Evaluating the Current Policies' Impacts on the 5G adoption in Indonesia using a systemic framework

Hermawanto Tjoa, Akhmad Hidayatno
Industrial Engineering Department
Universitas Indonesia
Depok, Indonesia
hermawanto.tjoa@ui.ac.id , akhmad.hidayatno@ui.ac.id

Abstract

Indonesia's 5G network deployment has faced challenges that have postponed the target to be available nationwide in 2022. However, with its potential to improve the interconnectivity of the people and increase business efficiency and effectiveness, the government still pushed the deployment of the technology. Therefore, this research aims to better understand these challenges and opportunities by offering the systems perspectives on the adoption of 5G. The study identified the sub-component and its relationship in developing the ideal 5G network deployment systems using a modified soft system methodology. It also lists recommendations for improvement after comparing the actual and conceptual models.

Keywords

Soft System Methodology (SSM), Technology Adoption, Stakeholders Analysis, 5G Network, Mobile Connection.

1. Introduction

The fifth-generation (5G) telecommunications network first launched in South Korea has many advantages. 5G uses lower energy and cost per link and supports more devices than the previous generation (Hutajulu et al., 2020). The use of a new generation of low-cost broadband data can encourage better communication in several areas such as education, social cohesion, exchange of ideas, access to information globally, science, learning, and the economy (Forge & Vu, 2020). Apart from having faster speeds, 5G also has reliable low latency and will allow the creation of several new services such as smart factories and automated driving [3]. Furthermore, 5G networks are becoming the only way to support high-performance and heterogeneous devices. More functional 5G features such as fixed cellular convergence, device-to-device (D2D) communication, ad-hoc meshing, and open access have made global interest in conducting research related to 5G high (Neokosmidis et al., 2017). Through faster services and extensive and more reliable network capacity, 5G technology will unlock the potential benefits for human-to-human communication and integrate human-to-machine networks and machine-to-machine communication networks (Indonesia Development Forum, 2021).

The development of 5G in Indonesia is in the initial phase; this can be seen from last 2019. The Telkomsel operator has just conducted a 5G Operational Feasibility Test (ULO) at the Ministry of Communication and Information (Kominfo). Telkomsel also presented a 5G service trial "Telkomsel 5G Experience Center" at the 2018 Asian Games momentum and a "Telkomsel 5G for Industry 4.0" trial in Batam in 2019 (Erika Dyah Fitriani, 2021). Since May 2021, Indonesia has only provided 5G services in 9 cities or algorithmic areas, including Jabodetabek, Bandung, Batam, Balikpapan, Makassar, Surakarta, Surabaya, Denpasar and Medan which only cover certain points (Novani et al., 2014).

The 5G network was initially planned to be available in 2020 in Indonesia. Although it is expected to improve the quality of life of the people and improve the performance of business and industry in Indonesia, itas encountered several obstacles, so this deployment needs to be postponed (Hutajulu et al., 2020). 5G services are still in the development stage, so it is not easy to see a clear view of the future. However, making an initial estimate on 5G adoption is essential to best use the enormous opportunity. In addition, it is necessary to understand how to contribute to strategic policy based on the predicted demand (Jahng & Park, 2020). Before 5G can become a commercial reality, various problems need to be resolved (Neokosmidis et al., 2017). A 5G network will have more significant challenges

than before. For example, to achieve the same network coverage as today's 4G, 5G requires the construction of denser base stations which automatically cost more (Luthfijamil S. Sastrawidjaja, 2018).

This research used the system perspective to evaluate 5G adoption because the system is composed of interaction between entities, i.e., government, ministry, local government, mobile network operators (MNOs), customers, and others. Another aspect that will make 5G network implementation successful is reliable and affordable infrastructure. Moreover, this aspect of infrastructure is related to aspects of government policy, so in this study, we will analyze government policies regarding the adoption of 5G networks. Therefore, an analysis is needed to understand the problem with a systematic framework based on the soft system methodology (SSM). Adopting 5G is exciting to investigate because of its unique characteristics. Meanwhile, the soft system methodology is suitable since it illustrates a rich picture and conceptual model.

2. Literature Review

2.1 5G challenges and opportunities in Indonesia and the world

There are several advantages for countries that have implemented 5G networks, such as competing with other countries to take investment opportunities, domestic technology becoming more efficient, and improving network quality, making it easier for users. In addition, other advantages are encouraging the digitalization of vertical industries that will increase efficiency and effectiveness, increasing return on investment for companies (Hutajulu et al., 2020) and gross domestic product in the country (Martinus, 2020), encouraging innovation that produces ripple effects in various industrial fields such as transportation, manufacturing, and construction (Maeng et al., 2020) as well as supporting the transformation of society towards the fourth industrial revolution (The Euro-5G Project, 2020).

