SCIENCE, TECHNOLOGY AND INNOVATION INDICATORS: WORLD AND VIETNAM DEVELOPMENT ACTUALITIES WITH IMPLICATIONS FOR VIETNAM

Dinh Tuan Minh[1]
National Institute of Science and Technology Policy and Strategy Studies

Le Thanh Ha
National Economics University

Nguyen Thi Nhat Anh
Research Center of Market Solutions for Socio-Economic Problems

Abstract:

Developing methods of measuring science, technology and innovation (STI) indicators is seen as the fundamental activity for the formulation of innovation strategies and policies of most countries. The absence of relevant indicators has created significant obstacles to the formulation and implementation of STI policies, especially in developing countries where Vietnam is. By reviewing the development of STI indicators at the global and domestic level, some suggestions for the improvement of the STI statistic indicator system in Vietnam towards including key innovation indicators.

Keywords: *Science and Technology; Innovation; STI indicators; Vietnam.*

Code: *20122101*

1. Introduction

Developing methods of measuring science, technology and innovation (STI) indicators is seen as the fundamental activity for the formulation of innovation strategies and policies of most countries. The absence of relevant indicators has created significant obstacles to the formulation and implementation of STI policies which would be bound to economic development objectives, especially in developing countries where Vietnam is.

Measurement indicators are the set of observations reflected in form of metric data for certain subject. Due to high costs of related works, only some observations get recorded and made public by statistic organizations. However, it is impossible to state that all the recorded data reflect necessarily relevant meanings or demonstrate usefulness. Then, it is necessary to bind a series of data to a theoretical framework to turn them meaningful and useful. For example, the data of the annual number of graduates would have the meaning

[1] Authors' contact email address: dinhtuanminh.maastricht@gmail.com

to reflect the rate of human resources when they get bound to a theoretical framework of human capital concepts. And, for being useful, they need to be bound to concrete targets of use. Subject to targets of use, defined strategies of implementation and operational capabilities, statistic organizations would base their orientations on different theories for works to collect data and build up various indicators of the same observation subject *(Hall and Faffe, 2018)*.

The history to build up STI statistic indicators in the world gets continuously developed since 1960s, particularly since appearance of the theory of national innovation systems (NIS). The standardization of concepts, data collection methods and computing methods was concretized in important manuals such as Frascati Manual, Oslo Manual and Canberra Manual. Following these guiding manuals, many countries and international organizations developed the sets of STI statistic indicators for their own use.

This paper provides an overall study of the development history of STI measurement activities and a review of world popular sets of STI indicators. The paper also provides a view of the status of statistic works and measurement of STI indicators actually used in Vietnam. On basis of the conducted overall studies, some suggestions are made for the set of STI indicators which are expected to fit well actual conditions of Vietnam.

2. Overview of the history of development of STI indicators

2.1. History of development

As shown by *Godin (2012)*, the history of development of STI statistic activities can be shared into three stages: starting stage, institutionalization stage (in some advancing countries) and internationalization stage (Table 1).

In starting stage, the statistic activities of some STI indicators were conducted by organizations and universities of some countries as assigned service in administrative framework. For example, the first statistic data of patents in the US were recorded since 1790 where the first patent law of the US was promulgated. The first statistic data on the number of scientists was available since mid XIX century. Some Governments with the leading position of the US, started statistic records of R&D budgets since 1930 *(Godin, 2012)*. Then, Canada and the UK followed the US in these activities.

STI statistic activities, however, start large scale steps since 1960s with the first surveys based on international standards. OECD has built up a series of manuals and guides for collection works of various STI information and indicators (Table 2). On basis of these documents, OECD has implemented periodic statistic activities for collection of basic data of S&T and R&D activities (OECD Science, Technology and R&D Statistics). In addition, since 1992, European countries also implement periodic statistic works for innovation activities in enterprise sector (Community Innovation Survey).

Table 1. Important stages in development of STI statistic activities in the world

Stages	Data colleting organization	Main statistic indicators
Starting stage (1869 - about 1930)	Data collection conducted by scientists *(Galton, de Candolle, Cattell)*	Number of scientists
Institutionalization stage (1920 - about 1970)	Data collection conducted by Government Statistic Service (leading position of the US)	Budget expenditures (and interest rate)
Internationalization stage (after 1960)	Data collection conducted by international statistic organizations (UNESCO, OECD, EU)	Technological innovation activities (international indicators and comparisons)

Source: Godin (2012)

Table 2. Important documents on practice of measurement and collection of STI indicators by OECD

