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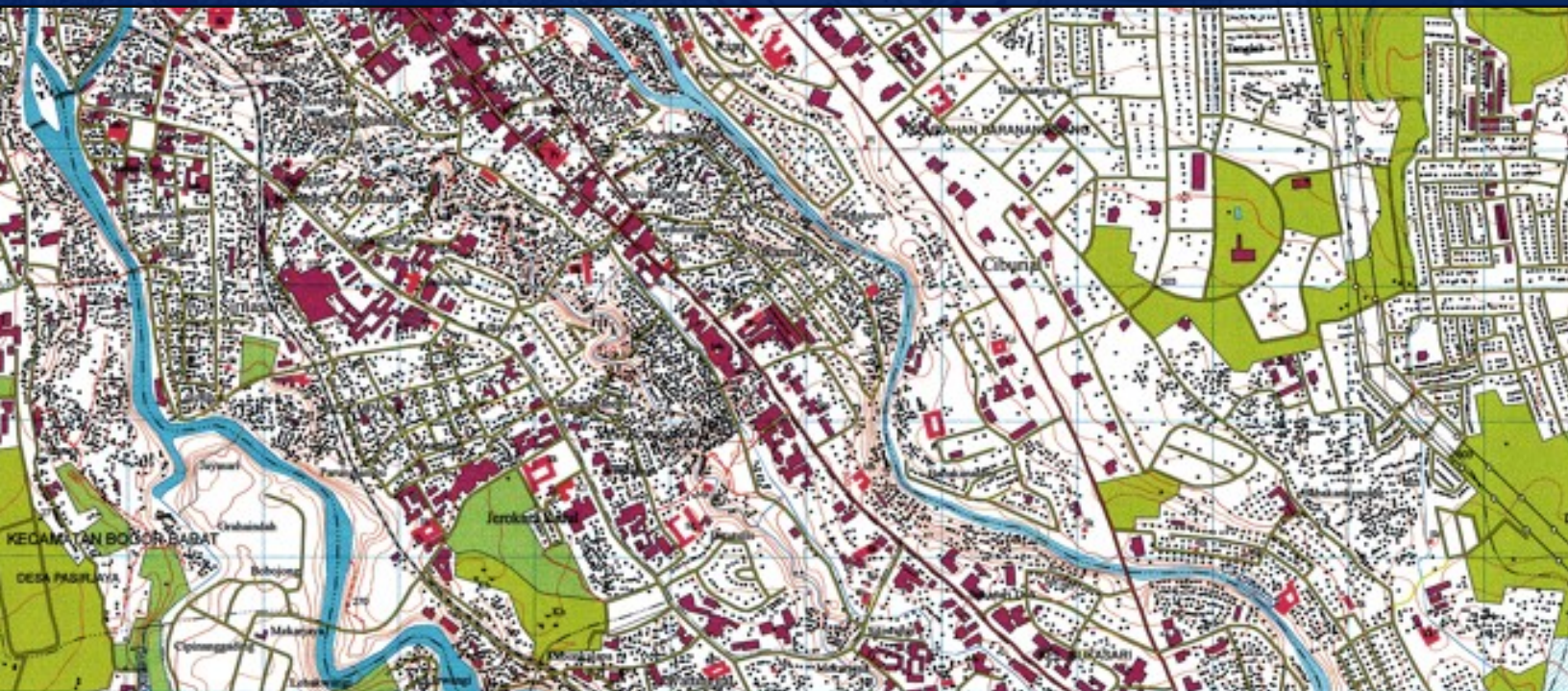
Funding Model for The Production of Large-Scale (1:5.000) Base Map in Indonesia

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Cover image shows a sample of base maps in Indonesia around Bogor city area from tile sheets number 1209-1432. The data was acquired from the Indonesia geoportal (https://tanahair.indonesia.go.id/)

The work in this thesis was carried out in the:

Delft University of Technology

Abstract

The Indonesian government mentioned the urge to accelerate the process of providing detailed spatial plan maps. Moreover, to have one standard of reference, detailed spatial plan maps need to use large-scale (1:5.000) base maps as reference. Furthermore, the Indonesian government established the One Map Policy agenda as a legal basis for accelerating large-scale data. The Geospatial Information Act (2011) mentioned that the National Mapping of Agency (NMA) of Indonesia is responsible for providing nationwide large-scale (1:5.000) base maps. However, until now, only 2.7% of large-scale (1:5.000) base maps are available from all over Indonesia . One issue is the gap between the budget needed and received annually from the national government. Dependent on the national government, the NMA faces budget uncertainty between the budget requested and received during the annual process. Moreover, the budget was focused on supplying a national program of large-scale (1:5.000) base maps. Therefore, the NMA tend to innovate its funding model to accelerate the production of large-scale (1:5.000) base maps.

