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Innovation Policy Implementation in Indonesia: Perspective of Triple Helix

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ABSTRACT

Innovation is key to accelerate economic growth in both advanced and developing countries. It brings about many changes in several fields including changes in public policy. In developing countries, implementing innovation policy is not easy, indeed, it will face big challenge to create an innovation ecosystem. In the case in Indonesia, though Government of Indonesia has many inovation programs at national level, practice of innovation policy is not optimal. Based on a triple helix perspective, position and role of the three actors academics, business, and government (ABG) are interesting, particularly in developing countries like Indonesia. This study is a qualitative research method using primary and secondary data sources. Few studies mention the specific role of a government in a developing country to implement innovation policy. This study aimed to fill that gap. The finding of this study was that the Government of Indonesia should play key role in creating an innovation ecosystem through its policy intervention.

I. INTRODUCTION

Nowadays, each country runs policy agendas to support innovation activites in growing or leveraging their national economy accomplishment, or commonly called innovation policy (Gustavsen, 2001; World Bank, 2010; Manzini, 2012; Smits et al., 2010; Leibowicz, 2018). Conceptually, basic rationale of innovation policy is to support private

investment in research and development (R&D) activities. It is important to create and maintain a conducive innovation ecosystem like growing patent regulations, reducing tax in R&D activities, and also providing governmental grants for private sector actively conducting R&D activities (Mani, 2002). Practice of innovation policy is well-known to bolster economic development in developed countries, but it is not easily implemented in developing countries (Pack, 2000; Mani, 2002; Aguirre-Bastos and Weber, 2018).

Innovation policy is not merely a single actor run by government, but it comprises multiple and different actors forming various network patterns (Kuhlmann et al., 2010; Sun and Chao, 2018). It means that linkage of related actors from academician, business, and government (ABG actors) is necessary to create innovation and known as a Triple Helix Model (THM) (Kim and Lee, 2016; Guerrero and Urbano, 2017). Each actor plays its role: academician to produce knowledge, industry to absorb and use knowledge, and government to govern interlinkages among academics, industry, and government itself (Ivanova and Leydesdorff, 2014).

In the frame of a triple helix model, innovation policy is highly tied and aimed to: develop national industry, support R&D activities operated by R&D institutes and universities, and increase spillovers of R&D activities (Svensson and Hartmann, 2018). Even in the The Organization for Economic Cooperation and Development (OECD) countries, one of three macroeconomic determinants namely government consumption expenditure is a long-run determinant for improving economic growth in those countries (Pradhan et al., 2017). Those determinants are also leading players in creating models and initiating of science and technology (S&T) policy since the 1960s including its implementation (Henriques and Larédo, 2013).

China and South Korea are two countries that have been successfully impemented innovation policy. According to Lee (2000) & Lim (2006), South Korea pursues economy growth by means of promoting S&T policy tied to industrial policy to achieve the further leapfrog of economy development. In 2010-2014, South Korea ranked first of 60 countries in the world in government's R&D spending intensity, it is also highly ranked at 5th to 9th globally in the amount of R&D infrastructures and other quantified outputs like scientific publications, intelectual properties (patent), science degrees, and R&D staff (Lee and Kim, 2016). While, China's economy development is not separated from how Government of China implements innovation policy, a breakthrough occurred firstly by immitation and followed by innovation (Yip and Mckern, 2016). Rapid economic growth of China is strongly promoted by policies of The National Program for Medium-Long Term on S&T Development 2006-2020. This policy facilitates enterprises and R&D units to do more R&D activities (Fiaz, 2013).

China, South Korea, and Indonesia has similiarity in starting S&T-based economy in early 1970s, but Indonesia lags behind both countries. Like China and South Korea, Indonesia has Ministry of Research and Technology since 1960s and public R&D institutes as the focal point to conduct innovation policies. In 1970s, the "strategic and high-techno industries" *(BUMNIS)* was built to bolster a national self-reliant economy. Again, Government of Indonesia has S&T documents as policy guidance to implement innovation policy such as Act Number 18/2002 that was renewed to National Act 11/2019 about National System to Research, Development, and Application of S&T, the Long Term National Development Plan (RPJP) 2005-2025, and Presidential Decree Number 32/2011 for a Master Plan for Enhancement and Expansion of Indonesian Economic Development (MP3EI) in 2010–2025 Period (Lakitan (2013).

Government of Indonesia has also allocated specific funding for S&T programs to public R&D institutions and universities (Lakitan, 2013; Mulyanto, 2014), building national science techno park (STP) (Kusharsanto and Pradita, 2016), and coordinating at cross-sector among various actors of industries, universities, R&D institutes, and related government agencies (Lakitan et al., 2012; Lakitan, 2013). Practically, the interlinkage of ABG actors is weak (Lakitan et al., 2012; Lakitan, 2013; Mulyanto, 2014). It is a challenge for Government of Indonesia is why innovation policy implementation is difficult though there are many supports like R&D instutions, S&T Acts and documents, and S&T funding.

1.1 Research Problem

Triple Helix Model (THM) is appropriate to analyse the issue of relationship between ABG actor in promoting innovation policy in Indonesia, eventhough recent literature showed that THM is not sufficient to elaborate the inter-relationship of ABG of innovation policy due to an increase of public participation. Society or community is

a latecomer as well as ABG, and then concept of triple-helix model evolves to be Academician, Business, Government, and Community (ABGC) - called as quadruple helix (Carayannis et al., 2018). Three actors namely, Academician, Business, and Government (ABG) were key actors in making successfull innovation policy or not in developing countries like Indonesia. Therefore, the THMis appropriate to use in this study.

Studies of triple helix elaborate that presence ABG actors and its linkage can yield innovation activites whereby each actor has role. Referring to the triple helix concept, ABG actors and their interrelationships are present in Indonesia, but its presence has less impact to innovation activities, and cannot be realized as an innovation policy. It is a challenge for Government of Indonesia to realize innovation policy in the frame of a triple helix perspective. Sarpong et al. (2017) asserts that triple helix is not easy implemented in developing countries, even role of government is vital for emerging countries to realize innovation policy. Though, there are few studies revealing the dominant factors of government's role of emerging countries in implementing innovation policy. This study fills this academic gap. By filling this gap, it will be a challenge for Government of Indonesia to play a role in implementing innovation policy among academician and business actors. Therefore there are two main questions to this study:

1) What is the current status of interlinkage of academics, business, and government (ABG) in implementing innovation policy in Indonesia?

