

STI SYSTEM IN UNIVERSITIES OF VIETNAM

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Abstract:

Science, Technology and Innovation (STI) has become an important means and goal of countries for national development and international integration. The STI system not only serves as a link of different stakeholders, i.e State - Enterprise - Research Institute - University not only to make achievements in socio-economic development, but also to enhance the internal capacity of each element.

In the STI system, universities and colleges play an important role because they are not just considered as a provider of high quality scientific and technological (S&T) manpower but also a nursery to incubate scientific ideas, research and development achievements before putting them into production. Through a case study of four universities: Vietnam National University, National University of Ho Chi Minh City, Hanoi University of S&T and University of Thai Nguyen, the author of this paper described and assessed the status of STI activities in those universities to understand the present capacity and the role of universities in aligning their research - training - production functions in the STI system.

Keywords: *Science, technology and innovation system; STI; Universities; Research; Training; Teaching.*

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1. Introduction

Today, many countries around the world have recognized the important role of innovation as a decisive factor to build up the competitive capacity of all sectors of the economy that are strongly influenced by S&T. Modern S&T revolution is making profound changes in the world economy, international relations and mankind society activities. Development strategy of all the countries is based on S&T, in which the core is to master the highest S&T achievements required for development.

Higher education establishment is one of the important components in the STI system with the functions described by OECD, which include: *“education, training, skills development, problem solving, creativity and dissemination of knowledge, developing new evaluation methods, storage*

*and transfer of knowledge”*¹. Universities and colleges can form clusters of innovative activities in S&T community, be a bridge between enterprises, research institutes and state or between nations. This component performs the function of development and training of young scientists, providing them with specific skills and knowledge to be able to contribute to the economy and create aspiration, interest in scientific research and technology innovation. Best of all, this is the cradle to train young workforce with skills and qualifications for enterprise with a view to enhancing the competitiveness and flexibility in the knowledge economy, globalization, international integration of S&T.

In Vietnam, especially during the reform period, many important documents on S&T development oriented policy have been promulgated, e.g the Resolution of Second Central Party Conference Session VIII (1996); The conclusion of the Sixth Central Party Conference, IXth Session (2002); Law on S&T 2000; Strategy of S&T Development in Vietnam up to 2010 (issued in 2003); S&T development strategy for period 2011 - 2020 (issued in 2012); Law on S&T 2013 and many other specific policies on S&T potential development and management mechanism reform. The Ninth Party Congress pointed out some basic limitations of current S&T development, including: *“Research institutes and enterprises have not had close linkage. The investment in building physical-technical infrastructure is still concentrated on clear-cutting completion of each goal. S&T personnel of high competence are still in shortage, and underutilized”*. Universities play an important role in the creation of intellectual property (IP) including patents/research results, through which it will contribute to promote innovation. IPP's view² was that the key to promote innovation is increasing the communication, link and coordination in innovation implementation between different actors in society, mainly through collaboration of universities/research institutes with enterprises and the State. The system of universities and colleges in Vietnam have made significant progress in the scientific research and technological development in the period 2011 - 2013, the ranking of Vietnam in respect of number of scientific publications on the database web of science has risen to position 60 (three grades higher compared to the position in the period 2006-2010). However, it was observed that there still were many drawbacks in STI works as well as in the association among research institutes, universities and businesses.

¹ OECD. (2010) *Workshop Proceedings: Funding for public research conducted at of higher education institutions*, page 9.

² IPP stands for Innovation Partnership Program, an Official Development Assistance (ODA) program co-funded by the Government of Vietnam and Finland in order to expand the scale of innovation training and improve innovative mechanisms in Vietnam to support for start-up innovative businesses towards international market. IPP had completed phase 1 (2009-2013) and now implementing phase 2 (2014-2018).