Five innovative funding models will be assessed in this thesis research: 1) Public Private Partnership, 2) Local-National Matching Ratios, 3) Cost-Sharing, 4) Multi-year State Budget, and 5) Civic Crowdfunding. One multi-criteria analysis method is used in this research, called Analytical Hierarchy Process (AHP). In the AHP method, experts in the base map production business process are involved and give opinions in a pairwise comparison of criteria and alternatives. The result shows that cooperation between local and national governments in sharing financial resources is the best viable option for the funding model. However, the amount of sharing financial resources may consider three factors of local governments: 1) fiscal capacity, 2) commitment of local leaders, and 3) awareness of using spatial data to improve local citizen wellbeing. Moreover, the NMA should manage a proper relationship among stakeholders to implement the funding model successfully. Hence, a stakeholder analysis is conducted in this research. Five stakeholders from the One Map Policy team, including the chairman and executive team, are interviewed. The result is that stakeholders can be grouped into four categories: key stakeholders, keep informed, satisfied, and monitor. To successfully implement the funding model, the NMA must collaborate more with stakeholders in the key stakeholder quadrant. These stakeholders are the Coordinating Ministry of Economic Affairs, Geospatial Information Agency as the NMA, Ministry of National Planning and Development, Jakarta province as the local government, Ministry of Internal Affairs, Ministry of Environment and Forestry, Ministry of Public Works and Housing, Ministry of Agrarian and Spatial Planning, Ministry of Agriculture. Overall, this thesis project has provided recommendations for the NMA based on evidence to implement an innovative funding model.

Acknowledgement

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List of Abbreviations

NMA	National Mapping Agency
RPJPN	*Rencana Pembangunan Jangka Panjang Nasional* (Long-term National Plan)
RPJMN	*Rencana Pembangunan Jangka Menengah Nasional* (Medium-term National Plan)
RKP	*Rencana Kerja Pemerintah* (Government Working Plan)
PPP	Public-Private Partnerships
PUP	Public-Public Partnerships
MOF	Ministry of Finance
MONDP	Ministry of National Development and Planning
CMOEA	Coordinating Ministry of Economic Affairs
OMP	One Map Policy
NPV	Net Present Value
IRR	Internal Rate of Return
Musrenbang	*Musyawarah Perencanaan Pembangunan* (Development Planning Forum Activity)
MCDA	Multi-Criteria Decision Analysis
AHP	Analytical Hierarchy Process

Chapter 1. Introduction

1.1. Background

Spatial Data Infrastructure (SDI) plays an essential role in data sharing across stakeholders, leading to a better digital government transformation (Barbero et al., 2019). Digital government transformation is defined as moving from traditional to digital government, which gives more portion of online services through an e-government system (Liva et al., 2020). Digital government transformation has an impact on reducing human involvement, government expenditure, and corruption, increasing the transparency and accountability of government activities, and empowering citizens and other stakeholders to contribute to or lead the creation of public value (Barcevičius et al., 2019).

Rajabifard et al. (2002) mentioned that SDI consists of five key interrelated components: people, access network, policy, standards and data. Moreover, these components can be grouped into two categories based on the nature of their interactions within the SDI framework (Rajabifard et al., 2002). The first category comprises access networks, policy and standards, and the second comprises people and data (Rajabifard et al., 2002). Generally, spatial data can be grouped into basic and thematic geospatial information (Collier, 2009; Mcdougall & Koswatte, 2019). In most countries, basic geospatial information is used as a foundation and reference for other thematic data (Jasim, 2017). Moreover, basic geospatial information is regarded as means to support core government and business operations (Mcdougall & Koswatte, 2019). Therefore, basic geospatial information is often provided by an authoritative source as a national program which follows an official process during data production (Mcdougall & Koswatte, 2019).

In 2018, the United Nations developed Sustainable Development Goals (SDGs) to achieve by 2030 (UN, 2018). The SDGs aimed to reduce inequality among nations; thus, no nations are left behind (UN, 2018). Moreover, the SDGs agenda comprises 169 targets and 232 indicators (UNSTAD, 2017). Arnold et al. (2019)mentioned that around 20% of the SDG indicators could be interpreted and measured by basic geospatial information. UN-GGIM (2018) defined 14 data themes within the basic geospatial information: geodetic reference frame, addresses, buildings and settlements, elevation and depth, functional areas, geographical names, geology and soils, land cover and use, land parcels, ortho imagery, physical infrastructure, population distribution, transport networks, and water. In general, 10 out of 14 themes of basic geospatial information (excluding: geodetic reference frame, geology and soils, land parcels, and population distribution) can be represented and visualized in the base map (Mcdougall & Koswatte, 2019). However, the global coverage availability of a complete base map is diverse. For instance, the 1:50,000

base map is estimated at around 75% and the 1:25,000 base map at around 30% (Arnold et al., 2019). Therefore, it can be seen that the availability of the base map decreases as the level of detail increases (Arnold et al., 2019).

