STATE INTERVENTION IN SCIENCES

Hoang Xuan Long[1], **Hoang Lan Chi**
National Institute for Science and Technology Policy and Strategy Studies

Abstract:

Three categories of science: the science as cosmos religion, the science for the State and the science for enterprises which are different in their features of motivations of activities. Motivations of the science as cosmos religion are based mainly on faiths, aspiration and sacrifice spirits. Motivations of the science for the State target values and interests of the State and the nation. Motivations of the science for enterhprises are related to production activities and competitions in business activities. The scope and the level of State interventions are also different from one category to another one. These remarks serve as background for proposal of new directions of management activities to meet features of every category of science including their motivations, orientations, modes of investment and specific modes of management.

Keywords: *Science as cosmos religions; Science for the State, Science for enterprises; State intervention in sciences.*

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1. Categories of sciences

1.1. The science as cosmos religion

Albert Einstein compared sciences with religions[2]. According to his view, the sense and the aspiration are motivations of all the human efforts and, because of that, there exist religions at different extents of faiths.

In the primitive era, the fear made appear religious symbols. At that time, peoples have fear of famine, wild animals, diseases and death. At this level, the comprehension of causality is low and their mind created imaginary figures of human-like "dummies". Fearful experience of the human kind depends on willing, wishes and actions of these dummies.

[1] The author's contact email address: hoangxuan_long@yahoo.com

[2] This argument was made in his essay *Religions and Science* which first appeared on 11th November 1930 in *Berliner Tageblatt* (See: Albert Einstein: "The World As I See It" (Vietnamese translation by *Tri thuc* Publishing House - 2005, pp. 34 - 41).

The second level of religious symbols is social senses. The father, the mother and the leader of large tribes would come finally to death and they could make errors but God does not. The aspiration to be led, loved and protected stimulates the creation of God in social as well as ethic meanings. It is God who is powerful to protect, decide, reward and punish the human.

The third level of religious experience is the capacity of individuals to sense the nihility in their wishes and targets, to sense the grandiose magnitude and marvelous order of the natural world as well as imaginable one. A. Einstein called it the Cosmos religion.

The cosmos religion is the strongest and most noble motivation for scientific research. This motivation is filled up with the religious spirits of faith, aspiration, sacrifice and loyalty. Namely, the believing in the rationality of the nature's structure and mechanism, the aspiration for understanding to catch the little halo that illuminates this universe[3]; the self-sacrifice that is the practical absenting of minimal life needs[4] - because of the power of the sense from huge efforts and extreme sacrifice; the loyalty for targets to understand the universe and to devote the own life for these targets despite of endless failures and even necessary sacrifices[5]. The cosmos religion is the highest sense which gives the strength for the human to do sciences.

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[3] This was remarked in more details in the essay *Research Religion* which says that his religion (*e.g.* scientist) is the fascinated stupefaction toward the harmony of the nature which gives a halo of the super rationality at such extent that while facing it all the most valuable thoughts and arrangement by the human remain only an illusive reflection. When passing the slavery world of personal ambitions, this sense would be the main sense which leads his life and efforts. No doubt, this sense is related closely to the one which were with religious founders of all the time. (Albert Einstein: "The World As I See It" (converted back from Vietnamese translation, *Tri thuc* Publishing House - 2005, p. 42).

[4] There are some typical examples, namely:

- Marie Curie (1867-1934) used her Nobel Prize money mainly for research investment. Marie Curie, Wilhelm Rontgen and some others had refused to patent their inventions.
- The life of Michael Faraday (1791-1867), even very famous for his discoveries, was very hard and he paid no attention for that. By 1858, thanks to active lobby by his friends, the scientist received a small villa as a gift from the British Queen Victoria. On the day, he entered the new house the famous scientist said his adopted daughter that he accepted this house because of his daughter while, for him, nothing is better than the small room under stairs in the building of the Royal Society where his family lived many years.
- Louis Daguerre (1787-1851) was the author of a famous process of photography which was applied largely. By 1939, he made public his work without making a patent from his invention.
- Ivan Petrovich Pavlov (1849-1936) was a famous biologist. In the post-October Revolution time, the Soviet Union faced large economic difficulties. He refused a special ration given as privileged offer and, instead of that, he asked to get more dogs for experiment.

[5] For example: Franz Reichelt (1879-1912) died when decided to test himself the equipment which help pilots leave from the aircraft if it has problem; Horace Lawson Hunley (1823-1863) died while testing the third submarine model in the sea off-shore Charleston; Valerian Abakovsky (1895-1921) died during the test of engines for high speed trains; Elizabeth Fleischman Ascheim (1859-1905) died from radioactive exposure at age of 46; Carl Wilhelm Scheele (1742-1786) died in result of a mercury poisoning at age of 44; Louis Slotin (1910-1946) died in an experiments to produce plutonium for atomic bombs, and many other cases.

1.2. The science for the State

The development of science which attracts attentions of the State power includes two components: General sciences which are to enhance the knowledge of the human kind and the science with direct service for the State needs. The service exhibits the specific links between sciences and the State that we called shortly "the science for the State".

The main features of governance of science by the State include:

- Sciences are oriented to serve the nation's values under vision of the State interests instead of the values of the whole world. Sciences target to solve problems defined in relations to the State who exercises duties of social administration and national defense instead of freedom for exploration of the endless world;

  Since the 1930s, the German academic tradition which had been holding the world leading position at that time collapsed and then gave up the position to the values of the Nazi Germany. During the Second War time, USA developed the Manhattan program to attract tens thousand scientists for research and fabrication of atomic bombs. After the Second War, the governments of industrialized countries followed USA to make investments for scientific research in a perspective vision that the science is not only means to enhance human knowledge but is a deciding factor for development of economic and military powers;
- Scientific activities are organized and administered toughly according to the State administration principles including actual requirements of the schedule of implementation and propagation of results instead of free and self-conscious activities, like aspiration, of researchers;
- Scientific activities get strong investments from the State instead of supporting allowance.

