

Commercialization of Research through Spin-off Enterprises in Vietnam During the 1990s

Erik Baark^{1,*}, Mai Hà², Phạm Tuấn Huy³ and Phạm Thị Bích Ngọc⁴

Abstract

Science and technology policy in Vietnam has been dominated by a linear model of innovation and the influence of a centralized science management approach transferred from the Soviet Union. However, after the Vietnamese Government embarked on reforms introducing a combination of market driven and State regulated economic mechanisms in the 1980s, scientific organizations were encouraged to commercialize research. In the transition, the leading research organization, known as National Center of Natural Science and Technology (NCNST), pursued technological development in addition to scientific research, and started to establish the first spin-off enterprises to commercialize its innovations. This paper employs institutional analysis to delineate the experience of the spin-off ventures on the basis of government resolutions to support the establishment of spin-off firms, together with the basic institutional requirements such as the autonomy of organizations and the need to mobilize capital for startup funding. Combined with a few case studies, this analysis shows that commercialization of research is difficult in a transition economy without institutional reforms that fully support autonomy, and encourages markets and financial support for spin-off ventures.

Keywords: Vietnam, spin-off enterprises, commercialization of research, science and technology policy

1. Introduction

The Vietnam Center for Scientific Research (NCSR)[†] was established in the 1970s to further research capacity in the country, and serve the

reconstruction of the country after decades of war. Inspired by a combination of French and Soviet elite research organizations, the NCSR initially concentrated on fundamental research in natural sciences such as mathematics and physics. Following

¹ Professor Emeritus, Division of Social Science and Adjunct Professor, Division of Environment and Sustainability, Hong Kong University of Science and Technology

² Associate Professor and Senior Researcher, Ministry of Science and Technology of Vietnam

³ Researcher, Vietnam Academy of Science and Technology, M.Sc.

⁴ Researcher, The Institute of Mechanics, Vietnam Academy of Science and Technology, M.Sc.

*Corresponding author: sobaark@ust.hk

[†] The organization has changed its Vietnamese and official English name several times. In this paper, we shall designate the organization as the National Centre for Natural Science and Technology, which was the official name during most of the 1990s. The table below summarizes these changes:

Period	Name in Vietnamese	Official Name in English
1975-1993	Viện Khoa học Việt Nam	Vietnam Center for Scientific Research (literally: Vietnam Institute of Sciences)
1993-2004	Trung tâm Khoa học Tự nhiên và Công nghệ Quốc gia	National Center for Natural Sciences and Technology
2004-2012	Viện Khoa học và Công nghệ Việt Nam	Vietnamese Academy of Science and Technology
2012-present	Viện Hàn lâm Khoa học và Công nghệ Việt Nam	Vietnam Academy of Science and Technology

the government's decision in the mid-1980s to engage in Đổi Mới reforms that introduced policies allowing market-based transaction, the leadership of NCSR recognized the importance of innovation and proposed that scientific activities should be encouraged to link up with production practice and fast commercialization of research results. The Center initiated a pilot project to establish spin-off enterprises, which very soon led to a boom of spin-offs during the decade. The Center was also encouraged through a series of resolutions by the Vietnamese government to create new conditions for entrepreneurial scientists from research units to help them establish technology based start-ups.

In 1993, the National Center for Scientific Research changed its official name to the National Center of Natural Science and Technology (NCNST) and the government approved a new mission, which included being a facility for professional research institutes, but also developing a site for the formation of spin-offs and becoming an incubator of technological start-ups. During the following decade, enterprises that were more successful gradually became completely independent of the Center and several have become well-known innovative firms in Vietnam.

However, the majority of the spin-off firms faced substantial difficulties in commercializing technologies and products, and frequently became lossmaking ventures, even after gaining more autonomy in decision-making. Thus, the experience of commercialization of research through spin-offs during market-based reforms in Vietnam was less successful than those of advanced countries. This paper describes this experience in terms of policy changes and case studies, with the aim to contribute to an institutional analysis of the difficulties of science and innovation policy in developing and socialist transitional economies. The key research questions are: How did Vietnamese government regulations promote the establishment of spin-off for commercialization of research? What role did

managerial autonomy play in the success or failure of spin-offs? How does the structure of a transition economy affect the fate of research spin-offs?

2. Theoretical Background: Research Commercialization and Spin-offs from Public Research Institutes

The commercialization of research results has been an important item on the science and technology policy agendas of many countries seeking to make public research institutes (PRIs) or universities more useful for society, and the efforts of NCNST in Vietnam were also motivated by the need to serve national economic development. However, the implicit conceptual model for science and technology that Vietnamese policy makers had used in the 1970s was heavily influenced by traditional ideas of the “automatic” benefits of science (Bush, 1945) and what has become known as the “linear model of innovation” (Godin, 2006).

