

Commercialization of Public R&D in Indonesia (*)

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ABSTRACT

Most of science and technology research activities conducted in Indonesia, in term of budget, are carried out by public research institutions and public universities, whereas private institutions play a minor role. The public R&D institutions could be grouped into two i.e. Departmental Research Institutes (DRI) and Non-Departmental Research Institutions (NDRI).

In order to increase utilization of R&D results produced from NDRI, especially the utilization by industries, some programs for information dissemination, for facilitating interaction between scientists and industry, and for enhancement small and medium scale industries in regions have been implemented.

Barriers for commercialization of the research results come from weaknesses in the R&D institutions especially in designing R&D activities and marketing programs, and lack of interaction among the elements of innovation system. Moreover there is no incentives from government to drive industry to utilize local technology or research results.

In the era of regional autonomy, local government need to take action to facilitate interaction among the elements of the system in the region, so that specific local knowledge and innovation could be utilize to develop local economy based on specific local resource and capability.

This paper provides highlights of activities conducted by several NDRI in order to commercialize R&D results and activities, shows barriers in R&D commercialization, and suggest some action to local government in order to enhance regional or subnational economic competitiveness.

Key words: R&D commercialization, element of SIS, Linkages, NDRI.

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INTRODUCTION

There is no doubt that National Innovation System (NIS) is an important factor which determine national competitiveness [Theodore Levit, 2001]. Functioning NIS in a country could be evaluated from intensity and effectiveness interaction and interconnection between the element of NIS i.e. R & D institutions, universities, and industries, and also performance of supporting organizations such as venture capitals. Many publications clearly indicates that the interaction and interconnection between the elements is strongly influenced by the government policy [Boulding, 2003]. Most countries acknowledge that the government has an important role in its innovation system, but there is less agreement as to what that role should be [Spurling, 2002].

National Seminar on National Innovation System with a theme 'Public Policy to Enhance Industrial Innovation Policy' 2006 revealed that the interaction among the element of NIS has not yet perform properly so that the innovation system in Indonesia has not functioned effectively [Amru H., 2006]. In the absence of effective national innovation system, the regional government can take serious attempts to develop and strengthen its regional innovation system (sub national innovation systems) in order to enhance its regional competitiveness, especially in the era of regional autonomy.

