gtz

CIEM

THE LINKAGES BETWEEN UNIVERSITIES/RESEARCH INSTITUTES AND SMALL AND MEDIUM ENTERPRISES

By: Nguyen Dinh Cung

Pham Hoang Ha, Phan Duc Hieu

Hanoi, 2006

Introduction

In the context of the economic globalization and the development of the knowledge-based economy, the strengthening of enterprise competitiveness is are increasingly important for Vietnamese economic development. Recent international experiences show that science and technology have become direct and first production forces and competitiveness of nations depend mostly on science and technology capacities. Advantages of natural resources and cheap labor become less important. The role of human resources which have professional and creative capacities has become increasingly decisive. The time to introduce research results into use and technology cycles is more shortened. Competitive advantages belong to enterprises which know how to make use of new technologies for making new products and services and meet diversified and changing demands of customers.

Experiences from developed as well as developing countries indicate that universities and research institutes have played a crucial role in applying knowledge into enterprises, and therefore supporting enterprises competitiveness. As a result, national policy makers and international development organizations have stressed the need to bring about more direct collaboration between universities, research institutes and enterprises.

In Vietnam, most of enterprises are small and medium sizes, therefore the linkage between universities, research institutes and small and medium enterprises is a key to strengthening the competitiveness of enterprise sector. However, the existing linkages among these actors are very weak. This weakness is acclaimed for the low competitiveness of small and medium enterprises in Vietnam and also considered one of main reasons for failure of science and technology activities as foundation for the shortened industrialization, sustainable development and successful integration in the global economy.

This report analyse the existing linkage of universities, research institutes and small and medium enterprises. Section 1 briefly presents some basic concepts of the linkages among universities, research institutes and enterprises. Section 2 analyses the exiting linkages through describing the characteristics of actors in, constraints on, and

framework conditions for these linkages. Based on the foregoing analysis of current situations and constraints, Section 3 provides some general recommendations to universities, research institutes, enterprises and government to take appropriate steps to remove the obstacles in the path of establishing closer university/research institute – enterprise partnership.

1. Basic Concepts for University/Research Institution – Enterprise Linkages

❑ The importance of university/research institution – enterprise partnership

The importance of the university - research institutes – enterprise relationship (UREL) emerged during the latter part of the 20th century in the developed countries. In the context of knowledge-based economies, the developed countries have increasingly considered the UREL being instrumental to provide complementary skills and resources to keep up the technological frontiers and leading edge research, to improve applicability of knowledge for social needs and to use the resources for international competitiveness. The commercialisation of public research and accelerating development of formal mechanisms for UREL have been observed in the developed countries.

Since the 1990s, more intense global competition, rapid technological change, speedier progression of technological development and commercialization, and increasing complexity of new technologies create more pressure on enterprises to look for new ways to compete effectively. Most of the enterprises, especially small and medium enterprises, do not complete array of expertise and facilities needed for successful technological development and commercialization. Therefore, they consider better utilizing the external sources to gain competitive advantage. Meanwhile, the university's redirected mission and focus, which includes developing and commercializing applied technologies, has opened the door for greater UREL. In fact, interaction between researchers and enterprises become more important than before as enterprises are relying more heavily on UREL to broaden and enhance their existing knowledge base.

Recently, the importance of UREL is also increasingly recognised in the developing countries. Compared to the developed countries, the developing countries possess have less capabilities for leading edge research due to lack of skills, competencies and weak industrial bases. However their enterprises need technological capabilities to become competitive in the local or export market, to capture required skills and know-how for understanding borrowed technology, and to access to process adapting the technology to suit local conditions. The enterprises can achieve these purposes by many ways.

Among them, establishment of networks and relationships with universities and research institutions is a favorable solution.

- **Incentives to UREL**

There are major incentives for UREL in enterprise sector: (1) access to manpower, including well-trained graduates and knowledgeable faculty and researchers; (2) access to basic and applied research results from which new products and processes will evolve; (3) solutions to specific problems or professional expertise, not usually found in an individual firm; (4) access to university facilities, not available in the company; (5) assistance in continuing education and training; (6) obtaining prestige or enhancing the company's image; and (7) being good local citizens or fostering good community relations.

On the other hand, the reasons for universities/research institutions to seek cooperation with industry appear to be relatively simple: (1) Industry provides a new source of fund for university and research institutes; (2) Industrial money involves less "red tape" than government money; (3) enterprises-sponsored research provides student with exposure to real world research problems; (4) enterprise-sponsored research provides university researchers a chance to work on an intellectually challenging research programs; (5) Some government funds are available for applied research, based upon a joint effort between U&Is and enterprises.

- **Types of the UREL**

The UREL in this report refers to different types of interactions between the universities/research institutes (U&Is) and enterprises which are directed at the exchange of knowledge and technology. Furthermore, concept "enterprise" in this UREL is a small and medium enterprise. There are different ways of classifying UREL. Based on the nature of exchange, UREL can be divided into three areas educational/ training, service/consulting and research/R&D. Education and training collaboration can be

carried out through the activities of cooperative education, continuing education, further professional education, curricula planning, graduate education, and PhD programs. Service based interactions can take place in the form of testing, certification, trouble shooting and short term consultancies on solving a specific problem of an enterprise. The R&D based relationships include joint R&D activities, contract research, R&D consulting, cooperation in innovation, and temporary or permanent movement of researchers from enterprises to U&I and vice versa. The R&D partnership can be carried out in a more structured form, which is usually extended over a long period with specific resource allocations such as science and technology parks, innovation centres, incubators, collaborative research centres. Furthermore, commercialisation of R&D results in science is usually undertaken through spin-offs: disclosures of inventions, licensing patents, start-ups of new enterprises.

Table 1. Type of interactions between U&Is and enterprises

Education and training
Academic programmes
Cooperation in graduate education
Vocational training for employees
Continuing education
User-oriented programs
In-house training programs
Services and consulting
Industrial extension services
Technology brokerage/licensing
Consulting/services
Coordination of technology issues
Routine technical services
Research based industrial consultancy

Research

Collaborative research
Contract research and technology consulting
Personnel mobility
Start-up of technology-oriented enterprises by researchers in science
U&I-enterprise networking

- **Framework conditions of UREL**

In addition to the main actors of enterprises and U&Is, the framework conditions such as public promotion programs, intermediary infrastructures, legislation and regulation, and institutional settings, may either stimulate UREL relations by reducing barriers and setting behavioral incentives, or impede UREL relations by erecting barriers or by setting disincentives.

2. The University/Research Institute – Enterprise Linkages in Vietnam

2.1. Assessment of existing UREL in Vietnam

- **Education and training activities**

The knowledge exchange between universities and enterprises largely takes place through the employment of university graduates by enterprises. Universities are main suppliers of highly educated people in Vietnam. Over the past decades, the universities and colleges have provided 1.8 million of staff with undergraduate or college background, 30 thousands masters, 14 thousands doctors and about 2 million technical workers. Among those graduates, around 34 thousands people work directly in S&T field

under the State-owned sector. This is the important human resource for the country's S&T activities.

However, there remain some problems in this type of UREL. As can see from Table 2, there were nearly 345 thousand staff with college or undergraduate background working in the enterprise sector, accounting only for 20% college and undergraduate labours in 2002. There were much smaller post-graduate labours working in the enterprise sector: about 9.7% for master degree and 6.5% for PhD. These figures show that impact of education activities in universities through labour force in enterprise sector are moderate both quantity and quality. These impacts are further reduced for SMEs. Table 2 indicates that generally about half of college and university labours in the enterprise sector work in SMEs, while SMEs account for 95% of total enterprises in the economy.