In addition, it had been formed by the influence that accompanied the extensive economic, scientific and educational cooperation between Vietnam and the Soviet Union, which upheld a strict division of labor between scientific research, technology development and production (Graham, 1993). While the influence of such concepts of the role of science and the contribution of scientific research to technological and economic development remains strong in many developing countries, it has been challenged by innovation models that emphasize the role of market demand and commercialization of research results since the 1980s. For example, a report from OECD (2013, p.11) highlighted “concern among policy makers and practitioners about the effectiveness of commercialization policies and mainstream technology transfer practices at universities and PRIs. This has in turn generated interest in new approaches to turn science into

business as well as in new indicators for measuring the two-ways flows of knowledge and technology between public research and business.” Nevertheless, research has indicated the research-based startups generate more patent applications and more radical product innovations, on average, compared to a sample of similar firms (Stephan, 2014).

From a theoretical point of view, the advantages of collaboration between universities and industry are related to the role of scientific and technical human capital in economic growth (Bozeman and Boardman, 2014), especially as societies become knowledge economies. The long-term effects of universities as a knowledge source for industry are widely recognized (Mowery and Sampat, 2005) and the promise of contributions to private firms has become the theoretical rationale behind concepts such as the Triple Helix Model (Etzkowitz, 2008) and legislation such as the Bayh-Dole Act of 1980 that induced US universities to engage more actively in university-industry technology transfer (see Mowery et al., 2004). Nevertheless, the short-term effectiveness and economic impacts have been difficult to assess (Bozeman and Boardman, 2014: 54-55). Thus, there has been growing interest from policy makers and academics relating to the economic, commercial and societal impact of intellectual property generated by research.

The literature on technology transfer from research organizations primarily focus on two modes of output. On the one hand, many studies focus on patents/technology licensing (e.g. Thursby and Kemp, 2002); on the other hand, a number of studies analyze transfer in the form of university spin-offs (e.g. Steffensen et al., 2000). According to OECD (2013, p. 49), there is no standard definition of a public research-based spin-off (or start-up). In the narrow view, it may be defined as any new firm that includes a public sector or university employee as a founder. In the broader view, it may be defined as any new firm including a public sector or university

employee or student/alumnus or former public sector employee as a founder, based on a patent and/or other forms of IP (e.g. copyright) and/or non-technical innovations (e.g. business model improvements). Although many elements of technology transfer, licensing of patented knowledge, etc. are also observed in the setting up of research-based spin-off enterprises, there are aspects of entrepreneurial venture, financial resources, and management that are unique for the operation of spin-offs.

The importance of research and development for development of innovative firms and economies has encouraged a search for ways in which public research organizations can contribute through commercialization of results (Walwyn and Scholes, 2006). Although such efforts require consistent and powerful policy frameworks, it has been shown that several newly industrialized countries in East Asia were able to turn previous “Ivory Tower”—type research organizations into that were serving the demand for new technologies for various user communities (Mazzoleni and Nelson, 2007). In France, policies to encourage the commercialization of research output from universities and public research institutes were introduced in the 1980s; these policies have created stronger linkages between publicly funded research and the private enterprise sector, reorienting activities of organizations such as the Centre National de la Recherche Scientifique (Vavakova, 2006). In developing countries and transition economies such as Vietnam, this type of legal environment has only recently been emerging (Sharif and Baark, 2011). Recent research has also demonstrated that support by the parent organization in the early stage of commercialization by spin-offs speeds up the process and helps spin-offs from public research organizations generate first revenues sooner (Slavtchev and Goktepe-Hulten, 2016).

The new policies have often used new legislation, such as the Bayh-Dole Act of 1980 in the United States, to encourage research organizations to engage

in technology transfer. This trend is also stimulated by the “institutional turn” in the economics of innovation, providing a new emphasis on the role of transaction costs, regulation and cultural values in incentivizing actors to pursue economic development and innovation (Evans, 2006; Mahoney and Thelen, 2009). An institutional turn has proved very powerful in understanding essential development problems and policies in low-income countries, and can be considered the “third generation” of development economics (Altman, 2011). Key institutions that have been considered in relation to reform of research organizations have been laws and regulations, economic incentives, and the personal characteristics of entrepreneurial scientists.

