STUDY OF TREND OF LINKS BETWEEN SCIENTIFIC COMMUNITY AND ENTERPRISES

M.Sc. Nguyen Viet Hoa
National Institute for Science-Technology Policy and Strategy Studies

Abstract:

There exists actually many studies of research works which enhance the science-technology (S&T) roles but pay least attention to the role of the scientific community, where scientific knowledge is produced, and business community, where S&T research results get applied, brought into production and turn back to serve the socio-economic life. In this connection, there exist some topics for research. This paper deals with the two main contents: i) Concepts of links between the scientific community and enterprises, and ii) Trends of links between the scientific community and enterprises

Keywords: *Links; Trends; Scientific community, Enterprises.*

Code: *13071401*

1. Concepts of links between scientific community and enterprises

1.1. Introduction

The XXI century is marked by the S&T revolution with the explosive presentence of high techs (materials, biology, energy, information-communication). These technologies produced strong and deep impacts to the socio-economic development. They made appear new economies and new types of society which were knowledge-based economy and knowledge-developed society. They created also large links between the scientific community and enterprises. The values and the effects of links between the scientific community and enterprises are huge and therefore policy makers always pay attention to the trends of links between the scientific community and enterprises to issue effective S&T policies.

1.2. Concepts and contents of links between the scientific community and enterprises

1.2.1. Notion of the scientific community

The scientific community exists and develops in scientific organizations (departments, centers, labs, project teams in institutes, universities, R&D

units of enterprises. There exist numerous concepts for the scientific community.

- General concept: "the scientific community means the whole set of researchers who have a high qualification level specialized fields of activities and who have consistently united visions to scientific objectives and their connections to the social environment" [18]; "the concept of scientific community records the collective nature of knowledge production and the necessity of association between scientists, the unified evaluation of knowledge, the evaluation of members through standards and ideas of recognizing activities including the special features of science" [18].
- Concrete concept: "the scientific community is a special social group including scientists in general and scientific research orientations, scientific disciplines or scientific organizations [19].

The main feature of the scientific community is the scientific organizations with diversified forms. However, their members have a common point that they have highly trained qualification, high level of specialization, production of knowledge and unified evaluation. Scientific research is the soul of the scientific community. It is the main functions, special features of scientific research and the diversity of scientific research lead to the shape and existence of the scientific community, and at the same time establish certain position and role of the scientific community in the social systems. The scientific community has a specific institutional position which is made from the position and roles of scientists in building scientific standards and heavy duties to produce new scientific knowledge to meet social demands, to enhance the knowledge and to reform the world.

1.2.2. Notion of enterprises

There exist many types, sizes and sectors of activities of enterprises. They may be Government owned, non-Government, private and etc. In this paper, we give the following notions:

- Enterprises whose activities are related to business and innovation. According to Gordon Marhall, "enterprises are innovators in fields of business. Unlikely owners, capitalists of professional managers, these innovators who follow many established business procedures and targets" [19, p.195]. This notion was based on the original concept proposed in "The economic theory of development" by Schumpeter who gave the definition: "enterprises are particular

persons who know to coordinate the development and new production tools which a basic principle of economic development".

- Enterprises are economic organizations that have their own names, assets, stable transaction office and register the business activities as required by legal procedures for purpose of business activities [1].
- Enterprises are typical persons related to a type of activities, a procedure or a scope of activities of creators. They play a very important role in fields of venturous and creative activities [16].

The above notions show that not only scientists are creative, venturous and innovative people. The new approach shows that enterprises can participate in some activities particularly related to creativity, ventures and innovation in conformity to business procedures and regulations and established targets.