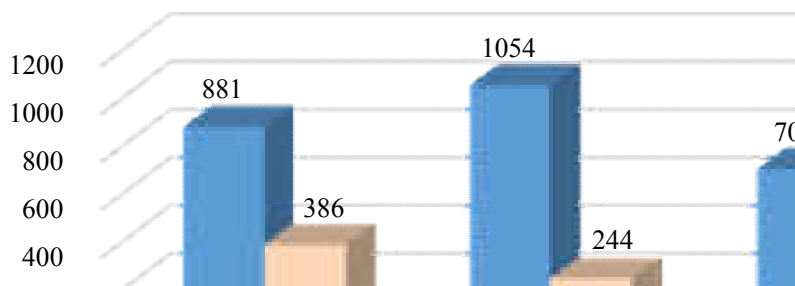
In terms of research in Vietnam, researchers, analysts and policy makers in S&T have many studies and papers on various aspects of such shortcomings in the operation of S&T as well as the achievements of universities... However, when considering the STI system in universities in Vietnam, there has not been a comprehensive analysis and overall assessment. Therefore, the author has studied the STI system in universities based the data obtained from Hanoi National University, National University of Ho Chi Minh City, Hanoi University of S&T, and Thai Nguyen University. These represent the regional higher education universities and are considered as units of promising scientific research and innovation.

2. Elements in the STI system of universities of Vietnam

2.1. S&T human resources

S&T human resources of Vietnam is concentrated mainly on universities with 62,095 persons accounting for 46.07% of the total R&D workforce (134.780 people)³.

Units: Person



Source: Data compiled from scientific reports of the 4 universities: Vietnam National University, National University of Ho Chi Minh City, Thai Nguyen University and Hanoi University of Technology

Chart 1: Number of scientific personnel with title of PhD/PhD of science and associate professor/ professor (in 2014)

A fairly common situation in universities was that there was no clear distinction between research and teaching personnel in the pool of S&T workforce. Teaching manpower participates as scientific researchers and vice versa. So, when conducting study on scientific human resources, it was hard to collect specific figures.

In Vietnam National University, in 2014, there were 881 PhDs and PhDs of science accounted for 47% of the total number of scientific personnel, for

³ According to Ministry of S&T's Statistics in 2011

natural, technology and economics sciences in particular, this rate was over 65%. The proportion of scientific personnel have doctoral degree under 45 years old was 25%. Team of scientists with title of professors and associate professors were 386 accounted for 20.5% of the total scientific workforce.

The National University of Ho Chi Minh City had a total staff of 5,662 people; out of which the number staff doing teaching and research was 2,773 persons, the number of professors/associate professors and PhD was 244 and 1,054 respectively and the number of researchers was 696 persons. The rate of scientific staff with PhD and higher title was 30.8% of the total research and teaching staff.

The Thai Nguyen University's staff was 2,895. Percentage of teachers on the payroll holding postgraduate degrees (PhD, M.Sc) of the university accounted for 87%, increased 5% compared to the same period in 2013. Out of which teaching and research staff was 2,100 persons, including 399 professors and associate professors, 703 PhD of science and Ph.D. Among 703 PhD of science there were 459 persons were leading staff in scientific research and technology transfer of the university.

Thus, in the universities surveyed, there were two National Universities having the highest number of teaching and research staff. In which, the National University of Ho Chi Minh City had largest number of teachers and researchers with PhD and PhD of science with high academic titles, i.e assistant professor and professor. This is entirely consistent with the objectives of the two universities to become the top national research universities nationwide. Most universities provided primarily teaching and engaged research for teaching or technology development associated with technical consulting activities. Hanoi University of Technology was one of the strongest universities in respect of teaching and science research and technology development. Regional universities like the University of Thai Nguyen had the scientific workforce relatively small compared with other three universities, but this picture is increasingly changed over time in quantity and quality.

2.2. Financial investments for S&T activities

Financial investments that universities in Vietnam have received so far came mostly from the State budget which accounted for 82.17%, funding from non-state sectors only accounted for 17.83%.

According to the statistics in 2014, the total spending for S&T at the National University of Ho Chi Minh was 362,798 million VND, out of which the funds allocated by the central budget was 149,902 million VND, accounted for 41%, funds mobilized from domestic and international

cooperation was 58,796 million VND accounted for 16%, funding from technology transfer was 154,100 million VND accounted for 43%.

