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DEVELOPMENT OF AN INNOVATION ECOSYSTEM MODEL IN HANDLING THE COVID-19 IN INDONESIA

PENGEMBANGAN MODEL EKOSISTEM INOVASI DALAM PENANGANAN COVID-19 DI INDONESIA

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ABSTRAK

Inovasi teknologi di bidang kesehatan sangat dibutuhkan ketika Covid-19 menyerang banyak negara termasuk Indonesia. Salah satu inovasi yang dibutuhkan yaitu fasilitas kesehatan untuk uji infeksi. Melalui TFRIC-19, beberapa periset Indonesia telah mengembangkan sebuah laboratorium mobile yang kemudian diberi nama Mobile Lab Biosafety Level 2 (MBSL2). MBSL2 merupakan salah satu hasil inovasi teknologi di bidang kesehatan dari TFRIC-19 untuk penanganan pandemi Covid-19 di Indonesia. TFRIC-19 merupakan ekosistem inovasi yang pembentukannya dinisiasi oleh Lembaga Pemerintah di bidang Litbangjirap. Pembentukan TFRIC-19 sebagai langkah awal dalam penanganan pandemi Covid-19 di Indonesia. Tujuan dari penelitian ini adalah mengidentifikasi bagaimana peran aktor yang terlibat dalam pengembangan MBSL2. Teknik yang digunakan untuk menganalisa yaitu Ecosystem Pie Model (EPM). Dalam penelitian ini ditemukan bahwa salah satu hal terpenting agar sebuah ekosistem dapat menghasilkan inovasi yaitu kolaborasi yang terjalin antar Aktor yang terlibat.

Kata Kunci: *Ekosistem Inovasi; Covid-19; Inovasi Teknologi; Ecosystem Pie Model.*

ABSTRACT

Technological innovation in the medical area is vital when the COVID-19 pandemic strikes, including in Indonesia. One of the essential innovations is a health facility for infection testing. Through the TFRIC-19 program, several Indonesian researchers have developed a mobile laboratory named Mobile Lab Biosafety Level 2 (MBSL2). MBSL2 is one of the medical innovations from the TFRIC-19 program as a measure to handle the COVID-19 pandemic

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in Indonesia. TFRIC-19 is an innovation system initiated by government institutions in the RnD area. Establishing TFRIC-19 was the initial step in handling the COVID-19 pandemic in Indonesia. This research aims to identify the actor's role in developing MBSL2. The technique uses the Ecosystem Pie Model (EPM) approach for analysis. It was found that the most essential aspect of creating innovation is collaboration between involved actors.

Keywords: *Innovation Ecosystem; Covid-19; Technological Innovation; Ecosystem Pie Model.*

INTRODUCTION

The innovation ecosystem is a set of actors, activities, developing artifacts, institutions, and relationships, including complementary and substitution relationships essential for those actors' innovative performance (Granstrand & Holgersson, 2020). The definition of artifacts includes products and services, tangible and intangible, technological, and non-technological resources, and other system input and output, including the innovation itself.

In other words, the innovation ecosystem involves an actor system with a collaborative or competitive relationship with or without a firm focus and an artifact system with complementary and substitution relationships (Shaw & Allen, 2018). Increasing attention is being paid to the innovation ecosystem concept because of its necessity to leverage the capabilities of respective entities: firms, industries, regions, and nations (Jackson, 2011).

Along with the defining process, the Agency for Technology Assessment and Application of Indonesia (BPPT) on March 15, 2020, which is now integrated into the Agency for National Research and Innovation, initiated the development of innovation ecosystems named Task Force Research for Innovation to Covid-19 (TFRIC-19). TFRIC-19 is conducted by collaboration between stakeholders to build a conducive innovation and valuable ecosystem for the COVID-19 pandemic in 2020.

The involved parties are government institutions, non-governmental institutions, academics, industries, and media. Hopefully, the innovation ecosystem can save the innovation process from the valley of death as in handling the COVID-19 crisis, the government does not have an abundance of time to secure the people's lives.

As there is an increasing trend of confirmed positive suspects of Covid-19 in Indonesia in 2020, the triumph of medical technology innovation becomes very essential. One of the successful innovations of TFRIC-19 is a mobile laboratory for COVID-19 testing named MBSL-2 (Mobile Laboratory Biosafety Level 2). With the existence of the mobile lab, testing can be done in many regions with inadequate BSL-2 standard laboratories so that the sample can be analyzed immediately without being sent to other big cities.

In the middle of 2020, MBSL-2 was placed in several hospitals, such as Ridwan Meuraksa Hospital in East Jakarta and Level II Hospital Putri Hijau in Medan, North Sumatra. The success story of MBSL-2 needs to be identified clearly to formulate the best practice and an example in creating necessary innovation.

Therefore, this study is essential to examine the establishment of the innovation ecosystem in Indonesia during the COVID-19 pandemic to harmonize the steps in realizing an innovation ecosystem that can provide and map value added (actor's role) from the products.

METHOD

This research uses a case study approach. A case study is deep research regarding a particular case (Yin, 2018). Generally, case study research emphasizes the selection of a case with uniqueness. The case in this research is unique when the COVID-19 pandemic strikes, limiting all activities, but the collaboration effort in TFRIC-19 can develop an innovation. According to Yin (2018), a case study identifies contemporary phenomena in the context of real life, where the limitation between the phenomenon and the context is blurry, and there is an attempt to clarify the limitations using various evidence. Hence, the finding in TFRIC-19 in developing MBSL2 is deduced to modify the general existing theory.