2) How does Government of Indonesia play a role among academics and business to the successful implementation of innovation policy?

This study is firstly aimed to describe interlinkages of academics, business, and government (ABG) in implementing innovation policy in Indonesia. Second, to elaborate the proper position and role of Government of Indonesia in implementing innovation policy.

II. THEORY REVIEW

2.1 Innovation, Innovation Policy, and Innovation Ecosystem

Innovation is the idea, practice, or object perceived as a new thing either by individual or other units adopting it (Rogers, 1995). Innovation is defined as spearheading activity, rooted basically in a firm's internal competencies in developing and introducing a new product to the market at the first time (Kim and Nelson, 2000). A broader definition: innovation is not only new technology produced in a organization (Wu et al., 2017; Ní Fhlatharta and Farrell, 2017), but also the implementation of new ideas in the form of products, processes, service, or business models which are able to be commercialized. However, this term innovation, is relativelynew for the world , but is new for a country or a organization, including improvement to existing products, process, or services to users or customers (Yip and Mckern, 2016). Summarizing , innovation is defined by scholars with various elements, the key innovation element is a newness in market or a new thing used by users.

Definition of innovation policy is different to root theory of public policy. Anderson (2011) defines public policy is as *"relatively stable, purposive course of action or inaction followed by an actor or set of actors in dealing with a problen or matter of concern"*. According to Anderson, public policy tends to what the government does instead of proposing its policy. In this term, a government unit is the most responsible actor to conduct public policy, eventhough other actors often influence the public policy making process. Whereas, Birkland (2015) provides definition of public policy as "*A statement by government of what it intends to do such as a law, regulation, ruling, decision, order, or a combination of these"*. There is no single definition of public policy, policy is created by involving many actors of society, politics, institution, economics, and others related actors.

Innovation is not run by single actors, it involves many and various actors starting from industries, R&D institutes, universities, and government itself. Even, involvement of social institutions and other innovation-supporting

agencies are required to promote innovation (Mani, 2002; Kuhlmann et al., 2010). Role of government is pivotal to support innovation in a country, then it is called innovation policy. Both in advanced and developing countries, innovation policy is a current issue to leverage economy growth (Gustavsen, 2001; Dodgson, 2000; Yip and Mckern, 2016; Zehavi, and Breznitz, 2017). As coined by many scholars, we provide relevant concepts of innovation policy based on its main goals as follows.

Innovation policy has a wide dimension. It is conceptually linked to science and technology (S&T) policy. Dodgson (2000) states that S&T policy is aimed to development of basic and scientific as well as education research (scientific policy) and to create strategic and generic technologies as new technologies development (technology policy). While innovation policy or STI Policy comprises development of economy and industry within each nation, national innovation system of each country, and also quality of existing institutions and the social-economic linkage within them. S&T and Innovation are easily dichotomy as conceptual progress, but it is blurred to portray what is S&T policy and Innovation policy in the practice. For sake of this

study, we use definition of S&T policy, innovation policy, and STI Policy interchangbly. Therein, we propose that innovation policy is government intervention involving multiple actors at the begining stage of doing R&D activities until the end-stage of commercializing R&D products to market.

Nowadays, innovation policy concept is interlinked to innovation ecosystem concept. According to Granstranda & Holgersson (2019), innovation ecosystem is a bunch of actors, activities, and artifacts that are tied in a particular institution, which are mutually complementary and competitive to create an innovation. Xu, et al. (2018) assume that innovation ecosystem stems from two main attributes namely, value chain and interactive networks. First, integrated and cross-value chains are important to enrich an ecosystem. Second, network and collaboration among academics, business, and government are pivotal to create an innovation ecosystem. They interact with each other cooperatively and commpetitively.

Innovation policy is important to create an innovation ecosystem, it is intentional or untinentional actions carried out by public institutions

Table 1.
Definition of Innovation Policy

Author(s)	Main Goal of Innovation Policy
Dodgson (2000)	To build technological capability by means of increasing R&D activities
Mani (2002)	• To combat private underinvestment in R&D, • To provide more incentive to organization conducting R&D, • To increase diffusion of technology • To develop human resources in S&T field • To protect intellectual property rights • To synergize industrial and trade policies • To increase supply of technologies to local firms
Kuhlmann et al. (2010)	As systemic in a double sense: • as policy actions that promote innovative things by means of involving many interactive actors and (a system-wide distribution), or • as policies designed to work on system characteristics (demand-oriented policies) .
Borras and Edquist (2013)	To influence all innovation process which is undertaken by government institutions by means of intentional or unintentional actions
Patanakul and Pinto (2017)	• To promote favorable national business environment supporting innovation and entrepreneurship activities • To increase capacity building to national firms
Leibowicz (2018)	Policy intervention to address market failures in running innovation programs or public activities relating to innovation

Sources: Compiled from Dodgson (2000); Mani (2002); Kuhlmann et al (2010); Borras and Edquist (2013); Patanakul and Pinto (2017); (Leibowicz, 2018)

to synergize related various actors such as ABG to create favorable innovation climate through accomplishment of a united goal to support national economy development. Sun, et al., (2019) distinguishes two roles of government through innovation policy in an innovation ecosystem. First, the top down model by which government directly creates programs and its mechanisms to leverage interaction and collaboraton academician and business actors. Second, the bottom up model by which government facilitates network and collaboration of academician and business, makes a rule for competition and collaboration (market model).

2.2 Triple-Helix Model

Discussing innovation policy and innovation ecosystem is not separated from discussion about actors of universities, firms, and government agencies. Triple helix model is is concept by which at least three related institutional actors namely academician, business, and government (ABG) are each mutually connected to carry out a particular progam/project, especially in supporting knowledge-based economy development (Kim and Lee, 2016; Guerrero and Urbano, 2017). Strength of economic development in the post-industrial phase is more determined by socially organized knowledge, than by longer manufacturing activites. It is necesarry that institutions play a key role to generate increasing knowledge in interaction among three main actors: university as science producer, industry as science user, and government as a initator to governance (Ivanova and Leydesdorff, 2014).

