RESEARCH AND DEVELOPMENT ACTIVITY TO SERVE INNOVATIONS IN ENTERPRISES OF PROCESSING AND MANUFACTURING SECTORS IN VIETNAM

Ho Ngoc Luat[1]
Ministry of Science and Technology

Abstract:

Research and Development activities (R&D) in enterprises are novel for practice in Vietnam, particularly when they are viewed in the chain of innovative activities by enterprises. The notions on innovations and R&D activities in enterprises set the theoretical background for research of R&D activities to serve innovation in enterprises. From outcomes of statistical surveys of innovations in about 8,000 enterprises in processing and manufacturing sectors in 44 provinces and central controlled cities, the paper focuses on analysis and evaluation of R&D activities in those enterprises which undertake innovations in processing and manufacturing sectors in Vietnam during 2014-2016 period. Concrete works of analysis and evaluation of R&D activities for innovations in enterprises turn focused attentions to the status of R&D units of enterprises and the number of staffs directly involved into these activities as by 31st December 2016, total expenditures for technological innovation by 2016, implementation of S&T tasks (programs and projects), applications of technical advances and solutions.

Keywords: *Enterprise; Processing, manufacturing; Research-Development, Technological renovation, Innovation; Human resource; R&D investment.*

Code: *19030501*

1. Related notions

Innovation and innovative activities by enterprises

According to *Oslo Manual 2005*, innovation is the realization/completion of a product (good or service) or a new procedure or their considerable improvement, a new marketing method, a new method of organization and management in practical business activities, organization of production activities or external relations. The common essential feature of innovations is that the work must be completed and provides a ready-to-use result.

The implementation of a product (good or service) or a new procedure or their considerable improvement, a new marketing method, a new method of

[1] Author's contact email address: hnluatv@gmail.com

organizational and management in practical business activities, organization of production activities or external relations are called *innovative activities.* Therefore, innovative activities are all scientific, technological, organizational, financial and commercial steps which actually, or are intended to, lead to the realization/implementation of innovations *(OECD. 2005, p. 47).*

A firm (enterprise) considered as to have an innovative activity is the one who conducts innovative activities during certain period including also uncompleted or pending activities.

An innovative firm (enterprise) is one that implemented an innovation during the period under review.

Research-development (R&D) activities by enterprises

According to *Frascati Manual (OECD, 2015, p. 44),* research and experimental development (R&D) activities comprise "creative and systematic work undertaken in order to increase the stock of knowledge - including knowledge of humankind, culture and society - and to devise new applications of available knowledge". R&D activities include basic research, applied research and experimental development.

In an enterprise, R&D activities are oriented directly to a concrete target of objectives while experimental developments are oriented to create a new product or procedure or improvement of available product or procedure. Therefore, these activities, in practice, are oriented to innovations. By sides, in the period under review, even activities of basic research by enterprises target only to increase the stock of knowledge of enterprises and this knowledge is not oriented to produce any concrete innovation, this stock of knowledge, in practice, increases endogenic capacities of enterprises and it is also considered as innovative activities. According to *Frascati Manual*, all R&D activities realized or funded by enterprises (called as R&D activities by enterprises) are recognized and innovative activities of enterprises.

Therefore, in measurement of innovation by enterprises, innovative activities of enterprises are usually classified into two types: (i) R&D activities; and (ii) Other remaining innovative activities, namely:

- *R&D activities:*

According to *Oslo Manual 2005 (OECD, 2005, p. 35-36)*, R&D activities in enterprises include:

(i) Basic and applied researches undertaken by enterprises or with participation of enterprises to acquire new knowledge and direct research

towards specific inventions or modifications of existing techniques of enterprises.

(ii) Activities to develop new product or process concepts or other new methods to assess whether they are feasible and viable, a stage which may involve: (a) development and testing; and (b) further research to modify designs or technical functions, and

(iii) R&D activities directly serving innovation projects.

- *Other remaining innovative activities:*

Some other innovative activities, being themselves creative activities (such as R&D ones) even are not R&D activities[2] but are necessary for realization/completion of innovations. These activities can strengthen capabilities that enable the development of innovations or the ability to successfully adopt innovations developed by other enterprises or institutions, namely:

(i) Activities that can identify new concepts for products, processes, marketing methods or organizational changes: (a) via its marketing side and relations with users; (b) via the identification of opportunities for commercialization resulting from its own or others' basic or strategic research; (c) via its design and development capabilities of enterprises; (d) by monitoring competitors; and (e) by using consultants.

(ii) They can buy technical information, paying fees or royalties for patented inventions (which usually require research and development work to adapt and modify the invention to its own needs), or buy know-how and skills through engineering, design or other consultancy services.

(iii) Activities that can develop human skills through internal training activities inside enterprises or purchase (by hiring); tacit and informal learning - "learning by doing".

(iv) They can invest in equipment, software or intermediate inputs that embody the innovative work of others.

(v) They can reorganise management systems and its overall business activities.

(vi) They can develop new methods of marketing and selling its goods and services of enterprises.

---

[2] According to Frascati Manual 2015: R&D activities have to satisfy with 05 criteria: (i) novel, (ii) creative, (iii) uncertain, (iv) systematic, (v) transferable and/or reproducible.

2. Actual status of R&D activities to serve innovation inside enterprises in processing-manufacturing sectors in Vietnam

By 2017, for the first time, National Agency for Science and Technology Information, had conducted the pilot survey on innovation among Vietnam enterprises for 2014-2016 period *(Ho Ngoc Luat, 2018)*. The pilot survey was the content of Sub-Component 1(b): "Completion of the system of statistics, evaluation and measurement of Science-Technology-Innovation" of Component 1: "Basic supports for planning and testing S&T policies" which were undertaken within the project "Fostering Innovation through Research, Science and Technology" (FIRST) under MOST lead and with WB preferential loan supports.

The survey had been conducted among more than 8,000 enterprises in processing-manufacturing sectors and here, in total, 7,641 questionnaires were replied. Among them, there are 1,892 large sized enterprises[3] (making 67.84% of the total number of large sized enterprises of the country), 820 medium sized enterprises (making 90.01%) and 4,929 small sized enterprises (making 26.25%).