One of the most particular features is the orientation of scientific activities on basis of the State defined tasks. This particularity would govern the modes of administration and investment which target the realization of defined tasks and bind investments with the implementation of defined tasks.

In comparison to the cosmos religion, the conformity of scientific activities to the State principles explores new capacities of science. In reality, the principle of the science for the State leads to a new strong development of achievement. The motivation for scientific development does not include only the aspiration for exploration but also other high values such as contribution to development of the country, social duties of scientists, tough

organization, coordination between scientists and large investment sources from the State.

At the same time, the framework established by the State also sets up certain binding requirements to science, namely:

- It is impossible to have a freedom of research and, at the same time, to conduct it under tough management of administrative organizations. There are even some conflicts between the truths from scientific research and the State power as A. Einstein noted[6]. This note should be remarked specially because in the 1973 Declaration "Intellectuals and powers", 407 intellectuals over the world stated that the top and first duty of scientists is to say the truths or the one they think to be the truth[7].

  Another aspect of freedom in scientific activities is the fast change of direction of research among scientific communities. The renovation of research topics seems to become an important motivation in exploitation of creative capacities of every individual scientist in particular and the development of science in general[8]. The priority to target the State defined tasks would re-define the border of research directions of scientists.

  As French mathematician Henri Poincarré (1854-1912) said: "The freedom for scientific research is as important as the air is for animals which now would have certain relative meaning from the stand of view of the science for the State";

- Scientific activities usually emphasize the independence on works. Scientists highly value the independent ambiance of works[9]. The status of "the science for the State", however, values the State control;

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[6] The essence of scientific development is based on the freedom of faiths and freedom of academic activities where the efforts to search the truth should be put higher than all the other efforts. The efforts to achieve scientific truths and to escape from practical benefits of the ordinary life need to be respected by all the State powers. (Albert Einstein: "The world As I See It" (Converted back from Vietnamese translation), *Tri thuc* Publishing House - 2005, p. 48).

[7] Michel Winock "Centuries of intellectuals" - *Seuil* Publishing House, P.9.97, p. 631.

[8] There are, in the history of development of science, many cases when new scientific areas get established not by those scientists which are highly familiar with old practice and concepts (even with a large scope of knowledge but well established) but by the ones which initially may do research in other fields of science, for example: philosophers René Descartes, Gottfried Wilhelm Leibnitz, Immanuel Kant were mathematicians, Adam Smit was a professor of languistics and logics. This fact shows well a reality that the initiatives play a more important role than the initial volume of knowledge and a too high level of theoretical knowledge may prevent inventive ideas and audacious concepts in science.

[9] One of the studies which showed well this is the work by Myers. He conducted a survey among various groups of labors (physicians, engineers, production managers and technicians) on impacts to motivations for high efficiency of works. The results show that for scientists the strongest influencing factor comes from "Independence of work", for engineers it would be "Position promotion upon completion of mission" (See M.S. Myers: "Who are Your Motivated Workers?", Harvard Business Review, 1964, N1, Vol.42.).

- Freedom of contact between scientists is necessary for them to conduct efficiently their research works. Many important benchmark events in the history of development of science were results of large meetings between researchers such as the 1986 International Conference which led chemists to the generally agreed definition of the molecule or the conference of the Bunzenosky Association in Germany which played an important role in development of electro-chemical field and other fields of physical chemistry and etc[10].

  Contacts between scientists are highly multi-form. They may be personal talks, workshops, open discussions, debates and, even, disputes in media. Here the debates are mainly events of these contacts. Hard disputes, sometime, are particularly useful to make appear new theories or conflicting situations (two disputing theories which reasonably exist) in science. Scientists are free to express their stands of views and to argue against opposite ones which would lead to contacts and interactions between different mindsets and concepts. This would be the necessary environment to deal with basic problems of science and to find out scientific truths. Niels Bohr (1885-1962), through his speeches and media presentations, repeated many times that the critisizing remarks by A. Einstein help him much in developing a different and deeper concept on quantum mechanics.

  We need to note that in many circumstances, open and straight debates are not suitable for the category of science for the State because of requirements of competition between countries;

- The personal of role of individual scientists is important in scientific research activities. Naturally, scientific research activities increasingly get to be more collective by nature. The collective structure of scientific research activities became prevailing trends since the second and third decades of the last century. For example, there is a collective coordinance in various stages of research programs, namely the preparation of conditions, implementation of experiments, harvest and assessment of outputs of conducted experiments and publication of research works. Facing this trend of "collectivities in research activities", the fingerprints of individual scientists do not reduce their values but get

[10] In the welcoming speech at the X-th International Conference on Theoretical and Applied Chemistry held in Moscow in 1965, N.N. Xemenov had noted the role of contacts between scientist for development of science through a mathematical expression. When noting the development of science as a process with bifurcations, Xemenov gave the formula W= Ae Ät where W is the speed the science develops with, Ae is the factor indicating the number of scientists and the level of scientific-technical infrastructure of research, Ät is the factor presenting the creative capacity of scientists which includes the efficiency rate of contacts between scientists. This shows well the contact in communities of scientists is a compulsory condition to promote science.

more expressed. The analysis of organizational structure of a scientific school shows well the role of the school's leading scientists. The establishment of a scientific school requires not only the involvement of outstanding scientists but also the qualities of leaders-teachers such as strong wills, disciples inspiring capacity and aspiration of scientific research. There exists a conflict between, from one side, emphasizing the role of individual leader-researchers and, from another side, respecting the hierarchic position in administrative management structure in conformity to State administrative rules;

- The science for the State emphasizes administrative functions. In this structure, scientist-managers really are reluctant to carry out their administrative duties. Differently from other fields of administrative activities, they do not make and concentrate efforts on management duties because this type of duties deprives much time they need for scientific research works. The assignment of talent scientists to carry out management duties would be considered as actions to force science to serve the State.