3. Reform and Government Policies of Vietnam During the 1980s

After the issuance of Decision No. 175/CP by 1981, the S&T management system passed many revolutionary milestones of conceptual nature. The most particular characteristic point is the gradual process to get out from the exclusive State management and ownership mechanisms and the increasing trends of particularities of self-governed scientific activities. A review of changes through mark stones of conceptual mindset from 1981 to 1992 shows well the reform process of S&T policies starting from efforts to get off from the exclusive State planning frames (as decided by Decision No. 175/CP, 1981) to the large opening of S&T activities to the all of economic components (as decided by Resolution No. 35/HDBT, 1992). The policy mindset also changed gradually in the direction of getting closer to market economy institutions (Dam, 2015)

Before the Đổi Mới reforms adopted in 1986, Vietnam followed a planned economy structure with a centrally controlled mechanism. This economic structure was dominated by State-owned economic

units and the collective ownership component remained in a minor position, while the private economic component was being fully rejected. In this economic structure, the State promulgated plans fixed in advance which assigned duties to enterprises to produce certain volumes of products. For the purpose of completing the assigned plans, enterprises did not pay much attention to quality of products or the demand of consumers. The price of products, which was called a “guidance price”, was fixed according to orders from the commanding center, without taking commodity-money relations, material costs, or labors’ salaries into consideration. Thus, the selling price did not reflect correctly any supply-demand relations and market values. The central control mechanism included an administrative machinery that defined basic operational norms for productive enterprises and economic units that did not carry any liability or face any prospects of bankruptcy. All products from factories were distributed by organizations that were specially assigned to take care of this distribution function, having no competitors. There was little room or incentives for science and technology to play a significant role in this economic structure.

After 1986, the economic management structure changed according to new principles of State economic policies. In this process, the structure of economic components, production structure, social structure and other institutional structures gradually moved towards market relations. From the position of accepting only the existence of state-owned or collective economic components, the Vietnamese government came to acknowledge a multi-component economic structure and started to promote joint business with other countries. These moves offered initial steps that generated a favorable socio-economic environment for science and technology (S&T) activities.

Following the start of the Đổi Mới reforms, numerous State documents were issued to facilitate the implementation of new management mechanisms for S&T activities. Particularly, Resolution No.

35/HDBT, issued by the Council of Ministers on 28 January 1992, offered favorable conditions for scientific organizations to undertake proactive initiatives to mobilize capital resources, to use available capital, and to develop their initial access to markets. Even if it can be argued that they still suffered from the impact of central control mechanisms, they were able to start practical actions that demonstrated the important shift in the managerial mindset, as well as the emergence of more open concepts of management of S&T activities.

Resolution No. 35/HDBT recognized the fact that S&T activities did not need to constitute a State monopoly: on the contrary, the existence and usefulness of private components in S&T activities were recorded, and the roles of individual researchers in S&T activities were respected. Issuing the Resolution by the government thus offered contributions to mobilize S&T resources and allowed the formation of S&T organizations with various economic components. The process of reform was driven forward by the recognition of the market potential of domestic research results, and the need for a new level of autonomy in the management of units that were undertaking production and conducting business activities.

4. The Transition of the National Center of Natural Science and Technology During the 1990s

By end of the 1980 decade, the leaders of the National Center of Natural Science and Technology remained frustrated in their efforts to promote transfer of research results to production. The institute had continued the structural model of Academy of Sciences in the socialist countries where the academic research activities held dominating positions. Facing the new context of economic reform and requirements for more advanced technology, this it became clear

that the Soviet model exhibited severe disadvantages, such as: a cumbersome organizational structure; low initiatives to mobilize capital sources; high costs of management; and a high share of non-researching staffs. Therefore, the center needed to restructure its activities to meet new requirements of an economic shift to market driven mechanisms.

In the new context, many research institutes or centers were reduced to the level of 50-100 scientists that cooperated closely in research. This structure would let them be more dynamic in searching for new opportunities to host or to participate in research projects, to develop links to partners, and to develop financial sources for research activities through S&T service contracts, including through international cooperation activities. Moreover, in the new context of decision-making power decentralization, the National Center of Natural Science and Technology created specific research centers to meet demands of development.

The National Center of Natural Science and Technology therefore set up research units to cover all the natural science fields including 24 research institutes, and research centers distributed over all the key cities and provinces of the country. During this period of time the activities of fundamental science and applied science research were implemented in 9 State level scientific and technical programs. An important element of this effort was to upgrade human resources, which led to a fast growth of research staff in terms of both quality and quantity. In 1975, the organization had about 900 scientific researchers including 50 with post-graduate qualifications. By 1985 the number of scientific researchers had increased to 2,400, including 40 doctors of sciences and 230 doctors (equivalent to international PhD degree). Thus, the number of doctors of sciences had increased by 24 times, and the number of researchers with a doctor degree had increased by 5 times (Long, 1996).

In addition to activities to increase human resources during 1990s, the National Center of

Natural Science and Technology initiated first steps to strengthen research infrastructure in terms of laboratories and equipment. The development of infrastructure was made not only for the Nghia Do Research Area in Hanoi, which had been constructed and equipped by the Soviet Union including laboratories in key sectors of biology, earth sciences, chemistry and physics. In addition, numerous researchers and huge volume of machines and equipment were sent to develop the second site of the National Center of Natural Science and Technology in Hochiminh City and to take over the Marine Institute in Nha Trang City.