Generally, there was only 29.7% of S&T staff in enterprise sector directly involving R&D works. Surprisingly, this ratio is high for college and undergraduate labour and very low for master and, especially, PhD. These findings may reflect a fact that R&D works in enterprise sector mainly relate to learning how to operate efficiently the imported technologies rather than to carrying research for technology renovation or product development. This situation is little bit worse in the SMEs as this ratio is generally lower than the average. Thus, the impacts of university education activities on the enterprise sector are further reduced as only small share of graduate people in the enterprise sector carry the R&D works and R&D works mainly relate to leaning the imported technologies.

Table 2. The number of college and university graduates in enterprise sector, 2002

	Total	College	Undergraduate	Master	PhD	Scientific PhD
Total S&T staff	348,711	66,380	278,542	2,938	638	213
% SMEs	46.7	45.4	46.9	49.6	66.0	53.5
Total R&D staff	103,696	25,113	77,961	543	68	11
% total S&T staff	29.7	37.8	28.0	18.5	10.7	5.2
R&D staff in SMEs	45,684	10,100	35,271	264	38	11

% S&T staff in SMEs	28.1	33.5	27.0	18.1	9.0	9.6

Source: Our calculation based on Enterprise Census 2002

Second, there is mismatch in the supply and demand for university graduates mainly because the universities' teaching programs do not response to needs of enterprises. For example, engineering studies have a less weight in total university education, and the ratio of engineering to pure sciences students is very low. Consequently, there is comparatively high unemployment rate of university graduates.

Third, the quality of graduates does not meet requirements of training high-quality S&T human resources. For example, the number of information technology has increased rapidly in recent years in response to the high demand for high skilled information technology labours. The qualification review by Japanese agencies on information technology graduates from these faculties found that only 13.5% of basic IT engineers, 15.4% of design IT engineers and 0% of computer network engineers meet the Japanese standard. The low quality of graduates is direct consequence of old teaching and study methods which are not connected to the real life.

Given the high pace of technological change in modern economies, qualifications have to be continuously up-graded and adjusted to new scientific and technology development through the further education and vocational training of employees. In Vietnam, universities and polytechnic colleges are engaged in such types of education activities although to varying degrees. Universities receive a significant income from further education and training. However, vocational training activities are largely provided by other suppliers (private enterprises, semi-public institutions).

In addition to training & education, the permanent mobility of researchers between U&Is and enterprises is not common. The highly qualified personnel are a scarce resource in Vietnam and enterprises attempt to attract talents by offering favourable salaries and career options. However, it is very hard for SMEs to attract scientists and engineers to leave permanently from U&Is. Those people primarily move within the science sector or

leave to large enterprises, especially foreign invested enterprises. There is temporary mobility of researchers but largely on personal or informal basis.

- **Services and consulting activities**

Most of technologies and equipments used in Vietnam are imported. The technology knowledge transferred through this channel is only skills to operate the production system to produce products at reasonable productivity, quality, and cost. The indigenous technologies are usually at small scale. Technology transactions and services have been mainly provided in the field of infrastructures. As a result, the consulting services, monitoring, and verification have not been developed. There are few domestic organisations offering technology services are widely accepted. The technology services provided by foreign organisation is very costly, and therefore, are inappropriate to small and medium enterprises. Therefore, the interaction between U&Is and enterprises in form of service provision is weak.

- **Research activities**

Research interactions between U&Is and enterprises are expected to be the most important one of UREL. In Vietnam this type of interaction remains very low. The research interactions in forms of ccollaborative and contract research, contract research and technology consulting, etc. are not common, especially with small and medium enterprises. A large number of R&D projects are sponsored by Government agencies with a view to generating new knowledge, developing a new technological process or creating new products. These projects are mainly carried by the public institutions with the limited participation of small and medium enterprises. As discussed latter, the R&D research by the enterprise sector is very low, providing few opportunities for research interactions between enterprises and U&Is.

Enterprises conducted 1,307 research projects in 2002 and 75% of these projects are enterprise research projects. The enterprises research projects were mainly carried out

by enterprise staff. The national research projects that are expected to see the research cooperation between enterprises and U&Is only account for 5% of total research projects. Furthermore, most national research projects (65%) were undertaken by the SOEs. The domestic non-state SMEs carried out 18 national research projects (or 34% of all national research projects. This research project structure suggests that the room for UREL in research was not large.

Table 3. Finance resources of S&T activities, 2002

(in project)

	Total research projects	National research projects	Ministerial projects	Enterprise research projects
SMEs	445	41	94	310
State sector	214	18	67	129
Non-state	214	23	27	164
FDI	17	0	0	17
Larger enterprises	862	26	165	671
State sector	753	26	159	568
Non-state	96	0	6	90
FDI	13	0	0	13

Source: Our calculation based on enterprise census 2002

Table 4 shows the number of initiatives applied in year 2002. It can see that enterprises applied 8,313 initiatives from the research projects and most the these initiatives (99%) are results of enterprise's research projects. This situation also means that the national and ministerial research projects undertaken by enterprises actually contributed very few initiatives that are applied in real production. This situation raises big question on the effective use of state budget for S&T activities. The low application of results form national and ministerial research prevent serious efforts of enterprises in looking at research cooperation with U&Is.

Table 4. Finance resources of S&T activities, 2002

(in initiative)

	Total research projects	National research projects	Ministerial projects	Enterprise research projects
SMEs	3154	21	8	3125
State sector	1042	1	2	1039
Non-state	1950	20	6	1924
FDI	162	0	0	162
Larger enterprises	5159	34	17	5108
State sector	4740	34	17	4689
Non-state	417	0	0	417
FDI	2	0	0	2

Source: Our calculation based on enterprise census 2002

Informal contacts and personal networks between researchers from both U&Is and enterprise sides are more important channel for knowledge exchange. Such informal contacts may take very different forms: meetings in advisory boards and scientific committees; occasional contact at industry fairs, exhibitions, conferences; participation in standardisation committees etc.; regional forums and events; and many more.

The following section analyzing the demand side, supply side and environment of UREL will provides more insights into the reasons for current weak UREL in Vietnam.

2.2. Analysis of actors in the UREL in Vietnam

2.2.1. Small and medium enterprise

- **Characteristics of Vietnamese SMEs**

Backward technologies. Except foreign invested enterprises and some large state-owned enterprises in several sectors such as telecommunications, petroleum, consumer electronic goods, electricity and cement production, generally the technology level of enterprises, mainly SMEs, is currently far behind from 2 to 3 technology generations as compared with that of other countries in the region. According to recent surveys of nearly 11,000 enterprises in 30 provinces in the North, 8% of surveyed enterprises, mainly foreign invested enterprises, use the advanced technologies, meanwhile 50% surveyed enterprises reported their technologies at average level and remaining 42% at low and backward level.

Low competitiveness. Majority of enterprises are not competitiveness in the export market and not being capable to enter the market or expand market share. The enterprise census in 2003 found that only 42% of enterprises are capable to export. This ratio vary among different ownership sectors. For foreign invested enterprise, this ratio is high as 79%, meanwhile 38% for state owned enterprises and only 33% for domestic private enterprises. Similarly, only 28% of enterprises think they are capable to enter the new marker or expand the their share in the exiting market. Again, this share is lowest, at 24%, for the domestic private enterprise. The backward technologies used by domestic enterprises are claimed to low labor productivity, high raw material and fuel consumption, high environment pollution, and high cost production, and consequently low competitiveness.