  The science for the State has to obey the framework of rules imposed by the State then it is a very specific type of science. Only those sectors of science which accept the confinement would fit well the duties to serve the State.

  The presence of the science for the State changes the scale and the essence of scientific research. Before the Second War time, the road into science was very difficult. The social reality put down very tough requirements to anyone who wanted to make scientific research carriers. The Second War made important shifts: numerous scientific projects were required to serve fighting needs but scientific human resources were not enough to carry out them. Then, needs appeared to restructure the scientific system to mobilize trained staffs with miner scientific qualification and minimal conscience state. This would lead to higher positions of science and scientists, and to higher recompenses for their scientific works. Since 1960s, there was an increasing trend to get more people working in science research sectors who are much different from scientists of previous generations in psychological aspects. Psychological documents on scientific creativity note the appearance of the new term "gentlemen scientists" which is used to mean those researchers who, in addition to research works, want also enjoy the noble and aristocratic style of life.

  Practice shows well the complex nature of relations between the scientific contents of research and the State contents in the science for

the State. There were cases when the State contents dominate largely the scientific ones[11]. Many embarrassing situations are noted but they still get stuck in settlement. It seems there is no concrete solutions for this type of problems but only certain general principles are indicated out, namely: applying adequate measures on basis of requirements the State assigned tasks. Some examples can illustrate this situation;

- A study by the US Department of Aquaculture shows that 2/3 of new inventions in the US in the XX-th century came from independent inventors and small size companies while a great part of scientists and engineers work in large organizations including the State own R&D organizations. In searching solutions to scientific problems, large scientific research organizations appear less efficient in using offered financial resources which are found in relations to creative potentials of scientific researchers. Many scientific staffs in US public R&D organizations complain to be held back in their creative capacities. Ideas and proposals of middle grade scientific staffs may not be passed since their authors are not positioned highly or reputed enough in these organizations. New proposals may evoke adverse reactions, even hostile actions, in various management levels in scientific organizations since, in common sense, these proposals may lead to large changes in daily operations and cause negative impacts to reputations of leading bodies. Those who propose new ideas need spend much time and efforts to

[11] It was time, in China, before reforms in S&T sectors, the S&T activities in public research institutes low efficient. Someone even suspect that activities conducted in research institutes are not really R&D works. A comprehensive nationwide survey was conducted by 1986 to collect data of the 1985 year end. The survey outcomes show that, for the Central Government controlled R&D institutes (under management of ministries and central government committees) more than 50% of activities of 622 organizations in total are not R&D works and more than 80% of activities in a total 3,946 organizations under management of local governments are not R&D works (The Chinese Government White Pages on Science & Technology, No. 1, p. 238).

Large volumes of non-R&D activities spent by R&D institutes seem to be a common practice in the countries with center-controlled economic structure. For example, in Democratic Republic of Germany, the volume of non-R&D works defined by Franscati range from 20% to 50% of the total activities depending on the survey sampling time and way (See *Bentley, 1992, p.46 and p.142*). More detail analysis confirms that it is a consequence of the R&D organizational system operated through the center-controlled economic mechanisms where the administrative machine has global deciding powers.

Being depending organizations, research institutes are "well closed under key" in the administrative structure. For example, industrial R&D institutes are subsidiary to ministries of industrial departments, design institutes are "closed under key" in Fundamental Construction Department. In China with center-controlled economic mechanisms and strong decentralization of power, the system of R&D institutes is extended and they are "closed under key" separately in various administrative levels (central, provincial and district). "Being well closed under key" means that the pure scientific activities are not controlled by administrative units but bear additional duties of managerial and technological natures to share burdens of administrative units. These additional duties of managerial natures include a collection of technological products and standards, preparation and set-up of sector and sub-sector development projects, control and analysis of quality of products by enterprises in the sectors. In addition, R&D institutes are required to help organize activities of technological exchange and working meetings for industrial ministries. In practice, the volume of these additional duties makes about 25% or more of the total activities of ministerial R&D institutes.

arrange relations with colleagues and direct bosses and to search protecting or covering actions from leading bodies.

During many recent years, experts in US management units spent time and efforts to search effective measures to enhance efficiency rate of activities by State-owned R&D organizations. Numerous analysis works show the reasons of low efficiency rate of State-owned R&D organizations come from trends of administrialization and bureaucratization of scientific research activities. These analysis works reflect increasing trends to make complex the process of approval of research related decisions. The decisions deal mainly with organizational aspects with a very low rate of scientific contents. At the same time, there appear coordinating organizations and small sized units to monitor the implementation schedule of scientific projects and even the control of finance quota. Official contact channels get added with inadequate channels. The identification of reasons, however, does not lead to measures to settle this situation;

- There is, in some countries, a popular practice to take researching staffs of State-owned R&D institutes as public servants. In these countries, the practice of administrative relations fits the nature of realization of scientific research activities through issuance of some specific and non-standard policies for these researchers-public servants. However, the application of these specific and non-standard policies is not enough to distinguish scientific researchers from public servants and then researchers have to suffer some adjusted legal regulations. For these reasons, some advanced countries such as France and Japan consider to liberate scientific researchers from the status of public servants[12].