Table 1. R&D Spending in 2011 by implementing institution and economic component (at current prices)

Unit: billion VND

Economic component	Implementing institution				
	Research Institutes and centers	Universities	Administrative agencies	Enterprises	Non-profit organizations
State	2,303.44	760.59	776.61	446.95	0
Non- State	7.58	165	0	614.68	68.55
Foreign investment	0	0	0	315.38	0

Source: Ministry of S&T: S&T of Vietnam in 2013

Table 2. Budget allocated for National University HCMC from different sources for scientific research and technological development in 2014

Funding sources	Funding provided in 2014 (million VND)
1. Central government	149,902
2. Cooperation with other partners	58,796
<i>Local Cooperation</i>	<i>44,071</i>
<i>International cooperation</i>	<i>14,725</i>
3. Technology transfer	154,100
Total (1+2+3)	362,798

Source: Report on scientific research and technological development activities of National University of HCMC in 2014.

In Hanoi National University, the total expenditure incurred in S&T cooperation projects in the country was more than 38 billion VND (accounted for about 25% of S&T operational expenditure). In addition, Hanoi National University had developed for approval of 20 S&T tasks at State level under the North West region development program in 2013 and 2014, in which, scientists of the University were successful bidder of 06 tasks with a total budget of 51.8 billion VND.

Funds allocated to S&T activities in Thai Nguyen University came from various sources: State budget, the university's tuition fees, funding from research collaboration agreement with local enterprises. Most sources were from the state budget, however in 2014 this funding was significantly reduced (only 1/3 compared to previous years).

As for Hanoi University of Technology, the funding for scientific research came mainly from the State budget (Table 4). Besides, the university also got funding from the co-production activities with enterprises (as of 2008, budget revenues from this collaboration was 2,904.45 million VND).

Table 3. Funding for the implementation of S&T activities in the period 2011 - 2015 of the Hanoi University of Technology

Unit: billion VND

Level of research themes	Total budget	Total funding from the state budget
State	311,980	311,980
Bilateral Protocol	4,032,316	26,316
Ministry	104,380	104,380

Source: Report on S&T of Hanoi Science and Technology University, period 2006 - 2015

In short, in most of the universities, the main source of expenditure for S&T activities came from the State budget. The allocation of this funding was not different between National and Regional Universities (such as Thai Nguyen University). It would say that, the funds spent on S&T in Universities was very low and not enough to encourage the implementation of S&T innovation. Activities just stopped at the implementation of research projects by management's order. Proactive research based on funding support/sponsorship was very limited. Thus, it inevitably leads to not high efficiency of scientific research is not high, efforts just tried to comply with the expectations of the task ordered, signed, scientific without high creative spirit. However, to overcome this difficulty, universities currently can have more autonomy to secure funding for their research from the collaboration with other partners and through transfer of technology to enterprises, investment from business network, local and international S&T organizations in order to diversify investment sources, increase funding level and improve the performance of S&T institution.

2.3. Organization of STI system in universities

In terms of overall structural model, the STI system in universities includes: university or its attached departments members; scientific research institute members; research, S&T services and training centers;

Specifically, the National University of Ho Chi Minh City includes 06 university members; 01 research institution; 01 affiliated faculty and various research and service centres, namely: English Testing Center, Quality Evaluation and Testing Center and Military Training and Education Center, the French Higher Education Centre, Circuit Design, Research and Training

Centre (ICDREC), etc. The Hanoi National University consists of 06 university members; 05 attached departments; 05 scientific research institute members; 04 training and research centers; 10 research and training services units. Hanoi University of S&T consists of 04 training and research centers; 21 research institute members; 08 subsidiaries; and one service unit for training and research activities. Thai Nguyen University includes: 03 research institutes; 01 hospital under the University; 8 scientific research and technology transfer centres, 01 limited liability company under a university member.