Primary data collection in this research is done through interviews. Data collection by interview is used whenever more information is required from the respondents. In this research, the interview uses semi-structured interviews. The semi-structured interviews were done more openly than structured interviews by asking for opinions and ideas from interviewees (Sugiyono, 2011). The semi-structured interview technique involves actors and their roles in TFRIC-19 in developing MBSL2.

Interviewee Transcript

Third Interviewee

Name : Dr. Agung Era Wibowo, M.Si., Apt.

Job : Director of the Center for Pharmaceutical and Medical Technology, BPPT

Time : Tuesday, March 7 2023

Place : BPPT Laptiab Building, Puspiptek Serpong Area

Before recording, the researcher was prepared not to distribute the recording results to anyone without permission from the informant.

3.	Question	Who are personnels from your institution that directly involve in the development of MBSL2		
	Answer	The person in charge was Mr. Teddy who used to be the Head of the Program. So, Mr. Teddy let anyone who wanted to be on his team be free. So, first we took all of Mr. Teddy's team from internal BPPT, there were automation experts from MEPPO, then structural experts from TKS, there were also architects from our center in Jogja. The biologist used to be Mr. Danang who was Mr. Teddy's Chief Engineer on that team.	AG-3	All of Expert in BPPT who have competences related to the development of MBSL2 participated.

Figure 1.
Interview Transcription
Source: Result of The Author's Analysis

Table 1.
Interviewee List and Information Requirement

No	Stakeholder	Interviewee	Information Type
1	Research and Development institutions	BPPT	Information regarding process, strategy, obstacles, and challenges in developing the MBSL2 prototype
2	Industries	• PT Sumber Daya Agung • PT Biofarma	Information regarding process, strategy, obstacles, and challenges in developing the MBSL2 prototype
3	Users	• Ridwan Meuraksa Hospital • Pertamina Plaju Hospital • Puspiptek Health Center	Information regarding the suitability of MBSL2 product with needs

Source: Result of The Author's Analysis

The selected interviewees are the critical actors in MBSL2 development activities. The results of interviews will be transcribed meticulously to avoid mistakes in data processing.

Meanwhile, secondary data is derived from secondary sources or other existing resources. The secondary data collection technique used in this research is an institutional data survey. An institutional data survey is used to collect secondary data owned by institutions regarding TFRIC-19 in innovation for the COVID-19 pandemic. Secondary data can be photo documentation, FGD and webinar video records, previous research, meeting results, and other sources regarding the TFRIC-19 program. The secondary data is used to strengthen the primary data obtained from the interviews.

This research uses the Ecosystem Pie Model (EPM) tool to analyze data. To analyze the innovation ecosystem, it is necessary to initially distinguish between complementarity potential (Adner & Kapoor, 2010). That potential can be the willingness and capability of actors within organizations and products/services from other organizations (innovator partners). EPM is a tool that enables qualitative mapping, analysis, and innovation in ecosystem design by considering those factors (Talmar et al., 2018).

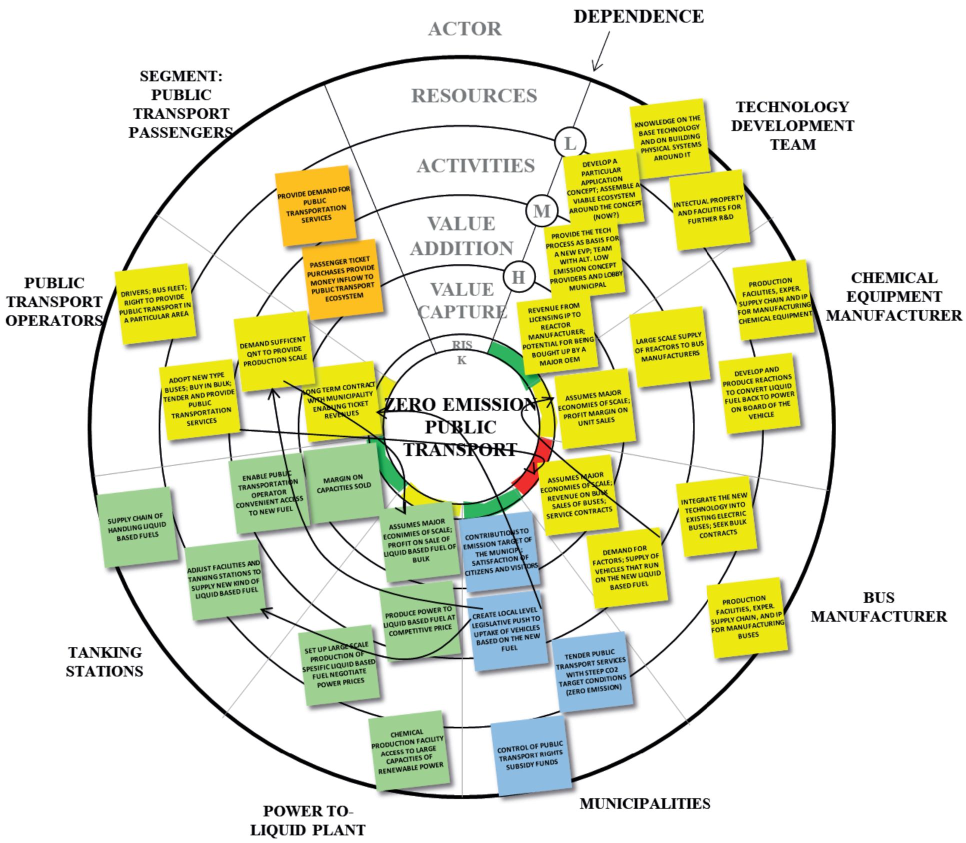

Figure 2.
EPM Visual Example
Source: Talmar et al., 2020

The use of EPM in mapping and developing innovative ecosystems will help governments orchestrate the model. EPM can identify which actors should be involved in the ecosystem, analyze resources, identify activities, value addition processes, and value capture (Muni2, 2022). There are three components (ecosystem level) constructing the Ecosystem Pie Model