Among the 7,641 replied questionnaires, 4,709 enterprises announce to have created, produced or introduced into markets new or improved products, new or improved technological procedures, organizational and management innovations and marketing methods. According to definition of innovation, these enterprises are considered as innovative enterprises.

According to data from these 7,641 replied questionnaires, 98.6% of the total expenditures by 2016 for R&D and technological renovation by enterprises in processing-manufacturing sectors come from innovative enterprises; 95.5% of the total R&D human resources by 31st December 2016 are of innovative enterprises *(Ho Ngoc Luat, 2018)*. Therefore, the following analysis and evaluations are focused on the status of activities of R&D and technological renovation by innovative enterprises and they may be also extended for enterprises in processing-manufacturing sectors.

The following data are selected and synthesized from the survey results focused on information of R&D activities by innovative enterprises and other details on: units specifically in charge of R&D, number of staffs directly involved into R&D activities of enterprises as by 31st December 2016, total expenditures of investments for technological renovations and R&D by

[3] Enterprises classified into the labor size according to Circular No. 56/2009/ND-CP on 30th June 2009, according to which small enterprises have 11-200 labors, medium sized enterprises have 201-300 labors and large sized enterprises have more than 300 labors.

2016; realization of S&T tasks (programs, projects), application of technical modifications and advances, and etc.

2.1. Units specifically in charge of R&D activities in innovative enterprises

Units specifically in charge of R&D activities (called afterward R&D units) can be a service, department, center or simply a team which have functions specifically designated for research, experiment and development of new products, new technological procedures or research for technical modification and improvement of existing products, related procedures and technologies.

Among the 4,709 innovative enterprises, 728 replies confirm to have R&D units (making 15.5%).

The structure of enterprises having or not having R&D units is presented in Fig. 1, according to classification of their economic status categories and labor size. In these classifications, the category of State-owned enterprises (SOE) has the highest rate of the R&D unit having status. This rate is lower in the category of non-SOEs and is the lowest in the category of foreign direct investment (FDI) enterprises. Also the SOEs hold the highest rate of the R&D unit having status, in classification by labor size, namely: 22.6% in the group of small enterprises, 30.8% in the group of medium enterprises and 44% in the group of large enterprises. The second position is of non-SOEs with 12.1%, 17.3% and 27.1% respectively and the last position is of FDI enterprises with 10.1%, 10.6% and 22.7% respectively.

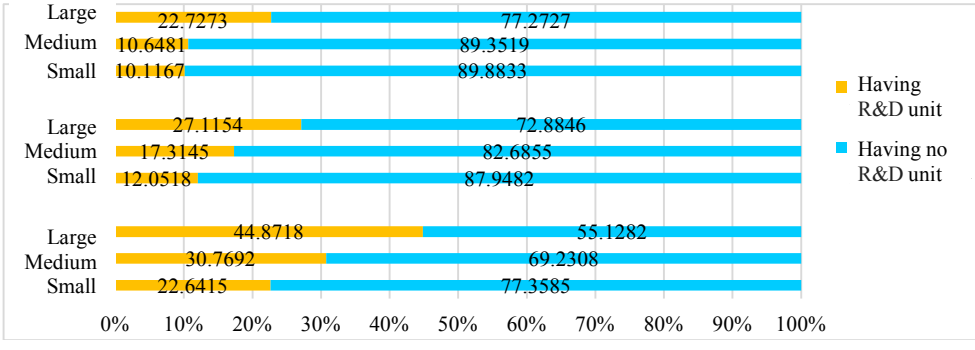


Figure 1. Rate of innovative enterprises with or without R&D units, being classified according to economic status category and labor size

So, in terms of presence of R&D units, the larger the enterprises are (in terms of labor size) the greater they pay attentions for R&D activities. And the order by economic status category is the SOEs, non-SOEs and FDI enterprises.

2.2. R&D human resources

The number of labors directly involved into R&D activities as by 31 December 2016 include the staffs with college level and up which are under administrative management of enterprises, in payroll by enterprises and specifically in charge of scientific research, applied research, technological development, S&T services, application of technical advances and other works for S&T development. They may be permanent staffs of R&D units (if any) or participants for implementation of innovation projects and S&T tasks of enterprises *(Ho Ngoc Luat, 2017)*.

In all the aspects, S&T human resources are the top important factor for innovative activities by enterprises. The great number of R&D staffs is the necessary condition for promotion of innovative activities.

In practice, the collected data show the surveyed innovative enterprises have 19,814 R&D staffs in total which makes 1% of the total number of labors. The greater the enterprises have the labor size, the lower they have the rate of R&D staffs to the total number of labors (the rates are 2,3%, 1,7% and 0,8% in the groups of small, medium and large enterprises respectively, as seen in Figure 2). So, this is the trend of proportionality of the total number of labors and the number of R&D staffs observed in practice.

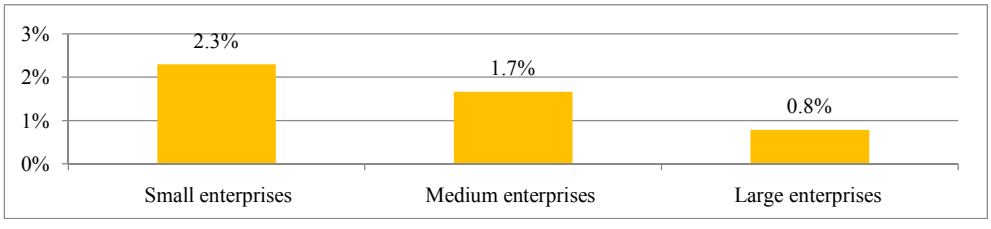


Figure 2. Average percentage rate of R&D staffs in the total number of labors in innovative enterprises

However, the average number of R&D staffs of every group of innovative enterprises is proportional to the size of the total labors. Fig. 3 shows that averagely every small innovative enterprise has 1.4 R&D staff, every medium innovative enterprise has 4.0 R&D staff and every large innovative enterprise has 10.5 R&D staffs. It means that averagely the number of R&D staffs in innovative enterprises is proportional to their labor size (small, medium and large).