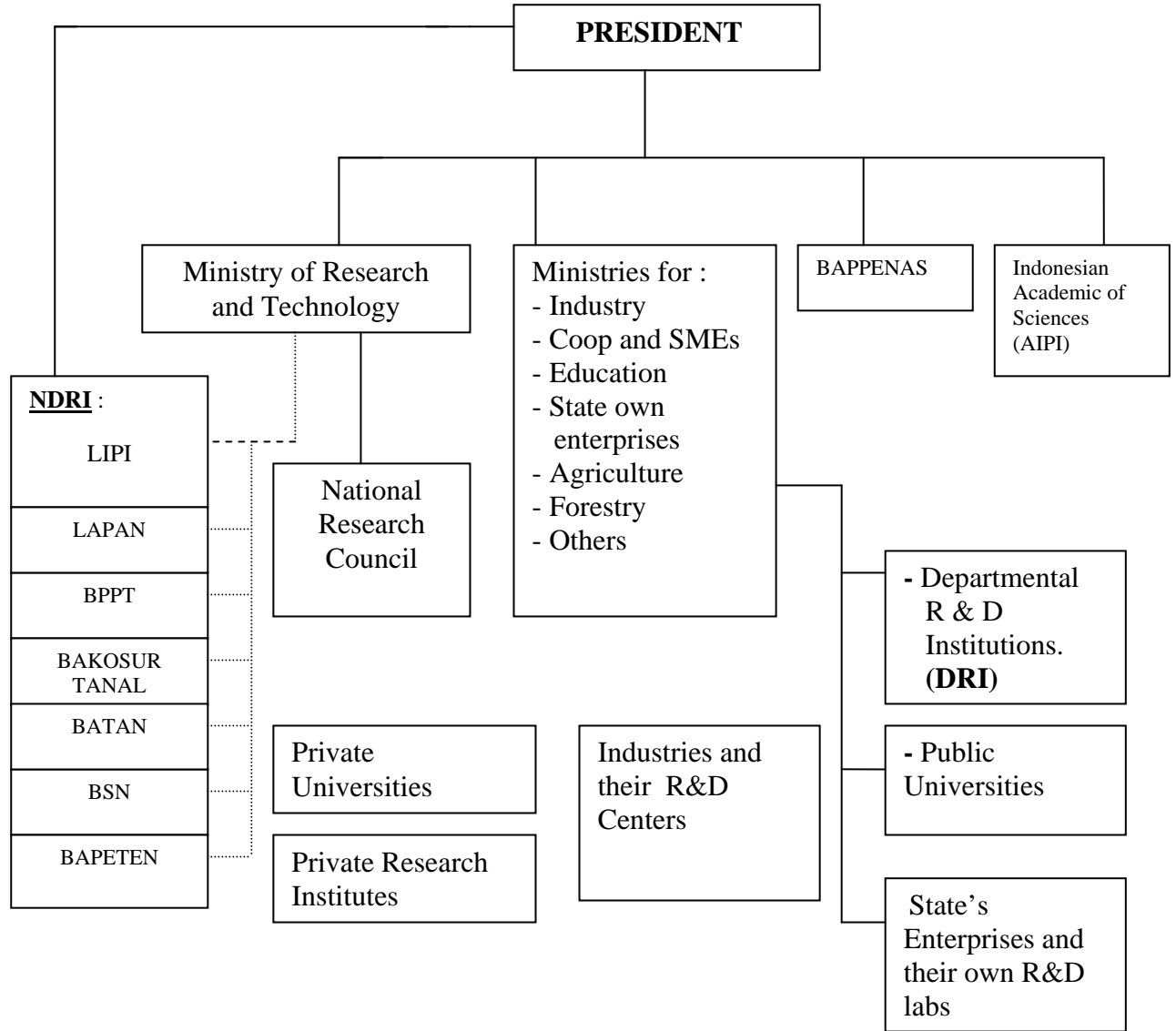
R&D Commercialization does not only mean how to commercialize research results, moreover it means how to commercialize R&D activities, i.e. how to invite investor, industry to make investment in R&D activities [ITDP, 1999]. Many people think that R&D marketing, in order to commercialize the activities or the results, need to be done at the end of research activities. This is incorrect opinion, since R&D marketing should be done since the beginning of research design, and it should become a program of the institutions.

PUBLIC R & D INSTITUTIONS

Mostly S&T research activities conducted in Indonesia have been carried out by government research institutions and universities. In term of budget, around 85 % of research budget in Indonesia has been provided by government [S&T Indicator 2006]. The government research institutions could be grouped into two i.e. Departmental Research Institutes (DRI) and Non-Departmental Research Institutions (NDRI). The NDRI are coordinated by Minister of Research and Technology. Figure 1 shows the organizational structure of R&D network in Indonesia

There are many DRIs distributed in the regions in the country which conducted R&D related to the task and function of the department. Some of them is shown in Table 1. A study conducted by Ministry of Research and Technology [MRT, 2002] showed that most of 22 of DRI studied which located in 10 regions have already linkages to and co-operations with Small and Medium Scale Enterprises (SMEs). 90 % of the DRI studied has hold certificate of ISO 9000 QM standard. However, the links between these institutions and big companies are still weak. Technology transfer from the research institutes to industries mostly about know-how, standardization and testing [MRT 2002].

Figure 1 : The organizational structure of R&D network in Indonesia



_____ Direct Coordination and responsible line
 - - - - - Coordination Line
 From Several Sources and Government Law.

Table 1 : Number of DRI in Several Departments.

No	Institutions	Number of DRIs
1	Department of Agriculture	31
2	Department of Communications	4
3	Department of Energy and Mineral Resources	4
4	Department of Forestry	19
5	Department of Industry and Trade	27
6	Department of Health	14
7	Department of Marine and Fishery	15

Source: Website of each Department, 2004.

PROGRAMME TO MARKET NDRI's RESEARCH RESULTS

In order to market NDRI's research activities and results, to increase flow of information from NDRI as S&T producers to industries as S&T Consumers, to increase interaction and communication among NDRI and industries several programs have been conducted. Ministry of Research and Technology has also launched several programmes and incentives to drive utilization of the research results by public especially by industry (KRT, Webside).