- **Constraints in SME side to UREL**

There are many factors on the enterprise side that constraint demand for and level of UIEL in Vietnam.

Low demand for S&T activities

Overall, there were small percentage 9.7 – 9.9% of enterprises investing in S&T activities, including R&D activities and technology renovation, in 2002 (see Table 5). Small portion (8.8 – 9.0%) of SMEs spent money on S&T activities as compared with 25.6 – 26.5% of large enterprises. Only 8.2-9.4% of domestic SMEs carry out S&T activities, while the corresponding figures for foreign invested enterprises were 26.9 – 28.2%. These figures confirm that majority of enterprises, especially domestic SMEs, do not invest in R&D activities as well as technology renovation.

Table 5. Percentage of enterprises spending on S&T activities, 2002

Types of enterprises	Overal		SMEs		Large enterprises	
	R&D	Technology renovation	R&D	Technology renovation	R&D	Technology renovation
SOEs	12.8	13.0	9.3	9.4	20.2	20.6
Non-state	8.6	8.8	8.2	8.4	31.3	31.6
FIEs	28.6	30.2	26.9	28.2	34.3	37.5
Total	9.7	9.9	8.8	9.0	25.6	26.5

Source: Our calculation based on Enterprise Census 2002

In 2002, total S&T expenditure of enterprise sector was 2.046 bill. VND, of which 1.819 bill. VND (or 88.9% of total S&T expenditures) for technology renovation. The SMEs spent 34 bill. VND on R&D activities and 428 bill. VND on technology renovation, representing only 17.9% of total R&D expenditure and 23.5% of technology renovation of whole enterprise sector. The domestic SMEs invest 29 bill. VND in R&D activities and 281 bill. VND in technology renovation. It is clear that most of S&T expenditure of enterprise is for technology renovation and demand from the SMEs sector S&T is very low and accounts for tiny proportion of total S&T expenditures, despite that SMEs account for 95% of total enterprises in the economy.

Table 6. Total investment on S&T activities, 2002

(in bill. VND)

Types of enterprises	Overal		SMEs		Large enterprises	
	R&D	Technology renovation	R&D	Technology renovation	R&D	Technology renovation
SOEs	163	719	13	162	150	557
Non-state	21	153	16	119	5	34
FIEs	5	946	5	147	0	799
Total	190	1819	34	428	156	1390

Source: Our calculation based on enterprise census 2002

S&T spending per enterprise was quite low in 2002. On average, each enterprise in Vietnam invested only 31.2 mill. VND on R&D activities and 291.6 mill. VND. Noticeably, non-state enterprise only spent 4.4 mill. VND in 2002 for R&D activities and 31.6 mill. VND in technology renovation. Compared to the larger enterprises, SMEs spent much less for R&D and technology, about 6.4 mill. VND and 79.1 mill. VND. The domestic non-state SMEs invest very small amount of money for S&T activities. The SOEs seem invest much more than other types of enterprises in S&T activities. Thus, it is clear that with very small money spent on S&T activities, especially for R&D activities, the demand for research cooperation with U&Is is low.

Table 7. Average investment on S&T activities per enterprise, 2002

(in mill. VND)

Types of enterprises	Overal		SMEs		Large enterprises	
	R&D	Technology renovation	R&D	Technology renovation	R&D	Technology renovation
SOEs	239.2	1036.6	38.5	478.4	434.4	1581.5
Non-state	4.4	31.6	3.5	26.0	19.6	123.6
FIEs	8.2	1355.5	10.5	290.4	1.8	4227.1
Total	31.2	291.6	6.4	79.1	196.4	1699.1

Source: Our calculation based on enterprise census 2002

Lack of attention to technological renovation. Table 8 shows that S&T spending of enterprise only accounts for very small portion (0.2%) of revenue. For SMEs this ratio is 0.1%, while for larger enterprises 0.31%. The domestic non-state SMEs only spent 0.05% of their revenue for S&T spending. These figures imply that enterprises, including SMEs. do not pay attention to S&T activities.

Table 8. Ratio of S&T spending/revenue, 2002

(in percentage)

	Overal	SMEs	Large enterprises
SOEs	0.18	0.12	0.21
Non-state	0.06	0.05	0.10
FIEs	0.53	0.29	0.64
Total	0.20	0.10	0.31

Source: Our calculation based on enterprise census 2002

Among total investment for S&T by enterprises, only 8.8% or 143 billion VND spent on implementation of research works. This amount of investment accounts only 0.036% of net revenue. Most of research projects were conducted by the SOEs (650), the non-state enterprises accounting for majority of enterprises in Vietnam only carried out 147 projects. The foreign invested enterprises carried out 28 research projects with large amount of money. The scale of projects is small with around 170 mill VND spent on each project. Of cause, the scale of project undertaken by non-state enterprises are much more lower this average figure.

The enterprises' spending on technology renovation account of significant proportion of 91.2% of total investment in S&T or 1,630 bill VND. However, this amount account for tiny part of net revenue (0.44%). The average investment in technology renovation was 3.67 bill VND. The highest investment on technology renovation is 14.8 bill VND, while the corresponding figures for SOEs was 2.6 bill VND and non-state enterprises was 0.6 bill VND. In fact, the spending on research and technology renovation mainly forces on equipments rather than development of new technologies or new products. Nature of technology by enterprises is to import the new machineries and equipments and learn

how to operate such machineries. There are few efforts on mastering, upgrading or developing technologies.

The technology renovation is passively implemented. Normally, enterprises undertaken technologies under the strong pressure of markets. That means enterprises only look for new technology when customers order the products and require new technologies. Recent study by National Institutes of Science and Technology Strategy and Policy found that 67% of enterprises reported that they undertaken technology only because of market pressure and 48% said that they invested because of market opportunities. Even, there is a case that enterprises did technology renovation because of suggestion from the higher agencies for the financing clearance purpose.

Although the investment for S&T is low, there are marginal enterprises though technology is a big problem. Among more than 32,200 responded enterprises in the enterprise census, only 12.3% of them said that they face difficulties in accessing new technologies. Noticeably, there were 67% of enterprises concern about the financial issues and 51% concern market problems. These figures can explain partly the obstacles to enterprises' technology renovation. It is obviously that with very low demand for research and technology renovation, there are very few orders from enterprises, especially from SMEs, for the scientists.

There are two main reasons for very low demand for technological renovation. First, for the long time, many enterprises, especially state owned enterprises, have been heavily protected by the state, and therefore not under real competition. These enterprises have not really under strong pressure to make technological renovation for their existence and development. Second, more importantly, many enterprises, including SMEs, realised that efforts and money spent on looking for policy incentives are much more beneficial than on technological renovation. The survey by MPI shows that nearly 40% of enterprises need for related policy and mechanism, as compared to 26% for new technology information. Third, many enterprises still concentrate on short-term benefits and hesitate to establish long-term relationships with universities and research institutions except for philanthropic purposes Consequently, there are few orders from the enterprises to universities or research institutions.

Limited absorptive capacities. It has been widely recognised that the human resource in the SMEs have low education level. Table 9 indicates that average number of S&T staff in SMEs was only 9.62 persons, much lower than 75.97 persons in large enterprises. The number of S&T in domestic SMEs were even lower, about 6.85 person. Look at the education level, the number of staff with postgraduate background was extremely low in SMEs, especially domestic SMEs. Table 7 show even worse picture for the R&D staff in enterprise sector.