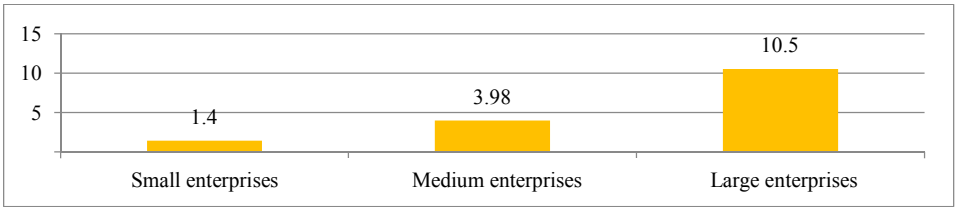


Figure 3. Average number of R&D staffs in an innovative enterprises

As seen in Fig. 2 and Fig. 3, enterprises do not assign their staffs for R&D activities proportionally to the total number of labors they have. But it is clear that averagely the large enterprises arrange their R&D staffs 7.5 times bigger (10.5 to 1.4) than the small enterprises do, and 2.6 times bigger (10.5 to 3.98) than the medium enterprises do. We also know that the importance of innovative activities of large enterprises is much greater than the one of small and medium enterprises *(Ho Ngoc Luat, 2018)*. So, it is possible to say that innovative enterprises assign their R&D staffs on basis of importance of innovative activities but not of the total number of labors. In practice, the survey data also show the difference in the rate of R&D staffs in innovative enterprises and non-innovative enterprises: in innovative enterprises the rate of R&D staffs to the total number of labors is 11 times higher than the one in non-innovative enterprises (0.97% to 0.088%). Therefore, it is possible to state that the presence of R&D staffs is nearly the necessary and sufficient condition for enterprises to undertake innovations.

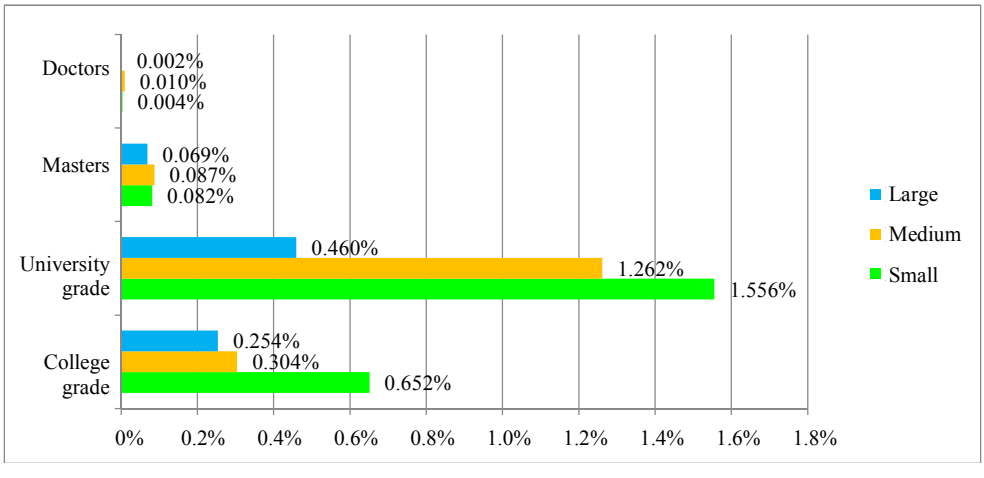


Figure 4. Rate of categories of R&D staffs in the total number of labors of innovative enterprises being classified by labor size

Fig. 4 describes the rate of R&D staffs in the total number of labors in innovative enterprises according to classification of qualification levels.

Accordingly, the rate of R&D staffs with doctor grade is highest in the group of medium enterprises (10/100,000 = 0.01%) and then the group of small enterprises (4/100,000 = 0.04%) and then the group of large enterprises (2/100,000 = 0.02%). The same picture is observed for the master grade: 0.087%, 0.082% and then 0.069% for the groups of medium, small and large enterprises respectively. The rate of R&D staffs with university and college grades reduces against the increase of labor size.

Globally, the rate of R&D staffs with qualification grades from college/university and up remains low in enterprises, particularly for post-graduate grades (Fig. 4). This low number of R&D staffs is difficult to meet requirements of enterprises for innovative activities. The matter gets more difficult when talking about "endogenic" and "internal" sources of staffs with high qualification and quality for promotion of development of innovative enterprises. The data from this survey and the S&T white page of Vietnam *(MOST, 2017)* show that in the total of 131,045 research staffs[4] of the country, only 15% of them are working in sector of enterprises (by 2015) *(MOST, 2016)* while the rate of South Korea is 70% in the total of 437,447 research staffs (by 2014 *(KISTEP, 2015)* (Fig. 5). Averagely, Vietnam has 2 research staffs/10,000 habitants to work in sector of enterprises while the rate of South Korea is 60/10,000 (30 times greater than Vietnam has).

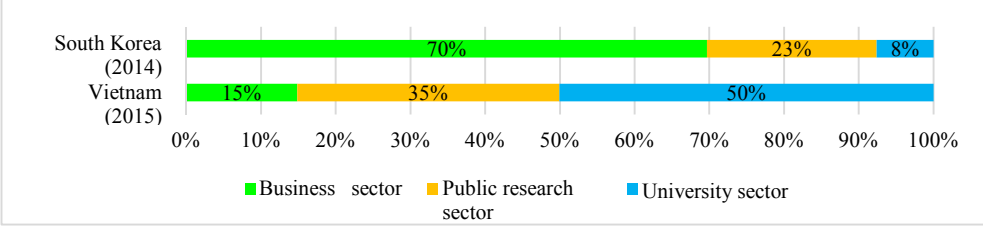


Figure 5. Structure of research staffs in activity sectors of Vietnam and South Korea

2.3. Expenditures for research-development and technological renovation

The total expenditures *(Ho Ngoc Luat, 2018)* for R&D and technological renovation during the year include the total expenditures for scientific research, applied research and technological development for higher quality of products, lower costs of production, substitution by new materials, new products and etc. (including costs for tests before introduction into application) and the total costs for renovation of outdated technologies