(EPM) framework to map the innovation ecosystem, as illustrated in Figure 1. They are:

a) EVP

The first part of the EPM framework, representing EVP, is located in the model's center. The ecosystem is characterized by system-level objectives in the form of solutions oriented to users coherently. The expected value from this solution becomes the ecosystem value proposition (EVP). EVP represents the supply side and end-user in an ecosystem. In other words, EVP is an expected value by all actors within the innovation ecosystem.

b) Actor

The second part represents actors from the innovation ecosystem. Organizations, institutions, communities, and individuals are the main actors creating and capturing value in any ecosystem. Actors are mutually exclusive stakeholders but economically are related to each other to determine expected value. The order in which the involved actors are analyzed with value transfer direction within the ecosystem should be explained in EPM clockwise. Several elements building the actor level are:

Resource

A resource that actors can utilize to create value within the ecosystem. It is necessary to understand the resources possessed by each actor in an ecosystem to understand the beginning of value addition by those actors.

Activity

Activities are the actions in which the actors contribute to the ecosystem. It includes mechanisms the actors use to utilize the available resources to create productive contributions.

Value Addition

EVP is embodied as a combination of complementary demands given by actors within the ecosystem. From an overall ecosystem point of view, each actor has a particular contribution toward EVP, which is seen as a value addition by the actors. In other words, value addition results from activities carried out by the actors in the ecosystem based on the user's competitive advantages. Other additional value elements combine products/ services (or other support like venture) provided by the actors and works obtained from the EVP point of view.

Value Capture

Value capture represents the value created by the ecosystem captured by certain actors as a reward to give their resources and activities in obtaining a particular EVP. The actors are interested in accepting various forms of benefit. The benefit can be financial or non-financial. For instance, local governments' community welfare is a benefit that can support particular ecosystems.

Risk

All necessary value additions to achieve EVP must be achieved from the overall ecosystem and other complements. This condition assumes that the actors are expected to support that and can contribute productively to the ecosystem. For example, whenever there is a disagreement on how the actors apply technological (or relational) standards in an ecosystem, how the ecosystem will most likely adjust to the competitive landscape within the industry, and even whether a particular ecosystem aspect aligns with the team vision regarding their organizational position in the industrial landscape. Therefore, the risk is influenced by all other actor-based components. To simplify, the EPM risk depicts actors' unwillingness to contribute to an innovation ecosystem.

Dependence (Dependence on EVP)

An ecosystem is a network that often involves actors from various profiles (for example, massive or small, private or public). For particular actors, achieving EVP may be the supreme mission. The higher the dependency of the actors, the less likely the actors will exit the ecosystem. In an EPM, the dependency of the actors on EVP is measured in three levels: L – low, M – medium, and H – high.

c) Users

This part includes a category of actors designated to the user segment and determines the target market for value created in the ecosystem. Regarding EVP, the user segment determines the target market created in the ecosystem. Because market competition becomes more competitive between ecosystems rather than individuals (firms), the capability to provide a user group specifically in the EVP boundary can be beneficial as a competitive advantage for an ecosystem in general.

RESULT AND DISCUSSION

Roles Between Actors

The fundamental challenge faced during the outbreak of COVID-19 is the development of a new form of coordination in a particular working partnership (Popov et al., 2021). In the development of MBSL2, the creative idea came from a discussion between BPPT and Biopharma. This innovation in TFRIC-19 at least considers the value created in the ecosystem (Talmar et al., 2020).

All values have been discussed thoroughly, starting with the BSL2 specification, and moving to the potential partner for fabrication. The discussion was carried out with Biofarma because Biofarma has gained sufficient experience in laboratory development. Nonetheless, Biofarma never developed a mobile laboratory before. Furthermore, all technical aspects of developing MBSL2 were handled by the expertise team from BPPT except the fabrication, as it was not part of BPPT's capability.

The MBSL2 developed by BPPT, together with Biofarma and PT SDA, has a value-added in mobility so that it has broader coverage. Moreover, activities within MBSL2 can be monitored remotely because it has already utilized the Internet of Things (IoT) system. The monitoring is not only for activities conducted by the officers but also for the equipment. Hence, whenever a work accident, like a fire, can be monitored instantly to inform the officers on duty about evacuation. The HVAC system implemented in MBSL2 is also another advantage. The system ensures that the inside pressure is negative so that the virus will stay isolated. With a proper HVAC system, people inside MBSL2 will feel comfortable despite limited space.

The most vital part of creating innovation is the collaboration between actors within an established ecosystem. Therefore, it is essential to analyze the value of each actor participating in the ecosystem. This measure is necessary to prevent the actors from actively participating in working partnerships (Choeriyah & Noviaristanti, 2021)—the success of TFRIC-19 in developing MBSL2 results from robust team solidarity. The collaboration between those parties (Davis, 2016) makes TFRIC-19 able to produce innovation in handling the COVID-19 pandemic. The involved actors in developing MBSL2 – BPPT, PT SDA, Biofarma – have their respective roles. Every actor works as their expertise with certain limitations. None of them has a sense of superiority. The strategy has harmonized the actors with the value proposition within the ecosystem (Walrave et al., 2018).

