Institutional Framework of Science and Technology in Indonesia: Encourage Interaction Academics, Business, and Government

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Abstract
Act No. 18 year 2002 about National System of Research, Development, and Application of Science and Technology (S&T) form the basis for the implementation of S&T in Indonesia. It become an instrument in the implementation of the national innovation system (NIS) in Indonesia. NIS in the concept of Kuhlmann and Arnold (2001) has institutional element which is become a key of NIS implementation. Based on this premise, this study is then dissected science and technology institutions in Indonesia through Act No. 18 year 2002. To analyze the data this study using content analysis approach. Based on a content analysis of Act No. 18 year 2002 on the National System of Research, Development, and Application of Science and Technology is known that institutional of science and technology become one of the main issues in provision 6-10. Description of these article mentions that the institutional elements of science and technology in Indonesia include universities, R&D institutions, agencies and supporing institutions. This is in contrast with the institutional model introduced by Kuhlmann and Arnold (2001) by entering the political system including the legislature as an integral part in shaping the policy framework of the system. Not only was the concept developed by Kuhlmann and Arnold (2001), elements of education and research becomes an inseparable unity, whereas Act No. 18 year 2002 both roles are run separately by universities and R&D institutions. Based on these conditions this study has advised to put political system in the model of science and technology institutions in Indonesia.

Keywords: Institutional, Science and Technology, Interaction, National Innovation System, Technologies.

Introduction

S&T has an important key to reach the goal of the nation. Zuhal (2008) reveals that science is a variety of systems related to the physical world and its phenomena are derived from objective observation by systematic experiments, while the technology is a system that is associated with the engineering of some of the science appropriate to increase the value of added of hardware products, software and intelligence. Both of these explanations imply that S&T can strengthen the economic foundation especially for the industrial sector. The industrial sector into an engine of progress of a nation in modern times.

Since 2002, Indonesia already have a national policy governing S&T, and it policy becoming the form of legislation as known as Act No. 18 Year 2002. It act concern on System of National Research, Development, and Application of S&T (Sisnas P3 Iptek). Sisnas P3 Iptek provide regulation of resources in building a national innovation system in Indonesia, through research, the development and application of S&T.

The existence of this Act into a container that holds and be a problem solver for all matters that related to innovation namely research, development and application of S&T (Mulatsih and Putera, 2009). Build a national innovation system is certainly not easy. There are a number of obstacles and constraints in terms of institutional, program, resource, etc. Research institutes, universities, industry and other stakeholders is a key actor in the development of the NIS.

Content of Act No.18 year 2002 includes 9 chapters, 32 clauses and explanations, including two chapters about sanctions and transitional provisions. Politically this Act has qualified in the drafting process so that this legislation has also been enacted since July 29th, 2002. Ideally, this national policy was become the guidance for every S&T actor in Indonesia (Mulatsih dan Putera, 2009).

Actor in the understanding of Act No. 18 year 2002 is institutional. Institutional contemplated in Article 6 Clause (1) that S&T institutions is composed of elements from universities, R & D institutions, business entities, and supporting institutions. Clause (2) states that the institution referred into clause (1) serves a) to organize the formation of human resources, research, development, engineering, innovation, and technology diffusion, and b) shaping climate and provide the necessary support for the implementation of the control, utilization, and the promotion of S&T. The existence of S&T institutions are becoming more important to institutional maketh as one of the goals of S&T development in accordance with the National Medium Term Development Plan (RPJMN) 2010-2014 (Presidential Regulation No. 5 of 2010), especially Book II, Chapter IV S&T area.

The existence of S&T's institutional in innovation system in order to be important in Indonesia to be assessed by review of the policy content of the Act No. 18 year 2002. Examine the contents of the policy become a choice because it is still rarely used method in reviewing the policy. Yet, an understanding of the content of the policy becomes important to be able to implement a regulation or legislation.

Institutional Theory Perspective in National Innovation System

NIS is the purpose of the Act No. 18 year 2002. Innovation system then written in the policy document in Appendix Presidential Regulation No. 5 year 2010 on the National Medium Term Development Plan (RPJMN) 2010-2014. Innovation system written in Book II "Strengthening Synergies between fields Development" in Chapter IV on S&T area. In the introduction of Chapter IV states that "In order to support S&T to national development can take a part in a consistent and sustainable, NIS as a vehicle for S&T development will be strengthened through institutional strengthening, resource, and network science". This content indicates that NIS is a form of support S&T to national development that is consistent and sustainable. In addition the NIS to become a vehicle of S&T development with institutional strengthening, resource, and S&T network.