[4] Research staff are high qualified staffs that have college, university, master and doctor grades, take part in process to create knowledge, new products and procedures, new methods and systems and spare at least 10% of working time for R&D activities. This group includes also managers directly involved into R&D activities (data from 2016 R&D Survey, National Agency for Science and Technology Information, MOST).

including costs of equipment, costs of capital construction, costs for commissioning and etc. Here the breakdown includes:

(i) Expenditures for R&D (investments for R&D) including expenditures for activities of scientific research, applied research and technological development (undertaken within enterprises and purchased from other enterprises and organizations);

(ii) Expenditures for technological renovation (expenditures for purchase of machines, equipment and technologies; expenditures for purchase and exploitation of inventions and etc.), namely:

- Purchase of advanced technologies, machines, equipment, computer software and hardware (from investments for capital construction, including finance lease, investments for upgrading/adjusting of existing equipments and etc.) for production of new products and technological procedures or for improvement of old products and outdated technologies;
- Purchase of external knowledge: enterprises purchase rights to publication, copyrights, patents, trademarks, licenses, know-hows and other forms of information/knowledge for development of new products and technological procedures or improvement of old products and outdated technologies;
- Training for innovative activities: enterprises hold training activities inside or outside enterprises for their labors for enhancing skills and experiences of labors or additional recruitment of new labors with skills and experiences necessary for enterprises.

2.3.1. Expenditures for R&D by innovative enterprises

Survey data show that expenditures for R&D by innovative enterprises in processing-manufacturing sectors are VND3,382,732 million, mainly from large enterprises (82.8%); expenditures by small enterprises make 8.6% and the ones by medium enterprises make 8.6%. FDI enterprises make 70% of the total expenditures for R&D while the ones of non-SOEs make 26.7% and the SOEs make only 3.4% (Fig. 6 and Fig. 7).

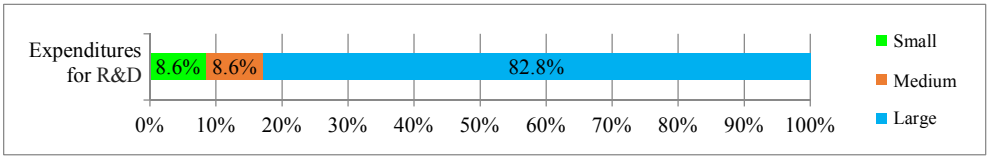


Figure 6. Structure of the total expenditures for R&D by 2016 by innovative enterprises being classified by labor size

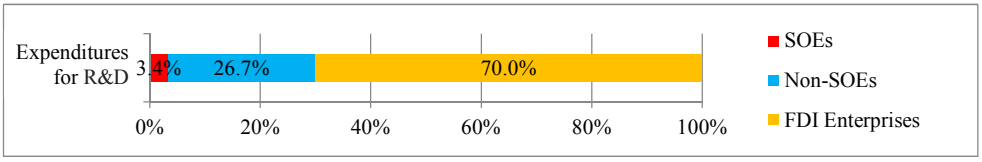


Figure 7. Structure of the total expenditures for R&D by 2016 by innovative enterprises being classified by economic status categories

So, as survey data show, the major part of the total investment for R&D by enterprises by 2016 comes from enterprises with FDI and once they do investments for R&D the latter would be always for large scale. Investments for R&D by large enterprises make only minor part. Averagely, every enterprise with FDI spends VND 1,651 million for R&D (the figure for SOEs is VND722 million and the one of non-SOEs is VND289 million). The total investment for R&D by 2016 is VND3,382,732 million making about 0.15% of the total turnover of enterprises in processing-manufacturing sectors. These figures are not big if compared to the national objectives of the budget of 2% of GDP for S&T by 2020. In addition to that, we need to take into account huge needs for R&D and technological renovation in processing-manufacturing sectors, almost the biggets one among industrial sectors. In this optics, the rate of 0.15% of the total turnover by 2016 for investment for R&D by enterprises is very small. This rate of enterprises in processing-manufacturing sectors of South Korea is 3.63% (2014).

Sources of capitals for R&D in categories of innovative enterprises

Sources of capitals for R&D by innovative enterprises are mainly the capitals of enterprises (84.6%), FDI capitals (10.6%) (mainly coming as supports from mother companies for R&D investment for their Vietnam branches through supply of equipment, machines, technological lines and etc. Supports from State budget for R&D activities by enterprises are very low making only 1.3%. The remaining 3.5% comes from other sources of capitals (Figure 8).

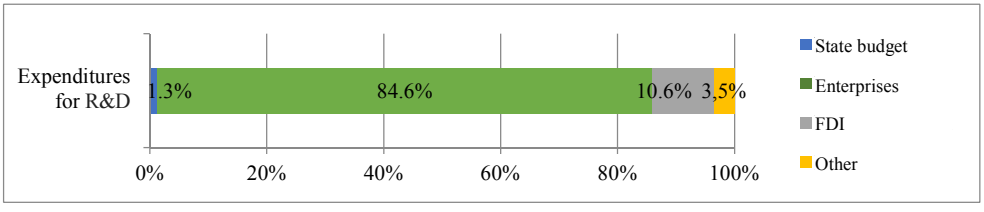


Figure 8. Structure of sources of capitals for R&D activities by innovative enterprises

A deeper insight of statistical data such as, for example, the review of investment structure of sources of capitals (State budget, capitals of enterprises and FDI capitals) for R&D activities in various categories of enterprises (labor size, economic status) can help us identify the categories of enterprises for which the policies for sources of capitals focused for priority supports for R&D are. In terms of the size of enterprises, Fig. 9 shows that the three sources of capitals (State budget, capitals of enterprises and FDI capitals) offer supports mainly for R&D by large enterprises (from 72.8% to 84.8%). R&D activities by small and medium enterprises receive only small part from the three sources of capitals, namely: 15.7% (= 13.4% + 2.3%) of capitals from State budget; 15.3% (= 8.9% + 6.4%) of capitals from enterprises and 27.1% (2% + 25.1%) from FDI sources of capitals.