  More than 50 years ago in France, the report "Perspectives of organization of scientific-technical research works in France" prepared by a consulting committee had noted that the shift from one research

[12] Example, Prof. Christiam Bréchot, Head, Hepatology Department, Necker-Enfants Hospital, Director of numerous research works of National Health and Medical Research Institute of France, answered to an interview by *La Recherche* Magazine on the main reason of the French falling-behind in scientific research fields. Answering to the question: "Do you agree with the interpretation of our falling-behind in science by the public servant mechanism, shortage of self-governing mechanism of universities, brain drain and too complex organization of research system?" Prof. Christiam Bréchot said that he believes the first important reason is the application by the State of the public servant status for researchers. With this scheme, from one side, researchers get a very low salary and, from another side, it restrains their self-governing and dynamic capacities. Many high qualified researchers, once getting low salaries, leave the country or change their profiles to other activities which lead to brain drain. In fact, the public servant scheme applied by the State has many positive points but it is regret that actually only negative points "deliver effects". In fact, the research should be considered as a specific vocation and researchers need to get a special status. (Extracted from the translation by Ngo Vu, 2003, "Liberation of scientists from public servant status" - Magazine *Tia sang*, March 2003, p. 21).

topic to another one should go in natural manner and this process can produce positive impacts and help prevent "sclerosis" symptoms. At the same time, the committee suggested, as measures for effective shift of research topics, it is necessary to introduce a time period when scientists may get away from works in his/her research institutes and join the works of other organizations and researchers. This would let them know new techniques and ideas from outside environment. This practice should turn to be a duty of researchers but not a favour for them. This proposal by the committee even recognized largely as reasonable, however, was not admitted in practice;

- Another situation which was not also settled is a difference in expectation and values between scientists and public R&D organizations. Miller drew out some remarks on organizational structure and research value generally observed among scientists, namely: the professional ethic principles of experts do not let them follow the instructions by managers if noting that the instructions go against their principles and values. Under view by professionals, the targets to develop professional qualification of scientists or research values are more important than the value of the organization.

The contradiction between scientists and the State in the category of the science for the State exists always when there are no global and common modes for scientific activities and State administration activities. While the State administration activities are based on clearly and apparently defined rules the scientific activities orient always to look for new solutions. The scientific activities are highly creative and then the search of solutions for new problems is usually conducted through new ways. Really it was long time the world expected to get a simple and clear method/procedure to conduct research activities in order to enhance efficiency of scientific labor. The works by Papp Alexandriski, Greek mathematician, second half of the third century, and then modern time mathematicians and philosophers Descarter, Leibnitz, Bernard Bolzano and others made great efforts to build up a universal system of scientific creativity. Finally, similarly to other fields such as efforts in the ancient medicine to look for the water of life or the ones in alchemy to look for ways to turn every things to gold, it was accepted to put end to efforts to simplify (meaning "to handicraft") research activities. The essential contradiction of research process is the fact that even knowing "the targets", it is not clear yet to see the way "to achieve the targets". Facing this situation, it is scientists themselves, but no other one, who has to look for and to create adequate working methods.

1.3. The science for enterprises

In relation to science, enterprises may act as generous sponsors who provide funds for scientific research without concerns for benefits the latter might bring back to them. Mainly these sponsoring actions attract the involvement of science as tools for development of production and business. Now we pay attentions to the following type of science which is called "the science for enterprises".

Both of them, the science for the State and the science for enterprises, have to operate on basis of external needs then they have certain common points, namely: (i) Being oriented to solve assigned tasks; (ii) Being toughly controlled by task assigning actors; (iii) Being strongly invested to complete assigned tasks; and (iv) Getting stuck between scientific contents of research and targets required by finance providers. Also being controlled by enterprises, the science for enterprises gets restrained in freedom of selection of research directions and possibility of large exchange among scientific communities. From another side, the science for enterprises has some specific features linked to interests of production and business activities of enterprises then it gets invested enough by enterprises and gets managed in conformity to rules by enterprises. Being tools to serve enterprises, the science should have more pragmatic orientation and follow competitive business principles in activities.

The prominent motivation of the science for enterprises is the target of application of scientific research, higher incomes from scientific research and realistic investment by enterprises for scientific research.

While satisfying demands of enterprises, the science exhibits more capacities and explores new potentials thanks to trends to link fundamental research to application research[13]. Investments for scientific research to serve production-business needs reduced costs considerably. The time from scientific research to market products gets shortened also. This time in the 19th century was 60-70 years, it was 20-30 years for the first half of the 20th century and it is 3 years by 1990s. The change of time and costs allows enterprises to extend links between scientific research and production-business activities.

In addition, from another vision, the science for enterprises allows to realize the wishes of scientists to promote application of their results of research. Generally scientists want to confirm the rightness and usefulness of their

[13] In the US, 4/5 of the total of researchers work in enterprises and the figure of Japan is 3/4. In Denmark, Finland, Japan and US, the ratio is 10 researchers to 1000 workers and the figures of France and Germany are 7 and 6 respectively (see STI outlook, OECD).

results of research and look for chances to improve them. This would push scientists closer to enterprises. Even scientists may set up their enterprises to apply themselves their own results of research.

As it was said above, there exist certain contradictions between scientific contents and business serving orientation. Similarly to the science for the State, here the science for enterprises needs to avoid the deviation from research targets. From one side, scientists wish to conduct highly difficult problems to affirm their capacities and, from another side they are required to focus efforts on settle problems rising in production-business activities. This contradiction opens new changes in management practice of the science for enterprises.