To achieve an improved management mechanism, the NCNST reduced management size and adopted a decentralization scheme that enhanced liabilities and power of units under its administration. In addition, it separated more clearly management functions and implementation functions, started practicing a more democratic decision-making scheme for S&T activities, proposed measures to encourage young leaders, and stimulated staff to enhance their qualification levels.

In order to improve the economic conditions at research institutes and centers, NCNST gradually reduced the existing subsidy scheme and replaced

it with self-financing opportunities, introduced policies for open and diversified international cooperation activities, and conducted pilot schemes of labor contract for recruitment of new staff with graduate degrees. Since Vietnam was still a developing country with a weak infrastructure, the National Center of Natural Science and Technology had to pay great attention to international cooperation ties to develop research activities. Efforts for higher level of international cooperation were important concerns not only of Institute leaders and the Department of International Cooperation, but also became central issues of research institutes and individual scientists. The NCNST leaders thus sought to offer a very favorable environment for researchers to participate in international cooperation activities.

After 15 years of development, the National Center of Natural Science and Technology had gained considerable achievements in development of relevant research by 1990. The most important initiative was to test a new model of linking scientific research and production activities were, allowing research units to sign contracts with industrial production enterprises. For the Center as a whole, the reliance on external business funding continued to increase during the 1980s, as shown in Table 1.

Table 1. Finances from business contracts and finances from State budgets, 1981-1988 period

Year	Finances from State budgets (VND 1,000)			Finances from business contracts (VND 1,000)		B/A (%)
	Salaries & Allowances	Research & Other expenditures	Total (A)	Number of contracts	Total income generated (B)	
1981	3,018	11,635	14,653	9	237	2
1982	3,872	26,150	30,022	46	2,384	8
1983	5,106	43,894	49,000	101	5,125	10
1984	7,155	64,365	71,520	106	13,342	19
1985	8,751	64,818	73,569	141	22,919	28
	4,110	4,760	8,870			
1986	15,501	49,604	65,106	154	54,118	83
1987	42,929	123,584	166,513	337	180,072	108
1988	144,144	1,110,455	1,244,599	448	2,393,548	192
Total	234,568	1,499,265	1,733,851	1,324	2,671,421	

Source: Dept. of Planning Services, Vietnam Institute of Sciences

5. Formation of Autonomous Commercial Spin-offs

As a result of the Đổi Mới reforms new spin-off enterprises or units emerged to implement research results in production or S&T services. By 1990 the government introduced Decision No. 268-CT which allowed research institutes to organize business enterprises engaged in industrial production or services, motivated by new requirements to settle redundant staff. Subsequently, the government issued Resolution 24/CP on 22 May 1993 to restructure the National Center for Scientific Research, and to change its name to the National Center of Natural Science and Technology. In the new structure, the NCNST became reorganized from 60 institutes into 17 research institutes and 9 affiliate institutes.

The NCNST had established 60 enterprises and implementation units during the short period from 1988 to 1990. These enterprises and development organizations were established as a result of facing market demands, and the interests of scientists motivated by new State policies that encouraged opening research to society. These units implemented research results, applied S&T advances, and transferred new technologies into production and service activities, on the basis of Decision No. 92-CT by the Council of Ministers on 22 April 1989 and later Decision No. 268-CT on 30 July 1990.

In their practice, the new R&D units relied on potential research results, research equipment, and the knowledge of researchers to develop economic contracts. In the new practice, institutes increasingly operated on the basis of self-governance, self-liability and self-finance without being supported by State budget funding. Operational finances were contributed and mobilized mainly by the scientists of the National Center of Natural Science and Technology themselves, together with external sources including bank loans and overseas sources. The same scheme was applied for mobilization of

scientific human resources including researchers of the National Center of Natural Science and Technology and external cooperating researchers.

Incomes coming from external sources at the R&D units sometimes exceeded State budget allowances. These incomes were often used for enhancement of living level of scientists. In addition, contributions were made to capital for scientific research and purchase of research equipment in order to shorten time gaps for application in production activities. After a certain time of operation, such R&D units tended to become separated from research units. Thus, some of the researchers were moved permanently to undertake R&D activities and to organize production and business activities. Their incomes came from realization of economic contracts, S&T services and trading business of products made by their R&D units. In general, they managed without getting salaries from State budget allowances. The management of these enterprises and R&D units was simple and flexible, which then permitted the units to secure development in both advanced research and the application of research results.