Table 9. Average number of S&T staff in enterprise sector, 2002

(in person)

	Total	College	Undergraduate	Master	PhD
SMEs	**9.62**	**2.79**	**8.00**	**0.25**	**0.08**
State sector	22.20	4.75	19.25	1.33	0.50
Non-state sector	6.85	2.42	5.47	0.11	0.05
FDI sector	14.45	3.21	12.03	0.50	0.07
Large enterprises	**75.97**	**17.95**	**60.70**	**1.48**	**0.29**
State sector	96.59	18.97	80.41	2.09	0.59
Non-state sector	38.98	12.95	28.43	0.55	0.08
FDI sector	64.09	22.25	43.88	1.38	0.09

Source: Our calculation based on enterprise census 2002

In SMEs, absorptive capacity necessary for the successful use of scientific knowledge and expertise is often lacking. It is hard for the people without university background to undertake the evaluation of ideas and interpret scientific knowledge into commercial technologies. The absence of highly skilled technical staff constraints SMEs' capability to absorb the technological transfer outside. In most SMEs, human resources available are mainly engaged in production and maintenance and not many are involved in product development. Many enterprises reported that they have staff for receiving, installing and operating the new machineries and equipment. However, the staff are capable of using

efficiently the technologies are too scare. The technological level of enterprises' managers also affecting the technology renovation as technology renovation heavily depend on the vision and technological understanding of of enterprise leaders. The lack of technological understanding of enterprise leaders not only reduces enterprises' willing to renovate technology but also cause importation of inappropriate technology.

Table 10. Average number of R&D staff in enterprise sector, 2002

(in person)

	Total	College	Undergraduate	Master	PhD
SMEs	3.60	1.23	3.01	0.05	0.01
State sector	6.99	2.42	6.06	0.28	0.07
Non-state sector	2.61	1.04	2.06	0.02	0.00
FDI sector	5.82	1.42	5.08	0.12	0.01
Large enterprises	25.07	8.97	18.82	0.36	0.04
State sector	27.32	8.47	21.78	0.57	0.11
Non-state sector	17.51	7.53	12.14	0.10	0.01
FDI sector	28.96	12.42	18.59	0.38	0.01

Source: Our calculation based on enterprise census 2002

Although the technological capacity of SMEs is very low, the survey by MPI found that only 5.6% of enterprises have need for technical education or training.

Limited finance. Table 11 indicates that main sources for financing S&T activities are enterprises own sources. Ebterprises almost do not mobilize foreign fund for S&T. The state fund is not important source for S&T activities, mainly for SOEs.

As with many companies, problems of finance often prevent SMEs from applying new technologies. SMEs also faces difficulty in securing loans for the commercial development of scientific ideas and inventions. Commercial banks are often not forthcoming with loans for the development of new ideas and there is an absence of appropriate venture capital finance. Therefore, the science result is only applied if it is certainly to produce profit for applying SMEs.

Table 11. Finance resources of S&T activities, 2002

(in percentage)

	State budget	Enterprise	Foreign sources	Other sources
SMEs	10.9	54.1	0.1	34.9
State sector	6.1	62.3	0.0	31.5
Non-state	0.0	49.9	0.1	49.9
FDI	5.9	55.3	0.1	38.7
Larger enterprises	6.4	27.5	0.1	65.9
State sector	13.8	28.8	0.1	57.3
Non-state	3.8	78.6	1.9	15.6
FDI	0.0	23.3	0.0	76.7

Source: Our calculation based on enterprise census 2002

Lack of information. SMEs often lack information on the existence and availability of science results even where they would in principle have a need for technological renovation.

Lack of confidence in local scientists. The absence of relations between SMEs and local universities and research institutions may be as a result of general lack of confidence in the ideas of local scientists. Many enterprises have a view that scientists of universities and research institutes are not capable to contribute sufficiently and effectively to enterprises/ technology renovation. The scientists are thought lacking understanding of real life, only knowing the technologies but without economic knowledge. However, in fact, the technology renovation in real life requires combine both technical and economic issues.

The attitudes of unreasonably favour to foreign technologies and equipments still existent, causing the long-term damage to the development of local S&T. The scientists

reported that it is very difficult to find the enterprises who agree to apply the research resukts if local scientists.

2.2.2. Universities and research institutes

- **Characteristics of Vietnamese universities and research institutes**

There are three types of S&T institutions: research and development (R&D) institutions, universities/colleges; and scientific and technological service institutions. The R&D institutions are organised in such forms as R&D institutes, R&D centers, laboratories, research stations, observation stations, experiment stations. Depending on their objectives, organization structure and operation scale, the R&D institutions are classified into: the national-level R&D institutions; the ministerial-level R&D institutions; the provincial-level R&D institutions, and the grassroot-level R&D institutions.

The national-level R&D institutions perform mainly the State's priority and key S&T tasks, aimed to provide scientific foundations for the elaboration of undertakings, policies and laws, create new S&T results of important significance for socio-economic development and the national defence and security maintenance, train personnel and foster talents for S&T. The ministerial- and provincial-level R&D institutions undertake mainly S&T tasks in service of the attainment of the branch and local socio-economic development targets, train personnel and foster talents for S&T. The R&D institutions at the grassroots level mainly conduct S&T activities according to the targets and tasks determined by their respective founding organizations and/or individuals.

Universities are tasked to conduct scientific research and technological development activities, combine training with scientific research and production as well as S&T services. Universities also perform the tasks of basic research as well as the State's priority and key S&T tasks and conduct scientific research on education.

S&T service organizations are tasked to conduct activities in service of scientific research and technological development; activities related to intellectual property and technology transfer; and provide services on information, consultancy, personnel training and fostering, popularization and application of S&T knowledge as well as practical experiences.

Until now, there are around 1,100 S&T institutions, of which 600 institutions are owned by the State and nearly 200 universities and colleges. It can be seen from Table 12 that there are large share of research institutes (28.6%) conducts researches on social and human issues. The mission of these institutes are to conduct basic research providing the scientific grounds for public policy or policy-oriented research directly designing nation-wide and industry-wide development strategies and policies. Their operation are toward the public sector rather than enterprise sector. The next group (25%) are research institutes conducting basic research in nature science. Many of them only conduct research projects that are very theoretical or not strongly related to the operation of enterprises. It can be said that operation of these research institutes are more toward the research community or government sector rather than enterprise sector. Thus, there are at least 53.6% of research institutes with the mission strongly toward the public sector and research community.

Table 12. Distribution of S&T institutions and research institutes, 2002

R&D areas	S&T institutions	Research Institutes
Basic natural science	18.1	25.0
Medicine	5.0	8.9
Agriculture	16.4	14.3
Basic planning	5.6	0.0

Environment protection	4.1	1.8
Other natural science	28.9	8.0
Social and humanity	8.0	28.6
Technology	13.9	13.4

Source: Our calculation based on Economic, Administrative and Development Establishment Census 2002

It is found from the 2002 Economic, Administrative and Development Establishment Census that the research institutes officially received 1,343 bill. VND to finance its operation in 2002, of which 49.4% from the state budget, 37.7% from services and 11.9% from foreign sources. It can be seen from Table 13 that research institutes in the science areas of basic planning, socio and humanity, and agriculture depend heavily on the funding from the state budget, meanwhile technology research institutes find that providing services is main source of funding. Noticeably, 65.6% of social and human research institutes reported that their funding for operation were totally from state budget. It is certainly that these institutes have other income sources that are not reflected in the institute's official budget. This situation reflects the fact that many income-generated relations with outsiders are personal relations. Nearly 60% of research institutes with the finding from the state accounting for more than 70%. These figures suggest that the operation of research institutes are heavily subsidised by the state budget. In other words, linkage with the enterprise sector does not provide the major source of findings for research institutes.