Apart from the advantages of 5G, some challenges are a concern in implementing and deploying 5G networks (Maeng et al., 2020). There are some real challenges in implementing 5G in various countries: challenges in making policies from the central government, in China, especially Beijing and Shanghai, excessive government intervention related to 5G will affect strategy and reduce the value of operator companies (Jeon et al., 2020), private operators object to continue the process of launching the 5G network because the return on profits is still unknown (Forge & Vu, 2020), there are also uncertainties in the development of 5G networks such as global uncertainty, government doubts about 5G networks, infrastructure problems, small steps in vertical industries and end-users.

The first 5G network deployment is a form of accelerating digital transformation in Indonesia. The government started the Acceleration of National Digital Transformation program, which stated that the 5G networks would be developed in commercial areas and other priority areas to complement the existing 4G networks. Therefore, Indonesia has begun the simultaneous operations of 4G and 5G (Kominfo, 2021). The Minister of Communication and Information, Johnny G. Plate, hopes that 5G technology will further encourage Indonesia's digital sector and strengthen national economic growth. Minister Johnny also invited telecommunications operators to be part of the acceleration of the 5G implementation in Indonesia (Indonesia Development Forum, 2021). Currently, three telecommunication companies provide 5G services, namely Telkomsel, operating on May 27, 2021. In addition, Indosat will operate on Jun. 7, 2021, and XL Axiata, which has just received a Certificate of Operation Eligibility (SKLO) for 5G services on Aug. 6, 2021 (Tommy Sorongan, 2021).

Acceleration of digital transformation, especially in the launch of 5G networks, is not the full responsibility of the central government but leads to broader areas such as the Ministry of Communications and Information Technology (Kominfo), local governments, telecommunication operators, and internet users. The adoption and implementation of 5G cannot go alone and individually. For example, according to (Bauer & Bohlin, 2019), in implementing 5G policies, telecommunication operators are key implementers and market players affected by a government policy. Telecommunications operators are not only the leading developers of communication technology, but they are also the basis for building the entire industrial ecosystem through network construction and service development activities. Therefore, implementing the new communication technology policies will significantly impact telecommunication operators.

2.1. Technology Adoption

Various Technology adoption has been widely discussed in previous studies. The discussion of technology adoption can use multiple methods or approaches, such as the system dynamic and bass diffusion models. Some examples of adoption research using a systems dynamics approach such as the adoption of the Internet of Things (Tripathi & Pandit,

2019), the adoption of household PV rooftop (Hidayatno et al., 2020), the adoption of renewable energy technology in the hotel sector (Dhirasasna & Sahin, 2021), the adoption of 3G (Pagani & Fine, 2008) and 4G (Chen et al., 2016) networks and the adoption of mergers 3G and 4G networks (Jha & Saha, 2020).

The Bass diffusion model was created by Frank Bass and describes how new products are adopted as an interaction between user and potential user (Shin et al., 2020). Bass diffusion model solves problems by assuming that potential adopters become aware of the innovations through external information sources (Hutami et al., 2020). The model is widely used in forecasting, especially product forecasting and technology forecasting.

2.2. Soft System Methodology based systems analysis approach

This research uses soft system methodology as a soft system approach. Soft system methodology is a widely used qualitative research methodology based on system thinking theory and action research (Aryee & Hansen, 2021). Soft system methodology is used to structure thinking in a complex problem. It consists of human activity since it involves many stakeholders, and each of them has a different point of view, interest, and belief (Novani et al., 2014). According to Checkland and Poulter, Soft system methodology is consists of seven stages process as follows: understanding unstructured problems, formulating problems holistically, developing the definition of the problem, creating conceptual models with the facts on the field, determining the desired change, and taking action for improvement (Checkland, 2000). We modified this SSM approach in this study because we plan to model dynamic systems after SSM. Therefore, only stages 1 to stage 5 will be conducted, while stages 6 to stage 7 will implement the model into the system, which will be done in the following research.

3. Methods

The first stage is namely understanding of unstructured problems, which is the comprehension of the system's problems which are unstructured, complex, and in need of a broad perspective. Problem comprehension is carried out through study literature.

Then the second stage, namely holistically formulating problems, works to uncover the structured problem. This stage produces a clear picture of the situation's complexity in rich detail. A rich picture is a basis for establishing a relevant system.

