

TECHNOLOGICAL INNOVATIONS IN MECHANICAL ENGINEERING SECTOR IN VIETNAM: ACTUAL STATUS AND SOLUTIONS

Dr. Nguyen Trong Hieu, Dr. Pham Ngoc Hieu

National Institute of Patent and Technology Exploitation (NIPTEX)

Dr. Nguyen Truong Phi

State Agency for Technology Innovation (SATI)

Dr. Nguyen Huu Xuyen¹

National Economics University (NEU)

Abstract:

Mechanical engineering sector holds the important position in supply chains of parts, components, machines, equipment and production materials. This sector is also the driving forces for development of numerous sectors in the society. Actually, however, mechanical engineering sector is evaluated as low developed despite priorities offered by the State for development. One of main reasons of that is the small segmented and non-integrated activities of technological innovations in the sector. Also the selection of development models and road maps for technological innovations is not clearly conceived then leads to low effectiveness of activities. This study targets to clarify the actual status of technologies and innovations in mechanical engineering sector, and then, on this basis, proposes solutions to promote activities of technological innovations in mechanical engineering sector in lines with the actual conditions in Vietnam.

Keywords: *Technological innovation; Mechanical engineering.*

Code: 15081101

1. Introduction

Actually, the mechanical engineering sector in Vietnam can meet about 1/3 of demands in products and equipment for various sectors of national economy. However, the technological level remains out-dated, the production scale remains small segmented and the majority of important parts and materials need to be imported. During recent years, despite efforts and attentions paid by mechanical engineering enterprises for research and development (R&D) activities and technological innovations but the innovation process goes with low speed. Therefore, the effectiveness of production and business activities remains limit including the 8 key groups

¹ The author's contact is at huuxuyenbk@gmail.com

of mechanical products which get the Government priorities for development (complete equipment, mechanical machines, machines for agriculture - silviculture - aquaculture - processing sectors, tool machinery, construction machinery, shipbuilding, electro-electronic equipment, automobile-transport machinery) according to Decision No. 186/2002/QĐ-TTg dated 26th December 2002 by the Prime Minister.

For promotion of development of mechanical engineering sector on S&T background, there are some studies made deal with problems of this sector such as: technological level in mechanical engineering sector (*Ministry of Industry, 2006*), S&T development strategies in mechanical engineering sector, 2011-2020 period (*Tran Viet Hung, 2010*), actual status of technological innovations in mechanical engineering sector and proposal of solutions to push up technological innovations, 2010-2020 period (*Dao Duy Trung, 2010*), technological innovations in support industry sector (*Nguyen Dinh Binh, Nguyen Huu Xuyen, 2015*) (where the mechanical engineering sector gets priorities for development). These studies made important contributions, conceptual as well as practical, to promote technological innovations by mechanical engineering enterprises. However, the topic of studies for technological innovations in mechanical engineering sector is required to be held continuously updated which would be a background to set-up a road map for technological innovations in mechanical engineering sector in future.

On basis of consideration of components of a technology, the technological innovation can be interpreted as uninterrupted improvement and development of technological components on basis of scientific achievements to enhance the economic effectiveness and efficiency rate of production and business activities of enterprises. Therefore, any change made in technological components can be considered as technological innovations. According to Circular No. 09/2013/TT-BKHHCN dated 15th March 2013 by Ministry of Science and Technology (MOST) on guidelines for management of the National Program of Technological Innovations up to 2020, the technological innovation is understood as full or partial substitutions of existing technologies by other more advanced and effective technologies. Here, main activities of technological innovations in general and the ones in mechanical engineering sector include the improvement and completion of existing technologies, and R&D activities to master and to create new technologies and production procedures, and substitution of technologies in use by new and more advanced technologies.

The paper targets to clarify the actual status of technologies and technological innovations in mechanical engineering sector on basis of survey results, collection and assessment of primary and secondary data,

and then to recommend policy solutions to promote activities of technological innovations in mechanical engineering sector in Vietnam with purposes to give contributions to limit imports of materials, to enhance product quality and market competitive positions of the sector.