We can see, in the four research universities, two had affiliated companies i.e University of Hanoi and Thai Nguyen University, while Hanoi University of S&T was the first university in Vietnam having *business incubator* and the largest number of dependent enterprises out of the four above mentioned universities. It must say that the establishment of technology incubators in universities was a major step forward in aligning the research - training - production functions in the STI system. In the first step, this model was effective in terms of enhancing the capacity of inputs and improving the efficiency and quality of outputs in many S&T activities, in the future it would create spillover effect to the other universities.

2.4. Current situation of S&T

As reported by SCImago Institutions Rankings in September 2014, among 2,744 universities, institutes and research organizations around the world, Vietnam had 04 institutions listed in the line-up, including the Academy of S&T of Viet Nam, the National University in Ho Chi Minh city, the Hanoi National University and the Hanoi University of S&T.

Table 4. Ranking of Viet Nam's institutions under SCImago rating

Unit	Domestic Ranking	World Ranking
Academy of S&T Vietnam	1	1,710
National University in Ho Chi Minh city	2	2,239
Hanoi National University	3	2,327
Hanoi University of S&T	4	2,422

Source: S&T report of National University in Ho Chi Minh City 2014

SCImago analysis was based on the following criteria: (i) The output (number of scientific papers published in 2007 - 2011); (ii) International Cooperation (percentage of papers had cooperation with international colleagues); (iii) Specialization index (value rating from 0 (multidisciplinary) to

1 (specialized disciplinary); (iv) Scientific quality index (the proportion of scientific papers published in 25% of top journals of the world); (v) Excellence Index (papers which had been cited most); (vi) Impact index (reflecting the degree of influence of the research); (vii) Scientific Leadership index (percentage of papers where the author was the person of the institution, it could be considered as "internal strength" index); (viii) Excellence with Leadership index (number of papers had been assessed excellence where the staff of the institution were the key contributors).

Table 5. Statistics of comparative indicators on scientific capability among local institutions in 2008

No	Indicator	National University of Ho Chi Minh City	Hanoi National University	Hanoi University of S&T
1	Output index	900	731	610
2	International cooperation index	51.11	60.6	54.59
3	Specialization index	0.83	0.78	0.8
4	Scientific quality index	23.89	27.5	24.59
5	Excellence index	16.52	7.36	8.89
6	Impact index	1.15	0.82	0.68
7	Leadership index	60.89	48.84	53.11
8	Excellence with Leadership index	6.09	0.67	4.04

Source: *SCImago Institutions Rankings, University Research Rankings*
<http://www.scimagoir.com/research.php?rankingtype=research&indicator=Output§or=&country=VNM&page=2&year=2008>

In ranking of top 702 universities in Asia in 2010, Vietnam had five universities, namely Hanoi National University, National University of Ho Chi Minh City, Da Nang University, Hue University, and Can Tho University was ranked 201 among universities ranked from 351 to 400.

Rankings of Quacquarelli Symonds - QS-Asia⁴ based on the following criteria: (i) Academic and training reputation, accounting for 30%; (ii) Reputation of the recruited graduates 10%; (iii) Percentage of teachers/

⁴ Quacquarelli Symonds (QS) is a British company specialized in study of world education founded in 1990 by Nunzio Quacquarelli. From 2004 to 2009, QS collaborated with Times Higher Education (THE) to annually release the rankings of world universities, it also is the world supplier database for ranking.

students 20%; (iv) Citation coefficient of scientific papers 15%; (v) Number of scientific papers/faculty staff 15%; (vi) Proportion of international faculty 2.5%; (vii) Proportion of international students 2.5%; (viii) rate of domestic exchange student 2.5% and foreign students exchange 2.5%.

The position of Vietnam's university rankings Top 300 in Asia by QS-Asia over the years from 2013 to 2015 was as follows:

Table 6.