Therefore, the orchestra in this working partnership should be accurate as a form of media so that every party works as expected clearly and appropriately portion (Deseve, 2007). BPPT, as the leader, plays the role of theoretical review and calculation in developing MBSL2. The role has been done with help from Biopharma, which has more experience developing laboratories. Biofarma helps BPPT in terms of the calculation of every required specification of MBSL2.

Meanwhile, for fabrication, PT SDA takes complete charge. PT SDA creates the prototype of MBSL2 according to study results from BPPT. While making the MBSL2 prototype, PT SDA was always accompanied by the team from BPPT. Thus, whenever there is any hindrance, the team from BPPT can immediately help PT SDA provide immediate solutions, resulting in the acceleration of the production process.

Table 2.
Actor's Inter-Role Analysis

Actor	Roles	Activities	Value Added	Value Capture
BPPT	• Idea Creation • Supervision	• Expertise discussion • Prototype design	• Idea of mobile laboratory • Detail of specification of MBSL2	• Expertise acknowledgement • Patent rights • Satya Lencana Pembangunan Award
Biofarma	• Standard Controller	• Validating qualification of MBSL2 in terms of technical equipments	• Quality MBSL2 complying medical equipment standards nationally and internationally	• Consultation honorarium • Satya Lencana Pembangunan Award
PT SDA	• Fabrication	• MBSL2 Manufacturing	• MBSL2 ready to be difused • MBSL2 mass production	• Manufacturing profit • Selling right to the market

Source: Result of The Author's Analysis

In an innovation ecosystem, the most essential part is innovative performance from individuals or several actors (Granstrand & Holgersson, 2020). The working partnership between the actors involved in developing MBSL2 is a collaboration that can work cooperatively and effectively so that, in the relatively short term, they are able to produce an innovation. The solidarity of each actor tackles the dynamics and challenges in this collaboration. They set aside their sectoral ego and accentuate mutual goals. It is strongly related to the orchestration conducted by BPPT as the initiator of TFRIC-19. An example of the leadership style BPPT shows is the claim that every innovation results from all actors' hard work, not just a particular one.

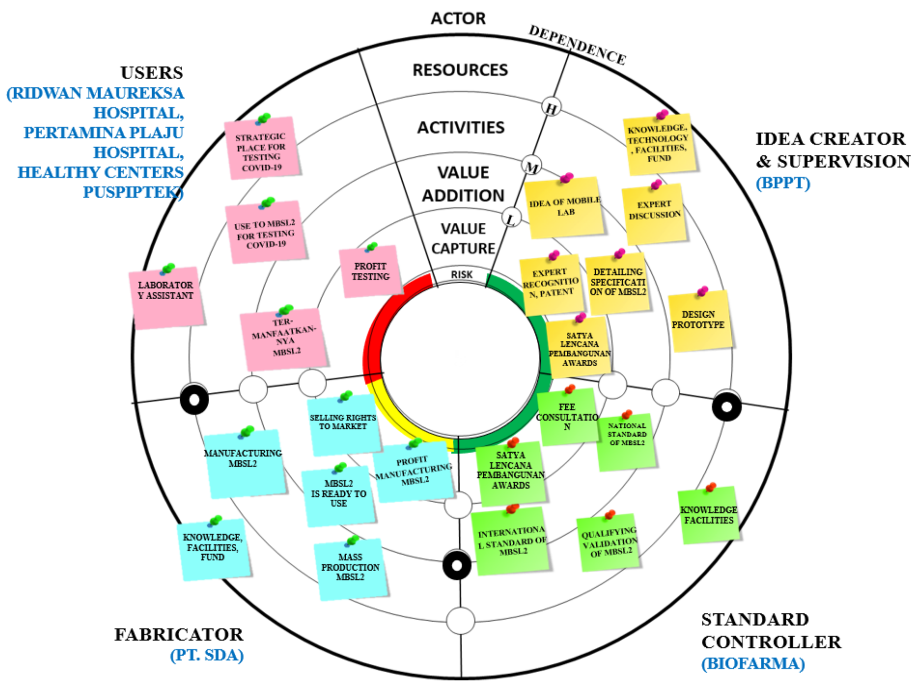

Figure 3.
Ecosystem Pie Model from the Development of MBSL2
Source: Result of The Author's Analysis

Based on the collaboration, several interrelationships between the actors in developing MBSL2 can be described. They are:

1. The relationship between BPPT, Biofarma, and PT SDA in terms of determining EVP
   The main determinants of EVP in the development of MBSL2 are the idea creator and supervisor. EVP may occur due to collaboration between the actors. However, the main determinator is the actor with the most interest (Adner, 2017), BPPT. Based on a suggestion from the engineering team from BPPT, Biofarma, and PT SDA, BPPT determined that the value that will be built in the development of MBSL2 is a safe, accurate, and standardized laboratory nationally and internationally with high levels of TKDN.
2. The relationship between BPPT and PT SDA in terms of the fundamentals of MBSL2 creation
   The relationship between BPPT and PT SDA regarding transfer of knowledge from the engineer in BPPT in the form of DED (Detail Engineering Design) will be given to PT SDA as the fabricator to apply it in an MBSL2 prototype form. There can be a design revision process to meet the needs of this fabrication process. The working partnership between these two actors motivates local firms to exploit knowledge and capture business value from the knowledge (Xu et al., 2018).
3. The relationship between BPPT and PT SDA with Biofarma in terms of prototype testing of MBSL2 as a process of product improvement
   The testing aims to assess the product's feasibility and suitability with agreed specifications between the actors in early planning. According to DED, the testing result also becomes feedback from the production process. Therefore, this testing is also a process to perfect the developed design.