One of the SDGs' agenda is to make cities and human settlements inclusive, safe, resilient and sustainable (UN, 2018). Cities or urban areas are prone to several problems, including non-optimal waste management, land and non-renewable resources misuse and air and water pollution (Moraci et al., 2018). The main drivers of urban vulnerability are caused due to competition for land, environmental degradation, and unplanned expansion of urban infrastructure (UNISDR, 2015). Moreover, UNCTAD (2015) predicted that by 2050, around two-thirds of people would live in urban areas, and 95% of the urbanization is happening in developing countries. Furthermore, the complex nature of cities or urban areas can be depicted by using a high level of detail in geospatial information, especially large-scale (1:5,000) base map (Konečný et al., 2011; Sliuzas & Brussel, 2000). However, developing countries face problems providing accurate large-scale (1:5,000) base maps (Arnold et al., 2019; Jokar Arsanjani et al., 2016).

Developing countries face technical and financial issues in providing accurate and up-to-date geospatial information (Choi et al., 2016). Furthermore, developing countries can only fund 35% of their national programs, including large-scale (1:5,000) base maps programs (Duffield et al., 2019). Moreover, UN-GGIM developed Integrated Geospatial Information Framework (IGIF) as a basis and guidance for developing and strengthening geospatial information, especially for developing countries (UN-GGIM, 2020). Furthermore, IGIF mentioned that financial is one of its strategic frameworks, which is essential in establishing an effective arrangement of geospatial information (UN-GGIM, 2020). Therefore, within the financial framework, developing countries may explore various funding models to be implemented for their large-scale (1:5,000) base maps production (UN-GGIM, 2022).

1.2. Motivation and Problem Statement

Indonesia is a developing country located in Southeast Asia, with an average economic growth of around 6% per year from 2010 until 2019 (World Bank, 2022a). Furthermore, Indonesia is one of the prominent economic growth and is predicted to be the fourth biggest economic country by 2050 (PricewaterhouseCoopers, 2017). Moreover, the Indonesian government has the vision to be a prosperous nation by 2045 (Bappenas, 2019c).

To be a prosperous nation, the Indonesian government focuses on four main pillars of development: building an equitable and inclusive regional development (Bappenas, 2019c). Since 2007, the Indonesian

government has followed the Thematic, Holistic, Integrative and Spatial (THIS) approach in creating national and regional development planning (Abidin et al., 2021). Therefore, spatial data is used to create national and regional development planning (Abidin et al., 2021). According to the Spatial Plan Act (2007), the spatial plan map is divided into two categories: regional and detailed spatial plan map. Furthermore, both spatial plan maps need to use base maps as their reference; therefore, it complies with the one data principle: one standard, one metadata, and interoperable (PD About One Data Policy No. 39, 2019). The Government Regulation About Spatial Planning No. 21 (2021) mentioned that the regional spatial plan map uses a medium-scale (1:50,000) base map as its reference, and the detailed spatial plan map uses a large-scale (1:5,000) base map as its reference. The Indonesian government established the One Map Policy to support the creation of spatial plan maps which use one single national spatial data reference (PD About One Map Policy in Large-Scale Data No. 23, 2021). Therefore One Map Policy can not be separated from One Data Policy, as shown in Figure 1.
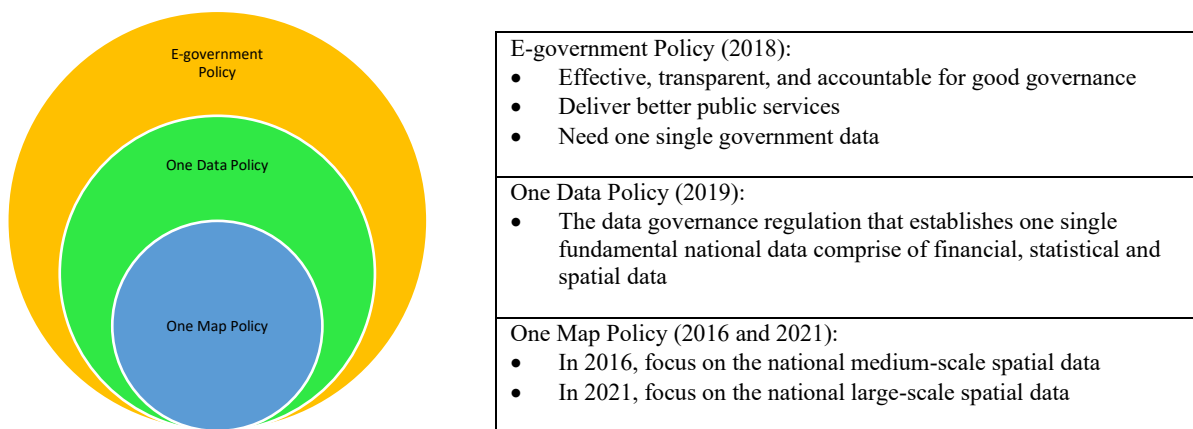
Figure 1. One Map Policy is an integral part of One Data Policy which means to improve the public service within E-Government Policy (Badan Informasi Geospasial, 2019c)