1.2.3. Links between the scientific community and enterprises

Here links are interpreted as "the existence or formation of connections between sides or decision to change the happening, and the transmission/connection of relations [20]". Up to now, there exist many concepts of links in general and links between the scientific community and enterprises in particular. This paper presents some concepts as follows:

- *Concept 1:* Links between the scientific community and enterprises are an economic type of links. "Economic links are the form of regular cooperation and coordination of activities conducted voluntarily by economic units to establish and implement policies and measures related to production and business activities of involved parties in order to push up these activities in the most profitable manner. The activities are conducted on voluntary, equal and mutual benefit basis through economic contracts concluded among involved parties in conformity to the State legal regulations" [12].
- *Concept 2*: Links between the scientific community and enterprises are a type of links which are clearly targeted, namely:
  + *Links for renovation of production activities:* There exist many activities of enterprises but, among them, there are two important type of activities which linked to the scientific community, namely: i) renovation of products; and ii) renovation of technological processes. The renovation of products and technological processes would be conducted if they can be brought into market (renovation of products) or used in production procedures (renovation of processes). Production and business activities of all

enterprises lead always to renovation of products and technological processes for their own existence, development and competition. For this target, majority of enterprises do investments for R&D activities, training and use of S&T services. "Knowledge-based services are driving forces for enterprises to conduct joint activities and to promote close links" [16].

+ *Links for enhanced knowledge*: For purpose of renovation of production activities, enterprises need to rely on results of R&D activities then conduct the improvement of renovation of products of new production techniques.

According Robert Boyer, if enterprises want to enhance innovation activities they need to develop links with scientific organizations because "Fundamental research is the work of scientists while the innovation is the work of enterprises. Innovation activities go longer than fundamental research activities. They have their own specific rules and features which link them to market and labs" [5].

The above notions show that links are conducted on basis of social relation and interactions. They are well unified and clearly planned in conformity to legal regulations. Under optics of social and economic studies, we can be defined as follows: Links between the scientific community and enterprises can be understood as social links which are set up to meet demands of socio-economic development of the scientific community and enterprises. Practice shows that all links have their own targets. As Prof. Micheal Porter indicates, the links are to enhance competitiveness, first of all, inside enterprises. Many studies show clearly that the links are to shorten the time and distance from research to creation of technologies, application in production activities and creation of products. "The time needed for that was 60 - 70 years in the XIX century, 30 years for the first half of the XX century and 3 years for 1990s" [9].

2. Trends of links between the scientific community and enterprises

2.1. Notions of trends and trends of links

There exist many concepts of trends subject to every research subject and scope. This paper proposes the following approach.

The trend is a global development or change in a situation or a way people behave [20]. There are some typical examples: Surveys show the trend to leave the house possession and to follow the house lease, trends to

increase/reduce turnovers during recent years, new trends of fashion and make-up, actual trends of natural beauties without make-up [20].

The trend is a dominating direction in certain time (Wiki Open Dictionary) with two forms of suspension and development. From point of view of sociology, the social trend is an attention attracting change of models/types of visualization of indicators or social indicators [19, p.622].

The trends of links between the scientific community and enterprises is understood as the dominating trends/global development from existing links which can continue developing, changing totally, returning to passed links, deviating, fluctuating in time, discontinue on basis of objective and subjective reasons. This paper deals with the following objective and subjective factors.

2.2. Analysis of factors creating the trends of links between the scientific community and enterprises

2.2.1. Objective factors

- Contemporary S&T revolution:

By end of the XX century and early the XXI century, the contemporary S&T revolution is the leap greater than the two previous Science-Technical revolutions[1] when scientific knowledge and technical elements change fast and become a close part of technologies in a unified integration in the process of material or non-material formation. The S&T revolution creates new producing forces and a new economy called knowledge-based economy. S&T becomes direct producing forces and produces great impacts to socio-economic development, namely: enhancing the power of producing forces, developing new economic sectors with high technical contents, changing the labor structure, developing international trades and foreign trades on global scales. These strong changes bring in many models of links between the scientific community and enterprises because the changes of producing forces make the production relations change.