Year	Number of schools	Name	Ranking
2013	01	Hanoi National University	201-250
2014	03	Hanoi National University	161-170
		National University of Ho Chi Minh City	191-200
		Hanoi University of S&T	251-300
2015	02	Hanoi National University National	151-200
		University of Ho Chi Minh City	201-300

Source: (<http://www.topuniversities.com/university-rankings/asian-university-rankings/2013; 2014; 2015>)

2.5. Results of S&T activities of universities

Hanoi National University organized review of 34 research proposals at national level (5 independent tasks implemented through Hanoi National University; 2 tasks under bilateral protocol, 27 subprojects under various KC, KX, Tay Nguyen, New Rural Development Programs). In 2014, the topics under protocol, international cooperation projects reached a total budget of 50 billion. Also in 2014, Hanoi National University published 342 articles in international scientific prestigious journals on the list of ISI/Scopus, in which the number of articles published in international journals belonging to ISI system was 265, conducted 8 technology transfer transactions, 11 bio-products and 1 technical toolkit.

Located in a dynamic economic environment, the National University of Ho Chi Minh City had many cooperative efforts with world leading universities and research institutes in implementation of research programs and personnel training under areas of both modern science and highly capable applications in society. In this regard, typical were cooperation projects with INPG Minatec (France), University of California, Los Angeles... Along with that, this university also cooperated very closely with five local corporations and general companies to improve outputs and inputs in terms of quality of human resources as well as the S&T performance. In 2014, National University of Ho Chi Minh City had 3,038 articles/conference reports in all areas published. The number of articles published in journals at home and abroad was 1,147 of which 48.5% (equivalent to 566 items)

published in international journals and 30% (corresponding to 341 items) was published in journals of ISI list. Among them, there were 46% article with IF larger than 2 (i.e, 128 items); 82% (corresponding to 281 items) with the main author was from the National University of Ho Chi Minh City and 47% (i.e, 161 items) was totally owned by authors of this University. According to the S&T report of the university, in 2014, the total number of patent applications was 85. Out of which, the applications for patent protection was 78 with more than 100 S&T products.

As a regional university, the S&T performance of Thai Nguyen University (TNU) was very admirable. In 2014, TNU hosted and implemented 10 State-level S&T tasks (consisting of 02 independent theme of State level; 03 research projects under bilateral Protocol; 02 biotechnological applications and 05 basic research projects funded by NAFOSTED) and 51 S&T tasks at ministerial level with 47 research topics, one S&T task to support the management, 1 task of gene bank development, 3 pilot production projects and 1 project on research capacity building. Regarding research co-operation, TNU had implemented 02 research projects under bilateral Protocol, 01 application of bio-technology, especially some research projects in the service program of socio-economic and cultural development in Northern midland provinces with a total expenditure of nearly VND 71 billion. Based on the report of the university in 2014, TNU had published 904 articles in local scientific journals and 177 articles in international journals. In particular, the College of Science (under the TNU) is an institution with 43 articles published in international publications in the list 31/43 ISI.

Through study and practical operation, it was observed that Hanoi University of S&T was one of the pioneer institutions in the STI system. In the period 2011 - 2015, the University conducted 116 state-level research projects with 22 themes and cooperation with more than 10 companies and general corporations in the field of S&T.

Technology transfer at universities during the past had made remarkable results, boosting socio-economic development in the context of regional and global economic integration. Some universities have achieved high revenues from commercialized inventions. For example, Hanoi University of S&T has signed many technology transfer contracts with many corporations, large domestic and foreign companies such as SUN Microsystems Corporation, Rang Dong vacuum thermos and bulbs JSC. The university is the place focusing on research, technological development and training of human resources for scientific research. General speaking, in the university system there was only a small number of institutions had been successful in technology transfer and commercialization of research results and mostly concentrated in scientific and technical areas. When comparing with the

need, this achievement was not enough as expected by the demand of society, it remained as potential in both terms quality and quantity compared with other components in the value chain of S&T development. In the mean time, in developed countries, universities and research institutes play an important role as a bridge to provide inputs (S&T manpower and information) and the support in S&T incubation period. This is a very important step in a series of activities of STI. The close linkage with other components such as businesses or research institutions is not only help university improve their quality of training of human resources for S&T, but also to promote the application of the results of scientific research and technological development.