Recent literature of triple helix is an evolving concept which developed from claasic triple-helix model by which role of government is more dominant than business and academician actors, which is commonly called etatistic model. It then evolves the extent to which role of government, academician, and business where each actor has a clear role to undertake R&D activities and its commercialization to end users separately, which is named as laissez-faire (Lee and Kim, 2016; Sarpong et al. 2017). Nowadays, triple helix is a more advanced concept to portray which is subtly interwined among three actors, which are increas-

ingly overlapping and interdependent relations in conducting innovation activities or even what actors do are reverse and substituting each other (Ivanova and Leydesdorff, 2014; Sarpong et al., 2017). The last is named as Hybrid triple helix model (Sarpong et al., 2017).
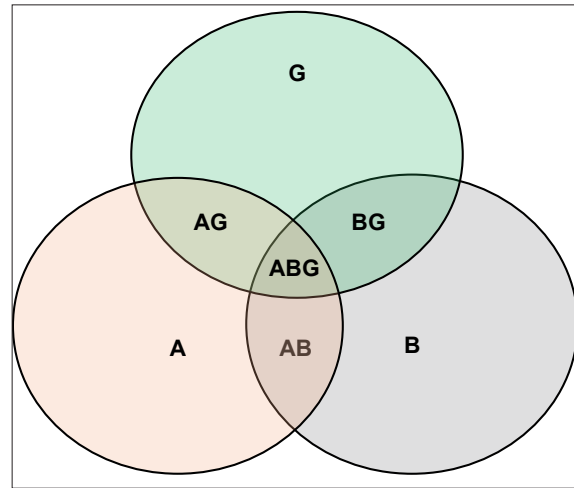
Notes: A: Academician, B: Business, G: Govenrment
Source: Ivanova and Leydesdorff (2014)
Figure 1. Area Intersection of ABG in Tripe Helix Model

Triple-Helix Relationship of ABG actors is clearly deliniated through area intersection of ABG, or hybrid triple helix. It is acknowledged that implementation of hybrid triple helix model where these actors are mutually integrated is not easy in developing countries (Sarpong et al., 2017). Relationship of ABG is often acceptes in the innovation field because basic characteristic of this model involved science producers (Academics) and its users (Business).

As presented above, THM is a non-linear process, rather, its complex and dynamic inter-relationship among suppliers of S&T (universities/R&D institutes), users of S&T (enterprises), and coordinator as well regulator in S&T linkage (government). Instead, each actor has "self-authority" which influence the structure of national system connecting three actor in "the balancing portion" is not easy. For example, South Korea where government fails to create mutually relationship in R&D networks. In line with what occured in South Korea, several studies like Larrinaga and Calvo (2015) and Sarpong et al., (2017) reveal clearly that the active role

Table 2.
Previous Studies of Triple-Helix Model in Innovation Field

| Author(s)	Case of Innovation	Result
Ivanova, and Leydesdorff (2014)	Rotational symmetry and the transformation of innovation systems in a Triple Helix of university–industry–government relations	Practically, triple-helix model is non-linear and self-interaction of the communication field, rather it is a more dynamic interaction. Each actor in triple helix model can play a role in either institutional communication or selection mechanism. Particularly, in post-industrial stage where knowledge-based economy is a breakthrough to increase economic growth, three actors of triple helix model colour ramified structure of innovation system. Institutionally, they create distinguishedly organization format by means of sharing task-duty division among them starting at national level and then profilerating at local level. Important to say that non-linearity of three actor interaction is also related to highly dynamic innovation wave.
Lee and Kim (2016)	Interaction in R&D networks using the Triple Helix method: Evidence from industrial R&D programs in Korean government	Eventhough South Korea is leading sector in quantitave R&D output until at the beginning of 2000s. But Korea is struglling to make better innovation network through ABG model because government fails to synergize R&D actors in network. Interaction between ABG actors is low because role of government is too dominant in supporting R&D activities particularly in 1990s, though leading actor of R&D is industry (large and small-medium enterprises), but initiation of government to support R&D and its commercialization is not inevitable.
Sarpong et al. (2017)	Organizing practices of university, industry and government that facilitate (or impede) the transition to a hybrid triple helix model of innovation	Recent literature accentuate about of hybrid triple helix model which is rooted in how individuals perceive and categorize their world, their rules and their meaning which leads to how they imagine and elaborate things. Transitioning from triple helix model to hybrid triple helix model can early started if three institutional actors of triple helix is considered as initial base in designing and developing policies supporting transformation of national innovation system. Countries which are responsible to transform a hybrid triple helix have to invest effort and time in understanding the organizing context, emergence of formal and informal structure shaping and governing situated practices, and surely socially organized relation of ABG actors.

Sources: Ivanova, and Leydesdorff (2014); Lee and Kim (2016); Sarpong et al. (2017)

of public institutions (government) to initiate and to the keep relation of three actors (ABG) in promoting innovation system and policy is a precondition, especially in emerging countries.

2.3 Analysis Framework

Referring to innovation policy concept and triple-helix model discussed before, innovation policy is not separated from innovation ecosystem. Chaminade and Edquist (2010) explains that any innovation does not occur in isolation, but is a complex interaction involving many actors and institutions in a system. A broad range of networks aimed to create a favorable climate for innovation and to co-produce innovation directly is termed an innovation ecosystem (Russell & Smorodinskaya, 2018). Hence, policy makers through policy can intervene in this innovation ecosystem either by top down or by bottom up.