- International integration and economic competition:

According to Béla Balassa, the economic integration is, in a closer interpretation, a connection of institutional nature of various economies. The economic integration is a pro-active process to carry out two works: i) connecting national economies and markets to regional and international

[1] The first science-technical revolution occurred by the end of the XVIII century and early the XIX century and the second science-technical revolution occurred by the end of the XIX century and early the XX century.

markets through efforts to open and to push up the liberation of markets, and ii) entering and contributing to build up regional and global economic institutions [10].

According to Dr. Pham Quoc Tru[2], the international integration is the process where the countries carry out activities to enhance the inter-connection on basis of sharing benefits, objectives, values, resources, powers and respects of common rules in the framework of international institutions or organizations. The international integration can be conducted in all the social sectors (economy, politics, security-defense, culture, education, science-technology and etc.). They can be conducted at the same time with very different connection rates, scopes and forms (bilateral, multi-lateral, regional, inter-regional, global).

The impacts from economic integration and competition to the links between the scientific community and enterprises are very big, namely, in addition to global international legal regulations (laws), the common institutions such as commitment, management and production standards put down many demands and regulations towards enterprises. The economic competition requires enterprises to make investments and to enhance their infrastructure for all the production and business activities. Therefore, enterprises need to develop links with enterprises to make knowledge transferred to management, production and business activities. For developed nations and territories, the links between the scientific community and enterprises become traditional and natural social relations in higher level than the one of developing and under-developing countries.

- *Spirit of the era: Links for innovation and development*

+ *Links for innovation:* "The rate of mobility of S&T experts causes impacts to the propagation of new development" [3]. Universities, research institutes, laboratories and research centers play a particularly important role in the process under impacts from innovation policies. They produce new knowledge then transfer them to enterprises through links. "Research is supplementary activities for innovation but not pre-conditions for innovation. Many research activities are set up from process of innovation. Many problems rise from innovative ideas created in other places" [3]. One of the important objectives of innovation policies is to develop knowledge to transfer from the scientific community and then stimulate enterprises to carry out innovation in more effective ways.

[2] Dr. Pham Quoc Tru. (2011) International integration: Some theoretical and practical problems

+ *Links for enhancement of capacities*: Enterprises, if wanting to compete and develop, need to enhance innovation capacities. Innovation is the important element of knowledge-based economy. "At macro scale, there are many evidences to show the dominating role of innovation in the national economic growth as well as the set up of international trade rules. At micro scale (companies), R&D is considered as measures to enhance capacities of enterprises in absorption and effective use of knowledge under various forms, but not only the one of technological knowledge" [3]. For this purpose, majority of enterprises make investments for R&D and training activities, use of S&T services and strong links with the scientific community.

2.2.2. Objective factors

- *From the side of enterprises:* There exist many factors which create the trends of links. During recent years, there are some main factors such as needs for change of products, renovation of technologies, production development, better competition, low productivity, reputation of scientists and scientific communities, products of scientific communities, enhancement of capacities of human resources, requirements of environment protection, requirements from higher bodies and etc.
- *From the side of the scientific community*: It has its needs also for transfer of research results, innovation and innovation of enterprises, demands from highers bodies, better reputation, better contributions to production and business activities, higher professional level, higher incomes and etc.
- *From the side of the State*: Links between the scientific community and enterprises basically are established from the State policies. For objectives of national socio-economic development, successful international competition and integration, the State issues policies and mechanisms to push up links between the scientific community and enterprises, namely: financial policies, investment policies, development of technological market, policies of training, organization of exhibitions and fairs, provision of information and etc.