The One Map Policy 1.0 started in 2016 and was completed in late 2020, resulting in a nationwide, medium-scale (1:50,000) base map used to refine, update, and create a regional spatial plan map (Abidin et al., 2021). In late 2021, the One Map Policy agenda continued into One Map Policy 2.0, which focuses on providing large-scale (1:5,000) data to support the creation of a detailed spatial plan map. The One Map Policy team mentioned that until 2021, 3% of detailed spatial plan maps were accomplished from the targeted number of 1838 since 2016 (Coordinating Ministry of Economic Affairs, 2021). Moreover, the One Map Policy team mentioned that the slow progress of creating detailed spatial plan maps was because of the lack of availability of large-scale (1:5,000) base maps (Coordinating Ministry of Economic Affairs, 2021).
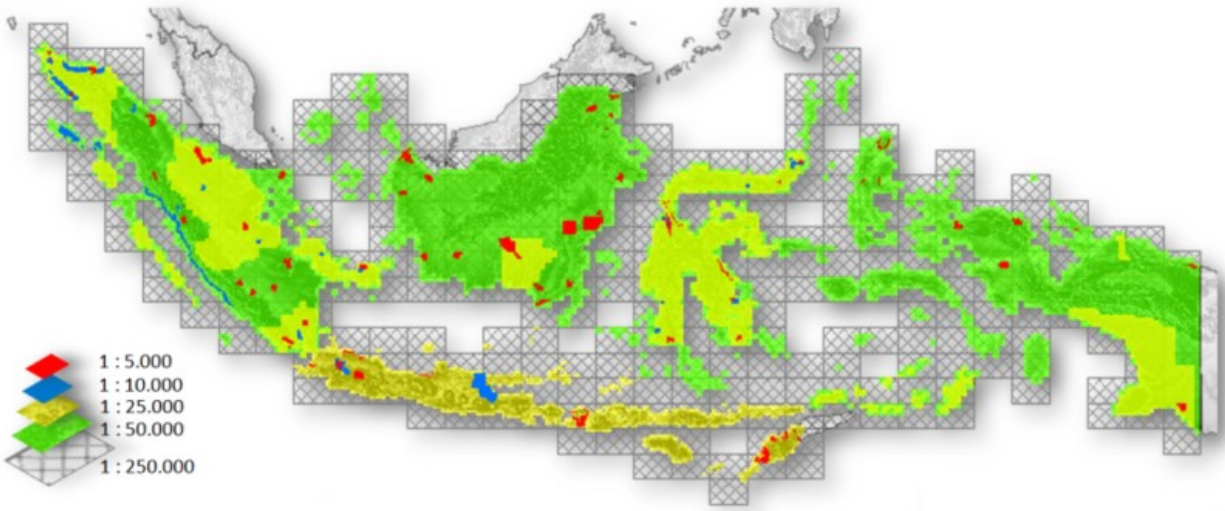
Figure 2. The availability of large-scale (1:5,000) base maps in Indonesia (red square) (Badan Informasi Geospasial, 2021b)

Until 2022, the large-scale (1:5,000) base map availability was 2.7% of the total land area of Indonesia or about 10,121 out of 372,858 large-scale (1:5,000) map tile sheets, as shown in Figure 2 (Badan Informasi Geospasial, 2021b). According to the Geospatial Information Act (2011), Indonesia's NMA is responsible for providing large-scale (1:5,000) base maps in all areas in Indonesia. The NMA mentioned that finance is one of the issues in producing large-scale (1:5,000) base maps (Badan Informasi Geospasial, 2021d). The NMA of Indonesia mainly relied on the traditional approaches of the funding model. Within this traditional approach, the NMA depend on the national government revenue as their source of income to fund the base map production. The NMA mentioned that around 46% of its budget was allocated for base map production activity, as shown in Figure 3 (Badan Informasi Geospasial, 2018b, 2019a, 2020a, 2021a). Within a four-year average, the annual budget for base map production is around 18 million USD (Badan Informasi Geospasial, 2018b, 2019a, 2020a, 2021a). Furthermore, the NMA estimated that a minimum of around 514 million USD would be required to produce large-scale base maps for all areas in Indonesia (Badan Informasi Geospasial, 2021d). Moreover, the NMA face a budget restriction from the national government, which is affected by the global condition. The global economic situation leads o uncertainty regarding the budget given to the public sector programs, including base map production. For instance, due to the covid situation in 2021, the NMA is facing a budget cut of 60% for base map production. Therefore, it can be seen that a significant budget gap followed by an uncertain global economic situation exists in the large-scale (1:5.000) base map production.
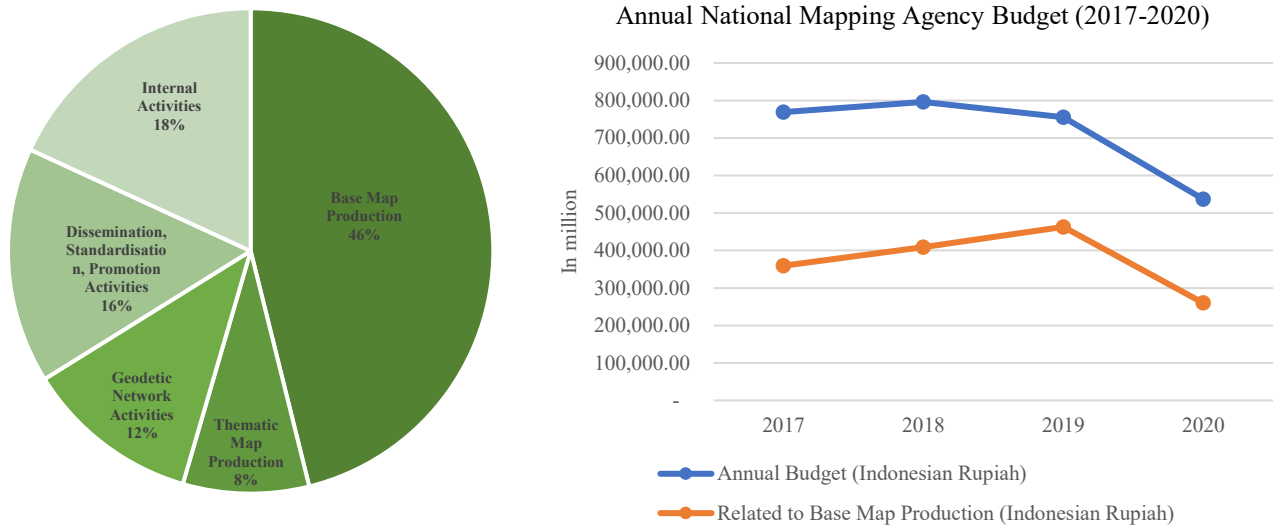
Figure 3. Left figure showing the proportion of base map production and right figure showing the trend of four years annual budget of the NMA (Badan Informasi Geospasial, 2018b, 2019a, 2020a, 2021a)