Concurrent ABG nexus is an adaptive and harmonized condition where each actor namely academician (A), business (B), and government (G) runs their role to carry out innovation activities in a newly-existing ecosystem. It is not a special area of three actors, but it is an united and integrated goal of those who have same perception and action to make innovation as national priority. Generally, innovation policy is a governmental instrument to support innovation activities and to tackle anti-innovation activities in a system (Chaminade and Edquist, 2010; Manzini, 2012). It is a needed key actor in the first stage to initiate and bolster inovation policy in a region or country. In Denmark, emerging niche innovation project and good interaction of academician, business, and government (ABG) is highly supported by policy maker(s) (Brem and Radziwon, 2017). This study adopts and modifies important elements (boundary condition) of
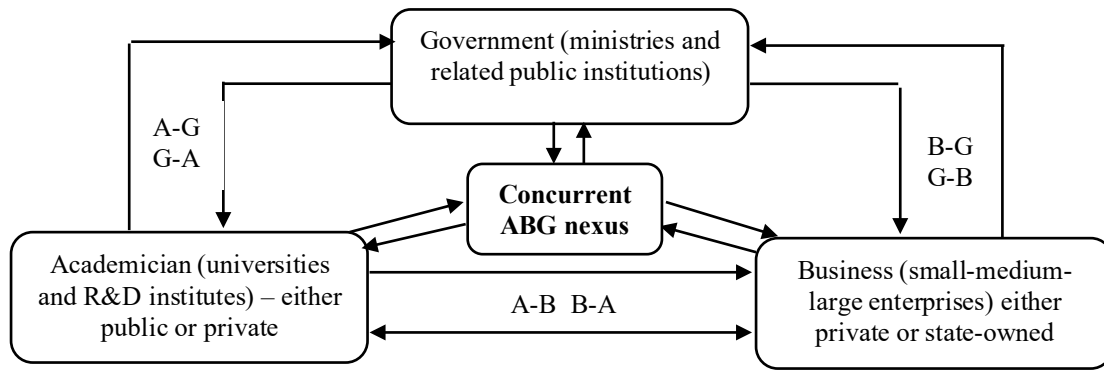
Innovation Ecosystem

Sources: Authors

Figure 2. Analysis Framework of Triple Helix in the Innovation Ecosystem

interaction among ABG actors related to successful innovation project in Denmark developed by Brem and Radziwon (2017).

This study presents "concurrent ABG nexus" in an innovation ecosystem by which each actor can conduct innovation programs according to common agreement of three actors. It is a subtle and complex inter-relation, because who an initiator in the first is and how they interact mutually are vague. New ideas are not restricted, and each actor is allowed to initiate innovation provided it is not trespassing common agrement or laws stipulated by government.

III. RESEARCH METHOD

This study is a qualitative method conducted from 2nd March 2018 to 2nd December 2019. Data collection were derived from direct interviews and involvement of researcher during 2018. Also, literature review is inextricable means to reinforce primary data collected previously (during 2019). To complete empirical evidence, several key informants of related public agencies, public research-development institutes, university, and a private company were deeply interviewed.

To gather empirical data to be precise and accurate, data triangulation method is used through consultation with expert of innovation policy to reinforce research findings, and is one of the main stages to corroborate data analysis using a particular framework. This data was

analysed through interactive data analysis coined by Huberman and Miles (1983), which had four stages of data analysis namely: data reduction, data display, single-site and multi-site analysis, and data triangulation to reinforce findings. Data reduction was conducted to ensure succinct data of an interview with ABG actors and their supporting documents. Data display was conducted after data reduction (key and relevant findings), single-site and multi-site analysis was conducted by compilation final data of each actor and all actors combined, followed by triangulation combining field findings with literature reviews to minimize bias of research.

This study had two such propositions concerning this study. First, the existing interlinkage of academician, business, and government (ABG) in implementing innovation policy in Indonesia. Second, analysing and elaborating position and role of Government of Indonesia in implementing innovation policy within the ABG interlinkage.

IV. RESULTS

Implementation of innovation policies comprises funding R&D activities, building strategic industries, building S&T institutions, legitimating national S&T legislation. This finding is divided into two sections namely, the existng innovation policies implementation and position, and role of each actor in implementing innovation policy. All sections are framed within a triple helix concept.

Table 3.
Interaction of ABG Actors in Supporting Innovation

Actors	Supporting Elements	Inter-relation Type
Academician (A)	Having capability of core competence as S&T producer	A-B and A-G
	Interested in innovation project and marketable R&D activities	
	Interested in entrepreneurship and start-up enterprises	
	Adaptable to regulation and program related to STI programs issued by governmental agencies	
	Having capability to commercialize R&D poducts to market	
Business (B)	Having core capability and competency in using R&D products and also in initiating marketable new ideas	B-A and B-G
	Interested in developing and widening new market	
	Supporting and cooperating with small-medium-and large enterprises	
	Adaptable to regulation and program related to industrial programs issued by governmental agencies	
	Having good capability to cooperate with government in innovation-supporting activities	
Government (G)	Robust commitment to problem-solving oriented innovation policy	G-A and G-B
	Interested in collaborating with multiple actors and wide project scale	
	Devoting full support to develop small-medium enterprises and national large enterprises based on R&D activities	
	Creating innovation ecosystem and pro-industrial climate (funding, regulation, programs)	
Academician together with Business and Government (the concurrent nexus of ABG)	Having capability and willigenss to support and complete innovation-supporting elements initiated and conducted by each actor. Each actor can substitute role and function of other actors because innovation is not a linear process, it is interdependent and often overlapping. The main task of government to maintain and build a stable interaction and to avoid innovation system failure. In this case, only government can stipulate and issue laws and not substituted either by business or academician actor.	A-B-G A-G-B B-A-G B-G-A G-A-B G-B-A

Source: Modified from Brem and Radziwon (2017) and author's own compilation

Table 4.
List of Key Informants

Actors	Name of Institution	Number of Key Informant(s)
Academician	Division of science-technology-innovation policy at Indonesian Institute of Science (LIPI)	2 persons as researcher (1 of them as also an expert of innovation policy)
	Division of specific area and innovaton system at Agency for Assessment and Application of Technology (BPPT)	1 official staff with specification of doctoral degree
	Faculty of Administrative Science at University of Indonesia (UI)	1 lecturer concerned with innovation studies
Government	Directorate of Science Techno Park and Other Related Institution at Ministry of Research, Technology, and Higer Education (Kemenristekdikti)	1 person as director of Science Techno Park and Other Related Institution
	Directorate of Innovation System at Ministry of Research, Technology, and Higer Education (Kemenristekdikti)	1 person as head of subdivision on innovation policy
	Agency for Industrial Climate and Quality Development – Ministry of Industry (Kemenperin)	1 official staff with specification of doctoral degree
Business	Private-owned company of food-processing machine (medium scale)	1 person as official staff in division of technology assembling

Notes: All information offered by informants is not representative of official policy or statement issued by their institutions respectively.