In this article some programs/approaches are highlighted i.e. a). increasing flow of information to MSE, b) S&T Support for Region, c) forming new organizations to facilitate technology transfer, and d) creating spin-off company,

A. Publish media for information dissemination.

It was realized that very limited number of publications produced by the R&D institutions were aimed to industries, especially to SME. Since many years, most of scientific publications have been designed for scientific community nationally or internationally. To increase flow of information to industry, several actions as follows have been taken.

i. Scientific Services Journals.

Several non or semi scientific journals, such as Indonesian Scientific Services (*Jurnal Jasa Ilmiah Indonesia*) and *Teknologi*, etc aimed to advertise R&D results to industry included MSEs are published lately. The journals are designed to advertise science and technology produced by universities and the R&D institutions, its present services, products and technologies produced and provided by the institutions and universities that may help and could be utilized industries. It is expected that via the publications, small and medium scale enterprises would be aware the result of research conducted in Indonesia which may help their businesses. It is expected to encourage transfer of technology from the institutions to the industry.

ii. Industry Forum and Exhibition.

In order to facilitate communication and exchange information between scientists and industry people, NDRI arranges Industry Forums and Exhibitions. In the forum research institutions present their research results and industry could expose their S&T need. The topic of discussion in the forum was designed as such to meet the industry need and current issues.

In addition to the forum, S&T Exhibition is also considered as important media for research institutes to inform public about their research activities and the results. This motion is a kind of routine program conducted by public the R&D institutions.

iii. Information on Multi-Media.

Many of micro and small scale enterprises (MSEs) in Indonesia located in rural areas where the availability of sources information are very limited and internet access is still an exclusive thing. In order to provide them with technology and research result information, Indonesian Institute of Sciences (LIPI) and MRT produces information related to appropriate technology and research results on CD or VCD. Those media were distributed directly to MSEs or Warnet (Internet Kiosk) in the areas. MSEs could get information related to process, quality control, and management of business, etc on CD, free of charge. Few months ago, LIPI just distributed free of charge CD and VCD containing information related to quality control in food processing following to HACCP method to hundred of MSE in regions in West Java. Several *Dinas* at certain regions have received the media to be used in their training program for MSE [Fatimah, 2005].

iv. Broadcast S&T Information via TV Stations.

In order to disseminate S & T information and results of research activities from the R& D organizations and universities, LIPI collaborates with several local TV stations such as Bandung TV, Bali TV, Sriwidjaja TV, Aceh TV, Jak TV, Q TV, and TVRI Jambi [UPT BIT-LIPI, 2006]. LIPI provides the stations with VCD containing LIPI's and other research institutions activities and products, and the TV stations broadcast it at their S&T program. It is expected the TV program could enhance flow of S&T information to community, especially to MSE.

B. Science and Technology Support for Region.

It is understood that (MSEs are generally weak in many areas such as finance, technology capability, human resources and business management.. If a small scale business is supported just in form of technology or management, the business is still difficult to increase its capability, since it does not have enough capital to increase its business. Considering the condition, 1998 LIPI formed a program to assist MSEs in several things to overcome their weaknesses. The assistance are in several forms of support such as technology, management, some capital, etc until their business really extend or grow up. The program is called 'S&T Support for Region' (*Ilmu Pengetahuan dan Teknologi untuk Daerah, IPTEKDA*) [Kusnowo, 2006]. Considering benefit of the IPTEKDA program to MSEs, since then other NDRI such as BATAN (National Nuclear

Power Agency), Agency for Assessment and Application of Technology (BPPT) have also run similar programs to support those industries.

The IPTEKDA program is aimed to :

- a) drive R&D institutions and universities in the region to utilize their capability and research results to support MSEs.
- b) in-line scientist activities in R&D Institutions and universities to real problems in businesses and industries, and so to participate in solving problems facing by MSEs.
- c) increase competitiveness of MSEs through management and technology support in order to produce better quality product or increase their market penetration ability.
- d) create more jobs opportunity for 'grass root community' in the region.

The programs have been focused on assisting small scale industries. Through the program, LIPI assists selected small scale industries to enhance their businesses by providing appropriate technology, business management, training and workshop and some amount of fund for working capital. The technologies introduced to the industries were not only as results of LIPI's research activities, but also technologies developed by universities in the region.