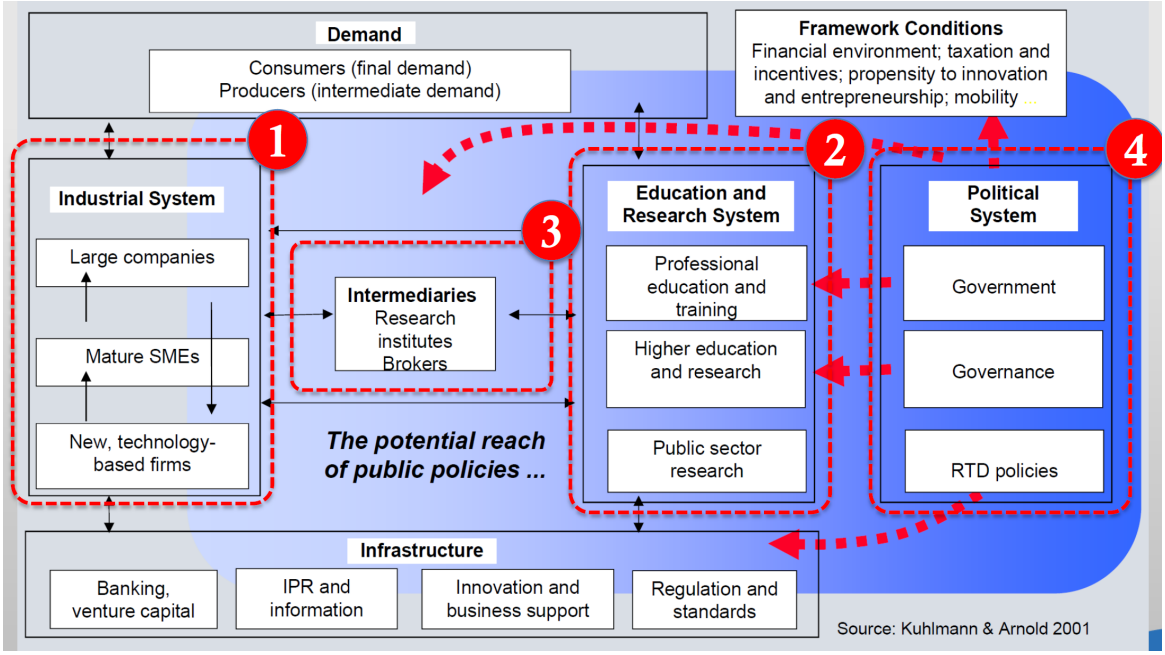
Innovation system can not be separated from the innovative performance. Triyono (2014) revealed that the innovative performance of a country depends on the interaction that is how the actors relate to each other as elements of a collective system of knowledge creation and technology using. The actors are mainly private companies/industries, universities, and public research institutions and the people in it.

Triyono (2014) again reveals that there is no single definition of NIS is acceptable to all parties, but what is important in the definition of NIS is the existence of a network or system interaction as reflected in the definitions presented below (Niosi in Joseph, et al. , 2009), including:

"…that set of distinct institutions which jointly or individually contribute to the development and deployment of new technologies as well as providing a framework for governments to establish and implement policies to influence the innovation process. As such, it is a system of interconnected institutions to create, store, and transfer the knowledge, skills and artefacts which define new technologies "(Metcalfe, 1995).

Another opinion expressed by Patel and Pavitt (1998) "... national institutions, the incentive structures and their competencies determine the rate and direction of teclhnological learning (or the volume and composition of change generating activities) in a country".

NIS, commonly known introduced by Kuhlmann (2001), the concept is shown in Figure 1. Figure 1 shows there are 4 types of actors in NIS include : 1) System acts as a producer of industrial products and services required by both customers as a final consumer or producers as well as consumers who need the products for further processing into final products, 2) education and research system serves as the center of creation and development of knowledge needed to strengthen and develop the industrial sector, 3) Institute intermediary role for bridging role of research institutions with industrial sector, and 4) the political system, including legislative act as a driver for NIS to working properly through infrastructure management and how to create condusive environmental framework.



Sumber: Kuhlmann dan Arnold (2001).
Figure 1. National Innovation System Model

Method

Content analysis is a general approach that's being used in the social sciences. Manning and Swan (2009) mentions that there are various kinds of analysis that can be used to describe and interpret the data. The degree of interest of documentary data can be reviewed one of them with content analysis. Content analysis is a technique which is actually oriented qualitative research, where the standard size applied to specific units, this technique is usually used to determine the character of the documents or comparation (Berelson, 1952; Kracauer, 1993).