Types	Names	Years
Manuals	The measurement of scientific and technical activities: proposed standard practice for surveys of research and development. (Frascati Manual)	1962
	Proposed standard practice for the collection and interpretation of data on the technological balance of payments.	1990
	Proposed guidelines for collecting and interpreting technological innovation data. (Oslo Manual)	1992
	Data on patents and their utilization as science and technology indicators.	1994
	Manual on the measurement of human resources in science and technology. (Canberra Manual)	1995
	Measuring productivity.	2001
Handbook	OECD Handbook on economic globalisation indicators.	2005
Guide	Guide to measuring the information society.	2005
Framework	A framework for biotechnology statistics.	2005
	Framework for nanotechnology indicators and statistics.	2008
	A conceptual and methodological framework for emerging technologies indicators.	(to be made public)
Others	Bibliometric indicators and analysis of research systems: methods and examples.	1997

Source: Godin (2012)

In context of gradual shifting of STI policies in many countries from scientific sector to technological and innovation ones, the need to build up a STI indicator system to reflect national innovation systems (NIS) has become the focal works of OECD countries. From theoretical point of view, components of NIS get inter-linked by flows of knowledge and resources circulating between them with purposes to produce more S&T knowledge, and by the ways to use them for creation of novel products/procedures of commercial nature or considerable improvement of these products/procedures *(Hall and Jaffe, 2018)*.

In statistic optics, the tasks turn to build up systems of indicators to reflect components as well as interaction between them so that scientists and policy making organizations can evaluate the relations between them and the relation between STI indicator systems and socio-economic development. One of the main challenges is to link rich information sources to integrated systems of indicators bound with a clear economic interpretation.

During recent years, with various approaches, many organizations in the world have started to build up integrated innovation indicators in theoretical framework of NIS. Table 3 shows a list of typical integrated indicators under development, test and use in many countries and regions of the world.

Table 3. Some typical integrated innovation indicators

Integrated indicators	Description	Organization
Bloomberg Innovation Indicators	Bloomberg classify countries on basis of global innovation oriented capacities and identify the group of top innovation 50 countries.	Bloomberg
Global Innovation Index by EIU	Global Innovation Index by EIU had been completed by 2009. For ranking countries, EIU distinguishes innovation inputs and outputs.	EIU
Global Innovation Index (WIPO GII)	GII was first made public by 2007. It is a set of indicators reflecting numerous aspects of factors to push up innovation of countries in the world. The set includes 80 indicators in 7 groups of main component indicators for measurement of 129 countries, in the 2019 Report.	WIPO
Dubai Innovation Index	This Index had been built up by 2015. It was the result of efforts by Dubai City for identification of position of Dubai among the world leading innovation cities. This includes indicators to help Dubai in measurement of changes of innovation indicators in vocational sectors for purpose to get stable growth and to identify sectors to be improved.	Dubai City
Massachusetts Innovation Index	Massachusetts Innovation Index was made public by Innovation Institute, MassTech and the reports are made annually since 1997. The measurement includes 22 indicators to cover various areas, namely: economic impacts, research, technology, business growth, capitals and talents.	Innovation Institute, Massachusetts Technology Collaborative (USA)
European Innovation Scoreboard (EIS)	EIS is the set of indicators allowing to evaluate relative innovation rates of EU countries. It allows to evaluate strong and weak points of member-states. This set of indicators was tested by 2007 and 2016. At present time this set of indicators contains 29 indicators divided in 7 groups of components in 3 blocks: support potentials, activities by enterprises and outcomes.	EU Statistic Service (Eurostat)
Portfolio	This is the set of indicators used in the US to	Project developed by

Innovation Index	measure innovation activities at state and county levels, similarly to EIS of EU. However, this set has only 4 groups of component indicators (human capital, economic dynamics, productivity and employment, and economic well-being). This set is completed at test stages and were applied twice: 2007 and 2009.	Economic Development Service with financial support by US Department of Trade.
British Innovation Indicators	This is the only set of indicators using growth accounting method for measurement of contributions from innovation activities in economic growth. Innovation indicators are reflected through investments for non-material assets which are seen as investments for innovation. GDP contributions from these investments are seen as main contributions from innovation activities (in addition to TFP). This set of indicators was first made public by 2009 and repeated twice by 2012 and 1014.	NESTA - National Endowment for Science, Technology and the Arts, UK.