2. Research methodology

The paper, in its targets to clarify the actual status of technological innovations and to recommend solutions for promotion of technological innovations in mechanical engineering sector, was prepared on basis of surveys and collection, selection, treatment and assessment of primary and secondary data, namely:

- *For primary data:* The research team had conducted questionnaire-based surveys of enterprises. The team sent 100 questionnaires (since May 2015) to mechanical engineering enterprises on basis of convenient and stochastic sampling methods in a systemized way. In result the team received back 56 correct qualified replies. More than that, in order to get updated and right primary data, the team organized round table meetings between research team members and experts of technological innovations and technological innovation policies to get additional information and more clarification of the actual status of technological innovations in mechanical engineering sector in Vietnam.
- *For secondary data:* The research team conducted collection and assessment of documents made public locally and abroad in relation to technological innovations, road maps of technological innovations in mechanical engineering sector and policies for development of mechanical engineering sector through projects, training documents, reference sources and specific papers of scientific studies. At the same time, the research team conducted search for and classification of legal documents related to technological innovations in mechanical engineering sector.

In addition to that, the research team collected and used on-line data provided on Internet in relation to activities of technological innovation in Vietnam enterprises. The research team also used points of view and remarks publicly provided by experts in mechanical engineering sector as well as technological innovation policy makers.

3. Research findings

3.1. Actual status of technological level in mechanical engineering sector

There are about 53,000 mechanical facilities in Vietnam where, as estimations, 50% of them are mechanical producing, manufacturing and assembling facilities and the remaining part operates as dedicated repair units. The total capitals of the State owned mechanical engineering sector are evaluated roughly about USD370 million. The registered FDI capitals are about USD2.1 billion (*General Department of Statistics, 2013*). The industrial production values of 2013 are about USD12.6 billion which makes a growth of 10.5% in comparison to the values of 2012 and almost 6 times in comparison to the values of 2000. Despite the annually increasing growth of industrial production values, the capacities of mechanical engineering sector to meet domestic demands remain low, only at the rate of 32% (much lower than the rate of 45-50% as targeted by Decision No. 186/2002/QĐ-TTg by the Prime Minister). The technological level of mechanical engineering sector is assessed as low and out-dated, namely: low automation level (about 7%), low integration level of production lines, high rate (about 70%) of use of multi-purpose machines (which is the 2/7 level of the complexity and state-of-the-art assessment scale of technological components defined by ESCAP (*ESCAP, 1989*)). Majority of technologies in mechanical engineering sector has been used for about 30 years (by 2014). Therefore, the capacities to provide the accurate level of manufacturing and stability of product quality of technological chains remain low yet (*Nguyen Hanh, 2011*).

On basis of consideration of components of a technology (including techniques, human factors, information and organization (*ESCAP, 1989*)), survey data collected from 40 mechanical engineering enterprises (*Ministry of Industry, 2006*) and focused on 8 key groups for the period from 2005 to 2010 with vision to 2020 (including completed equipment, working machines, tractors and agriculture machines, tool machinery, construction machinery, electrical equipment, automobile-motorbike and shipbuilding) show well the actual status: technical component in technologies is used at low level with the average rate of 0.48 (the full use is rated as 1), human factor component is used at rate of 0.65, information component is used at rate of 0.62, organization component is used at rate of 0.58. Also, from review of the life cycle of technologies and the relations between the life cycle of products, research outcomes show that the majority of mechanical engineering products are in stages of development and maturity (the life cycle of technologies and products include 5 stages: kick-off, introduction, development, maturity and replacement).

When considering basic procedures to produce a mechanical engineering product in Vietnam we can see (*Dao Duy Trung, 2010*): i) research-design work stage comes up to the advancing-medium level among the countries in

the region; ii) semi-fabricating work stage (molding, forging, welding) and fabricating work stage remain relatively out-dated; iii) surface treatment work stage is considered the most out-dated one in mechanical fabrication of mechanical engineering enterprises with new equipment almost not being used in Vietnam, except some laboratories and foreign joint venture facilities; iv) finishing-assembling and test work stage, and procedure of quality control of materials and products are considered as out-dated in comparison to other countries in the region.

