiences a fast increase, from 0.81% of GDP by 1981 to 2.7% of GDP by 2000 and then 3.47% by 2007 where the private sector made a contribution of 70% of the total R&D expenditures. By 1980, South Korea had only 321 industrial R&D laboratories with 5,100 researchers including 56 doctor grade holding staff. By 2007, the number of industrial R&D laboratories increased to remarkable figure of 14,975 with more than 190,000 researchers including about 10,000 doctors.

3. Science and technology of Vietnam in the actual stage

Strategies for S&T development, 2011-2020 periods², were initially implemented in context of the first steps of realization of the 5 year plan (2011-2015) where the country has got out from under-development

² The strategies were approved by the Prime Minister and issued together with Decision No. 418/QĐ-TTg on 11th April 2012.

situations and entered the group of middle income nations³. Now the important roles of S&T get more respected. S&T development and high quality human resources become *one of the three break-through strategies and are a leverage of the re-structuring process strongly linked with the shift of growth models*. After 5 years of realization of these strategies with useful and practical contributions from S&T sectors, the national economy keeps on good growth rates, positive directions of shift of economic structures and improvement of living level of population. However, the scale and potentials of economy remain low and the average income per capita of Vietnamese locates at the low end of the middle level of the world's standards⁴. The growth models based on growth of investment capitals, cheap labors and non-renewable natural resources are found incapable to fit real requirements and to give break-through solutions. It would be difficult for Vietnam to escape from middle income traps, even to get a higher mark of low-middle level of incomes in close future, without exploring new solutions on basis of S&T and innovation actors.

Entering 2016-2020 period, when Vietnam gets integrated in larger and deeper activities into the world's economy, multi-directional impacts of globalization, liberalization of trade and ever-strongest development of the world's S&T would bring huge opportunities and, at the same time, challenges for behind-going nations including Vietnam. The successful negotiations of free trade agreements (including Trans-Pacific Strategic Economic Partnership Agreement - TPP, Vietnam - EU Free Trade Agreement - EVFTA, ASEAN Economic Community - AEC) open opportunities coming from large markets but also tough challenges of economic competition Vietnam economy and enterprises have to face. Domestic and international contexts as well as ambitious objectives of socio-economic development (turning Vietnam to become basically a modern-oriented industrial country by 2020) have posed huge challenges for S&T development of Vietnam.

3.1. Objectives of S&T development of Vietnam through some indicators

According to the Mid-Term Report of 2011-2015 period of realization of Strategies for S&T development, 2011-2015 period, by Ministry of Science-Technology, *the values of high tech products and high tech applied*

³ Vietnam's average income per capita by 2010 was USD1,273 (Source: General Statistics Office of Vietnam). World Bank classifies a middle level national economies with income per capita from USD1,045 to USD12,736 (GNI based calculations) where the low-middle level of incomes ranges from USD1,045 to USD4,125 and the high-middle level of incomes ranges from USD4,125 to USD 12,736 (Source: WB, 2014).

⁴ During 2011-2015 period, the average economic growth rate was 6%; GDP by 2015 was about USD204 billion and the average income per capita was USD2,228.

products give increasing contributions to GDP growth during three years from 2013 to 2015 period making 11.75%, 19.2% and 28.7% respectively. However, in majority of cases, the main part of values of high tech products and high tech applied products comes from the FDI sector.

Another indicator deals with *the total number 11,738 of Vietnam scientific papers and research works published in ISI magazines* from 2011 to 2015. This figure is 2.2 times greater than the one from 2006 to 2010 which makes the annual average growth rate of 19.5%. Mathematics, physics and chemistry remain the fields with strongest potentials of Vietnam and they make 40% of the total number of international publications during the last 5 years. Regarding the mathematics, Vietnam has the leading position in the number of publications among the South-East Asian countries. In terms of the total number of international publications of the period from 2011 to 2015, Vietnam is 59th ranked in the world (which is higher than the 66th rank of the period from 2006 to 2010, and the 73rd rank of the period from 2001 to 2005) and 4th ranked among the South-East Asian countries (after Singapore (the world's 32nd rank), Malaysia (the world's 38th) and Thailand (the world's 43rd rank). One of important factors making the growth of Vietnam's number of international publications during the last 5 years comes from the larger scale and higher efficiency of support measures for research activities where the particular roles come from State budget resources through National Fund for S&T Development (NAFOSTED). This fund applies support mechanisms for research projects on basis of international standards where the key attentions are based on research output quality (number of international published papers and research works) and transparency of examination and selection procedures for research tasks⁶. However, majority of international published papers with Vietnam origine were joint research works with foreign co-authors, and the international citation index and the scientific impact factors remain lower than the world's middle level.