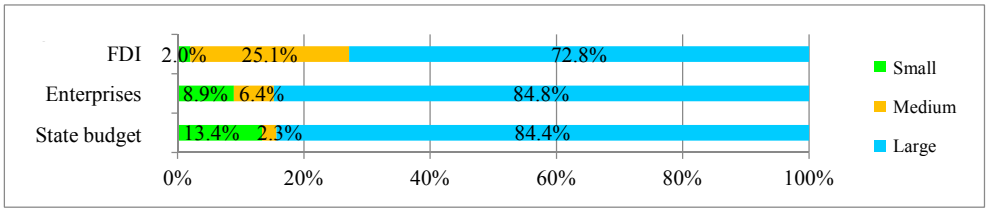
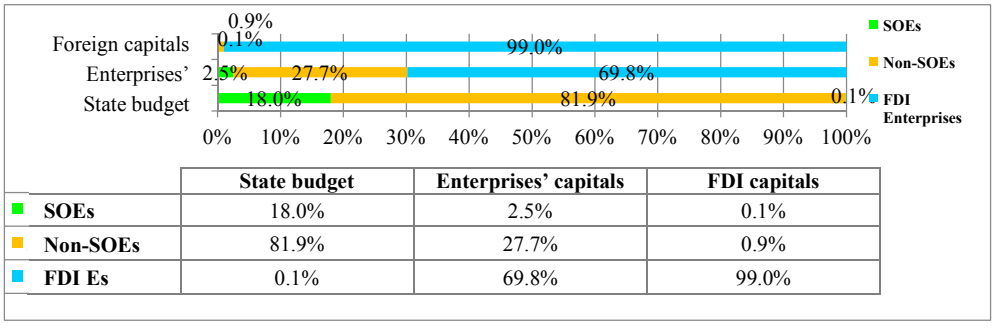


Figure 9. Structure of the total expenditures for R&D by 2016 by innovative enterprises being classified by labor size

Being classified by economic status categories, as shown by Fig. 10, the capitals from State budgets mainly support R&D activities of non-SOEs (81.9%). Capitals of enterprises mainly support investments for R&D by SOEs (69.8%). Capitals from foreign sources support almost wholly R&D activities of FDI enterprises (99%).



	State budget	Enterprises' capitals	FDI capitals
SOEs	18.0%	2.5%	0.1%
Non-SOEs	81.9%	27.7%	0.9%
FDI Es	0.1%	69.8%	99.0%

Figure 10. Structure of expenditures for R&D by 2016 by innovative enterprises being classified by economic status categories

So, as shown by Fig. 9 and Fig. 10, the capitals from State budgets for R&D by enterprises mainly support large non-SOEs (with minor part for SOEs -

18%), the sources of capitals from enterprises mainly support large FDI enterprises and the foreign capitals support R&D activities by large FDI enterprises. Therefore, the remaining part including non-SOEs of small and medium size and FDI SMEs get very low supports or even do not get them for R&D activities from State budget, sources of capitals by enterprises or foreign capitals.

2.3.2. Expenditures for technological renovations by innovative enterprises

From survey data as shown by Fig. 11, the expenditures for technological innovation in processing-manufacturing sectors are VND 24,320,193 million which come mainly from large enterprises (80.11%) the shares of small enterprises make 11.2% and medium enterprises make only 8.7%.

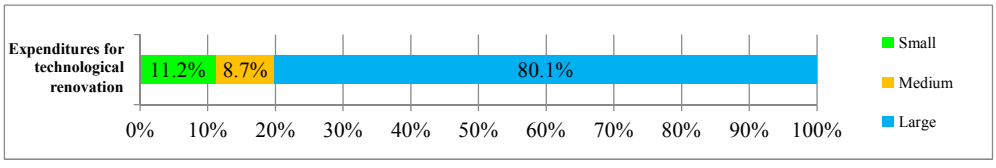


Figure 11. Structure of expenditures for technological renovation by 2016 as replied by innovative enterprises being classified by labor size

As shown by Fig. 11 and Fig. 12, majority parts of the total expenditures for technological renovation by 2016 of enterprises come from FDI large enterprises, small part of 19.3% comes from non-SOEs and a minor part comes from SOEs.

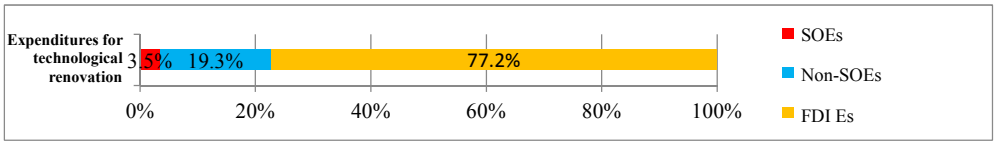


Figure 12. Structure of expenditures for technological renovation by 2016 by innovative enterprises being classified by economic status categories

In terms of sources of capitals for technological renovation (Fig. 13), major part of the total expenditures comes from enterprises (63.2%) and foreign sources (23.2%). Foreign capitals come mainly from other companies as supports for technological renovation by their Vietnam branches through supply of equipment, machines and technological lines. Supports from State budget for technological renovation for enterprises remain too low making only about 0.1%.

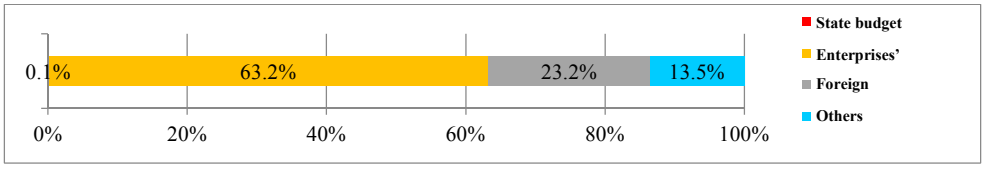


Figure 13. Structure of sources of capitals for technological renovation by innovative enterprises

A study of policies related to sources of capitals as supports for technological renovation, as shown by Fig. 14 and Fig. 15, indicates:

- Capitals from State budget for technological renovation by enterprises mainly support SOEs (52.8%) and FDI enterprises (46.9%), a very minor part of 0.3% is for FDI enterprises. If being classified by labor size, the capitals from State budget for technological renovation support mainly large enterprises (52.8%) and the remaining part of 47.2% is for SMEs (small enterprises get 32,2% and medium enterprises get 17%);
- The sources of capitals from enterprises for technological renovation support mainly FDI enterprises (75.3%), non-SOEs make a small part and SOEs make only a minor part (3.4%). Of being classified by labor size, majority of the capitals from enterprises support large enterprises (81.2%) and the remaining part of 18.8% is supports for SMEs (small enterprises get 11.1% and medium enterprises get 7.7%);
- Absolute majority of foreign capitals are used to support technological renovation by FDI enterprises (95.2), and the supports for non-SOEs make only 4.7% and the supports for SOEs are extremely low, only 0.1%. If being classified by labor size, absolute majority of foreign capitals support large enterprises (80.6%) and the remaining part of 19.4% are supports for SMEs (small enterprises get 8.9% and medium enterprises get 10.4%).