Furthermore, the One Map Policy team mentioned that the availability of large-scale (1:5,000) base maps is needed in urban areas due to around 70% of detailed spatial plan maps are needed in urban areas (Coordinating Ministry of Economic Affairs, 2021). Moreover, according to the Spatial Plan Act (2007), the creation of detailed spatial plan maps is the authority of municipalities (cities and districts) and the national government. However, the availability of large-scale (1:5,000) base maps in the urban area is the second smallest from the total availability as shown in Table 1 and visualized in Figure 4. Hence, this lack of availability of base maps in the urban area leads to difficulty for local and national authorities in creating detailed spatial plan maps.

Table 1. The percentage of larger-scale (1:5,000) base maps within area characteristics (Badan Informasi Geospasial, 2022)

Area Characteristic	Number of Tile sheets	The percentage from total Tile sheets
Urban	1492	14.7%
Rural	7611	75.2%
Forest	1018	10.1%

Urban, Rural, and Forest Area in Indonesia
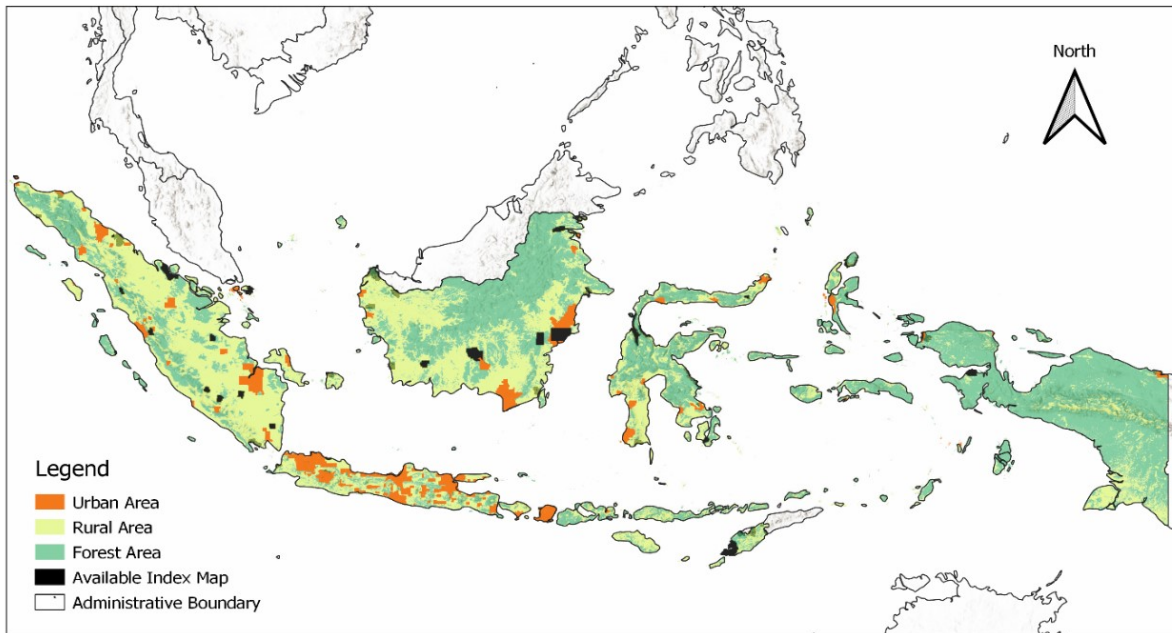
Figure 4. The area characteristics in Indonesia, comprise of urban, rural and forest areas (Badan Informasi Geospasial, 2022)