A good example of such R&D units was the Applied Physics Center which was separated from Institute of Physics and established on 8 March 1989. The Center was assigned with duties to conduct research and application activities and to implement various achievements of modern physics in production. The Center was equipped with technical infrastructure to secure industrial scale production of high grade products of pieces and equipment. It was also technologically qualified to be the contact point for coordination of research activities with domestic organizations and establishment of joint venture units with foreign organizations. During the 1990s, the Center produced many interesting international publications on renewable energy, electro-optics, TiO₂ nano techniques, catalytic optics and other topics. These publications were reported

in many international workshops on advanced technologies and enabled new cooperation ties with foreign research organizations which led to bigger international financial supports for researches.

The Center subsequently made offers on basis of its research results to large Vietnamese enterprises, including technological products such as SPM microscope, TiO₂ catalytic-optic membrane, and Ferrite based materials. These products were of high quality but low prices because of being produced from local materials. Accordingly, the Ferrite based materials produced by the Center dominated the domestic market with multiple applications such as magnetic pieces of power meters by Hanoi Electro-Mechanical Factory, fabrication of loud speakers, teaching tools, or heat sensors of rice cookers. The Center cooperated with other enterprises to fabricate thousands of tons of alloyed grinding balls of high quality for the Bim Son Cement Factory.

In addition, new enterprises were established on the basis of dissolved ancillary departments at the Center. Typical cases include the Science-Technical Material Company (established in 1988 from Department of Material Supply) and the Enterprise of General Construction (established in 1987 from Department of Construction). The Science-Technical Material Company was renamed the Technical Material Import-Export Company (REXCO) on 20 May 1993, and then to Technical Material Import Export Joint Stock Company on 1 November 2006. The scope of business of the Company is quite broad, including medical equipment, laboratory equipment, scientific research equipment, steel and steel semi-fabricated materials; oil and fuel; installation and maintenance of lifts; gemstone and jewelry exploitation and business, fine arts goods; civil construction (irrigation systems, bridges, roads, transport systems, house and industrial electrical systems); consulting, construction, installation and maintenance of medical gas systems, electro-cooling system, domestic and industrial waste treatment;

research and application of new S&T advances in production and business activities (Ha et al., 2015c).

6. The Semi-Autonomous 35-Type Units

On 6 July 1993 The Director of NCNST issued the temporary rules for application of self-governance scheme by R&D units on basis of Resolution 35-HDBT by the Vietnamese government (referred to briefly as 35-type units), allowing these to manage both activities of R&D and business as semi-autonomous units. The 35-type units under management of the NCNST included 1 research institute, 8 research centers, and 11 science-production unions. They are listed in Table 2.

Table 2. NCNST “35-Type” spin-off companies created in 1992

Companies established on Government Decision No. 35/HĐBT on 28/01/1992
Institute of Telecommunication Technology
Center for Energy Research
Science Production Union for New Materials and Equipment
Science Production Union for Chemical Optics and Electronics
Science Production Union for Software Technology
Science Production Union for Glass
Science Production Union for Refractory materials
Center for Chemical-Pharmaceutical and Bio-Chemical Organic Technology
Center for High-Tech Development
Center for S&T research, application and consulting
Science Production Union for Bio-Chemical Industry
Center for Food Technology and Engineering
Science Production Union for Hi-Tech Materials
Center for Marine environmental Monitoring, Research and Consulting
Center for Expertise of Engineering works and Equipment (before: Center for Marine Engineering and Technology Mechanics)
Center for Environmental Technology Research and Application
Science Production Union for Biological and Environmental Technology
Science Production Union for Information and Telecommunication Hi-Tech
Science Production Union for Hi-Tech

Source: Department for Planning and Finance, VAST

The 35-type units under management of the NCNST had full and equal rights to be eligible for participation in State programs and projects of scientific research and technological development. They also had full rights to conclude and to implement economic contracts, civil contracts or to develop partnership links with organizations and individuals, both domestic and overseas. These units were not provided with block finance from State budgets, but were allowed to use research and laboratory equipment provided by parent research institutes. They were required to mobilize the research potential of their staffs according to their own decisions, and to apply results of their research works for production and business activities to make their income resources, using the income for equipment purchase and for personal incomes.

During the establishment of 35-type units, some scientists were transferred to R&D activities, production and business organization works. The total number of staffs working in the 35-type units was 830, where 153 staffs got salaries from State budget sources. Their qualifications were high enough, including 9 doctors of sciences, 27 doctors, 282 bachelors and 312 technicians (Son and Cuong, 2004). At the moment of establishment of these 35-type units, part of scientists of the Center were moved to full-time status of technology implementation activities and production and business activities which provided them with certain additional incomes.