The third stage is developing the problem's definition (root definition), which attempts to build the definition for the root of the problem, including some particular views of the problem's situation from relevant perspectives. Root definitions compile information about the organization collected, explored, and discussed in the previous stage. The appropriate system will be controlled by CATWOE (Customers, Actors, Transformation, Weltanschauung, Owners, Environmental). Three criteria reference 'how this transformation process should be implemented.' Namely 3Es: efficacy, efficiency, effectiveness.

The fourth stage is creating a conceptual model, which describes the system's operation according to the observed problems. Finally, the model is built based on the researcher's idea to provide solutions for problems in the system.

Once the model is developed and returned to the real-world problem situation, in stage 5, the SSM approach compares the model and the real world. In this comparison stage, the participation of the stakeholders is of utmost importance to generate debate on possible changes that may occur to improve the situation.

4. Results and Discussion

4.1 Problem Situation and Descriptions

The problem in adopting the 5G network can be seen from the rich picture below. With the presence of 5G in Indonesia, the government, as the owner of the system, wants to accelerate the adoption of the network. Accelerating this network requires a significant investment from the state and is regulated by the minister of finance. In addition, technical readiness, such as the issue of frequency bands and network development held by the Minister of Communications and Information Technology, is also essential. Through Kominfo, the government encourages business entities and academics to improve the quality of human resources to create a new ecosystem for 5G networks.

Passive infrastructure development by BAKTI (Telecommunications and Information Accessibility Agency) in an area requires a location permit from the local government. The passive infrastructure will be transmitting a frequency

band that the telecommunications company regulates. Telecommunications companies have doubts about investing in infrastructure development because it is a significant investment. In addition, telecommunications companies will also choose vendors for their 5G networks by considering the security of the vendor's network. Telecommunications companies carry out the introduction of 5G and promotions through the media to attract consumers. Consumers will consider aspects of price and usability when choosing to switch networks.

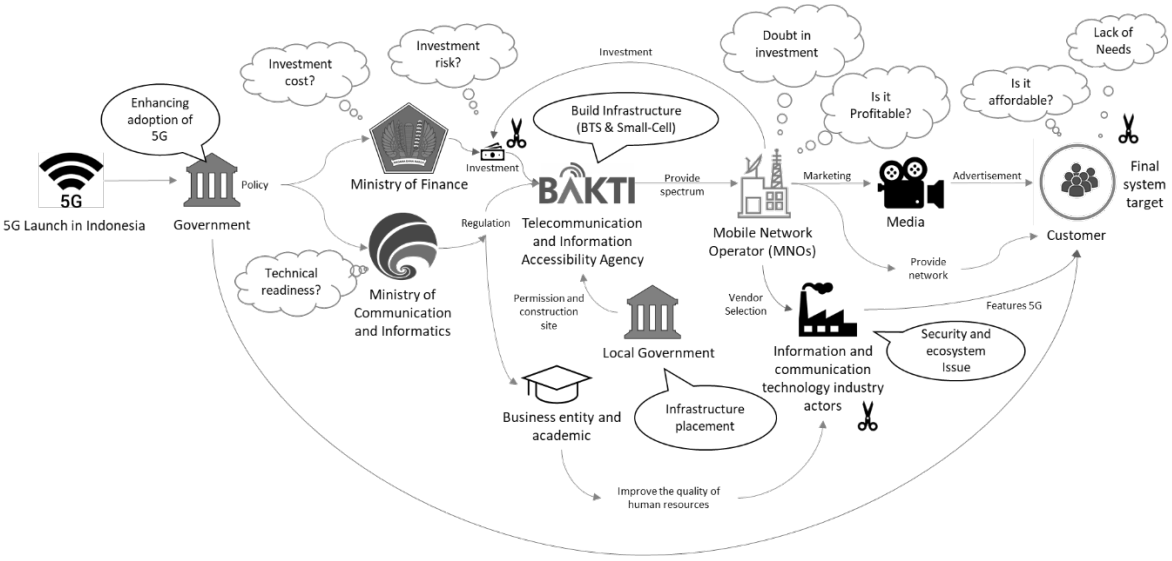

Figure 1. Rich Picture of Adoption 5G Network

4.2 Defining System's Problems

The enriched CATWOE analysis of the root definition is presented in Table 1. The main problem with this system is that the Indonesian government, as the owner of the system, needs to build reliable and affordable infrastructure through Kominfo to improve the network to accelerate the adoption of 5G networks.