4.1 The Existing Innovation Policies Implementation

Period of early 1970s - end 1990s

Initiation of science-technology-innovation (STI) development was a strikingly large phenomenon in 1970s when Ministry of Resarch and Technology (KRT) was built in 1962. The notable mMnister of KRT was Mr B. J Habibie, a professor and an engineer in Indonesia who leaded KRT in period 1978-1998. In 1984, Government of Indonesia also formed National Research Board (DRN) functioning to give advice to Minister of KRT in dealing with STI policy. DRN members are notable people from various background like academician, business actors, and government. To simplify coordination between both agencies, the leader of DRN was officially headed by Minister of KRT.

STI policy was directed to reinforce capacity of research and development (R&D) institutes like National Institute of Aeronautics and Space (LAPAN) built in 1964; National Nuclear Energy Agency of Indonesia (BATAN) built in 1964; Indonesian Institute of Sciences (LIPI) built in 1967, and Agency for Assessment and Application of Technology (BPPT) built in 1974. Then in 1970s, STI policy was directed to build "strategic and high-techno industries" *(BUMNIS)* to bolster a national self-reliant economy.

In 1989, Government of Indonesia formed Management Agency of Strategic Industries *(BPIS)* directly headed by President of Indonesia. The BPIS's members were minister of transportation, minister of finance, minister of defence, ministry of national development planning, ministry of trade and industry. Function of BPIS was to develop and superintend 10 state-owned companies classified as BUMNIS namely: PT BBI, PT Barata, PT Krakatau Steel, PT LEN, PT IPTN, PT INTI, PT Dahana, PT Pindad, PT Telkom, and PT INKA. Those industries were functioned to absorb and develop R&D products of LAPAN, BATAN, LIPI, and BPPT.

Reinforcing capacity of R&D institutions and BUMNIS was supported by mechanism of largely governmental R&D funding and scholarship to offical staff, engineers, and researchers to continue their level degree to bachelor, master, up to doctoral degree in the best universities around the world like Japan, Germany, Netherlands, United States of America, United Kingdom, Australia, etc. After several graduates of guarantee came back to Indonesia, they occupied strategic positions in both public R&D institutes and BUMNIS.

In this period, key S&T programs were attached to the national economy program plan arranged by National Development and Planning Agency *(Bappenas)*. The good point of this policy was that R&D activities operated by institutes and universities (particularly state-owned universities) was directed to fulfill needs of BUMNIS. Institutionally, role of KRT was pivotal as mediator and coordinator to bridge between S&T producers and users. In other words, whatever was produced by R&D institutes, could be potentially and widely used by BUMNIS. The national economy and industry development was remarkable in the period of 1980s-middle 1990s, even Indonesia was labelled as Tiger of Southeast Asia (Kozlova and Noguera-Santaella, 2017).

Period of end 1990s - early 2000s

Since 1997, Indonesia received a 'severe blow' to the economy sector which negatively effected the advance of S&T. Economy crices ruined several large companies including state-owned companies classified as BUMNIS. Most of those industries were bankrupt, and thousands of employees were dismissed from their work. Economy recovery occured at the end of 1998 until early 1999 when international organizations and several countries re-stocked Indonesia through financing assistance to accelerate economy recovery.

In the early 2000s, development of S&T was not clear, no pogress, and S&T development declined dramatically. It was caused by basic reformation on national bureaucracy structure including large changes in S&T organization structure. Even, international donor asked the Government of Indonesia to stop subsidies to BUMNIS in order to accelerate accomplishment of funding assistance by donor. The effect; BPIS was removed in 1997 due to high debt to external agencies, and the mechanism of STI policy was reformulated after in period of 2000s.

Period of early 2000s until 2019

After economy crices, national economic growth was better than past, unfortunately national S&T development was not good as economic growth. Due to BPIS been removed, BUMNIS faces big challenges to grow without large governmental subsidy; they had to search for new funding sources by themselves in the midst of finance difficulty. Also, Government of Indonesia slightly limited governmental budget to spend in R&D activities on public R&D institutes like LIPI, BATAN, BPPT, and LAPAN.

Government of Indonesia cannot carry out STI policy by involving public R&D institutes and BUMNIS to bring R&D products to market. There is no a connector and mediator agency functioning like BPIS. BUMNIS operates according to their internal vision and mission of company, likewise public R&D institutes run R&D activites based on internal organizational goals and researcher interest. Both public R&D institutes and BUMNIS are separate partners in developing national S&T programs. Thus, Government of Indonesia reformulates direction of STI policy to find appropriate formula in advancing S&T development. In 2001, National Resarch Agenda *(ARN)* was introduced as new STI policy in Indonesia after economy crices in 1997.

In 2002, Government of Indonesia promulgated Indonesian Act Number 18/2002; National System to Research, Development, and Application of Science and Technology. Based on this law, Government of Indonesia promoted S&T programs, increased performance of universities and R&D institutes to supply technology, and closed the gap between S&T supply and the demand by consumers of S&T (private and state-owned industries). This law had new STI policies: strategic Policy of Science and Technology *(Jakstranas)*, new National Research Agenda *(ARN)*, National Innovation System and Regional Innovation System *(SINas and SIDa)*, Research Incentive, technology transfer policy, and new schemes for managing R&D fund in public institutions. That Act was renewed as National Act 11/2019; National System of S&T.

To connect interest among actors of academician, business, and government (ABG actors), Government of Indonesia formed National Innovation Committee (KIN) and National Economy Committee (KEN) to harmonize innovation and economy policies (during 2010-2014). However, the role of National Research Board (DRN) existsto formulate ARN and give advice to Minister of Research and Technology (KRT). At a practical stage, KRT created science-techno park (STP) as the main part of innovation policy by optimizing role of ABG actors or application of triple-helix model. In this project of science-techno park, innovation policy was aimed to activate public R&D institutions and provide spill-over benefits for large enterprises in particular regions.

4.2 Position and Role of Each Actor in Implementing Innovation Policy

Actors of academician, business, and government (ABG) have respective perception and interest to support the Indonesian national innovation programs. Eventhough they have different perception and interest to support innovation programs, they do agree that innovation policy is a national goal which should be supported by all related actors and various ministries.