State owned enterprises and 35-type units under management of the Center conducted activities of implementation of scientific advances, technology transfer and scientific-technical services on basis of self-governance and self-liability principles. The operational capitals of the spin-offs were mobilized from their own resources without being supported by State budgets, nor the budget sources of the Center. All the spin-offs from the Center held

compact administration services with limited number of tertiary staffs, while the greater part of staff were mobilized for production and business activities. The main practice of spin-offs was to maximize the use of available research equipment, laboratories and capabilities of researchers for immediate implementation of research results of their institutes, scientific-technical services or intensive commercialization of research results. These activities let them produce extra-budget incomes which permitted them to strengthen research infrastructure. Some of the scientists, thanks to spin-offs, were moved permanently to R&D implementation activities, and organization of production and business activities. They stopped getting salaries from State budget sources, and solely relied on the income realized through economic contracts, S&T service contracts, or sales of S&T products.

By the early 2000s, the leading bodies of the National Center of Natural Science and Technology conducted a new reshuffle of equitation of spin-offs to make them joint stock companies (VAST Steering Committee..., 2009). The ownership of these units were assigned to their members, and they thus became completely independent of NCNST. In the end, while there were a few very successful spin-offs such as the DONA-TECHNO Company and FPT, a large number of spin-offs were actually losing money on their business, as shown in Table 3.

Accordingly, the National Center of Natural Science and Technology gradually removed spin-offs and the Vietnam Academy of Science and Technology currently does not have any of them in its organizational structure. Some were turned to private status or equitized, and then became completely independent. Some returned back to the status of research institutes under management of the Vietnam Academy of Science and Technology. Some were simply dissolved.

Table 3. VAST state-owned enterprises suffering losses in 2007

(Accounting in million VND; 1 million VND ~ 50 USD)

No.	Companies	State capital (in 2005)	Total capital (including state capital)	Debt	Employees (Person)
1	Company for Materials and Technology	2.255	20.120	20.016	11
2	Company for Construction and New Technology Development	1.180	11.571	10.365	55
3	Company for for Biochemistry and New Technology Development	555	14.828	14.530	61
4	Electronic Company ELECO	1.382	1.401	4.518	4
5	Company of New Technology	2.875	38.970	53.941	75
6	Company for S&T Application and New Technology Transfer	1.756	28.752	27.120	30
7	Company for Technology Expertise and Transfer	1.215	56.333	74.891	42
8	Company for S&T Export-Import Service and Production	1.824	68.727	122.679	44

Source: Department for Technology Application and Development, VAST

7. A Few Case Studies of Successful Spin-off Companies

Some of the best examples of models of spin-offs from the National Center for Natural Science and Technology are the Software Technology Science-Production Union (afterward renamed CSE) and the Biological Technology Development Joint Stock Company (DONA-TECHNO). We shall briefly describe the achievements of these two spin-off units.

The Company of Software Engineering (CSE) was originally established by NCNST as the Software Technology Science-Production Union on 14 August 1993. The Union was a self-financed unit that envisioned a target to become a leading software company in Vietnam. Renamed the Company of Software Engineering (CSE) on 14 August 2009, the company undertakes the following activities:

- Research, pilot trial, development and application

of new technologies and techniques in information technology and mathematical application areas,

- Development of software solutions oriented to essential application works,
- Consulting, training and education, and enhancement of qualifications and skills in the above noted areas,
- Cooperation for training of international grade experts of software development,
- Import-export service of products in IT sectors.

CSE is strong in analysis, design and building of information systems on diversified technology platforms. Particularly, many typical software systems were developed on UNIX and Oracle environments and were used in many sectors over the whole country for many years. Up to now, CSE developed more than 30 projects for the government agencies, provincial government agencies and international workshops/conferences.

The Biological Technology Development Joint Stock Company (DONA-TECHNO) was established and started operation in 1993. The main scope of activities of the Company include transfer of biological technologies and trading of chemicals and agricultural products. The products of the Company were recognized by State authorities as goods made on the basis of S&T research. Agri-Fos 400 is a chemical specifically to treat phythopthora on plants and has been sold in large amounts in over 35 countries including Australia, USA, Europe, Japan, Brazil, and South Africa. The chemical can be used to treat numerous diseases of various plants including pepper trees, durian trees, rubber trees, rice, blue dragon plants, etc. Agri-Fos 400 is produced in conformity to environment friendly standards and has no hazardous residuals on agricultural products.

During the two years of 1997 and 1998, DONA-TECHNO Company implemented a project related to import and transfer of technology of high grade fruit trees and investments for farmers to develop production, with a total capital of VND 25 billion. With this project the company became a new model for technological investment in both financial investment mode and technological development. The new products served as a solution for poverty reduction and population resettlement in remote areas and for creation of high quality fruit production areas. Up to now, the species of DONA durian and DONA rambutan were developed by the Company have been propagated by farmers in many localities in Western area of South Vietnam. The acreage of cultivation of these trees cover more than 100,000 hectares. The plantations give good harvests of high quality fruits. Farmers are happy to get higher incomes than the income from cultivation of other type of fruit trees.