There is limited knowledge regarding the funding model for producing the large-scale (1:5.000) base map. The NMA of Indonesia mainly relied on the traditional approaches of the funding model. Within this traditional approach, the NMA depend on the national government revenue as their source of income to fund the base map production. Moreover, the budget proposal and its approval process are conducted annually. Hence, the NMA initiate to build innovation in the funding model framework as a solution for producing large-scale (1:5.000) base maps. Therefore, due to budget constraints of the applied traditional approaches of the funding model in producing large-scale (1:5.000) base maps in Indonesia and the high urgency of large-scale (1:5.000) base maps availability in urban areas, this research will focus on finding a suitable funding model for the large-scale (1:5.000) base map production in the urban area. Furthermore, this research can be used as a recommendation to the Indonesian government, especially the NMA.

1.3. Objectives and Research Question

Spatial Plan Act mandates detailed spatial plan maps as a tool to design, control and monitor utilization periodically. Furthermore, detailed spatial plan map use large-scale (1:5,000) base map as a reference. The NMA of Indonesia mentions budget constraints to produce large-scale (1:5,000) base maps. The main research question for this thesis is:

"Which funding model may allow the Indonesian government to fund the production of large-scale (1:5,000) base maps in urban areas in a financially durable manner?"

A set of sub-question has been established to answer the main research question. The sub-questions are categorized according to the aspect of the research they are relevant for:

SRQ-1	What is the current funding model for large-scale (1:5.000) base map production in Indonesia?
SRQ-2	What funding models are available for large-scale (1:5.000) base map production?
SRQ-3	Which funding model is suitable for large-scale (1:5.000) base map production in urban areas?
SRQ-4	To what extent do stakeholders need to be involved in the funding model of large-scale (1:5.000) base map production in urban areas?
SRQ-5	To what extent does the funding model schema support the One Map Policy in terms of data sharing and access to the public?

1.4. Scope of the Research

This research focuses on assessing the funding model for large-scale (1:5,000) base map production of urban areas. The purpose is because of the high necessity of detailed spatial plan maps in urban areas compared to other areas, and large-scale (1:5,000) base maps are the reference for detailed spatial plan maps. The urban area that will be used as a case study in this research is Jakarta province. Jakarta province is the capital city of Indonesia, where around 16 thousand people per km^2 live (Central Bureau of Statistic, 2020). Moreover, Jakarta's detailed spatial plan maps are already out of date. The most recent detailed spatial plan maps of Jakarta were built in 2014 when the regulation was still limited. Hence, Jakarta province is willing to update its detailed spatial plan maps.

Moreover, a high-quality large-scale (1:5.000) base map is needed to produce a high-quality, detailed spatial plan map. Furthermore, depending only on the traditional approach of the funding model, the process production of large-scale base maps is not significant. Hence, an innovation in the funding model is needed. Innovative funding models are identified based on the Public-Public Partnership (PUP), Public-Private Partnership (PPP), Catalytic and Pure Private mechanisms.

1.5. Thesis Outline

The outline of this thesis is organized as follows:

Chapter 1	Introduces the background, objective, and research questions, as well as the scope of the research
Chapter 2	Explains the current situation as well as issues and limitations of the funding model applied in the large-scale (1:5.000) base map production in Indonesia and an overview of available funding models to use in the production of large-scale (1:5.000) base map
Chapter 3	Provides an overview of the research methodology followed by the process of data collection and analysis conducted
Chapter 4	Describes the results and discussions of the multi-criteria decision analysis and stakeholder analysis
Chapter 5	Provides a summary of the main result, conclusion, limitations, and future works of this thesis research.

Chapter 2. Literature Background

There are two sections in this chapter. First, it presents an overview of Indonesia's current funding model implementation. Second, an overview of innovative funding models for public sectors.

2.1.   Current Situation of Funding Model

The current situation of the funding model implemented for large-scale (1:5,000) base map production in Indonesia cannot be separated from the planning and financing of national program activities. The Indonesian government established National Development Planning System Act in 2004 and National Finance Act in 2003 as a legal basis for each government ministry and agency to plan their program and how it will be funded.

2.1.1.   National Development Planning Process

According to Conyers and Hills (1984), planning is a continuous process of electing one or more options using effective and efficiently allocated resources to achieve the agreed future objective. National planning aims to have a regulated and planned national economy (Hatta, 1992). According to the National Development System Act (2004), national development planning is an effort carried out by all nation's components to achieve the national goal by determining effective and efficient options considering available resources.

National Development System Act (2004) divides national planning into three periods of terms, namely long-term national planning (RPJPN), medium-term national planning (RPJMN), and government working plan (RKP). First, the RPJPN is arranged for twenty years and enacted into Law. Second, the RPJMN is a derivative product of the RPJPN and is organized every five years. Third, the RKP is referred to as the RPJMN and is arranged annually. The Ministry of National Development Planning and the Ministry of Finance are the most responsible institutions that formulated these three national planning terms (Wasono & Maulana, 2018).