Source: Summarized by authors

2.2. History of development of STI indicators in Vietnam

Before 2016, Vietnam has no actual legal documents for the systems of national statistic indicators in general and for STI activities in particular. S&T related indicators were collected separately and sporadically by various organizations without any systematic concepts. Innovation indicators were also collected non-officially by some international organizations. Since 2016, Law on Statistics (Law No. 89/2015/QH13) promulgated by the National Congress by 23rd November 2015 entered to force when the list of national statistic indicators gets clear regulations and includes 7 indicators for S&T sector. Then, the system of statistic indicators for S&T sector gets extended by Circular No. 03/2018/TT-BKHCN on 15th May 2018 by Ministry of Science and Technology (MOST). In the following part, the study is focused for analysis of the history of statistic works and measurement of STI indicators of Vietnam which is divided into two periods: Before 2016 and After 2016.

Period before 2106

In this period, S&T related statistic indicators of Vietnam were reported sporadically, without systematic approach concepts, by various organizations and agencies of MOST including: National Agency for Science and Technology Information, National Office of Intellectual Property of Vietnam and Directorate of Standards, Metrology and Quality.

National Agency for Science and Technology Information collects data for two indicators: R&D human resources and R&D expenditures. These indicators were made public in Reports of Scientific Research and Technological Development for two years 2012 and 2014. Even with high evaluations of quality of these two indicators (actually public made data divided into groups

for analysis purpose), the official data are available only for two years of 2011 and 2013[2].

In addition, since 2015, MOST had made public the book "Vietnam Science and Technology" for completion of the global picture of Vietnam S&T. This book provides additional information for other S&T related indicators such as the number of S&T organizations, S&T publications and etc.

National Office of Intellectual Property is in charge of collection of some other indicators such as the number of submitted patent applications, IP right protection titles, applications for industrial designs and etc. Data are made public in full by National Office of Intellectual Property for years and in time.

Directorate of Standards, Metrology and Quality is in charge to make public the indicators related to the number of approved measuring equipment, the number of organizations assigned for works of control, calibration, test of measuring equipment, metrological standards and etc. However, data are made public sporadically and without periodical indication, this leading to monitoring difficulties[3].

So, S&T related indicators in the period before 2016 were collected without systematic approach concepts. This situation leads researchers and policy managers to shortage of statistic data to see a global picture of Vietnam STI status as well as the impacts to economic growth. In the period after 2016 the S&T indicator system of Vietnam gets officially governed by clear legal documents.

Period after 2016

Law on Statistics (Law No. 89/2015/QH13) is applied for organizations and individuals conducting statistic activities and using statistic information for supply of statistic data to different users. The list of national statistic indicators is governed by this law in a special section (including 7 indicators) as presented in Table 4.

Table 4. List of S&T statistic indicators of Vietnam

Indicators	Actual status	Announcement period
Number of S&T organizations.	Not fully. Actually, the public made data are available only in 2014 Report of S&T Potentials.	Annual
Staff number in S&T organizations.	No data available.	Annual

[2] As shown by MOST website (www.most.gov.vn), the section of statistic data provides only 2012 Report of Scientific Research and Technological Development with the earliest report of this category.

[3] Some statistic data for management in sector of standards and metrology are made public sporadically in <https://tcvn.gov.vn/category/thong-ke-quan-ly-do-luong>

Indicators	Actual status	Announcement period
Number of individuals conducting activities of scientific research and technological development	Fully available since 2011 to nowadays by publishing period terms.	Every two years
Number of IP right protection titles granted for inventions.	Fully available since 1990 to nowadays by publishing period terms.	Annual
Indicators for renovation of technologies and equipment.	Data not found.	Annual
Ratio of the indicator for renovation of technologies to the total fixed capitals of enterprises.	Data not found.	Annual
Expenditures for scientific research and technological development.	Fully available since 2011 to nowadays by publishing period terms.	Every two years

Source: List of S&T statistic indicators in the National Statistic Indicator System promulgated together with Law on Statistics (Law No. 89/2015/QH13).

Following Law on Statistics 2015, Circular No. 03/2018/TT-BKHCN on 15th May 2018 by MOST *Issuance of the S&T Statistic Indicator System and assignment of collecting and summarizing works of national S&T statistic indicators* has purpose to provide more details on the system of statistic indicators in science-technology sector. By this Circular, National Agency of S&T Information is assigned to host and coordinate with MOST units and related organizations for collecting and summarizing statistic indicators, namely 53 indicators in 10 groups, which target to reflect fully the situation and results of S&T activities.

By statistic practice of these indicators during recent years, however, we note only 8/53 indicators are defined to collect data fully, timely and clearly, 22/53 indicators are defined to have certain data but some shortages still remain such as: data are not collected fully by defined terms of periodical reports and are not clearly announced, and the remaining 23/53 indicators are defined as having no data (See Table A.1. in Appendix for more details).