Objective factors causing strong impacts to links can create different trends of links. Here the role of the State is to build up plans and to orient activities for links between the scientific community and enterprises in an objective

way because the substantial nature of links is the voluntary activities of social groups. They would be more sustainable and stable than the forced ones. The role of the Government and the State agencies is to promote the relations between the scientific community and enterprises and to create voluntary links from the ownership relation of knowledge to the relations in organization, management and exchange of activities with enterprises to create new production mode. We know that "the agreement between the production forces and the production relations creates the production modes. The production relations depend on the forces. The changes of the production forces lead to the changes of the production relation. But the production relations have their own relative independence and cause impacts also to the production forces. The development of the production forces, at certain level, leads to the situation where the production relations becomes outdated and then hamper the development of the production forces. The objective demands will require the substitution of the old the production relations by the new one to fit the new production forces"[3].

In context of intensive globalization and international integration and explosive moves of the S&T revolution, S&T has become the direct production forces. Therefore, the governing and policy making roles of the State get important for sustainable development of the scientific community (producing knowledge and creating intangible assets) and enterprises (producing commodities and goods and creating tangible assets).

2.3. Actual trends of links between the scientific community and enterprises

2.3.1. Trend of links on basis of existing and developing cooperation and links

Links may come from investors. Investments and supports for scientific research have become a great need of groups which possess strong economic potentials and high social positions. Scientific research works can be seen as bridges linking investors and the scientific community. Scientific research works are as basis of assessment by investors for research capacities of the scientific community. They are also the evidence of knowledge values that the scientific community can offer to investors. On basis of research programs and projects, Peters and Fusfeld (1982) proposed the following classification of 6 types.

[3] Open Encyclopedia.

1) General supports: They are part of global social supports offered by enterprises. These supports can be donations of funds and equipment for training and research activities.
2) Research contracts: More than 50% of supports from industries for universities are made through contracts of concrete projects.
3) Research institutes and centers: In order to facilitate contractual procedures and transactions, some universities establish research centers which are focused on certain technologies. This may create an environment for multi-discipline approaches.
4) Research consortiums[4]: They may be considered as research programs for specific objectives to be conducted by one or several universities. As rules, consortium members, which are not universities, have to pay certain membership fee while universities contribute their laboratories, researchers and graduate students.
5) Industrial link programs: They are set up to help enterprises in their access to universities and their resources.
6) Incubators of enterprises and scientific parks: Majority of scientific parks and incubators locate closely to cluster of universities to attract technologically strong enterprises. Scientific parks can be beneficial for both universities and enterprises because of their synergy.

In addition, there exist also other classifications. For example, Korea Science and Engineering Foundation (KOSEF) makes a classification of forms of cooperation between research centers and enterprises on basis of research contracts, research cooperation, technical consultancy, establishment of companies, exploration activities, training courses and etc.

2.3.2. Trend of links of innovation team

During recent year, as purpose to enhance the guiding role of the Government, many nations have built programs to develop innovation teams through effective cooperation between training, research and production to enhance the national and regional competitiveness.

[4] *Consortium* has the meaning close to *association* or *union*. This word originates from *consors* which means *possessor of means* or *collaborators*. This word indicates the temporary collaboration for certain tasks to provide a service or product in a more effective way. A consortium is the connection of two or more individuals (legal term of this is *legal entity*), companies, universities or power administrations (or any combination of these legal entities) with objectives to participate in common activities or to contribute their own resources to achieve the common objectives. Every participant still keeps his own individual legal entity status and, because of it, the control of consortiums toward participants, in general, is limited in activities of common efforts, namely the share of benefits. A consortium is established on basis of contracts which describe benefits and liabilities of members. Consortiums are popular, in general, in non-profit fields (Open Encyclopedia).

In October 2008, EU Committee called to accelerate the set up of leading innovation teams as measures to enhance the EU's competitiveness. The set up of EU innovation teams has become one of the most effective regional innovation policies. This move has supported the cooperation and coordination between EU companies, and between companies and research organizations. Innovation teams on basis of research organizations. Suppliers, consumers and competitors in the same geological area create a good development platform for enterprises and wake driving forces and innovation energy of enterprises.