The RPJPN and the RPJMN documents are created similarly, as shown in Figure 5. There are three approaches to the creation process: political, technocratic, and participative approach (Wasono & Maulana, 2018). These approaches must synchronize to achieve an agreed document of the RPJPN and RPJMN. Within the political approach, political parties with legitimation from their constituents and different ideologies are compromised within the formal forum, in a House of Representatives, or informal forum by

lobbying. Within the technocratic approach, the RPJPN and RPJMN documents created need to build by using a legal framework. Hence, they can be accountable and suitable to the current socio-economic global condition and still relevant until five to twenty years ahead.

Moreover, the participative approach in a forum named *Musrenbang* is held to involve more participants and have a broader impact. The RPJMN document is created simultaneously after the new President is elected every five years. The President elected must use the RPJPN document as guidance. Hence the long-term national plan will not deviate from what the national plan intended.
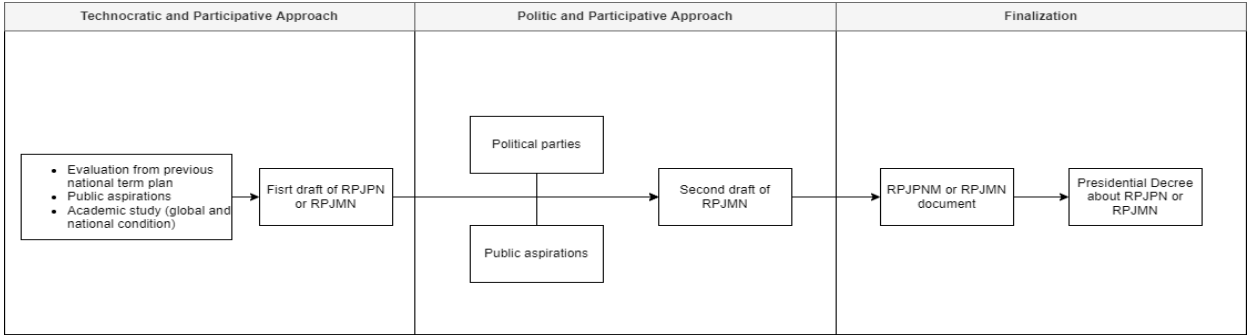
Figure 5. The technocratic, participative and political approach during the creation of national long term and medium-term plan (Bappenas, 2019a)

The RKP document is an annual working agenda of the Indonesian government. It comprises detailed information about each government ministry and agency's project plan within one year. These projects are meant to support the RPJMN document. The financial structure of the national government, including the revenue and expenditure, is also mentioned in the RKP document. Moreover, projects mentioned in the RKP document follow traditional funding model approaches. Three stakeholders are responsible for creating the RKP document: related government ministry and agency, the Ministry of National Development and Planning, and the Ministry of Finance. The Ministry of National Development and Planning and the Ministry of Finance ensure no overlap in projects within government ministries and agencies and provide efficient budget allocation.

2.1.2. National Financing Process

In general, national financing is related to public finance. According to Musgrave (2007), public finance refers to the complex problems that centre around the revenue-expenditure of government process. The National Finance Act (2003) govern the revenue and expenditure of the Indonesian government activities. The Ministry of Finance acts as the financial officer with the right to collect national revenue and

obligations governing the national expenditure to achieve the nation's objective. The revenue mentioned in the National Finance Act is collected through regular taxes. The national government manages five regular taxes: income taxes, value-added taxes, sales taxes on luxury goods, land and building taxes and stamp duty. Furthermore, all regular taxes are directly gone into national revenue.

The financial infrastructure, including the government expenditure, is mentioned in the RKP document. The government expenditure includes the project's budget that each government ministry or agency will conduct within one year. Moreover, there are five steps within the creation of a national state budget: 1) budget planning, 2) budget decision, 3) budget execution, 4) budget reporting and 5) budget audit and accountability. In practice, these five steps overlap within three years, as shown in Figure 6. The Ministry of Finance is responsible for distributing the budget needed to the related government ministries or agencies based on the priority programs mentioned in the RKP document (Wasono & Maulana, 2018).
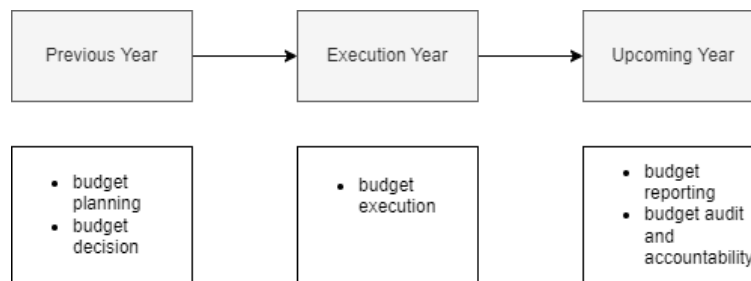
Figure 6. The timeframe of budgeting for financing public activities (Wasono & Maulana, 2018)

2.1.3. Large-Scale (1:5,000) Base Maps Production in Indonesia

Since the RPJMN 2015-2019, the Indonesian government has already paid specific attention to the availability of spatial information. There were three main focuses in the RPJMN 2015-2019, the first was increasing the human capital index, the second was developing priority sectors, and the third was reducing regional economic disparity (Badan Informasi Geospasial, 2015; Bappenas, 2015). Moreover, the Indonesian government mentioned the need for the large-scale (1:5.000) base map to accomplish the second and third focuses in the RPJMN 2015-2019. At the time, large-scale base maps were needed to fulfil the national priority projects. Hence, since 2017, the NMA has started to focus on developing large-scale base map production (Badan Informasi Geospasial, 2015).