By November 2015 the DONA-TECHNO Company was qualified by State regulations as S&T based enterprise (Ha et al., 2015c). In addition to technology implementation activities, these units participated actively in scientific research activities

of numerous programs and projects. Many research results were applied by these units in various economic fields. They also proved useful for development in national security and defense, or implementation of development programs for remote regions and poverty reduction programs. It is worth noting that S&T activities of spin-offs such as DONA-TECHNO were coupled with their targets to enhance economic efficiency of production and business activities. Success of this combination of research activities and production and business activities depended to a significant degree on the strategic visions of leaders as well as the financial potential of every spin-off. However, during this period, the technology market was not yet formed, with a weakness of institutions for intellectual property rights, which led to a practice of valuation of inventions that was much lower than their actual values.

FPT initially was a State owned enterprise in National Center of Natural Science and Technology with the import-export and processing of food machinery as main scope of activities. The Company developed import-export business of dried banana, sweet potatoes and cassava to the Soviet Union and Eastern European countries. FPT originally was the abbreviation for Food Processing Technology Company; on 27 October 1990 it was renamed to Corporation for Financing and Promoting Technology. After 1993, FPT was transferred to management by the Ministry of Science & Technology. More than a decade later, FPT had turned into a big economic group in Vietnam with IT-related service provision as main scope of activity. Other sources such as the Vietnam Report ranked FPT as the third largest private company in Vietnam by 2012.

8. Analysis of the Vietnamese Experience of Research Spin-offs

The operation and development of spin-offs of

the National Center of Natural Science and Technology during the 1990s demonstrates that the NCNST leadership recognized the need for pursue policies to link scientific research activities to production activities. Given the scope of reform stipulated by the resolutions of the government, the NCNST leadership decentralized decision-making to the leadership of individual research institutes and promoted the commercialization of research results.

However, during the initial steps of formation of spin-offs the National Center of Natural Science and Technology experienced problems with the difficult conditions for these initiatives in a transition economy. In order to evaluate the development of spin-offs of the National Center of Natural Science and Technology, it is necessary to consider the role of how the emergence of the market economy impacted on scientific units, and the capacities of these units for self-adjustment while facing challenges of market economy impacts.

The primary initiative consisted of a series of trial moves which turned research institutes from central duties of fundamental research to emphasize applied research. This led them to search and to open new modes of research activities and application of S&T advances for gradual adaptation to market driven mechanisms. During early years of 1990s, most of the difficulties that the country faced in general, and research institutes in particular, were related to capital mobilization. It is important to recall that the in Đổi Mới reforms of the economy were motivated to a large degree on a severe economic crisis in the 1980s, and the government continued to battle with a considerable budget deficit. One of the motivations for creating spin-offs was to save money on manpower and exploit any opportunity for generating additional income for the institutes. Such additional income of course did not materialize immediately and, in contrast, the initial problems experienced by spin-offs were usually the result of the absence of sufficient capital.

During the process of trying to overcome these difficulties of capital mobilization, spin-off enterprises of the National Center of Natural Science and Technology looked for a way to build links to commercial banks such as Techcombank, Habubank and some others. These banks were able to offer some support for spin-offs through active mobilization of capital, which in some cases helped spin-offs to manage survival during the “valley of death” for startups. It also provided useful experience for searching and mobilizing capitals for R&D activities at a later date. In addition to professional science and technology research activities, spin-offs of entrepreneurial researchers conducted a diversified scope of activities, and finally turned the National Center of Natural Science and Technology into an incubator of start-ups and helped set up one of the earliest science parks of Vietnam. The National Center of Natural Science and Technology also offered favorable environment to attract many entrepreneurial scientists from external research organizations, such as those that belonged to ministries and localities.

The formation and development of spin-offs from the National Center of Natural Science and Technology during 1990s provides important lessons: 1) the development of spin-offs required a complete market institutional environment and suitable legal environment for their operation; 2) success also depended on of the scientific and technological capabilities of R&D institutes, and the actual commercialization potential of products; 3) ultimately, success depended on the strong will of leaders, even before establishment of spin-offs themselves.

The establishment of spin-offs during 1990s was useful for re-arranging the organizational structure, and also for reducing the size of employees at the organizations. It is noteworthy that the government required the Center to cut 600 staff within the short duration of 18 months. The establishment of spin-offs therefore presented a simple solution to three critical

problems: to keep pace with development trends of the world; to adapt to market driven mechanisms; and to solve the difficult problem of staff-cutting as required by the government. The spin-offs diversified the functions and organizational structure of R&D institutes and linked them to production activities, allowing R&D institutes to shift to a new status of self-governance and self-liability, in conformity to Resolution No. 115/2005/ND-CP.