2.6. Status of linkage between universities and other components in STI system

Currently, universities conduct many S&T activities and the number of subjects and forms of activity as well as the number of articles published in international journals is on the rise, significantly. Benefits that STI brought about have created new face to universities, S&T potential capacity building for this education sector in particular and for the whole STI system in general. Above all, the links between research institutes in universities and business sector has provided the networking model which brings value to S&T in the trend of S&T international integration. However, in many universities, research activities are still not so many, not being of high practical value and mostly are still ordered from the State, very few from enterprises. In addition, the issue of intellectual property in universities has not been received adequate attention of management. This leads to a situation that technology transfer in many universities have less motivation to attract researchers to involve, no organization has sufficient professional management capacity and put the research results into production. Under the limited financial resources and difficult involvement of lecturers, scientists in scientific research, the collaboration of universities with businesses would be an important solution, not only for the supply of human resources, transfer of scientific research results into production, creation of an ideal practice environment after the students have "learned" theory from books, but also for obtaining increased competitiveness for businesses by applications of the results of scientific research and innovation in production. Although most universities so far have already a specialized unit to manage scientific research and technology transfer or a business incubator established, the university management functions are still general and not efficient, particular the issue of enhanced linkage of lecturers, scientists with of research activities for common goals and more efficient technology transfer, commercialization of scientific research results process.

2.7. Conclusions

From the former Soviet Union, Vietnam and other socialist countries experienced a similar situation, i.e, the universities merely performed training function, almost no scientific research function as there was a separate function under the responsibility of academy. Accordingly, universities only participated in research within the framework of a specific theme/program of the State at all levels and the people involved in research was only on part-time basis, rather than a professional researcher. This hindered the development and disconnected the functions of scientific research and training in universities.

Vietnam today is a country in transition. The nature of this change is the move from a state monopoly economy into a market oriented economy where exist many economic components. And in fact, public opinion in the research and education community is voicing the issue of building "research university". Thus, universities in particular and the society in general are forming the demand of connection between research and training functions to strengthen the linkage with other components such as research institutes and enterprises. The value chain in the STI system of Vietnam is being formed and requires that all components must make every effort develop internal capacity and external relationships to develop the system, adapt the trend of S&T international integration. However, for universities in the STI system there has not been any specific rules and regulations applied for research university, even for research institutes established within universities like Hanoi University of S&T, Hanoi National University,... This is an urgent issue that need to be studied and discussed in the upcoming time./.

REFERENCES

In Vietnamese:

1. Hanoi National University. (2014) *Report on S&T activities in 2014 and development goals for 2015*.
2. National University of Ho Chi Minh City. (2014) *Report on S&T activities in 2014*.
3. Thai Nguyen University. (2014) *Report on S&T activities in 2014*.
4. Hanoi University of S&T. (2015) *Report on scientific research in the period from 2006 to 2015*.
5. Dam Quang Minh, Pham Thi Ly, Pham Hiep. (2015) *The concept of universities is changing around the world*. Proceedings of the seminar: Global Education Dialogue held in Seoul, Korea, 26/02/2015.

In English:

6. UNESCO. (1984) *Manual for statistics on S&T activities*. ST.84/WS/12. Paris: UNESSCO.
7. OECD. (2002) *Proposed standard practice for survey of research and development - Frascati Manual*
8. OECD. (2010) *Ministerial report on the OECD Innovation Strategy, Innovation to strengthen growth and address global and social challenges: Key Findings*
9. OECD. (2010) *Performance-Based Funding for Public Research in Tertiary Education Institutions*
10. Carlsson, R. Stankiewicz. (1991) *On the Nature, Function, and Composition of Technological systems*. *Journal of Evolutionary Economics* 1, pp. 93-118.
<http://www.topuniversities.com/university-rankings/asian-university-rankings/2013;2014;2015>
11. *SCImago Institutions Rankings, University Research Rankings*
<http://www.scimagoir.com/research.php?rankingtype=research&indicator=Output§or=&country=VNM&page=2&year=2008>.