According to surveys conducted in 2015 by the research team for 56 enterprises, for the question “In comparison to the world level, where are the technologies your enterprise are using?”, the replies show: 39.3% of them are using low technologies, 48.2% are using medium technologies and only 12.5% are using high technologies (Fig. 1). In the mean time, 73% of mechanical engineering enterprises of Singapore are using high technologies, the one of Malaysia is 51% and the one of Thailand is 31%. The common rules require the rate of use higher than 60% of high technologies to achieve the industrialization level [12]. Also, the capacities of mechanical engineering sector are reflected also in capacities of operating, technology absorbing, technology absorption supporting and innovating. All of these capacities of mechanical engineering enterprises are evaluated as limited in many aspects. Then they face many difficulties in mastering, copying and creating new technologies.

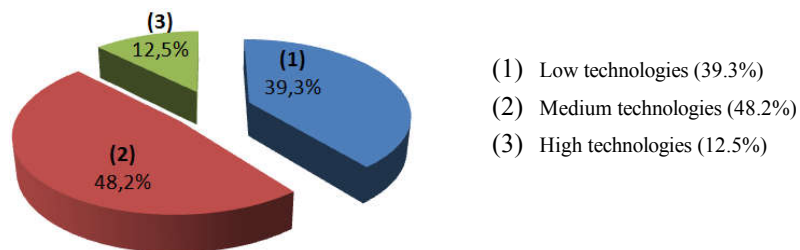


Figure 1. Technological level of mechanical engineering enterprises

Source: Survey results by the research team (2015)

So, in global view, the technological level and capacities in mechanical engineering sector of Vietnam remains low in comparison to the ones of the world and the region, namely production effectiveness is not high, stability of mechanical products is not ensured, products with high knowledge content are not produced at high rate which cause impacts to competitiveness of Vietnam mechanical engineering sector.

3.2. Actual status of technological innovations

Technological innovations in enterprises in general and technological innovations in mechanical engineering sector in particular are conducted mainly on basis of foreign imported technologies. Activities of research we can conduct ourselves for creation of new technologies and utilities for technological innovations are almost non-considerable. Surveys conducted among 7,621 enterprises (the ones of mechanical engineering sector make about 18%) in 63 cities and provinces of Vietnam (*Central Institute of Economic Management, 2012*) give results: only 11.9% of them conduct R&D activities, 16.4% of them innovate existing machines and equipment without conducting R&D activities, the remaining 71.7% of them do not do any activities related to technological innovations.

Investment finance for R&D activities and technological innovations in mechanical engineering sector mainly come from State budget sources which make from 1.5% to 3% of the total investments for S&T (the actual share of S&T investments makes about 2% of the total annual budgets (*Tran Viet Hung, 2010*). According to calculations (on basis of data for GDP and S&T budget expenditures of 2013), the State budget allocation was USD24.2 million for R&D activities and technological innovations in mechanical engineering sector. This rate of expenditures is low to meet development demands and speeds of mechanical engineering sector, and also investments are largely spread which lead to a low efficiency rate of efforts. More than that, non-State budget investment sources for mechanical engineering sector remain limited (being evaluated at volume of USD6.05 million by 2013) which makes about 25% of the total State provided sources. In comparison to the rates of South Korea and Thailand, the investment rate to S&T activities in general and R&D and technological innovation activities in particular of Vietnam remain very modest. The total S&T investment volume of South Korea is about USD46.5 billion where the State budget allocation is USD13.2 billion making 28.3% of the total volume, and the remaining part 71.7% is covered by economic corporations and enterprises in private sector. The total investment volume of 2012 for R&D activities of Thailand was about USD606 million where the non-State budget investment sources make 40% (*Ministry of Science and Technology, 2013; National Science Technology and Innovation Policy Office, 2014*).