Each actor has a different perception toward other actors in supporting innovation programs. They have priority programs to accelerate innovation, especially in government agencies where innovation programs are tied on a yearly working program. Notwithstanding, the three actors (ABG) acknowledge that the unresolved homework of Government of Indonesia until now is how to synergize and harmonize those priority programs as an united priority program at national level. Even, to close higher education and public R&D institutes, Government of Indonesia has merged General Directorate of Higher Education at Ministry of National Education and Ministry of Research and Technology to be Ministry of Research, Technology, and Higher Education *(Kemenristekdikti)* during 2014-2019 year.

Table 5.
Perception of Each Actors in Supporting Innovation Policy

Actors	Academician	Business	Government
Dealing with R&D activities and its commercialization			
Having core competence as S&T producer	Each researcher and engineer has capability to produce S&T	Researchers and engineers are able to produce new technology	Each researcher and engineer is able to produce recent S&T products
Interested in innovation project and marketable R&D activities	Most of researchers and engineers are preoccupied with their R&D actitivites by themselves	Researchers and engineers are proven in developing new products	Many researchers and engineers are focused on routine R&D activities like scientific publication, workshop, patents, etc.
Interested in entreprenurship and start-up enterprises	Researchers/ engineers are interested in studies of entrepreneurship and start-up companies	Most of researchers and engineers support small-medium enterprises	Most of researchers/ engineers are promoted to conduct R&D activities in entrepreneurship and start-up companies
Adaptable to regulation and program related to STI programs issued by governmental agencies	Each researcher engineer must oblige rules stipulated by R&D institutes and governmental laws	Researchers and engineers follow instructions of their organizations	All researchers and engineers obliges rules issued by government, particularly for those who are government-paid researchers (public servants)
Having capability to commercialize R&D poducts to market	Most of researchers and engineers are very limited or low capability in commercializing R&D products	Only few researchers and engineers whom they are able to market their product to industries	Not all of researchers and engineers (including their institutions) are able to market their R&D products
Dealing with business activities and its network			
Having core capability and competency in using R&D products	Industry sector is a motor to innovate, but how a company absorbs new technologies is in different ways.	Industry prefers to use "mature or marketable products" to R&D or semi-mature products.	Each industry has different capacity to absorb R&D products yielded by R&D institutes/universities
Interested in developing and widening new market	Each company is to get profit, widening market is a must	Main goal of industry is to widen and make new market	Industry is profit oriented, new market is important
Supporting and cooperating with small-medium- large enterprises	Large industry is not always fixed in cooperating with small-medium industries, it depends on industrial needs	Inviting in joint business of small-medium-large or related industries that have similiar interest	Large companies are selective to cooperate with small-medium companies which is driven by supply-demand interest.
Adaptable to regulation and program related to industrial programs issued by governmental agencies	Medium-large industries can adapt to regulations. While small industries is susceptible to regulation changes	Adaptable to government laws to sustain industry activities	All companies must oblige governmental laws without exception. Nevertheless, there are few companies that avoid it
Having good capability to cooperate with government in innovation programs	State-owned companies are more cooperative to support innovation programs initiated by government	Supporting government to simplify regulations and to make cheaper of buying raw materials	State-owned companies are feasible and cooperative in conducting governmental innovation programs.

Actors	Academician	Business	Government
Dealing with commitment of government in implementing innovation policy			
Robust commitment in implementing innovation policy	Government's commitment is on official agendas and laws, but innovation as a solution is not clear	Commitment to innovation is questionable, because innovation is not only R&D policy	There are many legal documents to support innovation like *ARN*, R&D funding, science-techno-park and innovation system.
Interested in collaborating with multiple actors and wide project scale	Government has many relations and sub-ordinate agencies, but coordination and collaboration is a big challenge	Government agencies work based on respective interests, not integrated at all	Ministry of Research, Technology, and Higher Education, and related government agencies have priority programs but they are less connected each other
Devoting full support to develop small-medium enterprises and national large enterprises based on R&D activities	Small-medium enterprises and also R&D-based enterprises are main focus of government. Innovation programs is specially aimed for them.	Small-medium enterprises are more paid attention by government, but many of them are operating without assisting from government	Small-medium enterprises are more paid attention because they are supporter of national economy. Besides, R&D-based enterprises and state-owned enterprises are promoted to support innovation programs.
Creating innovation ecosystem and pro-industrial climate (funding, regulation, programs)	Government has many STI programs, but it is scattered in many agencies and not well merged.	Innovation is dominantly yielded by internal enterprise, not by external environment.	Government and related agencies has built innovation ecosystem through inviting academician and business to work together in a symposium, industrial clasters, and others
Concurrent nexus relationship of academician, business, and government			
Having capability and willingness to support innovation programs initiated and conducted by each actor. They can substitute role and function of each actor because innovation is not linear process, rather, it is interdependent and often overlapping linkage.	Each actor has sectoral priority in supporting innovation programs, the programs are only run by institutions with focused on respective interest. Eventhough program arranged by each actor is accordance with innovation goal, but it is not part of another innovation program arranged by other actors.	Academicians works based on their preoccupation, so R&D products are difficult ro be marketable. Industry do not receive of what academicians do, while role of government is minimal to coordinate each actor in creating innovation climate at national level	Each ministry has innovation-supporting programs, but it is not connected each other. Self-interest is a big issue about inter-relation among actors like R&D institutes/universities, industries, and government agencies. It is big challenge for each actors including government agencies to collaborate and support innovation system.

Source: Constructed from interviews with informants and author's experience.

V. DISCUSSION

5.1 Innovation Policies Implementation: Ego-Sectoral Practice

Role of government to stipulate and issue laws are not substituted by business and academician actors. Case of Indonesia, first economy revolution occured in 1970s when Indonesia was lead by authoritarian regime by Soeharto is not different to South Korea when Park Chung Hee, an army general lead South Korea to bring national advanced economy. Eventhough the starting point of both in same period, Indonesia is not as fortunate as South Korea, economic development of Indonesia has been stagnant since the economic crises occured in 1997, whereas South Korea is multiple steps ahead than Indonesia.

After economy crices, change of public organization structure widely occured in 1997–1998, most national priority programs changed in Indonesia, exception being national S&T programs. As previously mentioned, significant change of STI policy appears when BPIS is removed of national organization structure. Consequently, each of "the strategic and high-techno industries *(BUMNIS)* runs business in order to achieve profit merely,

not to absorb and use R&D products yielded from public R&D institutes. There is no central agency functioning to coordinate and harmonize between public R&D institutes and BUMNIS.