For evaluating the covering rate of the S&T statistic indicator system in Vietnam, we need to compare it to international statistic indicators. Due to lacking resources and time, the authors present here only the comparison of the two sets: the one of Vietnam and GII by 2019. By checking every component indicator for identification of discrepancies and similarities we remark that majority of indicators noted in GII are not found in the System of Vietnam. Namely, only 4/81 GII indicators are present in the System of Vietnam. If taking apart 8 indicators which Vietnam does not have data up to nowadays we

can see that data of 69 indicators are collected by various organizations and are not monitored as STI indicators.

2.3. STI statistic practice at enterprise level

During recent years many domestic agencies and international organizations have conducted periodical surveys on STI activities by enterprises in Vietnam. We can provide certain information on these surveys.

First, MOST conducted evaluation of level and capacity of producing technologies of enterprises.

MOST had issued Circular No. 04/2014/TT-BKHCN *Guidelines for evaluation of level of producing technologies* which was substituted afterwards by Circular No. 17/2019/TT-BKHCN on 10th December 2019 *Guidelines for evaluation of level and capacity of producing technologies* which determines the rules of evaluation of level and capacity of producing technologies by enterprises. Particularly, the Questionnaire of 2019 adds a new content for innovation capacity of enterprises.

As indicated in Article 13, Circular No. 17/2019/TT-BKHCN: "Subject to needs of socio-economic development and international integration of every period, ministries and People's Committees of provinces and center-controlled cities are assigned to guide the evaluation works as instructed by the Circular and then to send the evaluation outcomes to MOST for building up the national database", and "State Agency for Technology Innovation and Department of Technology Appraisal, Examination and Assessment of MOST are assigned to guide, support and monitor units of ministries for implementation of evaluation works, coordinate works with related units for building up data collecting softwares (on-site collection and on-line collection), data processing and updating softwares for following implementation activities by ministerial and provincial units". However, the study team did not find out any information on evaluation works implemented by ministerial and provincial units under their duties on website addresses of State Agency for Technology Innovation and MOST.

Second, Annual Nationwide Survey of Enterprises by General Statistics Office of Vietnam.

It is one of the surveys to be conducted according to Decision No. 43/2016/QD-TTg on 17th October 2016 by the Prime Minister issuing the national survey program. The last survey by 2020 gives rules of the survey methodology applied for enterprises in Vietnam which combines two approaches of overall surveys and sample selections. One of the most basic new practices of 2020 Survey of Enterprises is the use of on-line questionnaires for data collection. Outcomes of the surveys, in addition to service for works of management, evaluation, policy making and edition of

indicators for the System of Vietnam, are also background for edition of the periodical publication *White Pages of Enterprises*.

In the questionnaires of the annual survey of enterprises, some indicators, even collected for activities of enterprises, can reflect S&T activities such as technology transfer from overseas suppliers, purchase of technologies, values of purchase of domestic/external technologies, R&D activities by enterprises, number of invention titles of national level and etc.

Third, Innovation Pilot Survey of 2017 by National Agency of Science and Technology Information.

The survey was conducted by pilot scheme for 8,000 enterprises in manufacturing-processing sector in Vietnam for 2014-2016 period. This innovation survey gives contributions to build up the global picture of innovation in sector of enterprises. By this survey, MOST considers and adds innovation statistic indicators to the list of indicators issued together with Circular No. 03/2018/TT-BKHCN as it was noted above in Section 2.2.

This is also background for MOST to carry on periodical surveys (every 3 ways) on innovation activities by enterprises in Vietnam. Accordingly, Circular No. 04/2018/TT-BKHCN on 15th May 2018 by MOST on rules of conducting S&T statistic surveys, out of national programs of statistic surveys. According to that, the innovation survey of enterprises is to be conducted every 3 years (of the years ended with 3, 6 and 9). The objectives of surveys are to collect information on innovation activities by enterprises for service of State administration in S&T sector. The surveys are oriented to innovation activities by corporations, large companies and enterprises which are set up according to Law on Enterprises.

The survey would provide information on innovation conducting enterprises (renovation of products, procedure, technology; renovation of marketing practice; renovation of organization structure and management) and innovation non-conducting enterprises. Also it provides information on content, rate and ways of innovation realization as well as information on various indicators such as: rate of innovation conducting enterprises, expenditures by enterprises for innovation activities. So, as ruled by this Circular, the most recent innovation survey of enterprises had been conducted by 2019.

Fourth, World Bank surveyed of enterprises.

In addition to data from the surveys realized by MOST and General Statistics Office, some information on innovation activities by enterprises can be found from data of the survey by World Bank. This survey collects data of enterprise level (125,000 enterprises) from 139 countries. The collected data are used for building up 100 indicators to reflect the business environment quality over the world.