Table 13. Revenue distribution of research institutes by sources, 2002

R&D areas	State source	Service source	Foreign source
Basic natural science	50.0	44.4	5.5
Medicine	43.8	13.6	42.5
Agriculture	64.1	31.5	4.4
Basic planning	88.0	0.0	12.0

Other natural science	58.6	35.6	5.9
Social and humanity	82.5	8.1	9.3
Technology	20.4	74.4	0.2
Total	49.4	37.7	11.9

Source: Our calculation based on Economic, Administrative and Development Establishment Census 2002

Some larger universities operate separate research institutes that are aimed at linking research with teaching and technology transfer and improving quality of lectures. Presently, there are 30 research institutions under the university management. Among them, 4 institutions established by the central Government, 23 institutions were established by ministries, and 3 institutions by the universities. Among 22 reporting institutions, 36.4% of them can finance total their current expenditures, 45.4% can cover 30-80% of current expenditures and 18.2% of them with 100% current expenditure financed by the state budget. These institutions have more than 1,200 staff with more than 50% of state having post-graduate degree. The number of associated staff is 3 time high the permanent staff. In fact, these research institutions under universities are major institutions of universities conducting research works and technology transfer. Over the 2001-05 period, these institutions carried out 460 research projects with total funds of 60 bill VND. These institutions also implement 960 technology transfer contacts with total value of 46 bill VND. Over the same period, 6,200 students graduated from these institutions with more than 500 masters and near 50 PhD.

- **Constraints in U&I side to UREL**

There are several major reasons from the U&I side for the lack of success of the effort to form closer collaboration relationship between the U&I and the SMEs.

Inadequate attention from universities to research activities. Until now, there seem having the common division that education and training are universities' responsibility

while research works are belonged to research institutes. Many universities consider science work is secondary tasks and only used for education and training purpose. Consequently, the budget allocated to research activities are moderate, policies and mechanism on research human development are slowly renovated, the most of personal policies are favour teaching than researching.

Low incentives to research at universities. The existing incentive structure seem encouraging faculty members to teaching than researching works. Income earned from teaching is much higher than researching stimulate faculty members prefer teaching and allocate much their time for teaching rather than researching. Consequently, most of faculty members does not conduct research works and they are considered as "teaching workers". Furthermore, the unclear policies on the research works by faculty members cause the fact that people who involved heavily into research are not invited to teaching activities while the teaching people are not created favourable conditions for research.

Imbalance of education and research duties in university. The universities recognised that it is impossible to improve the quality of education without research works. However, in response to the increasing demand for university education, universities expand scale and types of education. As a result, there is teaching overload on faculty members. Compared with the teaching standards, the time that lectures must spent on teaching works is 3 – 5 time higher. The ratio of education – research – services in Vietnamese universities is 7 – 2 – 1, while this ratio in advanced countries is 5-4-1 and research universities is 2-6-2. It is clear that the existing expansion of education deteriorates the research capacities of universities.

Weak collaboration between universities and research institutes. Under the teaching overload, the collaboration between universities and research institutes are important solution to reduce the overload for faculty members and exploit the update knowledge and more advanced equipments. However, in fact this collaboration remain weak. The main reason is the compensations paid by universities for teaching works is too low.

Lack of entrepreneurship. For commercializing science results, it is required the scientists must find out the specific problems faced by enterprises. Only doing so the

scientists can hope that their research results will be accepted and acquired by enterprises. Furthermore, the scientist must market their ideas to interested enterprise partners. However, most scientists do not have business skills and marketing capabilities. This affects their ability to promote their ideas among potential users or investors and make usable results. The scientists does not know what is happening in some industries that may be interested in his/her idea. The enterprises do not know what technologies are available. Many enterprises have spent large amount of money on imported technologies that are can be provided by domestic S&T institutions. The lack of an entrepreneurial climate at universities and managerial knowledge, especially in the case of researchers from natural sciences and engineering, is a main barrier to start-ups from science.

Financial resource limitations. A major constraint is the lack of funding from the expected sources such as government. Research and development work thrives on funding for the purchase of research tools, travel and other expenses associated with the work. Without funding it is difficult for scientists to undertake further development. In fact, the research facilities in U&Is are poor, backward and incomplete.

The absence of business incubators within universities and research institutions is also a constraint. Such companies, if they existed, could take up the commercialisation of the technology and its transfer to industry

The absence of institutional policy and framework to promote partnership is also a major constraint on the development of University-industry partnership. Most universities and research institutions have no policy on the promotion of cooperation with industry. As a result there are no institutional arrangement (e.g. Liaison centres) for the promotion of communication between industry and the university. This affects the ability of the scientist to market his ideas. He is forced to act on his/her own without the strength that would come from institutional support.

Irrelevant services offered by universities. The research conducted in universities has been largely based upon the personal interests, skills, and expertise of its faculty. Moreover, the faculty's research agenda was often highly influenced by the academic

calendar and their own current teaching schedules. The faculty viewed publications as the critical output of their research. The generation and diffusion of knowledge therefore was to scholars, meanwhile enterprises are concerned with employing knowledge to solve immediate problems in order to maximize earnings. This disparity in focus between universities and enterprises has made for a tenuous backdrop for UREL.

Inadequate autonomy. Universities haven't been delegated with adequate autonomy on planning, finance, human resource and international cooperation in order to promote the dynamics, creativeness and links between research - training and production and business.

2.2.3. Framework conditions for UREL

- **Legal framework**

Science and technology (S&T) are considered as foundation and motivation for speeding up the Vietnam's industrialization and modernization process. S&T development has been affirmed by the State as the first national policy.

Science and Technology Law of 2000: Among other things, this law stipulates rights of universities and research institutions and some measures to pushing up development of science and technology in Vietnam. U&Is have autonomy and take self-responsibility in conducting the registered S&T activities; conclude scientific and technological contracts; train personnel and foster talents for science and technology; and register participation in selection for performance of scientific and technological tasks. The U&I are allowed to set up dependent R&D institutions, S&T service organizations and enterprises. The U&Is are also allowed to enter into cooperation or joint venture with organizations and individuals through contributing capital in cash, assets or value of intellectual property rights in order to conduct scientific and technological activities as well as production and business activities. U&Is intellectual property rights are protected.

The Law on Technology Transfer (LTT) of 2006: The Law provides some breakthrough measures in order to create financial mechanism and motivation for organizations and individuals in technology transfer activities. The Law allows to establish the Fund on supporting national technology renovation in order to assist S&T organizations, enterprises and investors in technology transfer, technology renovation, advanced technique use. Enterprises can use minimum 10% of increased profit from using and renovating domestically created technologies for 3-year period to award staff who directly contribute to the technology use and renovation. The authors creating technologies are entitled from 20% to 30% of income from technology transfer. The Law also stipulates some policies and measures on supporting technology transfer as creating favourable conditions for high-level experts who are foreign and Vietnamese living in foreign countries to work for projects on applying and transferring technologies in Vietnam, sending Vietnamese technology experts to foreign countries to receive technology transfer; having preferential policies on taxes, credits for enterprises using and renovating technology.