Table 1. Root Definitions

Root Definitions	Mobile Network Operators View
After the 5G service was launched, the Indonesian government, as the system owner, needed to build reliable and affordable infrastructure to accelerate the adoption of 5G services.	C = Potential User 5G
	A = Kominfo
	T = Upgrading networks
	W = 5G network covered all areas with high speed, low latency, and affordable price.
	O = Indonesia Government
	E = Doubt in 5G investment

In the conceptual model created, the author identifies ten actors in the system. Although each actor has their own goals and interests in 5G development, each actor needs to collaborate to accelerate adoption. The analysis actor table is shown in table 2.

Table 2. Actor Analysis

No	Actor	Problem Perception	Objective(s)	Interest(s)	Root Problem	Resource	Position
1	Indonesian government	There is an obstacle in the process of implementing a 5G network	Want to speed up the adoption of the 5G network as one of the acceleration steps in digital transformations	Growth country's digital economy	Challenge in understanding the level of future market demand.	Power to Make a policy	Will create policies that can support the deployment of the 5G network becomes faster.
2	Ministry of Communication and Informatics	Technical problem related to 5G network	Formulate technical regulations; allocation spectrum network	Speed up 5G network adoption	Technical readiness	Power to make a regulation in communication and technology aspect	Waiting for the following government policy
3	Ministry of Finance	How much investment costs need to be issued by the state?	Disburse funds according to the budget	Reasonable allocation of state funs	Limited funds	Allocation government budget	Waiting for a government policy related to budget
4	BAKTI (Telecommunications and Information Accessibility Agency)	How many infrastructures need to be built?	Providing infrastructure for 5G networks	Equitable infrastructure	Required a huge investment	Build network infrastructures like fiber optic, BTS, and satellite	Continue the construction of 4G throughout Indonesia while waiting for the government's next step
5	Local government	Determine location construction; permission	A city that has even 5G network coverage	Increase the value of the city to attract investors	Required cooperation with BAKTI to determine point location development	Permission	Waiting to get a 5G network in their area
6	Telecommunication company	Doubt in investment	Expect a small investment with a significant return	Profit	Required a significant investment for providing service	Provider service	Development slowly while looking at opportunities and conditions.
7	Information and communication technology industry players (device vendors, startups, developer, and community)	Challenges in presenting 5G features in all segments *smartphone*	Creating 5G features in all segments *smartphone*	Enhancement adoption of 5G network	5G network is still in progress development	Supporter 5G service	Wait until 5G becomes commercial
8	Business entities and academics	Improve quality in education to match the development of technology	Provide competitive human resources and digital talent	Increase the quality of human source power	Lack of educators	preparation education to improve quality source power man	As a medium for enhancing education resources, ability to create a digital ecosystem
9	Media	The average community hasn't got 5G coverage	Increase the awareness about digital transformation	Information sharing to the public and profit	-	Ability to spread information massively	Waiting for other actors to ask to promote 5G
10	Customer	Service price and necessity	Get an affordable and reliable service	Get better benefits and usability when compared 4G network	Lack of needs and the majority are not covered by the network	As a user or customer	Can choose to upgrade the network or not

4.3 Conceptual Model of System's Problem

The conceptual model will be described through a system diagram, as shown in figure 2. As the problem owner, the Indonesian government aims to accelerate the 5G network to reduce congestion and fulfill high telecommunications data requirements. There are several stakeholders such as the minister of communication and informatics, the minister of finance, local governments, operator companies, BAKTI, and industry actors.

Government intervention can be done in pricing for 5G networks, investments used to build telecommunications infrastructure, and regulations related to the spectrum for 5G networks. The input in the system is total investment for 5G, price of 5G service, percentage of device 5G in area, adoption fraction, and contact rate. The resulting output is the number of 5G network adoptions.