Some indicators from the set reflect STI activities such as the rate of enterprises using licensed technologies from foreign companies, the number of enterprises conducting innovations for logistics activities, transport, inputs, products or services, the number of enterprises making expenditures for R&D activities and etc.

Fifth, Project "Study of the sector of enterprises" by Danish International Development Agency (DANIDA)

The survey "Study of the sector of enterprises" on enterprises in Vietnam was supported jointly by DANIDA (Denmark), Central Institute of Economic Management and Ministry of Planning and Investment (Vietnam) and was realized from 2005 to 2014. This survey provides the full nation-level data on competitiveness and technology transfer as well as realization of social duties by enterprises in Vietnam.

So, at the present time, Vietnam conducted at least 4 nation-level periodical surveys on STI activities by enterprises in Vietnam. Only the World Bank led survey had made public the collected data while the other remaining surveys did not do. Due to high costs of realizing enterprise-level surveys, the organizations in charge to conduct them should make public the produced outcomes which would lead to an unified system of indicators for right use as practical background by STI policy making organizations.

3. Implications for building up the STI statistic indicator system of Vietnam

Driven by the global trends, STI policies of Vietnam actually are shifting from science focused policies to technology-innovation focused policies. For this purpose, the STI statistic indicator system of Vietnam should also cover innovation activities. More than that, the STI indicators of Vietnam should be compatible with the international ones which would lead to possible comparisons of STI activities of Vietnam and the ones of the world.

For that, the STI statistic indicator system of Vietnam should be bound to NIS components which play the role of theoretical framework/background. Similarly to the GII, the STI statistic indicator system of Vietnam should include indicators of the following components.

- Input innovation indicators: institutional framework, human resource and research, infrastructure, market development level, business development level.
- Output innovation indicators: knowledge and technology products, creative products.

Based on the list of indicators from the set of integrated innovation indicators as presented in Table 3 and the list of STI statistic indicators of Vietnam, we

provided a suggested list of innovation indicators from views of priority aspects, data availability and interference rate with the S&T Statistics System of Vietnam.

First, for priority aspects, we suggest to introduce 3 levels. Group of Level 1 Indicators includes the indicators regularly found in largely used sets of STI indicators and innovation studies. Next, Group of Level 2 Indicators includes the indicators appearing in some sets of STI indicators and some innovation studies. Group of Level 3 Indicators includes the remaining indicators of the above noted sets of indicators.

Second, for data availability, every indicator would be assessed as having or not having Vietnam related data. For interference rate, the indicators should be assessed as being compatible with the S&T Statistics System of Vietnam including the ones listed in 2015 Law on Statistics and Circular No. 03/2018/TT-BKHCN by MOST. The final suggested scheme in summarized in Table A.2, Appendix.

Some remarks are made as follows:

- 4 indicators in Group of Level 1 Indicators have data and are compatible with the S&T Statistics System of Vietnam, namely: "Researcher, FTE", "Total R&D expenditures", "Number of published scientific-technical papers" and "Export of High Techs".
- 5 indicators in Group of Level 1 Indicators have data but are not compatible with the S&T Statistics System of Vietnam, namely: "R&D expenditures realized by enterprises", "R&D expenditures paid by enterprises", "Number of invention applications by origins", "Number of utility applications by origins" and "R&D expenditures supported by foreign sources".
- 1 indicator in Group of Level 2 Indicators have data and is compatible with the S&T Statistics System of Vietnam, namely: "Product volume of high tech sector and upper-middle tech sector".
- 5 indicators in Group of Level 2 Indicators have data but are not compatible with the S&T Statistics System of Vietnam, namely: "Rate of higher education enrolment", "Number of enterprises conducting official training activities", "Number of trademark applications by origins" and "Number of PCT invention applications".

4. Conclusion

This paper provides a global study of the history of development of STI statistic indicator systems of the world and the one of Vietnam. With increasing trends of shifting from science focused policies to technology-innovation focused policies, the STI statistic indicator system has the similar move leading to development of integrated innovation indicators. From initial

studies of the status of the existing STI indicators of Vietnam we note that pillar-role indicators used largely in the world lack a high rate of data in Vietnam. As shown by international lessons and experience we suggest Vietnam should follow global trends of the world in building up a STI statistic indicator system to cover innovation indicators where important innovation indicators should be listed as national statistic indicators as governed by Statistics Law actually. It is background for related organizations to implement periodic surveys and make public the collected data. These indicators are also background for policy making organizations to monitor and evaluate the development level of the STI system as well as contributions of this system to global socio-economic development of the country./.