Many specific policies on developing potentials and renovating the science and technology management mechanism.

Policies on development of S&T market. In order to bring together U&Is and enterprises, the Prime Minister approved the Proposal on Development of S&T Market by 2010. This Proposal aims at establishing and completing the basic institutions of S&T market, create fair competitive environment, and at the same time promoting and supporting enterprises in technology renovation, increasing volume and quality of technology transactions at the planned growth rate of 10% annually over the 2006-2010 period.

- **Government's direct investment in S&T activities**

State budget expenditure on S&T activities. The State provides funds for performing priority and key S&T tasks, S&T tasks for public interests, and basic research; maintaining and developing S&T potentials; building material and technical bases for the public S&T institutions; and supporting enterprises in conducting applied research and technological development in priority and key fields. The Government commits to maintain the state budget expenditure on S&T at 2% of total budget expenditure. Therefore, the budget expenditure on S&T have steadily increased over time in line with increasing budget expenditure and reached 4,270 bill. VMD in year 2005 (see Table 14). The S&T expenditure consists of capital expenditure (physical infrastructure) and current expenditure (on salaries and other operation costs). In can be seem from Table 6 that although both capital and current expenditure increased, the share of current expenditure have steadily declined over past ten years from 86.7% in 1996 to 59% in 2005. This structural change reflects the change in government financial policy on S&T activities: the State encourages public S&T institutions to be financially autonomy and self-financed; reduces gradually the subsidy to S&T institutions, first though decreasing the state budget expenditure of salaries; and reallocate the S&T expenditure to key state and ministerial tasks.

Table 14. State expenditure on S&T activities

	1999	2000	2001	2002	2003	2004	2005
Total	876	1885	2322	2814	3126	3727	4270
Capital expenditure	154	535	722	1004	1114	1431	1750
Current expenditure	722	1350	1600	1810	2012	2296	2520
% of total budget expenditure	1.13	2.0	2.0	2.0	2.0	2.0	2.0
% of GDP		0.43	0.48	0.53	0.51	0.52	0.51

Source: Ministry of Science and Technology and our calculation

Despite the increased budged spending on S&T activities, its impacts on UREL are not strong. Most of state S&T expenditures go into the state sector or, in other word, to

supply side of the UREL. The impacts of state expenditure on S&T institutions are unsatisfied. Table 6 shows that although the S&T spending by the State increased over past years, its share in GDP remains low and are moderately raised.

There is only 25% of S&T capital expenditure for research equipments ann tools. For example, in 2003 only 300 bill. VND from capital expenditure of 1,114 bill. VND were spent on upgrading scientific tools, the remaining fund were allocated to the basic planning activities. Consequently, although the capital expenditure have increased significantly in past years, the condition of scientific equipments and tools is poor and does not meet the scientific tasks. The survey on 50 S&T organisations found that the the equipment spending per scientist is not high: on average, 121 mill. VND in universities and 139 mill. VND for research institutes, much lower than the 492 mill. VND in enterprises.

Furthermore, the spending on S&T activities are also not meet the demand. The yearly S&T activity spending per scientist is very low: on average, 48.57 mill. VND in universities, 110.02 mill. VND in research institutes and 11.25 mill. VND in enterprise (see Table 15).

Table 15. S&T activity expenditure

R&T institutions	Per institutions (mill. VND/institution/year)	Per scientist (mill. VND/person/year)		
		Average	Maximum	Minimum
Universities	874	48.57	50.44	3.54
Reseach institutes	3,171	110.02	92.40	11.66
Enterprises	1,223	11.25	18.00	0.42

Source: Ministry of Science and Technology

Key National Research Schemes. One of the channels that enterprises can access to the financial support from the state budget is the key national research schemes which

are determined for each five-year period. The 2000-2005 Key National Research Schemes provided funds for enterprises to conduct trail production as well as S&T projects with the view to speed up the introduction of research results into production and daily life. Among 342 S&T projects financed by the Schemes, the enterprises carried out 65 projects, while public research institutes 227 projects and universities 50 projects. The Schemes created 1,064 research results and 325 of them were introduced into production. During implementation of the Schemes, 89 people get PhD degree and 258 master degree. Although the Scheme produced some positive results, their impacts on UREL are moderate because of the following reasons:

- Most of enterprises undertaking S&T projects under the Schemes were large state owned enterprises, normally general corporations, therefore it produces no direct benefit to the SMEs;

- The application of research results into production is not satisfied. Except enterprises carrying out research projects, many other enterprise do not accept or not seriously use research results. There are several reasons for this reluctance. First, some enterprises, mostly state owned enterprises, are stilled protected by the State and face no market competition. Therefore, they do not seriously pay attention to technology renovation for their existence and development. Second, many enterprises try looking for the State policy incentives for maintaining their production rather than investing in technology renovation. Third, many enterprises have no information on the results of the Schemes. As a result, many enterprises have still invested unreasonable large amount of money on importing foreign technologies that the domestic scientists are capable to provide.

- The management agencies have no effective mechanism to ensure right selection of applicants and quality of research results, Enterprises do not want to apply the research results that have poor quality or not strictly qualified. There is no mechanism to support enterprises who are the first organisation to apply the research results. There is no appropriate mechanism to commercialise the research results.

The national S&T development fund. National S&T Development Fund was formed by the Government to provide financial support for the basic research, the urgent or newly-arising S&T tasks, and S&T tasks with good prospect but also risks and to provide low-interest or non-interest loans for application of scientific research and technological development results to production and life. It is noticed that the Fund provide financial support or preferential credit to the research projects directly submitted by institutions or individuals. The Fund will be provided 200 mill. VND form the state budget in the first year and further 200 mill. VND each year. In addition to the state contribution, the Fund is also expected to mobilise funds from other sources.

The ministries and provinces are also required to set up the S&T development funds to meet their scientific and technological development requirements. Organizations and individuals are encouraged to establish S&T development funds. Their S&T development funds are non-profitable organizations that provide nonrefundable or refundable aids, low-interest or non-interest loans in order to support organizations and individuals involved in S&T activities.

The S&T development funds are expected to provide fund for competitive research projects. The problem is effective implementation. The National S&T Development Fund was established in 2003 by the Government Decree, however, until now the Fund have not operated mainly because there is absence of implementing documents, the procedures and particular conditions for financial support. Therefore, the S&T development funds have not yet impacts on enterprises, including SMEs.

Government's Incentives to S&T activities

The Government provides enterprises investing in S&T activities many incentives in forms of taxation, credit, and others.

The S&T Law provides the incentive measure in terms of taxation, credit, infrastructure and information to push up the S&T activities. Enterprise income tax is exempted for Income from R&D contracts; import tax and value added tax are exempted for imported

machinery equipment, spare parts, supplies and transport means, which cannot be produced in the country, and imported technologies which cannot be created in the country. Tax preferences are also applied to products being in the period of trial production, S&T consultancy activities and enterprises renewing technologies or raising the technological standards.

Regarding to the credit, organizations and individuals borrowing medium- or long-term capital to conduct scientific and technological activities shall enjoy preferential interest rates and terms. Scientific and technological programs, subjects or projects demanding large capital amounts shall be given priority in consideration for the use of the official development assistance .

The Government will take a role of building the infrastructure for S&T activities. Particularly, the Government invests in the construction of material and technical bases of important scientific and technological organizations; building a number of key laboratories up to regional and international standards; building a modern national system of scientific and technological information, ensuring full, accurate and timely information on important scientific and technological achievements.