Innovation is a complex process and interactive system, it is not only addressed by one actor of S&T, but also many actors are involved in dealing with making conducive ecosystem of innovation starting from friendly investment, law protection, funding for R&D, appropriate infrastructure, support of human resources and so on (Kuhlmann et al., 2010). Case of Indonesia, function of government in dealing with innovation programs is still centred on Ministry of Research, Technology, and Higher Education *(Kemenristektkdikti)*. Policies for national economy development are slightly separated from policy for growing national industry. Context of business; large-scaled enterprises sector is less active to promote innovation policy,which are heavily related to foreign R&D institutes in doing innovation.

National innovation programs are supported by other priority program of related government agencies like Ministry of Industry *(Kemenperin)*, Ministry of *Cooperatives and Small-Medium Enterprises (Kemenkop-UKM)*, Ministry of National Development Planning *(Bappenas)*, Ministry for Coordinating Economy Affairs *(Kemenko Perekonomian),* Ministry of State-owned Enterprises Affairs *(Kementerian BUMN)*, and Creative Economy Agency *(Bekraf)*. Recently, support of innovation at local government level is also promoted by Ministry of Internal Affairs *(Kemendagri)*.

Kemenristekdikti had initiated science-techno park (STP) to facilitate interaction among ABG actors. However, this project is not easy to be run due to underlying and classical issues hindering innovation policy such as: coordination and cooperation of cross-sectors among public institutions to support innovation policy and rigid budget schme for R&D activities. Eventhough, *Kemenristekdikti* is a new breakthrough in implementing innovation policy with merging between S&T and universities affairs, but budget allocation to develop STI programs is relatively smaller than programs of higher education and local

empowerment at universities. It means that main focus of Kemenristekdikti is still on developing higher education affairs. As Head of sub-division on innovation policy at *Kemenristekdikti* said:

> *"Recently, budget allocation in our ministry is dominant on developing education and empowerment programs in universities, not on innovation programs as whole. Again, innovation is main duty of our ministry like R&D activities, not main duty of all related ministries in Indonesia".*

Each government agency has priority programs based on their vision and mission, but the programs are not connected to support innovation programs initiated by Kemenristektkdikti, it calls 'ego-sectoral'. This term is commonly prevailing as director of Science Techno Park and Other Related Institution at Kemenristekdikti said:

> *"Ego-sectoral is big and old homework in coordinationg policy innovation, we are in Kemenristekdikti, needs strong effort to achieve it, but it is not easy, each ministry has priority programs arranged by themselves".*

Innovation policy matter is concerned with what each actor can shake hands with each other to contribute in established innovation system/network. It will be accomplished provided each related actor has similar or same interests and a main goal, or at least they can unite their priority programs through a well-working system/network. Factually, each ministry has priority programs that are very strategic for advancing their organizations. In other words, there are many priority programs of related ministries so there is no real program to create a national innovation ecosystem.

For example, Ministry of Industry has priority program of 'planning for national industry development (RIPIN) 2015-2035' derived from National Act No. 3 year 2014 about Industry, but it is not directly connected to STI policy held by Kemenristektkdikti, but it is more focused on developing national industry in general. Another example, related to develop small and medium enterprises (SMEs) and start-up enterprises, was a joint agreement between Kemenristekdikti and Kemenkop-UKM that Kemenristekdikti focused on developing R&D-based SMEs and start-up

companies, while Kemenkop-UKM focused on trade-based SMEs and start-up companies. There is no united goal in promoting innovation policy through aggreement between two ministries. Important to be noted that innovation policy is commonly focused on SMEs or start-up enterprises supported by the governmental budget,.

Ego-sectoral is a systemic failure, according to Smith (2010) it is a problem of coordination among STI actors that can be claimed as coordination failure. Based on key informants, there were reasons why ego-sectoral occurs wiyh STI actors, particularly on governmental agencies as follows:

- Poor culture of innovation. Aactor with different backgrounds found it difficult to discuss and dialogue together to solve problems of innovation matters. Though Indonesia is rich on local culture it is poor on technology culture (Dodgson, 2000). For example, STI management, incoherent S&T policy, and minimal role of government to support STI climate. A senior lecturer concernedwith innovation studies at University of Indonesia said:

  "Culture of innovation in Indonesia is very weak, less dialogue and less self-awareness of people to make innovation climate"

- Existing public institution including bureaucracy structure is not syncronized to harmonize actor's different interests related to innovation policy. Bureaucracy reformation was aimed to improve performance of internal organization, not to create new institution supporting innovation climate as a whole. A senior researcher of innovation policy at Indonesian Institute of Sciences said:

  "Bureaucracy and public administration needs to be reformed to support innovation in Indonesia. Existing institution should be changed with new one".

- Innovation is a new idea for stakeholders in recent times. Innovation has a long trajectory, thus *Bappenas* through Medium Term National Development Plans (RPJMN), which supports STI, was firstly and explicitly mentioned on RPJMN 2015-2019. It will take more years to establish innovation builders in Indonesia. A doctoral official staff from division of specific area and innovaton system at Agency for Assessment and Application of Technology (BPPT) said:

  "Innovation term is a new for public, at early 2000s, innovation at stakeholders was firstly introduced after economy crises through Act No.18/2002 about STI in Indonesia. It is long term to practice innovation in Indonesia like developed countries".

- Government officials mostly perceive that innovation can be merely conducted by large and high-technology enterprises (case of BUMNIS in *Habibie* era). That is why most innovation programs are related to state-owned enterprises operating R&D activities. While, innovation programs to SMEs or start-up enterprises are considered as creative enterprises.

- Imported technology is cheaper and easier enter the market than technology produced in domestic R&D institution. Quality of products is also a main consideration why national companies prefer imported products than domestic products. Import tariffs stipulated by Government of Indonesia based on international trade agreement also influences cheap cost of imported technology.

- Weak commitment from all levels of government. Often, the top leaders commit to spend budget in creating innovation ecosystem including spending to R&D activities at public R&D institutions, but differently recognized at lower leaders level of government organizations. Structurally, there is a gap in the case of delivering directions from top-middle-low level in government agencies. As Head of sub-division on innovation policy at Kemenristekdikti said:

  "Committment in doing innovation of the top leader is good, but it is will be different at lower level which is occured almost at each public agency".