For higher effective set up of innovation teams, EU Committee had made the following recommendations: continuing the improvement of functions of European internal markets, enhancing operational effectiveness, establishing the highly qualified organization of policy research for European innovation teams which would support effectively EU members and enhance innovation teams at the world's scale, extending dialogues of policies for innovation teams which were initiated by "the EU Industrial Team Union", collecting success experiences to facilitate the issue of policies of innovation teams, continuing the extension of functions of "the European Inspection Organization of European Industrial teams" which would become a service provider of functional innovations for establishment of innovation teams and development of new enterprises, starting a program to training directors of innovation teams and providing a space for cooperation of directors of innovation teams. As measures to make enterprises to get the above benefits, EU issued the support policies for innovation teams and regulates "EU Link Policies", "EU Program for S&T Development" and "EU Program for Competition and Innovation". All of these activities target the establishment and development of innovation teams of international level.

In 2004, as measure to enhance the cooperation between universities, independent research institutes and enterprises, the Japanese Government set up two important innovation plans for innovation teams, namely: i) "Plan for teams of enterprises" (kick-off includes 19 teams) of the Ministry of Economy and Industry, and ii) "Plan for teams of intellectuals" (kick-off includes 10 projects) of the Ministry of Education, Culture, Sports and S&T. For these projects, the Japanese Government has provided large supports for establishment of teams. Actually, the policies for industrial teams had gained initial results. For example, the number of companies and universities of the projects related to "the Plan for teams of enterprises" increases annually. The number of newly set up enterprises increases too. The three indicators of employees, total turnover and benefits of companies in the projects exceed the national average rates.

In March 2008, four agencies including the Japanese Government Office, Ministry of Education, Culture, Sports and S&T, Ministry of Economy and Industry and Ministry of Health, Labor and Welfare had coordinated to establish "Technology Districts" which conducted the first pilot project of "the District of Advanced Health Care Development" to push up R&D activities in field of medical treatment and medical equipment. The objective of establishment of these districts is to form streamline management mechanisms, to break down administrative barriers between organizations, sectors and financial mechanisms, to promote the effective transfer of S&T advances from research sectors to production sector and to accelerate the technological innovation of targeted sectors.

The French policies for development or innovation teams mainly focus on the plan for intensive competition which was initiated in 2004. The "Plan for Intensive Competition" means that in certain geographical areas, some enterprises and State/private research organizations link and agree mutually the forms of cooperative partnership which has innovations as focused target. At the end of bidding process by end of 2004, the French Government had issued the license of "intensive competition" to 66 projects over the whole country. The French Government committed to provide the projects, during three year since 2006, with the financial support of Euro 1.3 billion. In July 2007, the French Government had selected further innovation teams and this increased the number of innovation teams to 71 among which 17 teams were recognized for the world level of intensive competition.

Germany paid high attention to establishment of innovation teams. In March 2008, the Federal Ministry of Education and Research initiated a contest of "Breakthrough Team" and had set up a plan to provide a support of Euro600 million for the three rounds of the contest. The German Government pays high attention to support the establishment of "Kompetenznetze" - a regional network of competences for high/new technologies. The network members cover many segments if industrial chains and inter-discipline sectors. In 1995, The Federal Ministry of Education and Research started to build up a biological Kompetenznetze. Then other networks were established for other fields such as nano-technologies, optical technologies and medical technologies. Actually, the Federal Government of Germany provides supports for almost the important technological fields on basis of competition. This initiative had pushed up many technological innovations and establishment of high/new technology based SMEs.

In 2002, Canada had formed clearly the innovation strategies up to 2010, Canada would build up at least 10 internationalized innovation teams. With

great supports from the Government, Canada had set up teams with specific particularities in many fields such as agriculture, aquaculture, forest and forestry products, minerals, plastics and rubber, chemical fibers and garments, steel and products, communication products, automobile, information-communication service, education, bio-medicine, trade service, finance, culture, logistics, construction, oil and natural gases, foods and drinks.