Then, the main situation can be summarized: the share of investments for technological innovations in mechanical engineering sector remains low and non-integrated, the speed of technological innovations is low, the technological level is low also (*Ministry of Industry, 2006*). The speed of technological innovations of the whole country in the period from 2010 to

2012 was only 9.7% which is very low in comparison to the one of advanced countries. In industrial sectors we are observing the following rate of shares: 1.9% are automated enterprises, 19.6% are semi-automated enterprises, 26.6% are mechanized enterprises, 35.7% are semi-mechanized enterprises and 16.2% are handicraft enterprises (*Ta Viet Dung, 2014*), despite very high demands of technological innovations in mechanical engineering sector, particularly in fields of engineering of manufacturing machines and tools, transport machinery, high accurate cutting machinery and industrial robot manufacture. However, there are difficulties in mobilization of resources for R&D activities because majority of manufacturing enterprises in Vietnam are SMEs. From another side, policies are not strong enough to force enterprises to innovate technologies.

Research results show that the community of enterprises in Vietnam in general and mechanical engineering enterprises in particular are highly aware of needs of technological innovations. Namely, 98% of enterprises consider technological innovations as necessary activities but only 50% of them keep on investments and re-investments for R&D activities and technological innovations (*Nguyen Viet Hoa, 2011*), 55% of enterprises have needs to upgrade their technologies for improvement of quality of products, 23% of enterprises have needs to upgrade technologies for diversification of products, 25% of enterprises have needs to upgrade technologies for enhancement of production capacities and a few only enterprises consider that the technological upgrading is due to legal requirements (*Central Institute of Economic Management, 2012; Nguyen Huu Xuyen, 2014*). It is worth to note that survey data were collected from 150 enterprises in Southern region who take part in Vietnam-Finland Innovation Partnership Program (IPP) (*Ministry of Science and Technology, 2013*). Among 50 surveys in mechanical engineering sector, 20 of them (making 40%) have set up R&D units and 6 of them have set up their own S&T development funds.

Being questioned: "Has your enterprise conducted regularly activities of technological innovations during the last three years?", 56 mechanical engineering enterprises gave their answers which show (Table 1): majority of enterprises have conducted activities of technological innovations such as improvement of/investment for production lines (average score is 3.07/5), research for implementation of new products/new production procedures (average score is 3.5/5), enhancement of human resources for technological innovations (average score is 3.48/5), re-structure of organizational schemes for technological innovations (average score is 3.25/5).

Table 1. Activities of technological innovations in mechanical engineering sector

Activities of technological innovations	Average score*	Deviation
Improvement of/investment for production lines	3.07	0.912
Research for implementation of new products/new procedures	3.50	0.831
Research for implementation of new products/new production procedures	3.48	1.079
Re-structure of organizational schemes for technological innovations	3.25	0.694

* Use of Likert 5 scale

Source: Survey results by the research team (2015)

Despite attentions and efforts paid by mechanical engineering enterprises for activities of technological innovations, the average ratio of investments to annual turnovers during three recent years for activities of technological innovations remains low, namely among the 56 surveyed mechanical engineering enterprises only 10.7% of them made the ratio more than 2%, 23.2% of them made from 1% to 2% and 39.3% of them made the ratio from 0.5 to 1% and 26.8% of them made the ratio less than 0.5% (Fig. 2).

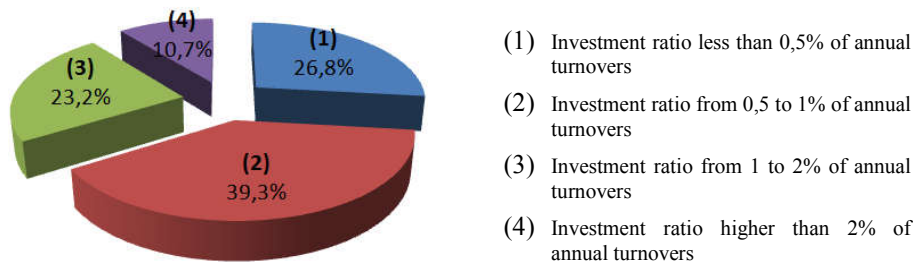


Figure 2. Average ratio of investments to annual turnovers for activities of technological innovations of mechanical engineering enterprises