From one side, large industrial corporations want their research centers to be linked closer to and to serve better production-business activities. The typical case is AT&T Corporation. This corporation has Bell Research Center which gathers numerous outstanding scientists including Nobel laureates. However, the leading bodies of the corporation remain unsatisfied to hear the claims from business directors about uselessness of academicians. Then AT&T leading bodies had to conduct many reshuffles to improve relations between research centers and enterprises.

From another side, many industrial corporations limit the share of activities defined by research contracts at the rate 50-70% instead of 100%. Siemen Corporation permits to limit the research focus through contracts at the rate of 70% and the remaining 30% is for free research activities which get financed by the Corporation's funds. The same ratio of Toshiba is 50:50 and the one of AT&T is 5:95. The extra freedom for research here is interpreted as to avoid the race for immediate needs without doing fundamental research which provides the background for enterprises to deal with future challenges.

Apparently, the share of free research activities is similar, in terms of motivations, to the science as cosmos religion. However, in fact, this share remains under certain control by enterprises which is most seen in the scope of their interests. Therefore, there are no absolute way for integration of the science as cosmos religion and the science for enterprises. There is only some possibilities, if any, to search to extend the scope of scientific research for benefits of enterprises still remaining in confinements of the science for enterprises.

More than that, recently a new trend appears in research activities by enterprises: no more borders between research (R) and development (D). Researchers, as result, become a kind of "mercenary scientists" for business units. Really, Bell Labs now is part of French Alcatel-Lucent and

concentrate efforts on development segments. By 2003, Bell Labs had only 1,000 researchers with a budget of USD115 million. 50 years ago, it had 25,000 researchers and its own physic laboratories. By 2002, Xerox PARC became a sub-company specialized in provision of research services and licenses for external clients but not for the holding company as it was preciously[14].

1.4. Comparison of the categories of science

The above presentation on relations of science to religion, the State and enterprises shows a new approach. Traditionally, the science and the religion have been seen as completely oppositive poles of visions. The comparison and the clear note of common specifies between the science and the religion lead to an unique approach based on strong wills and braveness. There exists another way to define specificities of science on basis of a Maslow introduced scale. Namely, scientists, in addition to ordinary needs as other people do, have own specific needs: needs of comprehensive understanding, needs of right conscience, needs of aesthetic sensing (rationality, simplicity, order) and etc. The comparison may show how is deep the view by A. Einstein thanks to his emphasis of religious aspects of the science.

The assessment of relations between the science and the religion underlines the common points between opposite poles while the one of relations between the science, the State and enterprises is focuses on the differences and unions. The differences between the science, the State and enterprises mean that not all the sciences can be bound to the State and enterprises. The sciences for the State and for enterprises are specific types.

The new approach opens possibilities to consider some basic aspects of science. The science together with religions, politics and business are popular activities of the human kind. The position of the science, in its consideration among other activities, has an important meaning for it because the science would be mobilized, developed and transferred through these relations. Then it is possible to clarify eventual diversification in orientations, motivations and conditions of scientific activities.

The sciences get distinguished by orientations of activities in conformity to needs, investment sources, management modes and etc., but the most one is the motivation for activities. Even it is necessary to distinguish the science for production-business activities and another one for enterprises. The science for production-business activities can be conducted by scientists

[14] See *The Economist*. 3,2007.

having research aspiration, similarly to the science as cosmos religions, and is not governed by requirements from a concrete enterprise. The illustration for that is the case of Wright brothers - Orville Wright (1871-1948) and Wilbur Wright (1867-1912) - who conducted research and made themselves the air heavier flying machine - the first aircraft.

The interaction among the sciences also may be. The fact that certain scientists focus efforts on academic research and then neglect interests to solve practical needs rising from service for the State and enterprises has causes from the science as cosmos religion. The "practice of confidentiality" largely observed among universities has roots from the science for enterprises. Nevertheless, the interaction cannot remove the borders between them. The clear evidence of these borders is the fight to protect the actually existing principles. For example, "the practice of confidentiality" (researchers in adjacent labs hesitate to discuss new findings and therefore a large silence covers around universities) is a topic just not seen largely during discussions. During a workshop held by Massachusetts Institute of Technology and American Association for the Advancement of Science, John Deutch, former head of a science department of Massachusetts Institute of Technology said the confidentiality is "a big hazard for science… and it goes against objectives and reasons for existence of universities".

In a global view the science as cosmos religion appeared first, then the science for the State and then the science for enterprises. Though they appeared in this order but the sequence does not mean the one appears as result of the previous one. The sequence also does not mean the one replaces or excludes another one. There exist many different paths the science can go.

2. State interventions in the categories of science

2.1. State intervention in the science as cosmos religion

The thing researchers which follow the science as cosmos religion need is finance support to provide enough conditions they can live and work. The State can provide finance and issue policies to encourage social sources to support scientists.

The State supports for science appeared very early but from chance to chance. The example was the case by 335 B.C. where Alexandros the Great, after coronation, provided Aritoteles (his teacher) big money to conduct scientific research. The King did not refuse any requests from the scientist and it was not for any hidden interests but simply a respectful and

thankful gesture from the King. It was maybe the first time in the history a scientist gets a big volume of money to conduct his research works from the Government and also the last event in the following centuries. Now, some Governments pay attention on development of science for purpose of better images of their countries. The German State supports the advancement of science because the latter exhibits the national strength even not paying yet attentions to relations between science-technology and economic development.