Nawawi (2009) states that the analysis content of the policy includes a description of the specific policy and how it is evolving in terms of the relationship with the previous policy, or analysis can also be based on information provided by the framework of the theoretical value that tries to provide a critique of the policy. In addition, according to Putera (2012) that may reveal the contents of the policy network of institutional linkages in a policy document. It is important to reveal the role and interaction in policy implementation.

Based on a few understanding above, the method that can be used in this study is more focused on the analysis content of policy with the goal of revealing patterns, roles, and interaction of actors/institutions in S&T policy (Act No. 18 Year 2002).

Result and Analysis

Institutional aspects of S&T based on the documents Act No. 18 of 2002 contained in provision 6, 7, 8, 9, and 10 following verses in each chapter gives a description of the institutions of S&T.

Institutional of S&T as mentioned in provision 6 clause (1) consists of several elements: universities, R&D institutions, agencies and supporting institutions. The science and technology institutions serves to organize the formation of human resources, research, development, engineering, innovation, diffusion of technology, and also climate form and provide the necessary support for the implementation of the control, utilization, and promotion of S&T as include in clause (2).

In carrying out the functions of organizing, institutional of S&T is an umbrella looks a like for organization, where it is the place for planning, implementation, monitoring and supervision of the formation process of human resources, research, development, engineering, innovation, and technology diffusion. While the function of shaping the climate in clause (2) is the establishment of conditions that can accelerate the growth of the elements in implementing the formation of human resources, research, development, engineering, innovation, and technology diffusion, and also foster interactive relationship.

Climate formation that desired by clause (2) of Article 6 is a condition of bonding interaction existence which covered all elements in the overall whole that are complementary and reinforce each other and control to support the achievement of the mission or purpose of it system.

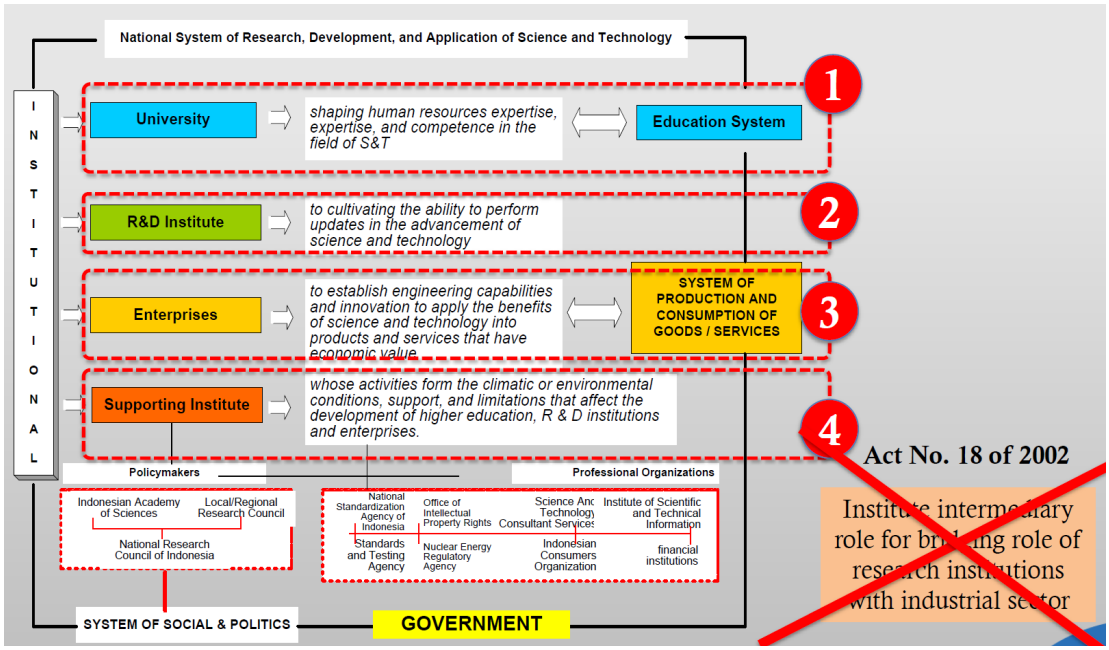


Figure 2. Scope of S&T Institutional

The existing system is a system that is open to life and behavior, orientation, and patterns of interactive relationships of its elements that can be changed dynamically depend on the inputs, constraints, and the condition derived from his environment. Elements of the system of research, development, and application of S&T is also an element of other systems, such as the education system, production system, and so on. All of these part from social and political systems that make up the identity of the state. Therefore, behavior, orientation, pattern of relationships between elements of

the life system and environment research, development, and application of S&T was also influenced by other systems.