Source: Survey results by the research team (2015)

In order to push up technological innovations in general and the ones in mechanical engineering sector in particular, the State and the Government have promulgated some policies, namely: Decision No. 677/QD-TTg by the Prime Minister on approval of the National Program for Technological Innovations up to 2020; Decision No. 186/2002/QD-TTg by the Prime Minister on approval of Strategies for Development of Vietnam Mechanical Engineering Sector up to 2010 and vision up to 2020; Decision No. 10/2009/QD-TTg by the Prime Minister on approval of Mechanisms to

support key mechanical products and the list of investment for production of key mechanical products, 2009-2015 period; Decision No. 2888/QĐ-BCT on approval of the Master Plan for development of complete equipment manufacturing industry up to 2015 and vision to 2025; Decision No. 12/2011/QĐ-TTg by the Prime Minister on Policies for development of some supporting industry sectors; Decision No. 1483/QĐ-TTg (2011 year) by the Prime Minister on the development priority list of supporting industry products; Guidelines No. 16/CT-TTg dated 18th June 2014 by the Prime Minister on Settlement of difficulties and intensive implementation of Strategies for development of Vietnam mechanical engineering sector where the Prime Minister indicated clearly: “the implementation of policies for development of mechanical engineering sector remains limited and low-integrated, the roles of State competent agencies for management duties and their proposal of policies for development of mechanical engineering sector are not mobilized, the roles and activities of associations are not pre-actively mobilized”. In addition to that, the policy environment was not really favourable for activities of technological innovations and the work is not defined clearly for preparation of technology maps and road maps for technological innovations in mechanical engineering sector. Being questioned: “Are the State policies favourable for activities of technological innovations in enterprises?”, the 56 surveyed enterprises gave their replies which show that 14 of them (making 25%) gave positive and high positive answers (the average score is 2.8/5 and the deviation is 1.182).

One of the reasons of this fact is that the incentive measures are not strong enough to push up efforts for technological innovations. Issued policies were assessed by enterprises as non-integrated (56.2% of the total number of 56 surveyed enterprises agreed with this view). Issued procedures remain intricate then lead to low effective implementation of policies. More than that, majority of surveyed enterprises stated that difficulties they face in mobilization of capitals and human resources of high quality are the biggest barriers to implementation of technological innovations. Namely, among the 56 surveyed mechanical engineering enterprises, 60.7% of them agreed and highly agreed that they lack and cannot mobilize capitals for activities of technological innovations. 66.1% of them faced difficulties in mobilization of human resources of high quality for activities of technological innovations. Also, supports offered by Vietnam Association of Mechanical Industry and Vietnam General Union of Mechanical Engineering Associations were assessed by enterprises as low effective for activities of technological innovations.

Therefore, in global view, the following remarks can be made for mechanical engineering sector in Vietnam: (i) Limited activities of

technological innovations; (ii) Low speed of innovation process; (iii) Low ratio of investment for technological innovations to total annual turnovers; (iv) Difficulties in mobilization of resources for technological innovations; and (v) Low effectiveness of policies to promote technological innovations in mechanical engineering sector.

4. Conclusions and recommended solutions

We have the targets to achieve a growth in the number of enterprises which conduct technological innovations with the annual rate of 10% by 2015 and with the annual rate of 15% by 2020 including 5% of them to apply high technologies (Decision No. 677/QĐ-TTg dated 10th May 2011 by the Prime Minister), and, at the same time, to enhance our own capacities to carry out researches for, to absorb, to master and to create new technologies which can assist us to introduce to markets more mechanical engineering products with high competitiveness. These targets require from us many efforts for the following volume of works, namely:

First, building technological maps and road maps for technological innovations in mechanical engineering sector, and then, on this basis, implementing supports for mechanical engineering enterprises to conduct technological innovations in every stage in lines with available national resources. The road maps of technological innovations would help the mechanical engineering sector to identify strong-weak points and favourable-difficult aspects in their resources to realize the targets of technological innovations, and then, on this basis, to support the establishment and assessment of development strategies for technological innovations and to identify their market competition positions. Also this would help State competent agencies identify categories of core technologies, incentive technologies and new technologies for development of the mechanical engineering sector and then to issue suitable policies for promotion of R&D activities and technological innovations for mechanical engineering sector. Therefore, the building of road maps plays important roles for development of the country in general and of the mechanical engineering sector in particular. This move brings in benefits in plans of national development in general as well as of the mechanical engineering sector in particular including the set-up and implementation of projects of technological innovations for higher capacities and competition positions, namely:

(i) *For national targets:*

- Identification of strong-weak points and prerequisites necessary for establishment of long-term and feasible objectives for activities of

technological innovations and, at the same time, identification of national endogenous technological capacities in present time as well as weak points in activities for implementation of technological innovations in future time;

- Identification of clear objectives as well as specific indicators to reflect these objectives in activities of technological innovations and, at the same time, identification of necessary plans of actions to achieve the defined objectives of technological innovations in different context of situations;
- Identification of resources (finance, human resources and materials), on basis of established road maps for process of technological innovations, which are necessary and can be mobilized to achieve the defined objectives;
- Promotion of processes to link universities, research institutes, business organizations and investment sources. Also, the road maps can give considerable contributions to realization of target policies issued by the Government for promotion of technological innovations and enhancement of the national positions through calls of finance sponsors for technological innovations. These moves help promote and accelerate the transfer and propagation of technologies between public and private sectors.

(ii) For mechanical engineering enterprises

- Identification of road maps for technological innovations by enterprises and identification of those technologies which could enhance competitiveness of enterprises and then, on basis of that, promotion of activities of research, implementation, search and application of new technologies to produce high competitive products;
- Identification of strong-weak points and competitive advantages of enterprises on basis of available and mobilized resources for realization of objectives for technological innovations to diversify products, to enhance product quality and to create new business opportunities and, by this way, to enhance capacities and competitiveness of enterprises in markets;
- Identification of business strategies on basis of changes of technologies, technological life cycles and then identification of chances to get good links between strategies for technological innovations, business activities and commercialization actions;

- Stimulation of links and cooperation of investment sources for exploitation of technologies and reductions of risks in investment activities. On basis of that, enterprises can select targets for suitable technologies and accelerate processes to link and to share knowledge between sectors of research, production and State management. These moves can create new business chances on background of new technologies.

Second, reviewing strategies, plans, programs and projects related to development of the mechanical engineering sector in order to mitigate overlapping legal documents and, at the same time, to increase the coordination between State management agencies for technological innovations in general and for technological innovations in mechanical engineering sector in particular. On this basis, incentive policies (in terms of taxes and credits) would be issued for key products and technologies which cause high impacts to existence and development of the mechanical engineering sector in future (mechanical engineering for agricultural production, processing industries, shipbuilding, electro-electronic equipment and etc.). Therefore, for purpose of promotion of technological innovations, the Government should have measures for (*Nguyen Dinh Binh, Nguyen Huu Xuyen, 2015*):

- Issuance of policies to establish permanent two-direction information channels between State taxation agencies and enterprises. Through these channels, enterprises will provide fast and in-time feed-backs on difficulties and problems they may face as well as proposals they can make to formality procedures for incentive supports for technological innovations. From another side, taxation agencies would provide in-time supports and consulting services for enterprises and, on basis of existing regulations and practical context, adjust rules to fit demands of enterprises in their activities of technological innovations. The setting-up of an incentive tax systems specifically for activities of technological innovations needs to meet requirements of being fully integrated, reasonably structured and highly effective for R&D activities of enterprises;
- Identification of a measurement for effective incentive tax measures which are applied for technological innovations. Naturally, the Government should consider lower tax rates for those enterprises, particularly for SMEs, which apply advanced technologies and new technologies. These taxation measures may concern various taxes such as corporate income tax or import taxes imposed to materials and equipment for the supporting industry sector. From another side, these measures have

to avoid risks to be additional subventions for enterprises because many of them have conducted activities of technological innovations without getting supports through incentive taxes. The effectiveness of incentive tax measures needs to be considered on basis of comparisons which would exhibit if the application of these measures could make any effective growth of production-business activities of beneficiaries and if the Government could get any benefits worth of losses from tax collections;