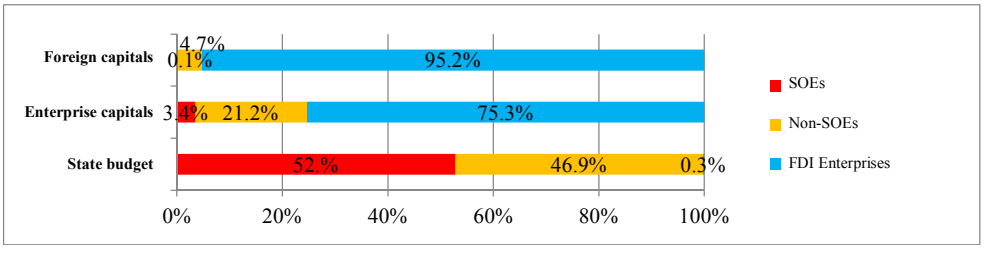


Figure 14. Structure of expenditures by 2016 for R&D by innovative enterprises being classified by economic status categories and types of sources of capitals

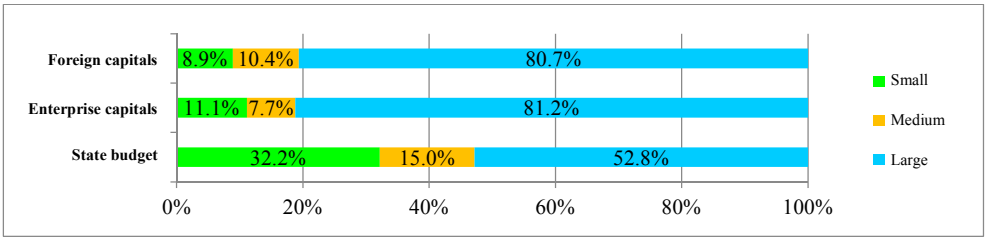


Figure 15. Structure of expenditures by 2016 for technological renovation by innovative enterprises being classified by labor size and types of sources of capitals

2.4. Scale of R&D activities by innovative enterprises

Fig. 16 shows the structure of average expenditures by 2016 for innovative activities by enterprises in processing-manufacturing sectors on basis of replies. According to them, in the total expenditures for innovative activities, the enterprises use major part of about 65.5% for purchase of technological, machines, equipments and software. The remaining part was used for internal R&D activities (14.1%), for purchase of external R&D results (0.8%), innovation training activities (9.9%), introduction of new and improved products (4.4%), purchase of knowledge (patents, know-hows and etc.) (3.4%) and other activities for innovation (1.9%).

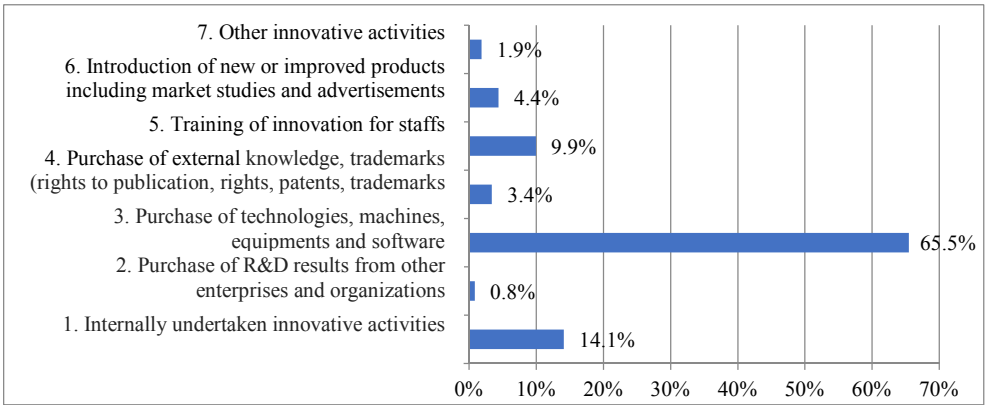


Figure 16. Structure of average expenditures by 2016 for R&D by enterprises

Therefore, the actual survey data show that 2/3 of the total expenditures for innovation was mainly used for purchase of new technologies and attached machines, equipments or for upgrading/modification of existing technologies and equipments. Only a small part was used for R&D activities and purchase of knowledge and trademarks. So, in the present stage, innovative enterprises do not really pay attentions and focus investment efforts for development of

their own knowledge assets as well as for new products and technological procedures to develop their own specific products.

2.5. Funds for development of science-technology

Only 198 enterprises among 4,709 innovative enterprises have their own funds for S&T development making 4.21%[5]. This figure reflects a reality inversely to policies issued to encourage the establishment of funds for S&T development by enterprises (2013 Law on Science-Technology, 2008 Law on Enterprise Income Tax, Circulation No. 95/2014/ND-CP and others). In fact, enterprises "hesitate" to develop funds for S&T development due to possible impediments in procedures of administrative controls and finance releases related to the use of funds of S&T development for technological renovation.