Similar to Indonesia, the government of India established a task force for pandemic handling named the National Task Force for COVID-19. The center of this task force comprises the Ministry of Health and Family Welfare and two other institutions: the Central Surveillance Unit (ISDP) and the National Center for Disease Control (NCDC). The task force also has an expert team from India's three most prominent and modern hospitals. The establishment of this task force aims to ensure all top-down attempts from various departments and ministries, such as the Department of Biotechnology and Scientific Research Council, as well as the activities within the industries, can synergize with scientists in finding a solution that can be applied to the medical workforce and public immediately (Sahasranamam, 2020).

Through the task force, the Government of India has a strategy named Atmanirbhar Bharat, which means independent India, to handle COVID-19. Several programs in the strategy provide locally produced medical devices, such as PPE, ventilators, ICU beds, and oxygen tanks, strengthen the research laboratory, reinforce hospital infrastructure, and leverage human resource capability in the medical area. Moreover, India, with their expertise in technology, also created a mobile application named AarogyaSetu, a telemedicine system named E-sanjeevani, antivirus (disinfectant) technology, and Asimov robotic to assist in delivering food and medicines to COVID-19 patients in hospitals (Iyengar et al., 2020).

The policy of the Government of India in science and technology, including the participation of industry to provide several innovative products, deserves appreciation. Nevertheless, the result seems contradictory compared to India's increasing trend of COVID-19-confirmed cases. Those policies need to be more effective in handling the spread of Covid-19. The overall role of science and technology in India at the national level is inadequate for several reasons.

One of them is the prerequisite for handling the pandemic from WHO that has yet to be met, like the test number per population. India has facility obstacles regarding the COVID-19 testing laboratory for such a large population, especially for the region far away from a big city (Gupta et al., 2020). Therefore, the collaborating actor's role in developing MBSL2 is an excellent effort to handle the COVID-19 pandemic in Indonesia. With the MBSL2, COVID-19 virus testing has become more accessible to Indonesians. It aligns with the Ministry of Health program: testing for infected COVID-19 cases.

Inhibiting and Driving Factors in Developing MBSL2

The development of MBSL2 was conducted during the COVID-19 outbreak, so extra attention is needed to prevent all the team members from being infected. It can be one of the inhibiting factors in the MBSL2 development process. The team members need help in terms of communication and discussion. All direct contact between teams is restricted. In comparison, the final product of MBSL2 is necessary for Covid-19 testing. Thus, more interactions were shifted online to ensure the discussion was still ongoing. MBSL2 is demanded to be finished promptly regardless of the many limitations of the interaction.

Besides limitations in terms of communication, the material required to create an MBSL2 prototype takes a lot of work to find. This happened because the demand for raw medical products increased significantly, causing the supply side to dwindle. The increasing demand leads to material scarcity. It automatically makes the price of the materials very expensive. Sometimes, the materials are also needed to match the procurement. Every actor in the development of MBSL2 is demanded to help each other tackle the issue. With their relations, the materials were eventually available as per requirements. Compared to previous outbreaks, such as MERS-COV, SARS, and Ebola, the death rate of COVID-19 is relatively low. SARS-CoV (Severe Acute Respiratory Syndrome Coronavirus) has infected 8.098 people and resulted in 774 deaths, accounting for 9,6% in 26 countries. MERS-Cov in 2012 – 2019 infected 2.494 people in 27 countries and took a death toll of 858 people, accounting for a 34,4% death rate.

The Ebola virus, which is suspected to be the most virulent virus ever identified, has a 90% death rate. From 2014 – 2016, 11.310 people passed away due to Ebola (Senel & Topal, 2021). Meanwhile, the death rate of Covid-19 is relatively low, accounting for only 3,6%. However, the virus has infected not less than 2015 countries. Even though COVID-19 is not as virulent as Ebola, the contagion is very high (Roser et al., 2020). Therefore, early detection is vital to prevent it spreading to more people. The Covid-19 virus outbreak has brought down the economy of many countries.

Some countries experienced a recession early in the Covid-19 outbreak, such as the United States, China, Germany, France, Italy, the United Kingdom, South Korea, Japan, Thailand, and Singapore. In comparison, all those countries are the leading suppliers of medical devices. Thus, the scarcity of raw materials occurred during the Covid-19 pandemic.

The standard for a mobile laboratory is also another hindrance in developing MBSL2. The Ministry of Health of Indonesia has no standard for mobile laboratory development. Before the COVID-19 outbreak, Indonesia did not have an urgency to produce a mobile laboratory, so the Ministry of Health and related stakeholders needed unique research for the particular technology. BPPT, PT SDA, and Biofarma must research from scratch to set a standard for their mobile laboratory. Their study used international regulations as references for a mobile laboratory specification. Therefore, the MBSL2 that has been developed will fulfill the feasibility of benefiting the public.