The Korean Government of Lee Myung-bak had issued the policy to build up "The International Belt for Science Trade" which took the construction of scientific infrastructure as focused attention for "Silicon Valley - Korean version". Incentive policies would be provided for local and Korean-overseas scientists. The Korean Government targeted by 2012 to invite 1000 overseas excellent scientists to work in the country.

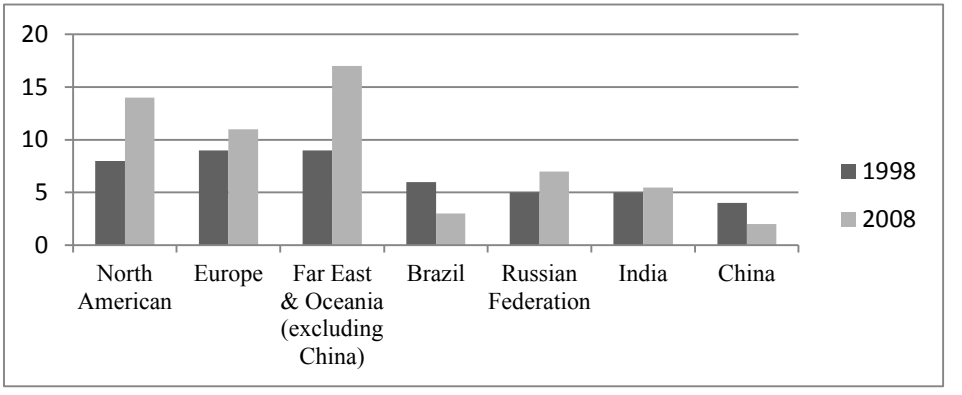
2.3.3. Trends of repeated links in the scientific community are possible deviation from policies.

The return to links inside the scientific community such as cooperation for scientific research, publication of journals and books and etc. is made in various forms which come from functions and particularities of scientific activities. It is the kind of internal links and outside-orienting links (regional, national and etc.). They are in majority of case have trends to link with other the scientific partners rather than to enterprises. This policy may deviate from the global State strategies. For example, in context of international competition and integration, the majority of Governments wants and issues many policies to encourage the scientific community to link with enterprises rather than to link among themselves. However, in practice, the links are very diversified including the both trends. In certain period, the trend to link among the scientific community is prevailing. There are some examples for illustration purpose.

- *Links based on cooperation of scientific research (international scientific communities):*

The cooperation based on publication of scientific works is one of increasing trends from 1998 to 2008 with more than 500 publications between EU and OECD country members: USA, Canada and Mexico (North and Central America), Austria, Belgium, Bulgaria, Belarus, Switzerland, Cyprus, Czech Republic, Germany, Denmark, Estonia, Spain, Finland, France, UK, Greeks, Croatia, Hungary, Ireland, Iceland, Italy, Lithuania, Luxembourg, Latvia, Malta, Netherlands, Norway, Poland, Portugal, Romania, Sweden, Slovenia, Slovakia and Ukraine (Europe),