During the period from 2011 to 2015, *the number of protection granted inventions and utilities* has increased by 62% in comparison to the period from 2006 to 2010. Namely, the number of filed applications for protection of inventions and utilities from 2006 to 2015 is 22,674 (the one from 2006 to 2010 is 15,989). The numbers of protection granted certificates for inventions and utilities are 6,391 and 3,940 respectively. It is needed to note that the number of applications filed by Vietnamese individuals and

⁵ The total number of Vietnam's international publications for 2006-2010 period is 5,228 and the one of 2001-2005 period is 2,506. (Source: *Web of Science*).

⁶ The number of international publications (ISI magazines) of every NAFOSTED supported research items was 2.9 by 2014.

organizations remain limited making only about 20% of the total number of filed applications. In some fields, typically pharmaceutical-cosmetically one, the number of filed applications and the one of granted protections are absolutely dominated foreign owners which are mainly from industrial developed nations such as USA, Germany, Switzerland, France, Japan, Belgium and Great Britain. The number of Vietnam original applications filed for international protection is very low. The low figures of Vietnam original inventions and utilities reflect limited real application research and technological capabilities of local research institutes, universities and enterprises. However, it is needed also to note that the complex filing procedures and formalities and high costs for establishment of rights, uneasy feeling to disclose novelty of technical solutions and a lack of needs to commercialize inventions in international markets are additional reasons of the fact that numbers of filed applications and granted protections of Vietnamese individuals and organizations are not high.

Actually, *the total social investment rate for S&T activities* is 0.71% of GDP (figures of 2013) where the ones from State budgets make 67% and the remaining 33% are from local enterprises and FDI ones. The ratio (33/67) remains low in comparison to countries with high S&T development level which have the figure of more than 3% of GDP for investment rates and 70/30 for the ratio. In context of low economic scale and potentials (GDP and average income per capita of Vietnam locate in the group of low-middle income countries), we need to acknowledge that the investments made from State budgets during the last years remain big efforts of the Government. However, we need to have break-through solutions to increase S&T investment rates from non-budget resources, particularly from the sector of enterprises. We need also to note that, even the total social investment rates for S&T sectors are about 0.71% of GDP but the total expenditures for R&D activities make only about 0.2% of GDP which are much lower than the one of S&T developed nations. The main part of that is the payment of salaries and operational costs of public tertiary S&T organizations.

According to results of surveys conducted by 2014, there are 164,744 researchers participating in R&D activities (about 14 researchers per 10,000 habitants) where the number of researchers which hold college and higher education grades and up is 112,430 persons. Regarding Full Time Equivalent (FTE) indicator, the number of R&D researchers is only 7 researchers per 10,000 habitants. Though, the volume of R&D human resources of Vietnam increased during recent years but they remain very low in comparison to developed nations in both indicators of the absolute figures and the ratio of researchers to habitants. For reference purpose, the

total human resources of USA are more than 1.4 million researchers and 44 researchers per 10,000 habitants, the ones of China are 3.5 million researchers and 26 researchers per 10,000 habitants, the ones of Japan are 851,000 researchers and 67 researchers per 10,000 habitants, the ones of Russia are 828 researchers and 58 researchers per 10,000 habitants, the ones of Germany are 591,000 researchers and 73 researchers per 10,000 habitants, the ones of South Korea are 396,000 researchers and 79 researchers per 10,000 habitants, and the ones of Finland are 80,000 researchers and 145 researchers per 10,000 habitants⁷.

Actually Vietnam has built 9 *high tech incubators and high tech enterprise incubators* and all of them started operational activities. Though some of them were successful projects but certain of them are not the same which are operating like facility and equipment leasing organizations. Some of them cannot provide many other services such as training, consulting, linking investors and linking large scale enterprises. These factors limit the roles of high tech incubators and high tech enterprise incubators in offering supports for establishment and development of high techs and high tech based enterprises in Vietnam.