REFERENCES

1. Statistics Law No. 89/2015/QH13 on 23rd November 2015.
2. Circular No. 04/2014/TT-BKHCN on 08th April 2014 by Ministry of Science and Technology to guide evaluation works of the level of producing technologies.
3. Circular No. 03/2018/TT-BKHCN on 15th May 2018 by MOST Minister on the S&T statistic indicator System and assignment of collecting and summarizing works for national statistic indicators of S&T sector.
4. Ministry of Science and Technology (2012). Report of Scientific Research and Technological Development, 2012.
5. Ministry of Science and Technology (2014). Report of Scientific Research and Technological Development, 2014.
6. Ministry of Science and Technology (2014). Report of Science-Technology Potentials, 2014.
7. Ministry of Science and Technology (2015). *Vietnam Science and Technology, 2015*. Hanoi, Science and Technics Publishing House.
8. Ministry of Science and Technology (2017). *Vietnam Science and Technology, 2017*. Hanoi, Science and Technics Publishing House.
9. Ministry of Science and Technology (2019). *Vietnam Science, Technology and Innovation, 2019*. Hanoi, Science and Technics Publishing House.
10. Godin, B. (2012). *Measurement and Statistics in Science and Technology: 1920 to the present*. Routledge
11. Hall, B. H. and A.B. Jeffe (2018). "Measuring Science, Technology and Innovation: A Review". *Annals of Science and Technology Policy*, 2 (1), pp. 1-74.

Appendix

Table A.1. List of S&T statistic indicators of Vietnam as by Circular No. 03/2018/TT-BKHCN

No.	Indicators	Evaluation	Time terms	Sources of information
1	Values of fixed assets of S&T organizations	No data available	Annual	
2	Land and working office superficies of S&T organizations	No data available	Annual	
3	Number of High Tech Zones, Information Technology Zones, High Tech Applied Agriculture Zones	Data available on the number of High Tech Zones but not known by years	Annual	Book Vietnam S&T, 2015, 2017; Book Vietnam STI, 2019
4	Number of staffs working in S&T sector	This indicator substitutes "Number of staffs in S&T organizations" No data available	Annual	
5	Number of researching staffs	Provided fully, timely and clearly	Every 2 years Data available: 2011, 2013, 2015 and 2017	Book Vietnam STI, 2019
6	Total annual S&T expenditures	Data available but not full by announced periodic terms	Annual Data available: 2011, 2013, 2015 and 2017	Book Vietnam STI, 2019
7	Expenditure for S&T activities	Provided fully, timely and clearly	Every 2 years (*) Data available: 2015, 2017	Report of Scientific Research and Technological Development by MOST
8	Number of S&T tasks newly approved	Data available but not fully provided by announced periodic terms	Annual Data available: 2015, 2017, 2019	Book Vietnam S&T, 2015, 2017; Book Vietnam STI, 2019
9	Number of accepted S&T tasks	No data available	Annual	
10	Number of S&T tasks introduced to application	No data available	Annual	
11	Number of S&T tasks with registered implementation results	No data available	Annual	

No.	Indicators	Evaluation	Time terms	Sources of information
12	Number of staffs trained through scientific research and technological development	Data available. Data from year to year are not full and clear	Annual	Book Vietnam S&T, 2015, 2017; Book Vietnam STI, 2019
13	Number of S&T international cooperation activities	No data available	Annual	
14	Number of signed S&T agreements	No data available	Annual	
15	Number of outbound S&T delegations	No data available	Annual	
16	Number of S&T inbound delegations	No data available	Annual	
17	Number of overseas Vietnamese and foreign experts doing scientific research and technological development in Vietnam	No data available	Annual	
18	Rate of enterprises conducting innovations	Data available	Every 2 years Data available: 2014-2016 period and 2018	Book Vietnam S&T, 2017; Book Vietnam STI, 2019
19	Expenditures for innovation by enterprises	Data available	Every 3 years Data available: 2014-2016 period and 2018	
20	Number of S&T enterprises	Data available but not made public adequately	Annual Data available: 2010, 2019	Collected from multiple sources
21	Number of enterprises having S&T development funds	Data available	Every 3 years Data available: 2014-2016 period and 2018	Book Vietnam S&T, 2017; Book Vietnam STI, 2019
22	Number of enterprises having S&T units	Data available	Every 3 years Data available: 2014-2016 period and 2018	
23	Number of technology transfer contracts registered and licensed	No data available	Annual	
24	Number of realized	Data available	Annual	Book Vietnam