The first element of S&T institutional in accordance with Provision 7 clause (1) and (2) is a university. University in the National System of Research, Development, and Application of S&T to carry out the primary mission of shaping human resources expertise, expertise, and competence in the field of S&T. University is also an institutional element in the education system so that it becomes a node element that links the National System of Research, Development, and Application of S&T with the education system. Linkage between universities in both systems is clearly seen from the type of activities that include the implementation of educational activities and teaching, research and development, and service community.

Research and Development (R&D) Institute as the second element of science and technology institutions, they mission in accordance with provision 8, clause (1), to cultivating the ability to perform updates in the advancement of science and technology. Through research and development, R&D institutions should always seek breakthroughs to gain new knowledge which can increase the treasures of S&T, look for the benefit of advanced S&T, as well as developing and preparing various aspects of the application.

R&D institutions in accordance with the explanation of the act, can be a stand-own institution, or a unit of organization of universities, enterprises, and the institutions are also supporting institutional elements of S&T. Thus, R&D institutions can be a node that links institutional elements of science and technology. R&D institutions also can be organizational units that are not related directly to the National System of Research, Development, and Application of S&T. Therefore, the agency also can be the node that links the National System of Research, Development, and Application of S&T with the other systems in Indonesia.

National System of Research, Development, and Application of S&T Enterprises also mandated to establish engineering capabilities and innovation to apply the benefits of science and technology into products and services that have economic value. This is in accordance with provision 9, clause (1). Institutional element and also diffusing technology, both produced themselves or others so that the resulting impact to people's lives become more widespread. Business entity is also an institutional element in the system of production and consumption of goods and services so that these elements into the node that links science system with the system.

Through its association in above two systems, the elements of institutional entities that utilize pull the market output simultaneously raises for research and development activities carried out by elements of R&D institutions and universities, so its benefits can be useful for the people.

In addition, Universities, Research Institutions and Enterprises, National System of Research, Development, and Application of S&T, and also supporting institute. Base on incorporate components of Provision 10 Clause (1) Supporting Institutions are institutions whose activities form the climatic or environmental conditions, support, and limitations that affect the development of higher education, R & D institutions and enterprises. Supporting organizations include the following organizations relevant

to policy makers in S&T such as Indonesian Academy of Sciences, National Research Council, and Regional Research Council; professional organizations; associated with standardization institutes like the National Standardization Agency standards and testing organizations; agency that handles IPR such as patent offices and centers of IPR; supervisory institutions in the field of S&T such as Nuclear Energy Regulatory Agency; agency consulting services in the field of S&T; institutions that represent the interests of consumers; institution that provides S&T information; financial institutions that funded S&T activities; other similar institutions.

Based on the model of the National Innovation System is raised by Kuhlmann and Arnold (2001) shows that the system of education and research as a center for the development of the knowledge needed penciptaandan untukmemperkuat and develop the industrial sector, while the Law No. 18 Year 2002 education systems and research systems are separated and played by different institutions, which is carried by the Education System of Higher Education to perform the function as shapers of human resources with expertise, expertise, and competence in the field of science and technology, and System research conducted by research institutions to cultivate the ability to update the progress science and technology .

Another basic difference is in the Act No. 18 year 2002 does not mention institutional role in the Social and Political System. This is different from the concept of Kuhlmann and Arnold (2001), they said serves as a driving political system in order to NIS for work properly through the management of infrastructure and creation of a conducive environment framework, through the creation of a number of conditions with the Financial environment; taxation and incentives; propensity to innovation and entrepreneurship; and also mobility.

Conclusion

Based on a content analysis of Act No. 18 year 2002 on the National System of Research, Development, and Application of Science and Technology is known that institutional of science and technology become one of the main issues in provision 6-10. Description of these article mentions that the institutional elements of science and technology in Indonesia include universities, R&D institutions, agencies and supporing institutions. This is in contrast with the institutional model introduced by Kuhlmann and Arnold (2001) by entering the political system including the legislature as an integral part in shaping the policy framework of the system. Not only was the concept developed by Kuhlmann and Arnold (2001), elements of education and research becomes an inseparable unity, whereas Act No. 18 year 2002 both roles are run separately by universities and R&D institutions.

Based on these conditions this study has advised to put political system in the model of science and technology institutions in Indonesia, and does not separate the role of education and research.

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