- Simplification of administrative procedures and formalities for enterprises to get benefits from incentive taxes (which is actually applied with the rate of 0% according to Circular No. 214/2010/TT-BTC dated 28th December 2010 by Ministry of Finance) imposed to imported materials and equipment for manufacture as well as other investments for key mechanical products;
- Measures to encourage establishment of independent project appraisal organizations including projects of investments for technological innovations. They are intermediate organizations which have the legal status and bear legal liabilities for exactness and credibility of appraisal outcomes. They are, from one side, to provide banks and credit agencies with required information on concerned projects of technological innovations and, from another side, to provide enterprises with plans to use effectively the provided loans. The intermediate roles of these organizations are seen clearly through their functions to settle conflicts between enterprises (as users of capitals) and banks/credit agencies (as providers of capitals). On basis of assessments provided by these independent organizations on potential capacities of concerned enterprises and loan providing capacities of banks/credit agencies, the two partners could identify the parameters of loans including the volume, interest rate and repayment terms to meet demands of technological innovations of enterprises;
- Necessity to diversify capital sources and to attract FDI sources for activities of technological innovations in mechanical engineering sector, particularly to support mechanical engineering enterprises to get preferential loans for projects related to key mechanical engineering products and supporting industries;
- Necessity to improve the rules to operate the National Fund for Technological Innovations. This fund should operate as a financial institution which is to provide credits for activities of innovations in general and technological innovations in mechanical engineering sector in particular on basis of principles of not causing difficulties to access to

this fund by enterprises. Here we have also another fund of the same nature, namely the National Fund for Science-Technology Development and, therefore, a mechanism should be set up to avoid the overlapping roles, functions and offers of incentive credits of these two funds. The National Fund for Technological Innovations should focus incentive credits on efforts by enterprises to commercialize research results and to introduce enterprises to markets and the National Fund for Science-Technology Development should focus incentive credits on initial stages of enterprises to conduct the process of technological innovation.

Third, offering supports for training of human resources to operate activities of technological innovations in mechanical engineering sector, and encouraging the hire of overseas experts for preparation of high quality human resources and for implementation of projects of key mechanical engineering products. These moves are to target the accelerated implementation of the plan for preparation of human resources in mechanical engineering sector up to 2025. The quality of human resources is an important factor to impact directly activities of technological innovations of enterprises in their efforts to absorb, operate and master transferred technologies. At the same time, the high quality of human resources would help enterprises to conduct well activities of improvement and creation of new technologies which are backgrounds to produce knowledge enriched and high competitive products in markets. Therefore, it is necessary to accelerate the implementation of Decision No. 22/NQ-CP and Resolution No. 56/2009/ND-CP by the Government on supports for development of SMEs as well as Inter-ministerial Circular No. 05/2011/TTLT-BKHĐT-BTC (Ministry of Planning-Investment and Ministry of Finance) to guide supports for training activities and enhancement of quality of human resources for enterprises. These moves are to target by 2020 the volume of 10,000 engineers qualified for management and operation of high tech based production lines in key sectors for development of the country including the mechanical engineering sector according to Decision No. 418/QĐ-TTg dated 11th April 2012 by the Prime Minister.

Fourth, coordinating closely Ministry of Industry-Trade, Ministry of Planning-Investment and Ministry of S&T to build up incentive policies to accelerate investment projects for technological innovations in mechanical engineering sector as well as to support and to encourage consumption of locally produced mechanical engineering products. These policies should be integrated and implemented in lines with the process of international economic integration which is important backgrounds to set up strategies/master plans for development of the mechanical engineering

sector up to 2025. At the same time, it is necessary to push up the implementation and control of policies to stimulate demands for key mechanical engineering products as regulated in Decision No. 10/2009/QĐ-TTg dated 16th January 2009 by the Prime Minister on promulgation of mechanisms to support development of capacities of manufacturing key mechanical engineering products and on the list of and projects for key mechanical engineering products.