Table 3.
Inhibiting Factors in Development of MBSL2 Analysis

Actor	Inhibiting Factors					
	Communication	Raw Material	Time	Product Dimension	Medical Devices Standard	Bureaucracy
BPPT		✓	✓		✓	✓
Biofarma		✓	✓	✓	✓	✓
PT SDA	✓	✓	✓			

Source: Result of The Author's Analysis

The availability of raw materials and producing time factors due to the COVID-19 pandemic are experienced by all actors involved in developing MBSL2. The actors must compete with other consumers to access the raw materials in developing MBSL2. In the meantime, the actors also need to race with the time to finish the MBSL2 immediately for social matters.

> *"Because I am chasing broadcasts, but parts are hard to get. You still have to be extra careful when working be careful because the virus is spreading. Everything is extra tight."* (SA-12, interview on March 17, 2023)

The limitation because of the COVID-19 pandemic is also explicitly experienced by the team from PT SDA. They struggled to communicate when assembling prototypes in the BPPT workshop, which contrasts with BPPT and Biopharma, which conducted online communication. In the end, PT SDA anticipated it by restricting the workers on duty for assembly to limit their mobility. Thus, they can at least minimize the testing process for workers because the testing price during that time was still relatively high.

After that, medical standards and bureaucracy became an obstacle for BPPT and Biofarma as those teams were responsible for setting the specifications for MBSL2. When proposing a standard for MBSL2, there were many bureaucratic conflicts. The bureaucracy did not only hinder the actors from administering the medical standard but also the automation process for MBSL2, especially for PT SDA. Even though BPPT has a capacity for bureaucracy, the process could be more straightforward. Collaborating contracts prevented BPPT with their expertise from being involved in a project when it had been delivered to the private sector.

Aside from inhibiting factors, there were also driving factors in developing MBSL2. Talmar (2020) mentioned that ecosystem-based innovation focusing on mutual goals determines the ecosystem's success depending on the factors from all stakeholders. The most essential thing is the participation of the experts in the development of MBSL2.

> *"There is a team of experts who are involved, and we are all united. It works very organized."* (SA-13, interview on March 17, 2023)

> *"Cohesion between members is crucial. If there were not that, this would not happen goods. Everyone has integrity and enthusiasm to contribute to the country, so everyone is trying to restrain ego for a common goal."* (AG-13, interview on March 7, 2023)

The involved experts have integrity so that they can collaborate without putting their egos. They work for one mutual objective: creating innovation to help the nation handle the Covid-19 pandemic. The collaboration was conducive because every actor has the same spirit to contribute to the country. Leadership is another factor that makes the collaboration between actors run smoothly. Leadership is essential to harmonize the involvement of each actor in the development of MBSL2. With appropriate leadership, every actor perceives fair treatment in an ecosystem.

Table 4
Driving Factors in Development of MBSL2 Analysis

Actor	Driving Factor				
	Integrity	Solidarity	Fund	Leadership	Expert Team
BPPT	✓	✓	✓	✓	✓
Biofarma		✓		✓	✓
PT SDA		✓	✓	✓	✓

Source: Result of The Author's Analysis

Several driving factors in the development of MBSL2 are the integrity and solidarity of the actors, leadership in harmonizing working partnerships, and the provision of sufficient funds and an expert team. The actors consider those factors very helpful in finishing MBSL2 with all the limitations. Without all those factors, the MBSL2 would unlikely be finished in less than three months. Integrity and solidarity between the actors fulfill their needs in their working partnership while developing MBSL2.

They collaborated cohesively to create innovation for the country. None of the actors became superior to the others. This is also created by good leadership so that collaboration orchestration becomes very harmonic. The new working environment the actors created places them in a conducive situation to innovate. Sufficient funds and expert teams become the cherry on top in the harmonization of working partnerships between the actors.

CONCLUSION

Building a robust innovation ecosystem requires the strong participation of RnD institutions in the innovation development process. They were then followed by the end user's participation from the beginning of the product development process, supported by government policies and industrial involvement, to determine EVP, business planning, market opportunities, and demand forecast so that the market would accept the product. TFRIC-19, as a form of an innovation ecosystem during the COVID-19 pandemic, has produced uneasy innovation. All limitations can be tackled with support from all stakeholders in developing MBSL2. This study found that three main actors are collaborating in developing MBSL2: BPPT as the innovation idea initiator, Biofarma as the standard controller, and PT SDA as the fabricator.

The collaboration between the actors can be harmonious because each actor has common values to achieve mutual objectives. Therefore, it is crucial to analyze all actors before they get involved in establishing an ecosystem. The matters that need to be considered are the resources, activities, created value, and the value they will capture in the ecosystem. Hence, the role of the actors can be optimum in the working environment. The collaboration can be appropriately conducted despite the pandemic. Research collaboration can help accelerate the fulfillment of pharmaceutical and medical device need in Indonesia for national advantage.

This study also found several inhibiting factors in developing MBSL2: difficulties in communication as a result of physical distancing, raw material scarcity in the market, a short period as the result of the product's urgency, limited product dimension, medical device standards, and bureaucracy. However, there are also driving factors, such as integrity and solidarity from the actors to contribute, leadership in working partnerships, funding, and expert teams.

REFERENCE

Adner, R., & Kapoor, R. 2010. Value creation in innovation ecosystems: How the structure of technological interdependence affects firm performance in new technology generations. *Strategic Management*

Journal, *31*(3), 306–333. https://doi.org/10.1002/smj.821

Adner, R., 2017. Ecosystem as structure: an actionable construct for strategy. J. Manag. 43 (1), 39–58.