Up to year 2006, by the program LIPI has assisted more than 5350 of small scale businesses located in 28 provinces of Indonesia. In implementing the IPTEKDA program, LIPI collaborates with local academic institutions or *Dinas* (a unit of Local Government for a certain task) in the regions. Information dissemination regarding to the IPTEKDA Program, activities, selection process, etc to public is facilitated through www.iptekda.lipi.go.id. So, the program is designed not only to disseminate and conduct technology transfer, but also to build interaction among LIPI, local universities, local government and industry in the region.

It is worthwhile to be noted that the program is designed as an Revolving Fund Program. Small scale enterprises which have received an assistance, especially in form of working capital and equipment, after several years agreed in a written contract, they have to return to LIPI some amount of cash money equivalent to value of equipment and capital received. The collecting fund is then used to assist other businesses in the region. Through the program, it has been assisted thousands of small businesses with several kind of activities, ranging from automotive spare part manufacturing, food processing, agricultural product processing, handicrafts, fish and shrimp processing, etc. Many of them now could export their products.

C. Form new organizations to facilitate transfer of technology.

As mentioned above that MSEs are under circumstance lack of technology, low management capability, and limited market knowledge and market penetration ability. Moreover, the important role of MSEs and Medium Industries (MSMEs) in providing job for people is well realized. In order to overcome the weaknesses, government institutions and many NGOs create several programs directed to enhance MSEs. In last several years, it is felt that spirit to perform transfer of technology from S&T producer to user, especially to small and medium scale businesses, and also intention to enhance interaction and relationship between S&T producer and User, are getting stronger.

To support MSEs, to promote transfer of technology which could enhance the enterprises capability, local government and Public R&D Institutions have form several types of organization as follow.

- Business Development Service (BDS). BDS is NGO supported by Ministry for Cooperation and SMEs (MCSMEs). BDS is aimed to provide assistance for MSEs located within *Sentra* (a place where a group of micro and small enterprises which has similar activities located) in using appropriate technology, certification of 'halal' label and trademark for food industry, strandardization of products, design, finding new market, and financing, in order to increase productivity and quality of products. Besides creating BDS, the government (through Ministry for Cooperation and SMEs) is also giving financial help in form of Initial Matching Fund (*Modal Awal dan Padanan -MAP*) to MSEs. BDS itself received some of their operational fund from the government to carry out its duties. In 2002 for instance, 200 Sentras throughout Indonesia received assistance from the government through BDS namely 41 Sentras of Food Processing, 20 Sentras of Agriculture Product Processing, 15 Sentras of Poultry, 30 Sentras of Fish Processing and 94 Sentras of handycraft industry [Simamora, 2006].
- Bandung Business Resources Center (BBRC). In November 2006 a group of experts in Bandung - West Java formed Bandung Business Resources Center (BBRC). The center is focused to help MSEs in West Java to find and get information concerning technology, market, expert availability and fund resource etc. The BBRC is supported by LIPI and BPPT) [BBRC, 2006].
- In 2001, LIPI formed Center for Innovation and 22 technical implementation units (TIUs) located at several provinces, and one of their tasks is to disseminate the information on LIPI's capability and research results to public and also to help MSEs and community in the region to find information related to their technology need. It is expected that the center and the units could help to channel information from LIPI's research centers to industry especially to SMEs or reciprocally.
- BPPT has formed a Business Technology Center, BTC aimed to assist and to facilitate technology transfer from BPPT to industry [BTC]. BTC is focused on SMEs development through technological upgrading.
- The Local Government of West Java Indonesia formed SENADA, an organization aimed to help MSEs to carried out financial analysis, business planning and preparing proposal, technology and human resource development [BBRC, 2006].

D. Spin-off company.

Many public R&D institutes in developed countries have used spin-off companies as an important transfer of technology mechanism in attempts to drive utilization of its research result by industry. Through this technology transfer mechanism stronger linkages between R&D institutes/universities and industry, an essential factor indicating effective functioning of innovation system, can be developed. This type of transfer of technology mechanism is becoming more important for developing countries, like Indonesia, where local industries are still doubtful to adopt or utilize technology resulted

from local research institutes or universities. Transfer of technology mechanism through establishment of spin-off companies can, therefore, assist in commercializing of research results from R&D institutes. Currently several the public R&D institutes and universities in Indonesia have also begun using so-called indirect spin off companies as a transfer technology mechanism alternative. Government policies through the enactment of Government Regulation (PP) No. 20/2005 on Transfer of Technology of Intellectual Property and Result of R&D by R&D Institutes and Universities and PP No. 23/2005 on Financial Management of Public Service Agency (*Badan Layanan Umum, BLU*) have further created a more conducive environment for R&D institutes to use spin-off company as a transfer of technology mechanism.