It is necessary to emphasize that the shortage of finance has been always problems to scientists. In order to get money for realization of the dream to fly up Wright Orville and Wright Wilbur had to set up a shop for sale, reparation and production of bicycles. Also, Johannes Kepler (1571-1630), astronomer, who discovered the three laws of planet movement, against his heart-breaking pain, had to practice astrology - a cheating science - to earn his life. At another extremity, thanks to supports by the governing power, the scientific activities developed strongly during the Renaissance era (15^{th} century end and through 16^{th} century).

The scope and level of support by the State should be restricted for the science as cosmos religion. The State is unable to subsidize all the people having aspiration for scientific research. Contrarily, the limited budget resources should be toughly selective for objectives of interest. Those who are selected for these supports need not only to have aspiration for scientific research but to demonstrate excellent research capacities. Here, the support level for scientists should not necessarily be high because their main motivation is the cosmos religion. These people are ready to accept minimal living conditions to follow their great aspiration of scientific research.

Actually, even in rich countries, the supports for outstanding scientists are governed toughly. A report by the British Royal Society by 2010 noted that only 7 among 100 doctor grade holders are able to work in research sectors and only one of them can gain the professor title. In the US, there are three professor grades: professor, associate professor and assistant professor. Only the professors are full power teaching staffs of universities. The professors make only about 30% in the total professor grades of a university[15].

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[15] According to practical standards of some leading US universities, an assistant professor must produce, during a 5 year period, one book written by himself and 1 paper at least to be published in a professional journal. All of these works have to get good assessment by an expert council composed by professors from the same department and other universities in the same discipline. Having satisfied these conditions the assistant professor can get the title of Associate Professor through a vote by the council members.

The same procedure is applied for associate professors. So, after the next 5 year the associate professor can get the title of Professor if there exists a vacant position in the department. The eligible condition for that is the

2.2. State intervention in the science for the State

The science for the State needs the presence of the State in many aspects, namely: orientation of tasks, provision of finance, organization and management.

The first important aspect is the clear definition by the State of concrete scientific tasks to be settled. As always there are two groups of tasks defined by the State for science. The first group targets to meet interior needs of the State (State administration activities, defense activities and etc.) The second group targets to serve common needs of the society and national economy that the State deems to take charge for. Difficulties to face, as rules, are seen in definition of the second group of tasks.

Finances spent by the State for the science for the State have to be big enough. The incomes of scientists should be high enough to make them leave behind their aspiration for freedom of research. The salaries they get, in their nature, are the payment for the price of their labor commodities which are classified as complex (multiple time of simple labor) and highly competitive.

The State intervention in organization and administration of this group of science should be deep and tough enough to justify effectively invested finances and, most of all, to meet expectations to settle defined tasks. The State administration also targets to recover low self-consciousness by researchers which more usually observed in the sector of science for the State than the one as cosmos religion.

Therefore, the State intervention must be exact (for defined tasks) and right (investment big enough and control tough enough). There is a similarity of them where the supports for scientists in the science as cosmos religion require clear research outcomes which exhibit the aspiration and capacities for research and the salary payment for scientists in the science for the State also requires the same condition, but additionally, plus the evidence of having settled the State assigned tasks.

In practice, the exactness and the rightness are not achieved uniformly. There are various types of research tasks. The first includes the ones

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recognized good teaching records, 1 book and 5 scientific papers at least as valued contribution for the sector of related discipline. Some other indicators may be taken into consideration such as participation in research programs in the country and abroad which enhance the reputation of the university. The best scores also would come from reputated prizes or big research support funds offered by large organizations or rich companies. So after the first 5 year, an assistant professor gets aware if he/she would continue the scientific research carrier. And only 10 years of successful works they might be sure, for a while, of the scientific carrier and research position. At the same time, the title of Professor could be revoked if the title holder turns not to meet qualification norms or is not allowed to give lectures.

concretely and directly assigned by the State such as some urgent problems with well-defined research subjects in fields of defense, natural disaster prevention, socio-economic development and etc. With this type of tasks, R&D organizations need only to have a comprehensive understanding of assigned tasks and then to implement them accordingly[16]. The second type of tasks includes research topics indicated in the defined activity functions of State-owned R&D organizations. In a large enough scope of activities, State-owned research institutes have rights and need to bear responsibilities in selections of concrete topics of S&T research activities. The State may assign some research tasks which are indicated in general outlines and then it is to R&D institutes to clarify the focused efforts for concrete research works. In a global view, the level of self-governance of the second type of tasks is higher than the one of the first type but the extent of this self-governance is also defined clearly. In addition to the scope of research which is limited in State defined functions, the plans of research works/projects should get approved by State agencies in tough manner of control[17]. The third type of tasks includes contracts R&D organizations sign with external actors in conformity to market economy mechanism. Some State defined research programs may be listed in the third type of tasks then R&D organizations might decide to participate or not in selection of programs.

In the US, the system of national labs has two types. In addition to the Government controlled labs (GOGO), the Government assigns the management to independent organizations and companies on contractual basis with another type of labs (GOCO). While GOCOs are usually free to sign contracts with private industrial companies for commercial potential research programs GOGOs are less flexible because of being restricted by regulations typical for Government agencies.

The disparity as noted here has links to the level how clearly and concretely are defined the tasks to be settled. The restriction of the State intervention is

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[16] Similarly to the laws of many other countries, the Law on Science and Science-Technics Policies of the Russian Federation (promulgated by the Russian Duma on 12th July 1996) stipulates: "The Russian Federation Government and executive institutions of the Russian Federation which establish national scientific organizations have rights to appoint national scientific institutions to make State orders of compulsory status for implementation by R&D organizations" (Item 2, Article 8).