Bomtempo, J. V., Chaves Alves, F., & De Almeida Oroski, F. 2017. Developing new platform chemicals: What is required for a new bio-based molecule to become a platform chemical in the bioeconomy? *Faraday Discussions*, *202*, 213–225. https://doi.org/10.1039/c7fd00052a

Choeriyah, S. S., & Noviaristanti, S. 2021. Model Ekosistem Inovasi Universitas (Studi Kasus Di Bandung Techno Park). *Jurnal Aplikasi Bisnis Dan Manajemen*, *7*(2), 451–464. https://doi.org/10.17358/jabm.7.2.451

Dasgupta, M., Gupta, R. K., & Sahay, A. 2011. Linking technological innovation, technology strategy and organizational factors: A review. *Global Business Review*, *12*(2), 257–277. https://doi.org/10.1177/097215091101200206

Davis, J.P., 2016. The group dynamics of interorganizational relationships collaborating with multiple partners in innovation ecosystems. Adm. Sci. Q. 61 (4), 621–661.

DeSeve, G. E. 2007. Creating Managed Networks as a Response to societal Challenges. In A. Morales (Ed.), The Business of Government (pp. 47-52). IBM Center for The Business of Government. http://www.businessofgovernment.org/sites/default/files/BOG_Spring07.pdf

Ding, L., & Wu, J. 2018. Innovation ecosystem of CNG vehicles: A case study of its cultivation and characteristics in Sichuan, China. *Sustainability (Switzerland)*, *10*(1), 1–16. https://doi.org/10.3390/su10010039

Fathoni, A. M., Sutriyanto, H., Maswan, A., & ... 2021. Development of hvac system for mbsl-2 tfric bppt: For the Comfort and Safety of Testing Personnel and the Safety for the Analysis Process and for the Environment from Exposure to SARS-CoV-2 Virus Contamination …. *Majalah Ilmiah …*, *15*(1), 59–63.

Gawer, A., & Cusumano, M. A. 2014. Industry platforms and ecosystem innovation. *Journal of Product Innovation Management*, *31*(3), 417–433. https://doi.org/10.1111/jpim.12105

Gomes, L. A. de V., Facin, A. L. F., Salerno, M. S., & Ikenami, R. K. 2018. Unpacking the innovation ecosystem construct: Evolution, gaps and trends. *Technological Forecasting and Social Change*, *136*, 30–48. https://doi.org/10.1016/j.techfore.2016.11.009

Granstrand, O., & Holgersson, M. 2020. Innovation ecosystems: A conceptual review and a new definition. *Technovation*, *90–91*(February). https://doi.org/10.1016/j.technovation.2019.102098

Gupta, M., Mohanta, S. S., Rao, A., Parameswaran, G. G., Agarwal, M., Arora, M., Mazumder, A., Lohiya, A., Behera, P., Bansal, A., Kumar, R., Meena, V. P., Tiwari, P., Mohan, A., & Bhatnagar, S. 2020. Transmission dynamics of the COVID-19 epidemic in India, and evaluating the impact of asymptomatic carriers and role of expanded testing in the lockdown exit strategy: a modelling approach. *MedRxiv*, *May*, 2020.05.13.20096826.

Helman, J. 2020. Analysis of the local innovation and entrepreneurial system structure towards the 'wrocław innovation ecosystem' concept development. *Sustainability (Switzerland)*, *12*(23), 1–17. https://doi.org/10.3390/su122310086

Isdahl, C., & Karlsen, M. 2022. *Value Creation in Ecosystem Business Models*. *May*.

Iyengar, K., Mabrouk, A., Jain, V. K., Venkatesan, A., & Vaishya, R. 2020. Learning opportunities from COVID-19 and future effects on health care system. *Diabetes and Metabolic Syndrome: Clinical Research and Reviews*. https://doi.org/10.1016/j.dsx.2020.06.036

Jackson, D. J. 2011. What is innovation ecosystem? *Nacional Science Foundation, Arlington, VA*, 1–13. https://erc-assoc.org/sites/default/files/topics/policy_studies/DJackson_Innovation Ecosystem_03-15-11.pdf

John w. Creswell. 2009. Table of Contents PART I - Preliminary Considerations PART II - Designing Research. In *Research Design Third Edition*.

Magistretti, S., Ardito, L., & Messeni Petruzzelli, A. 2021. Framing the microfoundations of design thinking as a dynamic capability for innovation: Reconciling theory and practice. *Journal of Product Innovation Management*, *38*(6), 645–667. https://doi.org/10.1111/jpim.12586

Mantovani, A., Ruiz-aliseda, F., & Mantovani, A. 2022. *MANAGEMENT SCIENCE wffiH Equilibrium Innovation Ecosystems : The Dark Side of Collaborating with Complemento*. *62*(2), 534–549.

Moore, J. F. 1993. Predators and prey: a new ecology of competition. *Harvard Business Review*, *71*(3), 75–86.