By November 2015, Vietnam has about 2,800 S&T enterprises⁸ including 204 enterprises already granted of S&T enterprise status, 23 enterprises granted of status of high tech based enterprises, 400 enterprises operating in high tech zones, 818 enterprises already qualified as S&T enterprises (which are mainly Hanoi and Ho Chi Minh City based) but waiting to get official status certificates, and 1,400 enterprises operating in IT sectors. Though we have a not-so-low number of enterprises practically qualifies for S&T enterprise status but the number of the ones which filed registration applications and were granted of certificates of S&T enterprises remains limited. A series of main reasons of that includes: (i) The lack of consensus still exists between State management agencies in implementation of incentive policies for S&T enterprises; (ii) Mechanisms just have been issued for acceptance of results of realization of non-State budget supported S&T tasks as backgrounds to file applications for S&T enterprise status; (iii) Many products by S&T enterprises are in fact innovative products, do not enter yet markets and then have no quality standards for benchmarking purpose. All of these factors make administration agencies embarrassed in examination for issuance of such certificates.

⁷ Source: OECD.

⁸ Source: National Agency for Technology Entrepreneurship and Commercialization Development, Ministry of S&T.

3.2. An SWOT analysis for actual S&T situation of Vietnam

Strengths

- Acknowledgement by international communities as dynamic and gaining strong economic growth rates, increased incomes and reduced poverty rate of population during the two recent decades.
- An exclusive geographic position and being in one the most dynamic regions of the world which offers certain advantages in distance and possibilities to access to large markets and favorable integration. Integration process would open larger its economy for international trades and investments as well as intensify flows of international knowledge.
- Considerable efforts implemented for education which are reflected through increasing enrollment rates in primary and secondary levels and in reading abilities of adults in comparison to similar low income countries.
- Certain attractions for investment by multi-national enterprises and, through that, transfer of more modern and advanced production processes and management methods, and open opportunities to new markets through innovation activities. Up to now, however, there is a limited number of FDI enterprises in Vietnam which base their business on intensive use of S&T knowledge and R&D activities.
- Successes to build up export advantages in some fields and global important integrated chains of values. Particularly, Vietnam exports big volumes of agricultural products (including coffee and rice) where S&T knowledge plays important roles.
- Developed reputations gained in some S&T fields such as mathematics and deep knowledge gained in agricultural and biological researches. Vietnam has positions higher than the middle level in some specific fields including Earth sciences, environment and bio-medical researches.
- Certain efforts made to create and to maintain a set of organizations and institutions to support innovative activities related to standards, quality, IP rights and information infrastructure.
- Provisions with important roles by local governments in tests for implementation and exploitation of innovations.

Weakness

- Low level in comparison to the world's standards of labor productivity and average income per capita, though gaining a fast economic growth.
- Lack of frame conditions and incentive encouragement for innovation where still needing further improvements in institutional aspects, business environment, competition rules and implementation of IP rights.
- Limited financial access for innovation, particularly in sector of domestic private enterprises which cause negative impacts to dynamic activities for restructuring economy.
- Shortages in infrastructure of communication, transport and energy distribution networks which restrict enterprises in activities for extension and integration into global chains of values as well as innovations.
- Lack of efficiency in sector of State owned enterprises which are partially burdens for economy and barriers for innovations.
- Low effective rates of education and training activities which are reflected through unequal qualities between regions and not-skill-oriented training contents which lead to limited innovative activities including business sectors.
- Low rate sophisticated knowledge and skills applied in production and business activities which lead to low positions in international trade activities and global chains of values. Vietnam's export remains based mainly in low technology and low added value sectors. Links between domestic and foreign enterprises are low effective.
- Low R&D and innovation capabilities of the sector of enterprises. Their competing capabilities are based more on cost indicators than on quality ones which lead to capabilities inferior to the ones of other countries in the region. Clearly, innovation capabilities will be a deciding factor of Vietnam's future positions in global chains of values.
- Low effective rates of research activities by public S&T organizations which are reflected through limited supports for research activities and low capabilities to meet standards. Then, S&T activities could not lead to excellent and suitable results and low rates of contributions to economic development, except some particular cases.
- Low organization and administration capabilities of public universities and research institutes. Here the sharing of scientific research labors and duties between universities and research institutes is not clearly defined

which leads to low efficiency of budget use and popular practice of budget allocation not based on research results.

- A low-developed S&T information system to serve the innovation policy making process. R&D and innovation statistics and related information sources lack systematic structures, conformity to international standards and upgrading practice. Strategic analysis for S&T and innovation policy making activities do not meet required standards.
- Lack of effective S&T and innovation management mechanisms. R&D and innovation activities get low attentions of supports from policy making organizations and public resources. Existing S&T management systems have trends to make competition strategies segmented, limited, overlapped and top-down focused. In S&T fields, the system of distribution of roles and labors between State management organizations and representative organizations does not cover necessary sectors.