Nevertheless, the reality is that many spin-offs could not overcome the difficulties encountered during the initial development process, particularly their difficulties in capital mobilization. The issues of mobilizing capital in the early phases of entrepreneurship is shared with small entrepreneurial ventures everywhere in the world, but such problems are likely more severe in Vietnam (Tran and Santarelli, 2013). They were also not able to solve the problem of relations with mother research institutes, while remaining dependent on the parent organization for R&D, not having independent technological capabilities. During the 1990 decade Vietnam gradually strengthened market forces in the economy, but this was done without establishing the full institutional status of market economy. For the commercialization of scientific and technological achievements, for example, the absence of a strong intellectual property rights (IPR) protection regime hampered efforts to create a firm position in the market. In fact, the initial steps of shift from multi-economic planned structure to socialist market oriented driven structure did not offer a suitable environment for development of spin-offs. A more recent study of the role of science, technology and innovation in Vietnam also summarizes its findings in the following terms: “Innovation requires conducive and stable framework conditions. Viet Nam has made progress but there remains much scope for improvement, including through continuing regulatory and SOE reforms, stimulating competition, facilitating access to finance etc.

Frequent regulatory changes lead to a proliferation of red tape (OECD/TheWorld Bank, 2014).” Even if the government adopted many resolutions to support the ability of research organizations to set up spin-offs, the social and economic policy environment from the macro level to the micro level lacked vital supporting institutions (IPR laws and implementation, financing regulations, etc.), which had negative impacts on the formation and development of spin-offs. The situation for commercialization of research results continues to suffer from similar problems, as summarized by Ca and Hung (2011:140): “Furthermore, to help solve the problem of inadequate linkages between academic organizations and production activities, several issues should be addressed: capabilities of the human resource; financial packages and incentives; organization of R&D system; IPR issues; and assessment of research results. At the same time, a key issue is to increase innovative capability in order to meet the technological innovation needs of enterprises.”

A further reason leading to the limitations and failure of many spin-offs during the 1990s was that an organizational model of organic nature applied to spin-offs, while the State administrative structure and management mechanisms continued to follow the organizational model of mechanical nature. In this sense, the problem was that the spin-off model appeared too early during the 1990s, at a time when the administrative structure and management mechanisms of scientific organizations and the economy had merely taken the first steps of change. Once the traditional organizational models failed to accommodate the innovative new model of commercial business, the leaders simply opted for the solution to divest or dissolve the spin-offs.

9. Conclusion

The 1990 decade had experienced a boom of

spin-offs in the National Center of Natural Science and Technology. These enterprises were a reflection of a shift from central control to market driven economic mechanisms, and helped to restructure the National Center of Natural Science and Technology to suit the new economic institutions and trends of international integration. However, a closer analysis reveals that only a few of the entrepreneurial ventures were able to grow and become profitable. We have focused in particular on the institutional context in terms of government regulation, autonomy of management, and conditions for mobilization of capital to identify the intentions behind institutional reform and the actual outcomes of the process of developing spin-offs to undertake production in Vietnam.

Our study shows that the Vietnamese government took some courageous steps to issue regulations that was strongly believed to promote the establishment of spin-off for commercialization of research. The leadership of the National Center of Natural Science and Technology followed up with a decentralization of decision-making and an enthusiastic promotion of the ambitions of scientists to serve the community. This included a fundamental reorientation of the mission of NCNST from an almost exclusive priority on basic science to a mix of basic research, applied research and ultimately technological development. The new emphasis on the development of technologies for society created the space for innovative initiatives and thus the preconditions for entrepreneurship during the 1990s. The leadership of NCNST also used the opportunity to cut down on personnel resources, by spinning off manpower from ancillary units engaged in import-export, logistics, etc.; interestingly, some of these new ventures were among the more successful firms originating in NCNST.

It has also become clear that managerial autonomy was crucial for the spin-offs that became most successful. This provided enterprises such as

DONA-TECHNO or FPT the possibilities to explore market opportunities and international cooperation. Partly for this reason, some of the spin-offs were undergoing a transition to business firms and left the administrative purview of NCNST—especially during the early 2000s, when the Center turned them over to private status or equitized their share in the firms. Indeed, the largest and most profitable of spin-offs, namely the FPT Group, became complete independent of NCNST at an early stage, and prospered under the its alternative parent organization the Ministry of Science and Technology until it became privately owned.

Our analysis demonstrates that the structure of a transition economy like the one that Vietnam experienced after *Đổi Mới* reforms in the late 1980s had a significant effect on research spin-offs. In particular, the economic difficulties of the time made it difficult for the spin-off firms or the NCNST to mobilize sufficient capital to pass unscathed through the “valley of death” for startups, and finance production required for expansion on the market. These difficulties proved too large for the majority of the firms, and therefore the Vietnam Academy of Science and Technology—which is the current name of the organization—only includes a few self-financing units and one state-owned enterprise in its organizational structure (Vietnam Academy of Science and Technology, 2016:9).

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