Oh, D. S., Phillips, F., Park, S., & Lee, E. 2016. Innovation ecosystems: A critical examination. *Technovation*, *54*, 1–6. https://doi.org/10.1016/j.technovation.2016.02.004

Overholm, H. 2015. Collectively created opportunities in emerging ecosystems: The case of solar service ventures. *Technovation*, *39–40*(1), 14–25. https://doi.org/10.1016/j.technovation.2014.01.008

Popov, E., Dolghenko, R., Simonova, V., & Chelak, I. 2021. Analytical model of innovation ecosystem development. *E3S Web of Conferences*, *250*. https://doi.org/10.1051/e3sconf/202125001004

Ritala, P., & Almpanopoulou, A. 2017. In defense of 'eco' in innovation ecosystem. *Technovation*, *60–61*(January), 39–42. https://doi.org/10.1016/j.technovation.2017.01.004

Rohrbeck, R., Hölzle, K., & Gemünden, H. G. 2009. Opening up for competitive advantage - How Deutsche telekom creates an open innovation ecosystem. *R and D Management*, *39*(4), 420–430. https://doi.org/10.1111/j.1467-9310.2009.00568.x

Roser, M., Ritchie, H., Ortiz-Ospina, E., & Hansell, J. 2020. Mortality Risk of COVID-19 - Statistics and Research - Our World in Data. *Mortality Risk of COVID-19*, *2020*, 1. https://ourworldindata.org/mortality-risk-covid#case-fatality-rate-of-covid-19-compared-to-other-diseases%0Ahttps://ourworldindata.org/mortality-risk-covid?country=DOM

Sahasranamam, S. 2020. India: how coronavirus sparked a wave of innovation. Retrieved August 4, 2020, from The Conversation website: https://theconversation.com/india-how-coronavirus-sparked-a-wave-of-innovation-135715

Şenel, E., & Topal, F. E. 2021. Holistic Analysis of Coronavirus Literature: A Scientometric Study of the Global Publications Relevant to SARS-CoV-2 (COVID-19), MERS-CoV (MERS) and SARS-CoV (SARS). *Disaster Medicine and Public Health Preparedness*, *15*(6), E12–E19. https://doi.org/10.1017/dmp.2020.300

Shaw, D. R., & Allen, T. 2018. Studying innovation ecosystems using ecology theory. *Technological Forecasting and Social Change*, *136*, 88–102. https://doi.org/10.1016/j.techfore.2016.11.030

Sugiyono. 2017. *Metode Penelitian Kuantitatif Kuantitatif Dan R&D*. Bandung: Alfabeta.

Sun, Y., Koh, V., Marimuthu, K., Ng, O. T., Young, B., Vasoo, S., Chan, M., Lee, V. J. M., De, P. P., Barkham, T., Lin, R. T. P., Cook, A. R., & Leo, Y. S. 2020. Epidemiological and clinical predictors of COVID-19. *Clinical Infectious Diseases*, *71*(15), 786–792. https://doi.org/10.1093/cid/ciaa322

Talmar, M., Walrave, B., Podoynitsyna, K. S., Holmström, J., & Romme, A. G. L. 2018. Ecosystem Pie Model: Methodological Guidelines for the Qualitative Modeling of Innovation Ecosystems. *Methodological Guidelines*, 48. https://www.ecosystempie.com/guidelines.pdf%0Ahttps://ecosystempie.com/about-us/

Talmar, M., Walrave, B., Podoynitsyna, K. S., Holmström, J., & Romme, A. G. L. 2020. Mapping, analyzing and designing innovation ecosystems: The Ecosystem Pie Model. *Long Range Planning*, *53*(4), 101850. https://doi.org/10.1016/j.lrp.2018.09.002

Tsujimoto, M., Kajikawa, Y., Tomita, J., & Matsumoto, Y. 2018. A review of the ecosystem concept — Towards coherent ecosystem design. *Technological Forecasting and Social Change*, *136*(April 2017), 49–58. https://doi.org/10.1016/j.techfore.2017.06.032

Valkokari, K. 2015. Business, Innovation, and Knowledge Ecosystems: How They Differ and How to Survive and Thrive within Them. *Technology Innovation Management Review*, *5*(8), 17–24. https://doi.org/10.22215/timreview919

Walrave, B., Talmar, M., Podoynitsyna, K.S., Romme, A.G.L., Verbong, G.P.J. 2018. A multi-level perspective on innovation ecosystems for path-breaking innovation. Technol. Forecast. Soc. Change Forthcoming.

Wong, J. E. L., Leo, Y. S., & Tan, C. C. 2020. COVID-19 in Singapore - Current Experience: Critical Global Issues That Require Attention and Action. *JAMA - Journal of the American Medical Association*, *323*(13), 1243–1244. https://doi.org/10.1001/jama.2020.2467

Xu, G., Wu, Y., Minshall, T., & Zhou, Y. 2018. Exploring innovation ecosystems across science, technology, and business: A case of 3D printing in China. *Technological Forecasting and Social Change*, *136*(December 2015), 208–221. https://doi.org/10.1016/j.techfore.2017.06.030

Yin, R. K. 2018. Case study research and applications: Design and methods. *Journal of Hospitality & Tourism Research*, 53:5. https://doi.org/10.1177/109634809702100108

Yong, S. E. F., Anderson, D. E., Wei, W. E., Pang, J., Chia, W. N., Tan, C. W., Teoh, Y. L., Rajendram, P., Toh, M. P. H. S., Poh, C., Koh, V. T. J., Lum, J., Suhaimi, N. A. M., Chia, P. Y., Chen, M. I. C., Vasoo, S., Ong, B., Leo, Y. S., Wang, L., & Lee, V. J. M. 2020. Connecting clusters of COVID-19: an epidemiological and serological investigation. *The Lancet Infectious Diseases*, *20*(7), 809–815. https://doi.org/10.1016/S1473-3099(20)30273-5