Those problems were present in Indonesia especially where there is no special and strong leadership to direct innovation policy as a

united goal at national level. Each related actor is concerned about authority hegemony of their institution. Actors were found to run a self-interest organization according to internal vision and mision. While bureaucracy was strictly rule-driven in practice, there was no actor to be fully responsible in executing innovation programs at a whole. Because the Government of Indonesia does not have special law to guarantee risk of R&D activities run by public R&D institutes, universities, and state-owned enterprises. A doctoral engineer of Agency for Industrial Climate and Quality Development – Ministry of Industry said that:

> *"No strong and integrated leadership is problem for those who conduct R&D activities, there is no more protection for those who are unintentionally wrong in doing it. In effect, they are the suspect of mal-administration or misuse of governmental budget".*

Law protection

Researchers or engineers, professionally, had less protection under the law, even if there is unintentional practice of using R&D finance related to R&D activities, researcher(s) or engineer(s) and manager(s) can be defendants. The nature of R&D activities was spending money according to unpredictable and complex R&D needs. In Indonesia, funding mechanism of R&D budget management is categorized within the governmental budget mechanism, and impacts on all public organizations, including public R&D organizations.

5.2 Role of the Indonesian Government in Implementing Innovation Policy

Learning from South Korea and China, both latecomer countries in knowledge-based economy world, but they were successfull in harmonizing actors to make sound innovation policy in recent decades. In South Korea, role of government is essential in supporting generation and diffusion of knowledge and market creation. In catching-up phase, institutional elements of an innovation system are leverages for latecomers firms to bring their technology and new products in global market (Choung et al., 2017). Whereas in

China, two key actors, academician (university and R&D institutes) and enterprises are totally supported by government through innovation policy to collaborate and establish R&D activities involving non-government organizations to yield innovative-competitive things at global level (Fiaz, 2013; Sun and Cao, 2018).

Practice of innovation policy in South Korea as newly industrializing countries and China as an emerging country, had different pathways to develop national economy compared to developing countries like Indonesia. South Korea and China initiated technology policy at almost a concurrent period (1970s), though Indonesia also started implementation of science and technology in 1970s through establishment of national champion of state-owned "techno-strategic industries", it was not enough to say that Indonesia has good S&T policy (Dodgson, 2000).

Considering classic literature by which innovation was the output of only R&D activities in R&D institutes and universities (Boekholt, 2010). For Indonesia, innovation policy held by Kemenristekdikti was only concerned with internal affairs, specially in promoting public R&D institutes and universities to yield innovative products based on R&D activities, and scientific testing activities for products yielded by industries. Policy to attract many industries in joining R&D activities was very limited, and thus development of R&D institutes and universities was stagnant. However, the role of National Research Board (DRN) was minimal to execute innovation policy due to limited authority (only as STI policy formulator). No bargaining position was available for determining direction of innovation policy.

Institution is critical in developing innovation policy by which triple-helix model is prerequisite to involve three different institutions i.e academicians, business, and government actors. Innovation is output of interaction among ABG actors (Sarpong et al., 2017). Institution issue is not easily addressed, in China STI institution need to be improved (Sun and Cao, 2018), and in South Korea, STI institution is also reinforced to make better of innovation network (Choung et al., 2017). In the case of Indonesia, new innovation

agencies were formed, the most striking innovation agencies were national innovation committee (KIN) and national economy committee (KEN) in period 2010-2014. In 2016, Government of Indonesia formed the national economy and industry committee (KEIN) to support industry development. KIN, KEN, KEIN are similiar agencies which were appointed and regulated by President of Indonesia. If a president is not elected in next period, these agencies may be wiped out from a re-organizational structure of Government of Indonesia.

As the highest structure in bureaucracy, President of Indonesia has strength to direct related actors to conduct innovation policy. As discussed previously, that commitment of top leader is often different in delivering to middle-lower leaders in context of reformation era (recent condition). When Soeharto lead Indonesia until 1997, and Habibie was minister of science and technology (1978-1998), head of BPPT (1978-1998), and head of BPIS (1989-199), STI programs were connected and integrated in a main goal through strategic and high-techno industries (BUMNIS). Actors in the framework of ABG intitution was well coordinated by Habibie as a top leader in three public STI agencies where R&D producers can supply to industries as R&D products receivers.

After Habibie left as minister of KRT, head of BPPT, and head of BPIS, S&T organization structure changed, STI programs were vague. R&D institutes developed R&D products without considering how their products were marketable. Eventhough *Act No 18/2002* exists it is not necessarily working. There is no 'grand strategy' of innovation policy. Researchers and engineers were very limited or had low capability in commercializing R&D products. Most of their outputs were scientific publication, research documents, patents, protoype, and so on.

VI. CONCLUSION

Government of Indonesia has relevant ministries to stipulate innovation like Ministry of Science, Technology, and Higher Education; Ministry of Industry; Ministry of National Development Planning; and Ministry for Coordinating Economy Affairs etc., but innovation was not the main priority of the national development agenda. Coordination between governmental agencies in supporting innovation wass not optimally working. Again, coordination between R&D institutes and universities and industries was also weak. Each actor had self-interest programs, not united programs to support innovation. In this case, Ministry of Science, Technology, and Higher Education was a single player in implementing innovation policy in Indonesia

Proper position and role of Government of Indonesia are needed to implement innovation policies. Government has main responsibility to initiate, to direct, and to promote creation of an innovation ecosystem (top-down approach) as well as to facilitate, to mediate, and to provide supporting elements in order to create an innovation ecosystem (bottom-up approach). It means that involvement of government is critical to mobilize all existing resources (human, funding, opportunities) to support actors business and academician in creating an innovation ecosystem simultaneously. It will work if government, as central actor, is able to harmonize these actors in achieving one goal, namely 'innovation'.

Based on the above explanation, there are three action policies which can be conducted to create an innovation ecosystem in Indonesia.

1) Improvement of public management, laws, and institution through bureaucracy reformation to support national innovation system.

2) Creating one goal priority program which is in a line with innovation priority prorams at all public agencies. Therein, sharing resources among public agencies to support innovation will be feasible.

3) Innovation policy is well delivered by the integration of the top-down and bottom-up approach. The united grand design of innovation, the integrated approach of ABG and community is the prerequisite to create and implement innovation policy in Indonesia.

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