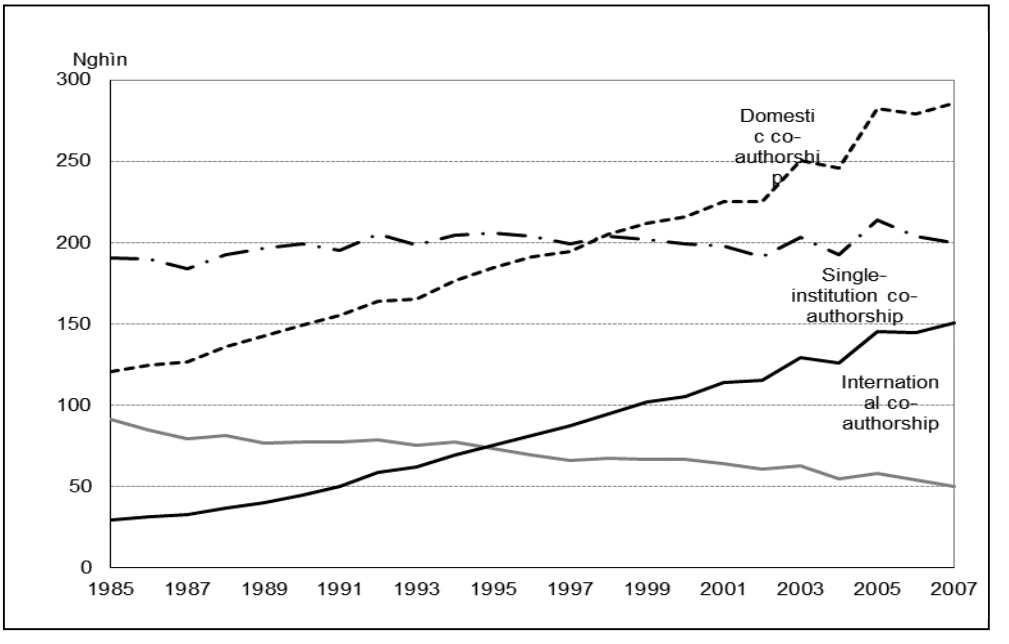
Australia, Indonesia, Japan, Korea, Malaysia, New Zealand, Singapore and Thailand.



Source: OECD Main Science and Technology Indicators, 2010

Figure 1: Scientific cooperation between BRICS members, 1998-2008.

Note: "BRICS" is the name of the bloc of emerging economies including Brazil, Russia, India, China and South Africa



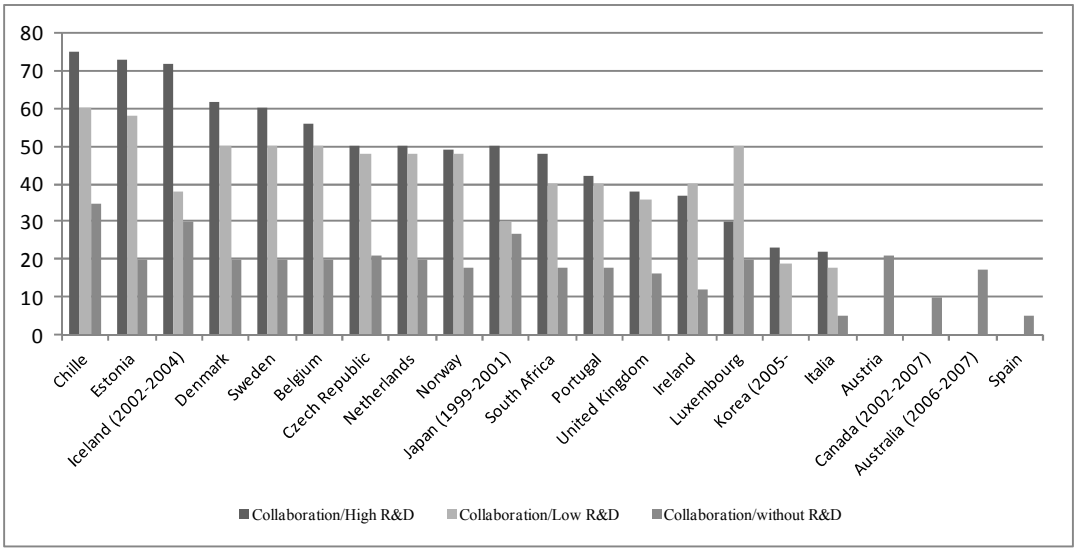
Sources: OECD Main Science and Technology Indicators, 2010

Figure 2: Trends of cooperation in publication of scientific works and books 1985-2007

The development of cooperation in publication scientific works and books, 1985-2007 periods shows the fast increasing trends in every nation while the cooperation between independent individuals increased slowly and even declined.