[17] For example, Item 2, Article 5 on proposal of research plans and report of research outcomes according to the Law on Training of Special Research Organizations of Korea (Law No. 2671, by 31st December 1973 and amended by 30th March 1981) stimulates :"Together with submission to the President, the special research organizations (they are legal entities which are indicated and sponsored by the Government, these organizations are established according to special orders by the President) need to present research programs and research outcomes to the Chairperson of the central administrative organization (who has rights to provide finances) and the Chairperson of local administration. This procedure is not needed when research organizations get authorization orders".

seen in actual *impossibility* to define clearly tasks and then to promote tough control of them. From another side, there is not an uniformity also in *necessity* of deep and comprehensive intervention. For example, for the sector of activities having no links to national secrete programs (security, defense and ect.), the level of intervention may be made lower to reduce management costs and to enhance the proactive participation of scientists.

The extension of scope of activities of public R&D organizations out of the State intervention part is usually related to orientation of service for general needs of the society and national economy the State has to pay attention to. However, it is necessary to restrict it at certain level for prevention of possible conflicts due to differences between the categories of science, namely the science for the State and the science for enterprises.

The world now observes increasing trends to force public R&D organizations to cover partially research costs. The Australian Federal Government requires Government research organizations to pay 30% of operation costs from external incomes. The Indian Government forces State-owned research organizations to look for private support sources at the rate of 50%.

It is believed that the requirement of self covering of partial research costs is useful solutions to enhance the self-governance status and to reduce slack and inactivity of scientists. However, the efficiency of the science for the State should be measured according to the level the State defined tasks get settled. A low efficiency rate has no links to the volume of produced research outcomes in general but mainly by the difference between the scope and scale of existence of the science for the State and the ones of the State defined tasks. The essential nature of the phenomena we are facing now is the existence of a part of science which receives no corresponding State defined tasks. The partial costs R&D organizations are required to cover themselves though external market demands, in fact, are not of the science for the State because the State has to make full investments for the tasks it defines. This extra part is exactly the science for enterprises which targets needs of enterprises. Enterprises pay the related costs and manage the works to meet their needs.

The policy to force public R&D organizations to cover partially costs exhibits certain unreasonabilities, namely:

- The fact that R&D organizations getting certain favors from the State may produce certain inequality towards other economic sectors in competition to get research contracts;

- The permission of public R&D organizations (having functions to work for the State) to conduct research tasks out of the State assigned ones is not better than the policy to attract external scientific forces to conduct the State defined tasks;
- The search for additional finances (from external sources) to feed the scientific forces which work for the State exhibits gaps between the ideas to develop the scientific force working for the State and the capacity of the State agencies to define tasks, investments and organization works;
- In case of difficulties to define tasks and to apply the self-governance mechanism as "probe" to set up new tasks, it is necessary to follow the way of the science for enterprises, namely: let scientists do themselves research works (similarly to the science as cosmos religion) but the finances for research works remain secured by enterprises.

Therefore, it is necessary to settle the gap problems on basis of re-definition of borders of the categories of science, to narrow the scope of the science for the State in conformity to the size and scope of problems to be settled and the finances to be rightly invested. This direction fits well the trend to re-consider the scope of activities of the State in general on basis of links between available capacities and expected outcomes.

2.3. State intervention in the science for enterprises

In this category of science, it is enterprises to define the direction of activities, investment, organization and management works. The motivations of the science for enterprises are bound to the business orientation of enterprises. The State intervention in this type of science includes mainly indirect supports via enterprises.

In case of the science as cosmos religion, the intervention measures are direct finance supports, while in case of the science for enterprises the intervention measures are mainly policies to promote investments for scientific activities by enterprises. The most popular supports are measures for incentive tax reduction and credits. There exist also measures of intervention common for the science as cosmos religion and for the science for enterprises such as the State financed support programs to link enterprises with universities and research institutes.

As practice shows, enterprises may have great potentials of investment for scientific research. In developed countries, the part of investment from enterprises makes more than 60% of the total investment for R&D

activities. By 2013, the community of enterprises made 62% of the total R&D investment in the US and about 80% in Japan[18].

In some cases, enterprises may face difficulties in definition of scientific tasks useful for investment. The State can support enterprises through provision of forecast of development directions of science and road maps of technological development.

3. View on science innovation in Vietnam

Vietnam actually passes a strong and integrated process of innovation in aspects of organization, management mechanisms and scientific activity structure. The orientation of innovation needs to fit socialist oriented market mechanisms, to meet requirements of international integration and specific aspects of scientific research[19].

On basis of the above analysis, it is possible to add another orientation which requires to fit the categories of science with specific motivations, orientations, investment modes and management modes. In this optics, the innovation of science in Vietnam should have the following contents.

3.1. For the science as cosmos religion

The State policies towards the science as cosmos religion are well shown through investments for fundamental research and some part of research projects of basic level (research tasks proposed by research organizations). In a general view, actually the State intervention here remains unfocused and unclear.

Among beneficiaries of the State provided investments for the science as cosmos religion there is a sizable part of researchers who do not really demonstrate aspirations for scientific research as well as corresponding research qualification. The separation of scientific research from training duties also leads to lower chances of researchers to use their research outcomes in training activities. There is also no clear separation between the science as cosmos religion and the science for the State.

The management of the science as cosmos religion (researchers provided with the State finances) remains too tough, similarly to the one of the

[18] World Bank. "International Monetary Fund". *Battele and R&D Magazine*. CIA World Factbook.

[19] The objectives were noted in the Program of innovation of S&T management mechanism (attached to Decision No. 171/2004/QD-TTg on 28th Sep. 2004 by the Prime Minister which stipulates: "… creating the basic shift in S&T management to fit socialist oriented market mechanisms and to meet requirements of international integration and specific aspects of scientific activities".

science for the State, which lead to extra restrictions of research activities by scientists.