No.	Indicators	Evaluation	Time terms	Sources of information
	technology transfer contracts		Data available: 2015, 2017	S&T, 2015, 2017
25	Total values of technology transfer contracts	No data available	Annual	
26	Number of intermediate organizations in S&T market	No data available	Annual	
27	Rate of values of high tech products and high tech applications in the total values of industrial products	No data available	Annual	
28	Transacted values of S&T market	No data available	Annual	
29	Number of investment projects with appraised technologies	No data available	Annual	
30	Number of IP rights applications in Vietnam	Provided fully, timely and clearly	Annual Data available: 2005- to now	Annual Report of IP Activities by National Office of Intellectual Property
31	Number of IP right protection titles in Vietnam	Provided fully, timely and clearly	Annual Data available: 2007- to now	
32	Number of international IP right applications of domestic organizations and individuals	Provided fully, timely and clearly	Annual Data available: 2007- to now	
33	Number of domestic entities granted with IP right protection titles in Vietnam	Provided fully, timely and clearly	Annual Data available: 2007- to now	Annual Report of IP Activities by National Office of Intellectual Property
34	Number of transfers of registered IP rights	Provided fully, timely and clearly	Annual Data available: 2003- to now	
35	Number of Vietnam papers published in S&T magazines	Provided fully, timely and clearly	Annual Data available: 2012-2017	Book Vietnam S&T, 2017
36	Number of citations of S&T papers of Vietnam	No data available	Annual	
37	Number of announced national standards	Data available	Annual Data available: 2015, 2017 and 2019	Book Vietnam S&T, 2015, 2017; Book Vietnam STI, 2019

No.	Indicators	Evaluation	Time terms	Sources of information
38	Number of issued national technical norms	No data available	Annual	
39	Number of issued local technical norms	No data available	Annual	
40	Number of approved samples of measuring equipment	Data available	Annual Data available: 2006-2014	List of measuring equipment with approved samples by Directorate of Standards, Metrology, Quality
41	Number of organizations for examination, calibration and test of measuring equipment and norms of measurement	Data available but not fully provided from year to year	Annual Data available: 2015 and 2017	Directorate of Standards, Metrology, Quality
42	Number of examined, calibrated and tested measuring equipment	Data available but not statistically provided. The situation is marked clearly in the book Vietnam S&T	Annual Data available: 2015 and 2017	Directorate of Standards, Metrology, Quality
43	Number of management system certificates granted to organizations and enterprises	No data available	Annual	
44	Number of organizations and enterprises applying for use of barcodes	No data available	Annual	
45	Number of certified test and calibration organizations	Data available	Annual Data available: 2014-to now	List of organizations acknowledged as new from Bureau of Accreditation
46	Number of organizations and enterprises winning national quality awards	Data available	Annual Data available: 2016-to now	Bulletin National Quality Awards, MOST
47	Number of organizations conducting check of conformity of registration of activity	Data available but not collected adequately, being provided from numerous statistic sources	Annual Data available: unknown	

No.	Indicators	Evaluation	Time terms	Sources of information
	scope			
48	Number of staffs working in nuclear energy fielded	No data available	Annual	
49	Number of facilities and individuals conducting radiation works	Data available	Annual Data available: 2012- to now	Annual Report on state management of Radiation and Nuclear Safety by Vietnam Agency for Radiation and Nuclear Safety (VARANS)
50	Number of staffs conducting radiation works	Data available	Annual Data available: 2012 - to now	Annual Report on state management of Radiation and Nuclear Safety by VARANS
51	Number of radiation equipment	Data available (Not known)	Annual Data available: 2012-to now	Annual Report on state management of Radiation and Nuclear Safety by VARANS
52	Number of radiation sources	Data available	Annual Data available: 2012- to now	Annual Report on state management of Radiation and Nuclear Safety by VARANS
53	Number of granted licenses for conducting radiation works	Data available	Annual Data available: 2013- to now	Annual Report on state management of Radiation and Nuclear Safety by VARANS

Source: Circular No. 03/2018/TT-BKHCN on 15th May 2018 by MOST issuing the S&T statistic indicator System and assignment of works for collection and treatment of national statistic indicators in S&T sector, and assessment by the team of authors.

(*) Following the rules applied for List of S&T statistic indicators on basis of Statistics Law 2015, the indicator of Expenditures for scientific research and technological development is to be made public every 2 years while the Circular issued by 2018 indicates clearly the term of 1 year for making public this indicator.