Fifth, necessity to enhance the roles of Vietnam Association of Mechanical Industry and Vietnam General Union of Mechanical Engineering Associations in coordinating with State management agencies for proposal of policies for development of Vietnam mechanical engineering sector in lines with conditions and process of economic integration. At the same time, it is necessary to encourage and stimulate mechanical engineering enterprises to enhance cooperation in production activities to target high market positions according to Guidelines No. 16/CT-TTg dated 18th June 2014 by the Prime Minister on settlement of difficulties and intensive implementation of development strategies of Vietnam mechanical engineering sector.

In addition to that, the Government should have measures to develop technological infrastructure and technical services for technological innovations, to build up standard systems of the sector, to enhance activities to link training organizations and mechanical engineering enterprises and to identify the clear road map for localization of mechanical engineering products. This would be the necessary conditions for successful implementation of activities for research, propagation and creation of new technologies. Also, it is necessary to promote the commercialization of inventions (patents) in mechanical engineering sector./.

REFERENCES

In Vietnamese:

1. Ministry of Industry. (2006) *Report of assessment of technological level of industrial sectors*.
2. Ministry of Science and Technology. (2013) *Survey of innovation activities in 150 enterprises in Southern region*.
<http://tiasang.com.vn/Default.aspx?tabid=112&News=7410&CategoryID=43>
3. General Department of Statistics. (2013) *Report of surveys of enterprises*. Hanoi.
4. Central Institute of Economic Management (CIEM), DOE, GSO. (2012) *Competitiveness and technologies at the level of enterprises in Vietnam: 2010 year survey results*. Hanoi: Labour Publishing House.

5. Dao Duy Trung. (2010) *Research of the status of equipment and technological innovations in Vietnam and proposals of solutions for promotion of technological innovations, 2010-2020 period*. Research project report, Institute of Mechanical Research.
6. Tran Viet Hung. (2010) *Research of strategies for S&T development in mechanical engineering sector, 2011-2020 period*. State level research project hosted by Vietnam General Union of Mechanical Engineering Associations.
7. Nguyen Viet Hoa. (2011) *Research, analysis and assessment of policies of technological innovations for industrial enterprises*. Ministerial level research project of National Institute for Science-Technology Policy and Strategy Studies (NISTPASS).
8. Nguyen Huu Xuyen. (2014) *Policies for Science and Technological Innovations*. Hanoi: National Economics University Publishing House.
9. Ta Viet Dung. (2014) *Enhancement of productivity in mechanical engineering sector: Lacks of capitals limit smart solutions*.
<http://vietq.vn/nang-cao-nang-suat-nganh-co-khi-von-khong-co-bo-cai-khon-d33240.html>.
10. Nguyen Dinh Binh, Nguyen Huu Xuyen. (2015) *Technological innovations in sector of supporting industries*. Hanoi: Science-Technics Publishing House.
11. <http://laodong.com.vn/sci-tech/can-tiep-tuc-hien-dai-hoa-nganh-co-khi-che-tao-12881.bld>
12. <http://www.hiendaihoa.com/co-khi-may-moc/san-pham-cong-nghe-moi/nang-cao-nang-suat-nganh-co-khi-von-khong-co-bo-cai-khon.html>
13. Websites: www.chinhphu.vn (the Government); www.most.gov.vn (Ministry of Science-Technology) and www.moit.gov.vn (Ministry of Industry-Trade): for referenced documents and policies in relation to technological innovations in mechanical engineering sector.

In English:

14. ESCAP. (1989) *Technology Atlas Project - A framework for technology based development*. Thailand.
15. National Science Technology and Innovation Policy Office. (2014) *Overview of Thailand's Science, Technology and Innovation Policy*. Ministry of Science and Technology, Thailand.