The low rate of exactness in granting supports and applying management modes are the main reasons of low efficiency and large waste of the State provided investments. This should be one of the focuses of attention in innovation process.

The stimulation of contribution by social sectors for development of the science as cosmos religion does not exhibit yet clear results. The comparison of social supports for arts and sports, from one side, and the one for science, from another side, shows well the disadvantage of the latter. But this situation also exhibits large rooms for future works.

3.2. For the science for the State

We are facing difficulties in definition of scientific tasks to be settled according to real and concrete demands by the State. The embarrassment in definition of tasks to orient activities of the science for the State is reflected in the way State agencies make orders. There is a popular situation where research projects remain far from practical needs, budget allocations for scientific research remain segmented and overspread. In the actual context, the scope of the science for the State, if extending, would lead to lower efficiency and larger wastes.

The clearly defined tasks will be the background for a right selection of implementing forces. The different types of actual tasks would require a different organization of forces. Some tasks can be realized through research projects which can be realized by freelancer researchers and only a small part of research projects requires the involvement of public R&D organizations. The large development of public R&D organization in our country has reasons from the limited capacity for definition of tasks of the science for the State.

The budget allocated to researchers in the science for the State is not atractive enough and even not different from the one for researchers in the science as cosmos religion. This would explain why public R&D organizations fail to attract high qualifies scientists and why researchers in public R&D organizations lack motivations for research. A policy was issued recently to deal with the role of scientists who chair national scientific projects, but this was only an innovative effort to stimulate a very small part of researchers working in fields of the science for the State.

The management mechanisms of the science for the State need, at the same time, to fit the nature of scientific research and to meet requirement of

service for the State. While the State intervention in the science as cosmos religion deals only with efficient management of the State allocated budgets, the State intervention in the science for the State adds a requirement to settle the defined tasks which is a prevailing content of management works. The innovation of management mechanisms of public R&D organizations in our country gets embarassed in dealing with the relations between scientific research and administrative requirements. The basic principle here is: the self-governance status of a research organization should be restricted in the limits of the science for the State. That means the need of tough management mechanism to control the realization of assigned tasks and the quality of produced products (including the time term) to meed actual requirements defined by the State.

It is necessary and possible to innovate radically the science for the State on basis of specific nature of this category of science, namely:

- Re-definition of roles of the State in development of science at the actual stage to set up tasks for scientific research. The scope of defined scientific tasks would define the limits of the science for the State;
- Classification of scientific tasks to serve the State will re-organize the scientific forces for purpose to set up a compact and flexible structure. Public R&D organizations would be established only in highly necessary circumstances such as continued tasks, long term tasks, tough controlled tasks (national confidentiality) and etc. This is the field where no order can be offered to scientists in non-public sectors. The authentic value of the science for the State is the tool the State can use for efficient settlement of the State defined tasks (input-output) but not the development of sizable public R&D organizations;
- Offer of attractive conditions for researchers who take part in scientific research to serve the State. It is needed to define and to implement management modes which combine a higher self-governance status and a tougher State management practice in order to increase the efficiency of scientific research activities for the State. The core focus is to manage tasks including the main components: clear definition of tasks, right investments for realization of tasks and evaluation of outcomes on basis of requirements of tasks.

It is necessary to distinguish two directions of innovation of public R&D organizations in the science for the State: (i) Extension of the scope of activities in addition to services for the State; and (ii) Change of management modes for activities to serve the State. It is necessary to extend the scope of activities from the only service for the State to a larger scope of service for enterprises and to apply other corresponding management

modes where the border between the categories of science will be removed. The innovation of public R&D organizations would be based on specific features of every category of science.

3.3. For the science for enterprises

Despite of big effots of the State to support the science for enterprises the specific features of this category of science (as presented above) require some particular views towards the State supports, namely:

- It is necessary to distinguish the supports for motivation and the supports for conditions in development of the science for enterprises. The supports for motivation can be provided through dissemination of S&T development strategies and technology road maps. The State should not use the supports for condition to compensate the gap of motivation of the science for enterprises. Those enterprises who get benefits from policies of financial stimulation for enterprises to conduct scientific activities should be ready in term of motivation and actually face limited conditions for scientific activities. Otherwise the provided supports would miss right beneficiaries and gain low effects;
- It is necessary to restrict, due to limited resources for supports, the scope of priority beneficiaries of supports. Actually, there two types of priorities: (i) Being based on potentials (for small and medium enterprises); and (ii) Being based on sector of activities (high tech enterprises). The considerations based on potentials deal with enterprises with poor conditions for scientific activities and the considerations based on sector of activities deal with motivation for high rank scientific activities. However, the gap between the motivation and the conditions can be introduced as single norm to assess them. If the gap is large the enterprises should need the attention from State supports to fill up the lacked conditions to implement the defined orientations;
- The State needs to control the invested finances to support the science for enterprises to ensure the efficiency of granted capitals. But a too tough management practice would cause impacts to contents and directions of scientific activities as it is the case of the science for the State. It is necessary to distinguish the beneficiaries of supports and intervention measures in their direction of activities. The State should draw out certain restrictions (sectors, fields, areas) to provide supports for enterprises while still respecting their self-governance rights in selection of concrete scientific directions.

The theoretical studies and practice show that it is necessary and possible to make analysis for the categories of science with different specific features

of every of them. The development of science, in a global view, is based on these particular features. The efficiency of the State supports depends on the level of exactness the borders between them get drawn out which would lead to adequate actions./.

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