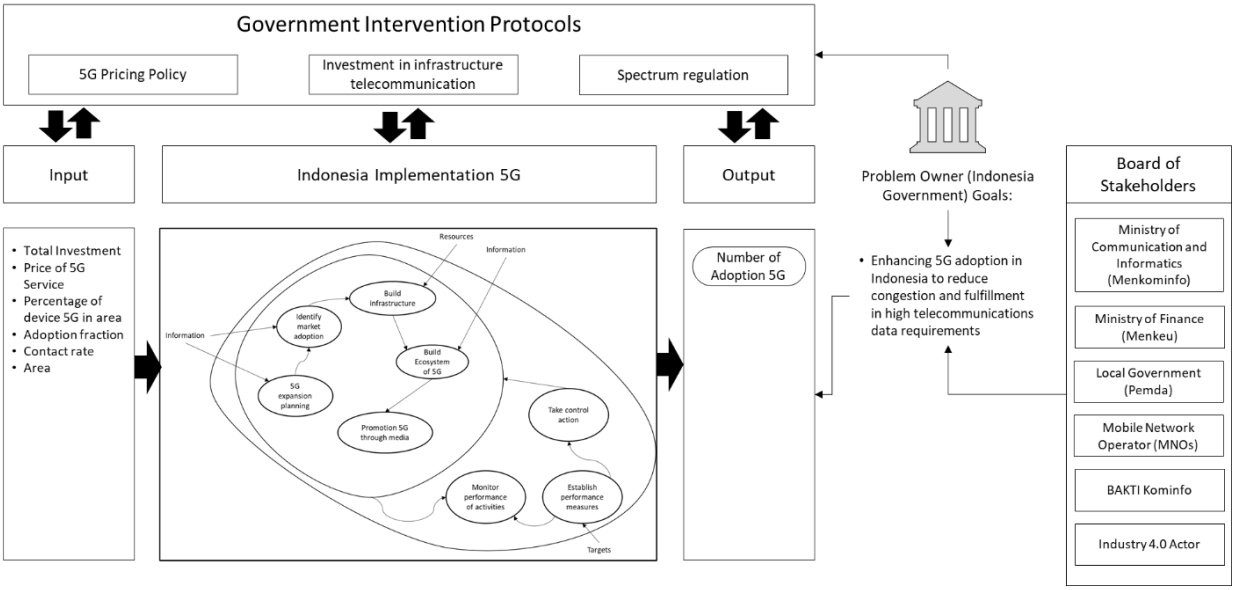

Figure 2. System Diagram that Illustrated the Context of the Conceptual Model

4.4 Comparisons of Model Gaps

After finding the root cause, system problems, and conceptual model. Then the next step is to compare the conceptual model that has been made with the actual model and provide ideas for improvement. The result comparison of the model gap is shown in table 3.

Table 3. Comparison Model in Real World and Conceptual

No	Activities MNOs Perspective	Exist? Yes/No	How is its E3	Measurement Criteria	Ideas for Improvement
1	5G Expansion Planning	Yes	By the President's direction regarding the Acceleration of Digital Transformation		
2	Identify Market Adoption	No		Adoption Rate	Required measurement related to 5G market demand
3	Build Infrastructure	Yes	Build infrastructure in stages	Coverage area	Need to build reliable and affordable infrastructure

4	Build an ecosystem of 5G	Yes	Early stages of development	Ecosystem 5G	Need to improve the quality of human resources to accelerate ecosystem development
5	Promotion 5G through media	Yes	Not on a large scale because not all locations have 5G networks		
Activities Connection					
1	1 and 2	No	Planning will be more mature with the measurement of market demand.		
2	2 and 3	No	Conducting market identification before implementation can increase investor and government confidence.		
3	4 and 5	No	Before promoting in the media, it would be better to create a supportive ecosystem to maximize the 5G adoption process because it has many advantages for users.		

5. Conclusion

By employing a systems-based methodology such as SSM, we have seen the value of capturing the perceptions from a researcher's point of view. To increase 5G adoption in Indonesia, it is necessary to calculate the 5G market demand to make investments by the government and investors, especially operators. There is also a need for reliable and affordable infrastructure and a digital ecosystem that supports 5G devices. Every actor needs to collaborate and communicate to accelerate the adoption of 5G networks in Indonesia.

In this paper, the presented results are preliminary. Furthermore, research needs to explore and expand the model and validate it with reality by collecting the data from each actor related to adopting 5G networks.

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Biographies

Hermawanto Tjoa is a Post- graduate student in Industrial Engineering at University of Indonesia since 2020. He finished his bachelor's degree from Industrial Engineering at the University of Putera Batam in 2018. His research interest is in adoption technology, industry 4.0, and system dynamics.

Dr. Akhmad Hidayatno ST, MBT is the Head of the System Engineering, Modeling, and Simulation Laboratory at the Department of Industrial Engineering, Faculty of Engineering, University of Indonesia. As a Professor, he currently manage courses including Systems Modeling, Industrial Simulation, Systems Thinking, and Introduction to Systems Engineering. As a professional consultant working with a variety of complex problems has provided experience in designing complex systems such as hospital service systems, management systems disaster, regional planning systems, and knowledge management systems.