Enterprises investing in S&T development are entitled to reserve part of their capital for investment in S&T development to renew technologies and raise the products' competitiveness. Such investment is accounted in their production costs. Enterprises can set up S&T development funds to take initiative in S&T development investment. Enterprises investing in S&T research in the State's priority and key fields will be considered for partial financial support for such research.

The major problems of existing policy incentives are insufficient level and ineffective implementation. Many enterprises that the current policy incentives are not strong enough to encourage enterprises to carry the S&T activities. Additionally, it is not easy for enterprise to access the policy incentives. In fact, many S&T programs and projects in basic research or import-substitute advanced technologies are fail to access bank credit.

- **Intermediary structures**

In addition to the universities and research institutes on the supply side and enterprises on the supply side, there are S&T intermediaries. The S&T intermediaries can be organisation or individuals specialising provision of S&T information, intellectual property, legal consultancy, technology verification, finance, advertisement, trade fairs and other services. Such intermediaries play the important role in establishing, operating, and developing the S&T market, stimulating the demand and supply relations and diffusing technology. These intermediaries are especially important to SMEs in Vietnam in the UREL as SMEs are often lack of capability in looking for the technology suppliers. In Vietnam, the S&T intermediaries are at the early stage of development. The S&T intermediary services and brokerage are absent or very weak. Abilities of S&T information service organisations in response to the demand for technology products are limited.

The consultancy, verification and valuation services for technology transactions are underdeveloped. Incubator services are at the research and trial stage. Finance services supporting technology incubators and commercialisation of S&T results such as capital ventures, innovative investment fund, and S&T supporting funds have not really operated. Services for intellectual property rights are still limited. Present, there are more than 20 licensed organisation presenting industrial property rights are providing services for foreign customers. Furthermore, there are no cooperation among S&T intermediaries, creating unattractive and low value services.

Science and technology market *(*Techmart). Techmart is a market for technologies and equipments. This market is organised on the basic of collecting information on demand for and supply of technologies from organisations and individuals participating technology transactions. Teachmart is considered as one of the necessary measures to create the linkages among universities, research institutes, enterprises and state management agencies. Techmart was organised for the first time in 1999. Since then 30 Techmart have been organised in many cities and provinces. The scale of Techmart

have been increasingly expanded. Thousands of technologies and equipments, software solutions, technology services have been sold at thousands of billions dong.

The Online Techmart have been opened recently. Supported by information and communication technologies, this market can be expanded significantly location and time of for technology transactions. The online Techmart is olso effective tools for U&Is to promote technology transfer, research results to enterprises and advertise the S&T results. The online Techmart also reduces significantly the costs of advertisement, marketing, and technology transaction. Organisations and individuals can access to the latest information, find quickly the partners; increase the ability to chose the appropriate technology and complete the S&T results. In 2005, there were more than 1.8 millions people access to the online Techmart, of which 2500 people have real demands and 1500 people complete the transaction.

There remain the difficulties in terms of specialists, infrastructure (locations for organising Techmart, information structures and other equipments), and finance that constraining strong development of Techmart and Online Techmart. The main limitation of Techmart is that Techmart is not organised frequently and widely and only exist for short period of 3-4 days. The Online Techmart can solve these problems but face an other limitation that not very one can access internet.

Technology exchange center have been just established. The center is expected to be a fixed and frequent location for technology transaction and integrates all contents of Techmart but without limitations in location and time. The center integrates three functions: presentation of technology products and equipments, access to Online Techmart, and provision of consultancy and supporting enterprises in negotiation, sign of technology contracts. After one month of operation, there have been 50 technology demand-supply connections and 100 accession to Online Techmart. More technology exchange centers will be established in Hanoi, Hochiminh city, Danang and Haiphong in near future.

High-tech parks

Enterprises having investment projects in high-tech park will be provided incentives in terms of enterprise income tax, exemption of land rent, credit guarantee, post-investment interest rate incentive, preferential credit for direct export and export bonus.

High-tech park is considered as effective tools to promote enterprises to invest in S&T. However, presently, two high-tech parks in Hanoi and Hochiminh have not been completed yet. Therefore, its real effects can be assessed at this time.

Venture capital

In the world, venture capitals play activite role in incubating the initiatives, especially in the science and technology. Presently, there are some venture capitals operating in Vietnam. IDGVF was established in 2004 with intention to invest in information technology with the initial capital of 100 mill. US$. However, until now only four Vietnamese enterprises were invested by this fund with the small amount of capital. Mekong Fund invested in the area of export and in fact this fund provided capital for three enterprises. Generally, Vietnamese SMEs have not been qualified to receive medium and long-term investment from venture capital because they have no long-term strategy for technology renovation, except some enterprises in the areas of export and information technology.

The situation of few venture capitals in Vietnam reflects the weaknesses in Vietnamese economy: there is absence of high-tech enterprises, incubators, adequate legislation, weak stock exchange and insufficient support policies for venture capital. Therefore, it is impossible to have full venture capital in Vietnam in near future.

3. Recommendations to promote UREL in Vietnam

3.1. Recommendations to universities and research institutes

- ***Reconsidering the mission and development strategy***

- Balance appropriate between the traditional functions of education and fundamental research with modern functions of creation of practical benefits for society.

- ***Rationalising management structures in order to facilitate UREL***.

- Establish separate business development units in universities to facilitate commercialization of technologies. These units may take a variety of legal forms from a faculty sub-unit to a firm that is wholly or partly owned by the university. These units include:

  Enterprise Liaison Officer responsible for linking the relevant enterprises with the core technologies of the university;

  Science incubators being mediators between university and enterprises .

  Setup patenting & licensing office being responsible for the patent application, transfer of research results, determination of commercial potential of invention, and negotiation of licensing. Such office easies enterprises' negotiating the contract and intellectual property rights with university and releases scientists from burden of the administrative affairs.

- ***Changing the ways of teaching and researching***

- Orient education strongly towards engineering fields, laying special emphasis on rather short-term and practical education and create more practically educated students.

- Renovate curriculum development into direction: basic research and application. Select and use some advanced teaching programs and materials on natural science, technology and economics. Invite foreign professors and oversee Vietnamese to participate in teaching activities or education management.

- Establish new degree programs with full participation of the appropriate personnel from the enterprises.

- Create strong incentives to encourage lectures to change the teaching methods and to combine teaching and research works; for example, the lectures without research works are not allowed to take teaching works.

- Change from talent-forced education to community-focused education, while remain train high skilled graduates for economic sectors. Change the ways of providing admission to university.

- Strengthen continuing education in order to update the changes in the technologies.

- Renovate the S&T management mechanisms and policies in universities, especially in valuation of research projects; give high priorities to research works have valuable application in real life or teaching.

- Scientists must carry out demand driven research. Such research must either be at the request of a potential user of the results or be identified through interaction with potential clients.

- ***Creating the entrepreneurship***

- Find out the ways to increase contact with enterprises: technology fairs, university/research institute – enterprise liaison center,

- Invite enterprise representatives, venture capitalists to serve on important committees dealing with research and curriculum development. This will encourage enterprises and other technology users to participate in the formulation of the research agenda.

- Make scientists and professors more discipline and sometimes deadlines driven.

- ***Creating the incentive to promote UREL***

  - Provide incentives to scientists for involvement into the UREL: success in technology transfer as well as consulting considered for promotion or merit increase.