Opportunities

- Development of human resources and skill backgrounds. Public universities and research institutes need to have large human resources and high skills to produce excellent and suitable researches. Production and business enterprises need a larger series of professional skills for enterprise driven strong development;
- Development of a dynamic and high innovative sector of enterprises with strong competitiveness in terms of capabilities for productivity, quality and adaptation to changes of demands;
- Diversification of economic activities, upgrading of production scale and enhancement of export added values through stimulation of learning and innovation which would lead to higher productivity, incomes and living standards;
- Opportunities to build up a more effective national innovation system which would put innovative enterprises to center positions. These efforts would make Vietnam get higher benefits from innovation investments;
- Intensification of global development. Innovation activities can provide new solutions and lower costs to meet challenges of economic development, to improve policy designing and implementing capabilities for settlement of challenges related to industrialization, urbanization and environment protection;
- Opportunities to build up a strong and sustainable political engagement to push up innovations. Practice shows that those nations which become

innovation based economies (the cases of South Korea and Finland) get strong and sustainable supports from highest Government levels.

Threats

- Unfavorable macroeconomic environment and slow-downing economic growth. External factors may cause difficulties for Vietnam to achieve its development objectives, even when East Asia remains a region more stable than other regions of the world.
- Failures in improvement of institutional structures and business environment.
- Failures in preparation for international competition. Vietnam gains very high benefits from integration into the world's economy and has chances to continue doing that in future. However, competitions would get more tough in next deep integration steps into regional economy.
- Higher crisis of brain drain. Vietnam may suffer high losses in global completions for talents.
- Stagnation risks from middle income traps. Incomplete upgrading of human resource capitals and economic activities may make Vietnam face more difficulties to avoid "the middle income traps".

4. Proposals of development directions

As measures to push up GDP growth to the level of 7-8% per year as recorded in Strategies for Socio-Economic Development, 2011-2020 period, Vietnam has to base more efforts on higher productivity level which requires a catching up of advanced technologies, first for the technologies coupled with import commodities and innovation of related organization and management procedures. However, this increase of productivity need to be realized through production processes and products made from innovative capabilities of domestic enterprises.

It is necessary, during 2016-2020 periods, to have solutions *to push up capabilities to manufacture products and to absorb technologies by domestic enterprises* to give considerable contributions to manufacturing and export of high tech products and high tech applied products. At the same time, it is necessary to develop high quality human resources and to improve business environment to stimulate FDI enterprises to make technology transfer and implementation of designing and manufacturing activities in Vietnam instead of promoting actual practice of intensive use of cheap labors for fabricating and assembling business. Namely, it is necessary to carry out programs to promote technology transfer from

technologically advanced nations to local enterprises, to build up and to implement policies to support technological innovation by domestic enterprises, particularly high technologies, through transferring and licensing IP rights. This direction of development is proposed in order to restrict existing weak points of S&T and innovation systems of Vietnam and, at the same time, to prepare to face risks during next future. It was also the way of success of advancing countries including South Korea during their S&T development stages corresponding to the actual one of Vietnam.

Vietnam needs to have long term and long vision strategies not only to gain economic benefits in immediate future but also to shortcut the way to economic development in close future. In addition, in R&D activities, ministries, economic sectors and S&T organizations need to set up concrete solutions to meet actual requirements of every development stage of the country. The thing Vietnam needs to do immediately now is to focus more resources for innovation activities and *to re-balance the innovation system by putting enterprises into center position*, to regulate S&T activities of State actors and, at the same time, to encourage enterprises themselves to build up capabilities and to commit to provide bigger resources for innovation activities. Namely, it is necessary to build up and to implement incentive mechanisms and policies for domestic enterprises to enhance research and innovation capabilities, to involve more actively into international cooperation and competition environment, to take initiatives to work with multi-national groups to get new technologies and to develop new solutions, procedures and products. This direction is proposed in order to restrict weak points of the existing S&T and innovation systems of Vietnam and to target future opportunities.

It is needed to remind the recent start of the Fourth Industrial Revolution when talking about directions of S&T development in the actual stage of Vietnam. The combination of technologies in physical, digital and biological technologies offer absolutely new opportunities which cause global and deep impacts to political, social and economic systems of the entire world and down to governments, enterprises, labor market and population. Therefore, in immediate future, it is necessary to prepare *policies to promote innovation and S&T application for Vietnam enterprises to exploit opportunities as well as to face challenges from the Fourth Industrial Revolution*. Namely, they are policies to encourage development, to support enterprises in technology transfer and certain new technologies, to apply administration and management systems in conformity to new trends of this Revolution. The key strategies and policies should be focused on development of sectors of automation and high techs, nano materials, energy, quantum computing and artificial intelligence./.

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