Table A.2. Evaluation of the list of innovation indicators suggested for Vietnam

Innovation indicators		Priority level	Data availability	Equivalent indicators	
				2019 GII Report	Circular No. 03/2018/TT-BKHCN
INPUT INDICATORS					
Human resources					
01	Rate of higher education enrolment	2	Available	2.2.1	Nil
02	Number of graduates in science-technics fields	3	Not available	2.2.2	Nil
Research and Development					
03	Researchers, FTE	1	Available	2.3.1	202
04	Number of staffs working in S&T sectors	3	Not available	Nil	201
05	Number of overseas Vietnamese and foreign experts conducting activities of scientific research and technological development in Vietnam	3	Not available	Nil	505
06	Total R&D expenditures	1	Available	2.3.2	302
07	Total national expenditures for S&T activities	3	Available		301
08	Average R&D expenditures by 3 leading companies having foreign investments	3	Not available	2.3.3	Nil
Infrastructure					
09	ICT access	3	Not available	3.1.1	Nil
10	ICT use	3	Not available	3.1.2	Nil
11	On-line Government services	3	Not available	3.1.3	Nil
12	GDP/used energy unit	3	Not available	3.3.1	Nil
13	Number of ISO 14001 certificate/USD billion of PPP GDP	3	Not available	3.3.3	Nil
14	Values of fixed assets of S&T organizations	3	Not available	Nil	101
15	Number of organizations conducting check of conformity of registration of activity scope	3	Available	Nil	911
Market development level					
16	Number of transaction of venture investments	3	Not available	4.2.3	Nil
Business development level					
17	Number of jobs in service sectors with intensive use of knowledge	3	Not available	5.1.1	Nil
18	Number of enterprises conducting official training activities	2	Available	5.1.2	Nil
19	R&D expenditures realized by enterprises	1	Available	5.1.3	Nil

Innovation indicators		Priority level	Data availability	Equivalent indicators	
				2019 GII Report	Circular No. 03/2018/TT-BKHCN
20	R&D expenditures paid by enterprises	1	Available	5.1.4	Nil
21	University-Enterprise cooperation	3	Not available	5.2.1	Nil
22	Development scale of industrial clusters	3	Not available	5.2.2	Nil
23	R&D expenditure supported by foreign sources	1	Available	5.2.3	Nil
24	Payment for royalties	3	Not available	5.3.1	Nil
25	Import of high techs	3	Available	5.3.2	Nil
26	Import of ICT services	3	Available	5.3.3	Nil
27	Number of researching staffs by enterprises	3	Not available	5.3.5	Nil
Innovation and technology transfer (Vietnam)					
28	Rate of enterprises conducting innovations	3	Available	Nil	601
29	Expenditures for innovation within enterprises	3	Not available	Nil	602
30	Number of S&T enterprises	3	Available	Nil	603
31	Total values of technology transfer contracts	3	Not available	Nil	608
32	Number of intermediate organizations in S&T market	3	Not available	Nil	609
33	Rate of values of high tech products and high tech applied products in total values of industrial products	3	Not available	Nil	610
34	Transacted values of S&T market	3	Not available	Nil	611
OUTPUT INDICATORS					
Knowledge and technology manufactured products					
35	Number of invention applications by origins	1	Available	6.1.1	Group 7 of indicators (for the same subjects)
36	Number of PCT applications	2	Not available	6.1.2	Group 7 of indicators (for the same subjects)
37	Number of utility applications by origins	1	Available	6.1.3	Group 7 of indicators (for the same subjects)
38	Number of published science-technics papers	1	Available	6.1.4	801
39	H indicator of cited papers	3	Not available	6.1.5	802
40	Productivity growth speed	3	Not available	6.2.1	Nil
41	Density of new enterprises	3	Not available	6.2.2	Nil

Innovation indicators		Priority level	Data availability	Equivalent indicators	
				2019 GII Report	Circular No. 03/2018/TT-BKHCN
42	Total expenditures for computer software	3	Not available	6.2.3	Nil
43	Number of ISO 9001 certificates/USD billion PPP GDP	3	Not available	6.2.4	Nil
44	Total product values of high tech sector and upper-middle tech sector	2	Available	6.2.5	610 (for the same subjects)
45	Payment for IP royalties, fees and licenses	3	Not available	6.3.1	Nil
46	Export of high techs	1	Available	6.3.2	Nil
47	Export of ICT services	3	Available	6.3.3	Nil
Creative products					
48	Number of trademark applications by origins	2	Available	7.1.1	Group 7 of indicators (for the same subjects)
49	Number of industrial design applications by origins	2	Not available	7.1.2	Group 7 of indicators (for the same subjects)
50	Produced national feature movies	3	Not available	7.2.2	Nil
51	Printed and published products	3	Not available	7.2.4	Nil
52	Export of creative goods	3	Not available	7.2.5	Nil
53	gTLDs names	3	Not available	7.3.1	Nil
54	ccTLDs names	3	Not available	7.3.2	Nil