  - Change the culture of the university by highlighting the benefits of forging relations with enterprises such as new sources of funding, new opportunities for graduates; and new directions for research in some fields.

- ***Creating cultural environment supporting UREL***

  - Allow for flexibility to professors or scientists to choose whether pursue entrepreneurial activities or not, while creating positive incentives for those who see a value to forging ties with enterprises.

- ***Generating spin-offs***

3.2. Recommendations to enterprises

- Recognise the importance and usefulness of locally developed technologies.

- Increase financial support for R&D activities; consider the award of contract research to local institutions; give financial support to technology fairs organised by scientific institutions.

- Encourage enterprise's research teams actively U&I – enterprise collaborations.

- Provide summer internship opportunity for the students and to start cooperative program in which students can spend a year or more working in the company

during their college careers. The universities should allow students to participate in theses cooperative programs.

3.3 Recommendations to the government

Governments should create the enabling policy environment for UREL through: (1) stimulating the demand side of the UREL; (2) pushing the supply side of UREL; and (3) strengthening framework conditions for the UREL.

- **Encouraging the demand side**

  - Create right incentive system for the enterprises to pay attention to S&T activies: removing state protection to the SOEs, establishing fair competitive business environment, and streamlining the administrative procedures. These measures will reduce the enterprises' incentives to looking for policy benefits rather than technology renovation.

  - Improve the absorptive capacities of enterprises.

  - Effective implementation of strong policy incentives in terms of taxation, credit, and investment for R&D activities, technology renovation, and product development by enterprises.

  - Raise enterprises' awareness of benefits of UREL.

  - Create the mechanism to increase the enterprises' involvement into the state-funded S&T projects: strengthen the fair competitive principle in bidding for the state-funded S&T projects.

  - Facilitate enterprises' access to equipments of national laboratories, technology information agencies, and funds for S&T activities, etc.

- **Encouraging the supply side**

  - Effectively implement the self-control and self-responsible mechanism for public S&T organisations which carry out basic researches, strategic and policy researches and researches of S&T key fields and other fields decided by the State.

  - Ensure the autonomy of public S&T organisation in terms of organisation, finance, human resources, international cooperation.

  - Shift research organizations of technology use and development into the enterprise mechanism. Shifting research organizations of technology use and development, which have products linked with the market into one of the following forms: S&T enterprise; enterprise; S&T organization which are responsible for its expenditures by itself.

  - Strengthen the establishment and development of science and high-technology enterprises.

  - Increase investment in S&T researches for universities: investing in building S&T infrastructure, increasing research and development budget, especially applied-oriented basic researches.

  - Encourage linkages between universities and R&D organizations: establishing and implementing regulations on holding concurrent leadership and professional positions for research and development organizations and universities, encouraging researchers of R&D organizations to participate in teaching, and sharing laboratories and equipment for research and teaching.

  - Establish mechanisms and policies to support technology universities to foster technologies and enterprises, especially S&T enterprises in order to soon establish small and medium enterprises which apply S&T research results to production and business.

- Classify and evaluate universities by their characteristics. As the development objectives of each universities are different, it is necessary to apply different indicators to the evaluation of different types of universities or colleges. For those aimed at developing industry-relevant skills for the students, promotion of enterprise-university collaboration and effectiveness of technology spillover should definitely be part of the evaluation.

- Provide funding for universities to establish Incubation Centers. The centers are organized to help entrepreneurs with appropriate background, tapping into the R/D resources of the universities, to start new companies based on new technologies.

- Consider setting up spin-off companies by the professors themselves and/or by the national universities using university funds.

- Establish research centers oriented for industrial technology. The government supports the research center for the early stage after the center is established. Meanwhile, the center is required to find partners from the enterprises to cooperate with. Such research centers can be established within universities or research institutions.

- Delegate the ownership and rights of the government-sponsored cooperative research results to either U&Is or even industrial companies so that they are more able to commercialize those patents.

- Provide scientist more opportunities to access the financial resource on the basei of competitive principle: encouraging individual scientists to bid for research projects under the national key research schemes or to apply the funds from S&T development funds.

- Provide incentives to attract young talents into S&T activities: financial assistance in improving knowledge and skills, good working infrastructure to develop talents,

open mechanism for domestic and foreign relations, good opportunities to get high income, etc.

- **Increasing, diversifying funds for S&T activities and strengthening access to the funds**

  - Increase state spending on S&T activities;

  - Diversify funds for S&T activities;

  - Reallocate state spending on S&T activities: reduce the subsidies; focus investments on key research projects;

  - Improve the access to state S&T investment: Increase transparency and channels in selecting candidates for implementing the state-funded S&T tasks (such as key national S&T tasks, S&T tasks of branches and pro vinces) in order to allow more people can access to the state S&T funding and select right people to carry out the S&T tasks; expand the bidding in S&T activities in order to create competitive mechanism in S&T activities;

  - Reform methods of allocating state S&T funds: state S&T finds should be allocated according to the classification of S&T organisations and performance; establishing the suitable and objective criteria for value and classification of reseach proposals.

  - Reform calculation of compensation for scientists: the finance provided to S&T projects should be lum-sum amount which are determined on the basic of market prices for the similar types of research activities. The leader of research projects have autonomy in specifying compensation paid to the people involving to the the project.

- **Strengthening intermediary structures**

Most of SMEs have a very weak R&D capacity and do not have a sufficient knowledge base to interact effectively with universities and research institutes. Therefore, intermediary organisations might play a role in assisting SMEs to use knowledge from U&Is and integrate knowledge into their business strategies.

- Develop technology intermediary organizations to mediate technologies and consult on technology transfer; provide information of the technology market; promote the S&T market; and organize equipment-technology markets. In advanced market economy, the technology service organisation are private ones. However, at the present, the private sector are not capable of doing this business. Furthermore, this business area is not attractive to them. Therefore, the government should have direct intervention by establishing such organisations and finance their operation.

- Encourage every economic sector to participate in providing intermediary services of the technology market.

- Promote and support independent and specialised committees for reviewing, monitoring the quality and prices of technologies before they are transferred or sold for industrial production.

- Raise public awareness of and demand for use of technology consultant services in economic activities.

- Improve and increase the enforcement of laws on intellectual property and technology transfer. S&T management agencies support Vietnamese organizations and individuals in registration procedures and fees of patents and useful solutions for S&T research results which are domestic and foreign-protected; consulting offices are established to support in registration and enforcement of intellectual property in S&T organizations which are capable of scientific research and technology development.

- Develop and modernise infrastructure of public S&T information services Establishing information infrastructure. There should be balanced development of public S&T information (free and very low fees) and commercial information required specifically by organisations or individuals.

- Develop, update, exploit and disseminate databases, e-libraries regarding S&T activities.

- Encourage organisation of Techmart. Regularly organise Techmart (technology and equipment market) at region or national levels in order to promote, support technology transactions, commercialise the S&T results. Organisation of Techmart should be held in many locations. The "post Techmart" activities should be encouraged to further promote technology transaction. The organisation of Techmart should be gradually professionalised and socialised.

- Develop the technology transaction centers at specific location or on internet..

- Promote the operation of venture capital funds.

- Develop specialists in technology intermediary area: attracting excellent specialists, competent organisations to involve the technology intermediaries; establishing the education and training programmes for specialists in technology intermediaries, and creating the culture of technology intermediaries (respect the contracts, honesty, reputation).

- Strengthen the international cooperation in the technology intermediary area.