Fig. 17 shows the relations between the size of turnovers and S&T funds, enterprises being classified by labor size. According to it, the rate of enterprises having funds for S&T development is proportional to the size of turnovers. Among small enterprises with turnovers less than VND10,000 million, only 1.25% of them set up funds for S&T development while other small enterprises with turnovers higher than VND 20,000 million have a higher rate of 2.51% (almost twice higher). Only 1.0% of medium enterprises with turnovers of VND 200,000 million set up their funds for S&T development while the same rate of medium enterprises with turnovers higher than VND300,000 million is 3.30% (three times higher). 2.49% of large enterprises with turnovers lower than VND300,000 million set up their funds for S&T development while the same rate of large enterprises with turnovers higher than VND500,000 million is 6.23% (2.5 times higher).

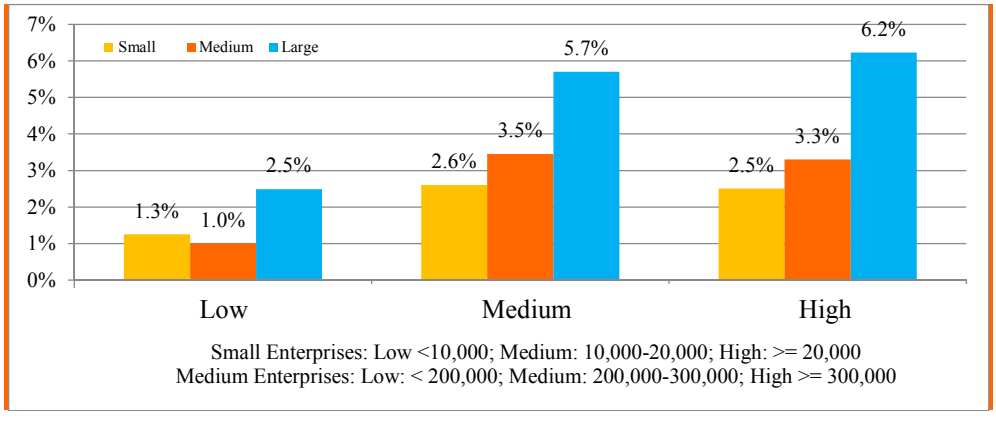


Figure 17. Rate of small, medium and large enterprises having funds for S&T development being classified by the size of turnovers

[5] The same rate among non-innovative enterprises is 0.69%.

2.6. Realization of S&T tasks by 2016

S&T tasks are organized in forms of programs, projects and tasks of S&T research in conformity to assigned functions of S&T organizations and other forms (Item 1, Article 15, Law on Science-Technology). S&T tasks undertaken within 2016 include: (i) Programs and projects of scientific research realized or involved for implementation by 2016; (ii) Technical utilities and advances applied by 2016 (whenever they were studied).

Realization of research programs and projects

In 2016, the surveyed innovative enterprises in processing-manufacturing sectors undertake 22,271 S&T tasks (31 tasks of national level (0.1%), 62 tasks of ministerial and provincial level (0.3%) and 22,178 tasks of grass-root level (99.6%)).

The number of undertaken S&T tasks does not depend fully on if enterprises have R&D units. The realization of many S&T tasks maybe depends on needs and capacities of investment for R&D activities and the labor size with univesity qualification and up of the enterprises.

Survey data show that large enterprises undertake the absolute majority of S&T tasks (97.4%). In that, non-SOEs undertake the main part of tasks of national level (83.9%), ministerial and provincial levels (72.6%) while FDI enterprises undertake majority of S&T tasks of grass-root level (95.2%). Averagely, every SOE undertakes 3.2 S&T tasks of grass-root level and the figure of one FDI enterprise is 0.2 and the figure of one non-SOE is 14.6 (4.6 times bigger than the one of SOEs and 73 times bigger than then one of non-SOEs).

Application of technical utilities and advances

By 2016, enterprises in processing-manufacturing sectors undertake 8,515 technical utilities and advances (11 of national level, 127 of ministerial and provincial level and 8,378 of grass-root level).

The level of application of technical utilities and advances does not depend on the availability of R&D units in enterprises. The application of many technical utilities and advances maybe depends on needs and capacities of investment for application of technical utilities and advances and capacities for technological renovation by enterprises.

Survey data show that large enterprises undertake majority (76.4%) of technical utilities and advances. Non-SOEs undertake 75% of technical utilities and advances of national level, 79.5% of ministerial and provincial level and 46.9% of grass-root level. In the mean time, SOEs focus on

technical utilities and advances of grass-root level (28.7%), ministerial and provincial level (5.1%) and have no technical utilities and advances of national level. FDI enterprises undertake technical utilities and advances of all the levels (25% of national level, 15.4% of ministerial and provincial level and 24.3 of grass-root level).

Roles of R&D activities

Innovative enterprises have a very clear awareness of and appreciate highly the role of R&D for their production-business activities. In practice, the important roles of R&D activities are most clearly reflected through direct service for innovative activities. For the class of innovative enterprises, the bigger the enterprises have the labor size, the bigger they pay attentions to innovative activities. Then they appreciate higher the role of R&D activities for production-businee activities of their enterprises (85.2 of small enterprises, 87.2% of medium enterprises and 88.3% of large enterprises). The rate of high appreciation of the role of R&D activities for innovative activities increases strongly from the group of FDI enterprises (81.2%), the group of non-SOEs (88.4%) to the group of SOEs (95.9%).

2.7. Modes of realization of renovation of products and technological procedures by enterprises

For realization of innovations, enterprises may “undertake themselves” or “cooperate” with other partners. Averagely, only 17.2% of enterprises “cooperate” for undertaking innovations. Innovative enterprises almost “close themselves” in their activities for renovation of products and technological procedures. The figures show well the trends: 86% of enterprises undertake mainly themselves renovation of products and 78% of enterprises undertake mainly themselves renovation of technological procedures; about 13% of enterprises coordinate with other partners for realization of renovation of products and technological procedures. A very low rate of outsourcing by enterprises is for renovation of products (1%) and renovation of technological procedures (9%).

Only 60% of innovative enterprises use sources of information for undertaking of innovations. The supply and supports of information mostly appreciated by enterprises come from internal sources, clients or competitors. Public research organizations and universities are evaluated by enterprises as partners having the lowest roles in supply and supports of information for activities of renovation of products and technological procedures by enterprises.