LIPI through the mechanism have transferred its technology to several spin-off companies. The companies belong to a cooperative organization, group of scientists and staffs who has retired, or other parties. Development of new companies by research scientist were quite successful since they have technological and management capability, although they have weakness on market knowledge. Collaboration between retired scientist and businessman have formed a sound business. Relationship between LIPI, as the owner of technology, and the spin-off is based on business relationship. As the owner of the technology, LIPI's research center receives royalty from the spin-off company.

Such mechanism has also been used by other R&D institutions in Indonesia, such as National Nuclear Power Agency, which developed a spin-off company to produce radio-active materials. Several major state owned universities formed companies to conduct services and technology transfer to industries. For instances, Bogor Institute for Agriculture (*Institut Pertanian Bogor, IPB*) formed a company which focus on commercialization of the institute's R&D Results in field of tropical fruits. Bandung Institute of Technology (*Institut Teknologi Bandung, ITB*) formed a company to commercialize their R&D results in fields of energy, information technology & communication, biotechnology, arts and design .

E. Incubator

Incubator is a program designed for a company or an investor who want to use technology resulted from a research in which all aspects of production are implemented such as production process, management of production, market test, etc. Some of the public R&D institutions have put the incubator program as one of R&D commercialization program.

F. Licensing

Performance of economics oriented S & T activities could be measured by number of intellectual property protected or Intellectual Property Rights (IPR) especially number of patents applied and granted. Like scientific publications, number of patents could give some information about characteristics of S & T activities in a country. Since patent documents are public domain, the application for patent protection might give valuable information to inventor's competitors. So that, not all of potentially profitable inventions are patented.

The NDRI are also concern about licensing of patent. Licensing of patent is also one of activities to commercialize research results. The S&T Indicator (2006) indicates

that number of patent licensed by public R&D institutes were increased from 2 patents in 2002 to 21 patents in 2004 (Table 2). The data indicates that there is a trend of increasing number of research results utilized by industry.

Table 2 : Progress of Patent from Public R&D Institutions (*)

Tahun	Number Of Patent Filed	Number of Patent Commercialized
2000	24	2
2001	62	7
2002	45	6
2003	47	8
2004	65	21

Source : S&T Indicator 2006, page 82-83.

(*) the number is not aggregate number from all Public R&D Institutions.

INTERACTION AND LINKAGE AMONG R&D INSTITUTIONS AND MSMEs

In year 2004, Center for Innovation LIPI conducted a limited survey to take a quick look how was interaction among the system innovation elements in several regions within two provinces, West Java and Lampung [Simamora, 2006]. In the survey, small and medium food industry was used as the case. The study was only covered around 140 SMEs, a very few number compared to total number of SMEs in the provinces, so that it is understood that figure may simply give a rough picture of real conditions in the provinces. Some of the information collected was concerning what are the service need by SMEs and how is relation among SMEs and research institutions, and others parties in the regions.

In the provinces, there are several kind of service providers such as Cooperative Unit, Public R & D organizations, Private R&D Organizations, public and privates universities etc. Services from those providers could be utilized by SMEs to support their business.

The study showed that major assistance needed by small industries from service providers, except assistance from Cooperative Unit, is shown in table 3.

Table 3. Type of Major Assistance need by small industries from Service Providers.

Type of Services	West Java (%)	Lampung (%)
Marketing	27	28
Management	6	16
Business Planning	11	15
Training for Technical Skill	19	28
Finance	21	11
Law	3	2
Others	2	-
No Answer	11	-

As one could predict, marketing is the major concern of small industries in both provinces. In West Java, financial assistance is placed at second rank, while in Lampung need for training as important as for marketing. The need for assistance related to Business Law is the least.

The organizations frequently be asked by small industries to assist them to solve their problems or to get information, exclude Cooperative Unit, is shown in table 4.

Table 4. : Organization / Source Frequently Ask for Assistance.