The roles and positions of individuals and scientific communities increase considerably through high quality of recognized scientific works. Research groups and collaborators are usually guided by high-qualified scientists. They have certain influences to orientations of development of scientific communities not only because their responsibilities for basic advances but also of their key roles in dissemination of information of research networks. Scientific research works make appear various forms of links to meet demands of the society.

- *Links which do not follow common trends:*



Source: OECD, Innovation micro-data project based on CIS-2006, June 2009 and national data sources

Figure 3. Rate and level of R&D cooperation

Figure 3 shows the rate and level of R&D cooperation between the scientific community and enterprises vary from country to country. For example, in Chile, the cooperation between the scientific community and enterprises made more than 70% with a very low rate of non-R&D cooperation. Some other countries, such as Spain, Denmark, Sweden, Belgium, UK, have a rate lower than the one of Chile but they keep the main rate for R&D cooperation. Korea, as exceptional case, has only R&D

cooperation. Some special cases are Australia (business cooperation), Canada (cooperation for production), Austria and Spain (production and trade) who have a similar trend of non - R&D cooperation.

- *Links based on system structures of scientific communities:*

Basically, they have similar features with social structures such as positions, roles, functional units, network of research activities, social norms and institutions and strong relations inside systems.

- *Links based on hierarchic structure*:

The scientific community is not union of equal individuals but it is clearly hierarchic. High qualifies and reputed scientists make important contributions to extend scientific knowledge, particularly the scientists who win high prizes and titles and who have large connections to social groups. This group of scientists has high roles and power in the scientific community. The group of young scientists and those who did not win prizes or did not make great publication works have lower roles and positions. This hierarchic structure[5] is a kind of norms and practice within the scientific community[6].

The hierarchic structure of the scientific community is of also relative nature. The roles of groups change on basis of their contributions to scientific knowledge and inventions. The moves of positions and the change of roles create new form of links. For this reason, "under this optics the scientific community can be considered as sandwiched layers on basis of scientific reputations" (M.J.Mulkay, 1980).

- *Links based on institutions of the scientific community:*

There exists the share of functions in all the scientific communities. Every unit has its own tasks. In the system of scientific communities, functional units follow scientific norms and standards, carry out defined tasks under control of the scientific community. For purpose to keep the common interests of the scientific community, the elements such as positions and role of every units, research activities, research time schedules, research orientation, research infrastructure are kept under certain norms and standards as "culture" of the scientific community (norms, values, truth, objective)

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[5] The concept of social hierarchy is still under disputes. Marx Weber proposed three criteria of hierarchy: reputation, income and power. Pasons considered the social hierarchy is an unavoidable element to meet the social operation on basis of social cooperation.

[6] M.L.Mulkay considered that many research works of scientific prizes in the last century disclose not only the hierarchic structure of the research community but also clarify the nature of social control in science. Researchers seem to be guided to follow the scientific community and the fact they are evaluated high or not depends on the way they follow that.

The strongly established scientific community relies on the links of cultural norms and standards within the scientific community which lead to common actions of the scientific community. The right and objectively set norms would lead to strong development of the scientific community. When one of these norms and standards is not found suitable, it could change the structure of the scientific community. The scientific community may change or collapse or re-group to re-build new norms and standards to fit the new socio-economic context. The cultural norms and standards are the background for formation, existence of the scientific community because the main functions of culture is "cultivating" and "educating". Auguste Comte considers that the social structure evaluates from low level to high one, from simple structure to complex one. The social development is seen through the differentiation, diversification and specialization of functions as well as the level of links between social sub-structures.

Conclusion

The trends of links between the scientific community and enterprises are based on socio-economic demands and benefits of the scientific community and enterprises. There exist different trends. Some of them increase while other may come back to the old form. Some of them develop internal links without developing external links. The role of policy makers is to orient and to build policies and mechanism to encourage links between the scientific community and enterprises for sustainable development as background for S&T development and socio-economic development./.

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