Survey data show that about 29.0% of small enterprises, 38.2% of medium enterprises and 37.6% of large enterprises undertake renovation of products *(Ho Ngoc Luat, 2018)*. These figures meet well with the remarks observed in a previous WB study: *"Vietnam - Enhancing enterprise competitiveness and SME linkages: lessons from international and national experience"*. As it was shown by this study, in Vietnam by 2015, 12% of small enterprises, 40% of medium enterprises and 45% of large enterprises have renovation of products *(World Bank, 2017)*. In reality, enterprises of Vietnam focus their top priority for "Improvement of quality of products". The second group of priority is "Enhancement of capacities for production of products and services", "Replacement of old products and outdated procedures" and "Reduction of production costs per product". The last group of their attentions is "Involvement into new markets" and "Growth of market shares". This reality meets also the remarks noted in another WB study *(World Bank, 2017),* where the most important feature of new products introduced by Vietnam SMEs is given to a higher quality of products which is similar to other countries in the region (Laos, Cambodia, Malaysia, Philippines and Thailand). However, the renovation of products by Vietnam concepts focuses more on cutting-down of production costs and less on studies to get fully new specifications of products.

3. Conclusions

The survey results for innovation by enterprises in processing-manufacturing sectors, 2014-2016 period help make some conclusions on the status of R&D activities by innovative enterprises. These conclusions derive from the above analysis which helps to make some hints on the status of implementation of R&D policies and national policies for technological renovation in the sector of enterprises as well as policies to foster linkages between the sector of public research and universities and the sector of production-business activities. They are only initial conclusions and further works are needed to get full backgrounds for amendment, revision and issuance of policies on R&D and technological renovation. In addition to the conclusions related to R&D activities by enterprises as noted under here, some recommendations can be referred to the document *"Statistic survey of innovation by enterprises in processing-manufacturing sectors in Vietnam" (Ho Ngoc Luat, 2018)*.

The conclusions are as follows:

(1) Only about 15.5% of innovative enterprises have their own R&D units.

(2) Averagely, only 1% of the total labors of innovative enterprises are R&D staffs. The number of research staffs with college qualification level up is even lower than the ones of other countries, such as South Korea for

example (Vietnam has 2 research staffs/10,000 habitants against 60 research staffs/10,000 habitants of South Korea *(KISTEP, 2015)*, which means 1:30).

(3) Averagely, the expenditure by research staff in enterprises in processing-manufacturing sectors of Vietnam by 2016 is USD7,831 while the one of South Korea is USD155,000 *(KISTEP, 2015)* which means 20 times bigger. It is worth to note that 70% of the total of expenditures for R&D by 2016 by enterprises in processing-manufacturing sectors come from FDI enterprises[6] and 82.8% of the total expenditures for R&D come to large enterprises[7].

(4) The capitals from enterprises and the foreign capitals are invested mainly for R&D activities by FDI enterprises[8] and the State budget allocated for R&D activities supports mainly large non-SOEs (small part (18%) being used for SOEs)[9].

(5) Enterprises do not really pay attentions to purchase of external knowledge/trademarks.

(6) Enterprises face difficulties and hampering barriers in setting up and using funds for S&T development.

(7) FDI enterprises pay attentions mainly to essential S&T tasks arising from production-business needs which are mainly S&T tasks of grass-root level while non-SOEs and SOEs mainly undertake S&T tasks of national, ministerial and provincial levels (noted as "high ranked"!).

(8) Enterprises underestimate the role of technological and R&D information supply by public R&D institutes and universities in regards to innovative activities by enterprises. Few enterprises undertake innovation cooperation. Enterprises mainly themselves undertake innovative activities (in context of low number of R&D staffs and low sources of capitals for R&D activities).

(9) Actually, only about 32.08% of enterprises undertake renovation of products. However, in Vietnam, the renovation of products focuses more on cutting-down of costs per product and less on research to get fully new specifications of products)./.

---

[6] 77.2% of the total expenditures by 2016 by enterprises in processing-manufacturing sectors come also from FDI enterprises.

[7] 80.1% of the total expenditures for technological renovation by 2016 by enterprises in processing-manufacturing come from large enterprises.

[8] Capitals of enterprises and FDI capitals are mainly invested for technological renovation of large enterprises with FDI.

[9] More than half of State budgets are supports for technological renovation by SOEs with large labor size, small enterprises get 32.2% and medium enterprises get 15% of State budgeted supports.

REFERENCES

In Vietnamese

1. Ministry of Science-Technology, 2017. *Vietnam Science-Technology, 2016*. Hanoi, Science-Technics Publishing House.
2. World Bank, 2017. *Vietnam - Enhancing enterprise competitiveness and SME linkages: lessons from international and national experience*. Trade and Competitiveness Global Practice. Washington, DC: World Bank.
3. Ho Ngoc Luat, 2017. "Science-Technology human resources: From notions by International organizations to applicability for Vietnam". *Science-Technology Information and Material Magazine*, Issue 1, 2017.
4. Ho Ngoc Luat, 2018. "Notions and financial measurements in science-technology activities", *Science-Technology Information and Material Magazine*, Issue 1, 2018.
5. Ho Ngoc Luat and Pham The Dung, 2018. "Statistic survey of innovation in enterprises in processing-manufacturing sectors in Vietnam", *Journal of Science and Technology Policies and Management*, Volume 7, No. 3 (2018).

In English

6. OECD, 2005. *Oslo manual: Guidelines for collecting and interpreting innovation data OECD Publishing*, third edition, Paris.
7. OECD, 2015. *Frascati manual 2015: Guidelines for collecting and reporting on research and experimental development*, The Measurement of Scientific, Technological and Innovative activities, OECD Publishing, Paris.
8. Korea Institute of S&T Evaluation and Planning - KISTEP (2015). *The Evaluation of Science and Technology Innovation Capacity 2014 - Composite Science and Technology Innovation Index*. Ministry of Science, ICT, and Future Planning; Seoul, Korea, Jan. 2015.
9. Korea Institute of S&T Evaluation and Planning - KISTEP (2015). *Survey of Research and Development in Korea, 2014 - Key Figures of Korea R&D Activities*. Ministry of Science, ICT, and Future Planning; Seoul, Korea, Jan. 2015.