Organization / Source	West Java (%)	Lampung (%)
University	8	23
R & D Institution	19	3
Private Consultant	19	7
Bigger Enterprise	8	14
NGO /BDS	3	-
KADINDA	3	-
Industry Association	5	2
Buyer/Other trader	24	31
Others	8	7
No Answer	3	13

The respond shows that in both provinces, buyer and trader are dominant partners for small industries in order to seek help for business enhancement. In several regions in West Java, where lot of universities and Public R & D Organizations located, these institutions are not yet become the first place for small industries to seek help. While in Lampung universities are much popular for the industries than in those in West Java.

The study reveals that there is interaction and linkage amongst the elements of regional innovation system in the food industry in the regions, although interaction and linkage need to be enhanced.

The local government has made serious attempts to strengthen and to improve capability of MSEs by providing several kinds of training for MSE workers, even though the training program was not sustain. The local government has important role to facilitate the interaction among the element. The use training facilities and training programs to facilitate those interactions is one of important roles.

CHALLENGES IN COMMERCIALIZATION OF RESEARCH RESULTS.

Transfer of technology from Public R&D Institutions to industry, especially by means of commercial mechanism, are challenging task. A study shows [Higgins, 2001, Aiman, S, 2002, and RAMP-IPB, 2006] that weaknesses in internal organization need to be overcome in order to increase utilization research results by industry commercially. Unclear in R&D marketing direction and policy, weakness in design of research, lack of R&D marketing capability, limited research budget to conduct market test, besides very limited incentive from government to industry which utilize local R&D results are the hindrances.

Many of researchs conducted by public R&D institutions, included what so called applied research, are not yet designed and aimed to fulfill the market / industry needs. The activity designed and proposed by a group researcher appears more to satisfy the researchers want rather than to support industry development or to solve industry problem.

Marketing is not designed from beginning of research design, neither become programme of the institutions. It is conducted only at the end research activity, so that marketing is become a kind of burden for researcher since marketing is not competency of the researcher. Many of researchers do not aware about industry need related to their activities, since very limited contact between researcher and industry / market. R&D Marketing should be responsible for all level of managements in the R&D organization, it is not only responsible of researchers who produced the technology or the results [Luxmore, 2000].

The effort to protect intellectual property yielded from research activities are very limited, most of research results are published only for benefit of the scientists. Those things finally cause difficulties to market the research results [RAMP-IPB, 2006].

Lack of government incentives for industries causes they, especially large industries, do not willing to attempt to utilize local research results and local technology, furthermore they have no incentive to make investment to conduct research by themselves. They do more willing to buy available technology from other country [Spurling, 2002, RAMP-IPB 2006]. Small and medium industries are more enthusiastic to utilize local technology and research results [RAMP-IPB, 2006], unfortunately they have limited budget to buy a license, so they are more willing to use free technology. This cause a limited collaborative research fund or limited royalty that could be received by public R&D organizations. At the end, these cause most of R&D budget should be provided by the government.

ROLE OF LOCAL GOVERNMENT

From sub national innovation system point of view, local government has very important role to develop and increase interaction and linkage among S&T producers and consumers in a region,. Local government need to create and facilitate networking among the elements in the region. Local government should enhance and protect local innovation and local knowledge, especially traditional knowledge, and utilize it to develop local economy. The government need to reconstruct innovative government organization i.e. to create effective bureaucracy and reduce regulations which may hinder development of local technology and product innovation. The government need to develop a program *to change mind set* of the government employee which hinder business innovation in the region [Erman A., 2007]. Ample of examples from other countries which shows that an effective and innovative local government could bring the region into a prosperous community based on utilization of available of local resources and local technology. One of keys to success is commitment and well managed local government to increase local economy based on utilization local resources and implementation of S&T in the region [Erman A., 2007].

CONCLUSION

The elements of National Innovation Systems (NIS) or Sub National Innovation Systems (SIS) are available and operating in Indonesia, however so far they are not interconnected properly, so that it could not yet enhance national economic competitiveness optimally. The government has made serious endeavor to strengthen its NIS. However, it is suffice to suggest that a more concerted efforts have to be made in order to have NIS and SIS work properly.

The NDRI have implemented programmes to enhance interaction between research centers with industry in order to increase utilization of the research results by industry commercially. A lot of barriers faced in R&D commercialization need to be overcome, especially the hindrance due to the weakness in R&D planning and marketing program.

Local government has important role to facilitate interaction and linkage among the elements of the system, and the government need to play its role in order to protect the local knowledge and to utilize local research result and technology in development of the region.

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