There are seven national focuses within the RPJMN 2020-2024, and the NMA was highly requested to participate in the second agenda (Bappenas, 2020a). Figure 7 shows the framework of the RPJMN 2020-2024. In Figure 7, the second agenda was the main objective among other agendas (Bappenas, 2020a). The

RPJMN 2020-2024 document explicitly mentioned that the lack of availability of large-scale (1:5.000) base maps was one of the issues in the delay of the creation of detailed spatial plan maps. Therefore, the Indonesian government set the target to finish the production of large-scale (1:5.000) base maps, except for the forest area, by the end of 2024 with a total of 125.810 tilemap sheets (Bappenas, 2020a).
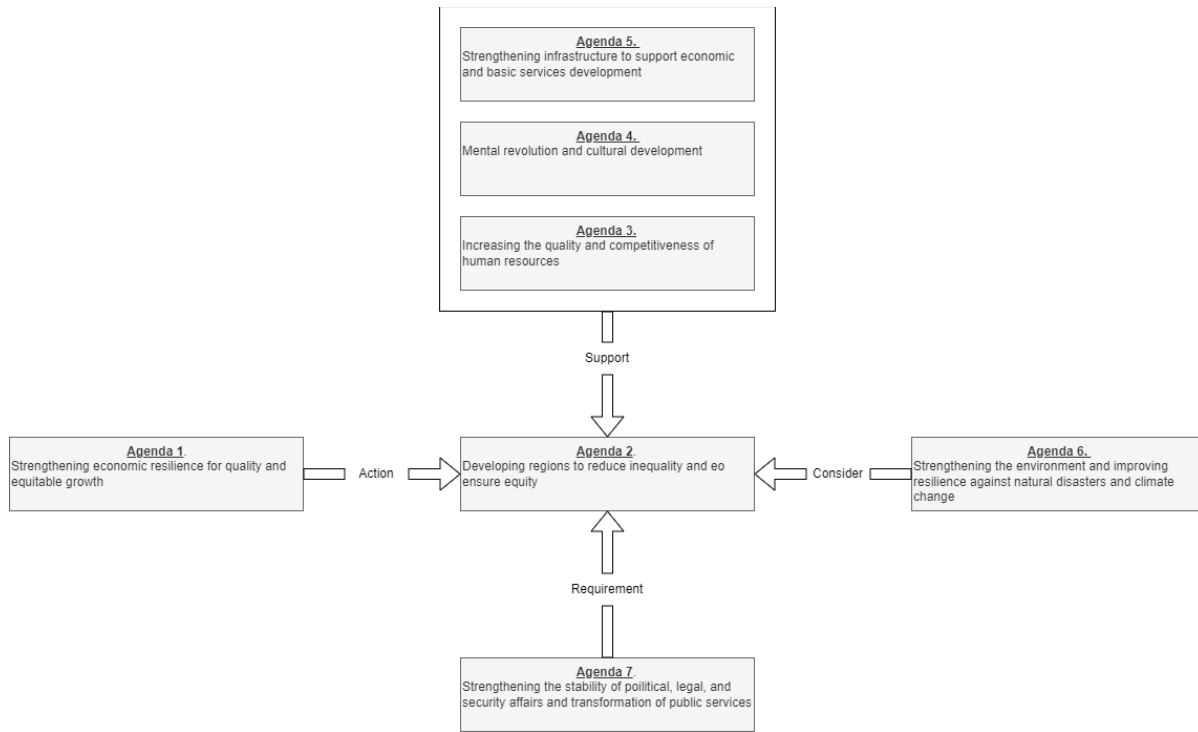
Figure 7. National development agenda framework (Bappenas, 2019b, 2020b)

2.1.3.1.   Methodology of Large-Scale (1:5,000) Base Map Production in Indonesia

According to the Geospatial Information Act (2011), there are seven layers to visualize on the large-scale (1:5.000) base map: building, transportation and utility network, land cover usage, hydrography, hypsography, administrative boundary, and toponyms or geographical name. In defining the quality of each layer, the NMA adopted ISO 19157:2015 about spatial data quality to measure the minimum standard quality of each layer (Badan Informasi Geospasial, 2017; Riqqi, 2018). To achieve the minimum standard quality, the NMA follow the methodology shown in Figure 8. In general, there are six steps to produce a large-scale (1:5.000) base map in Indonesia, namely data acquisition, object delineation, Digital Terrain Modelling (DTM) generation, topology validation, toponym survey and field checking, and geodatabase sync and cartography (Badan Informasi Geospasial, 2021c).
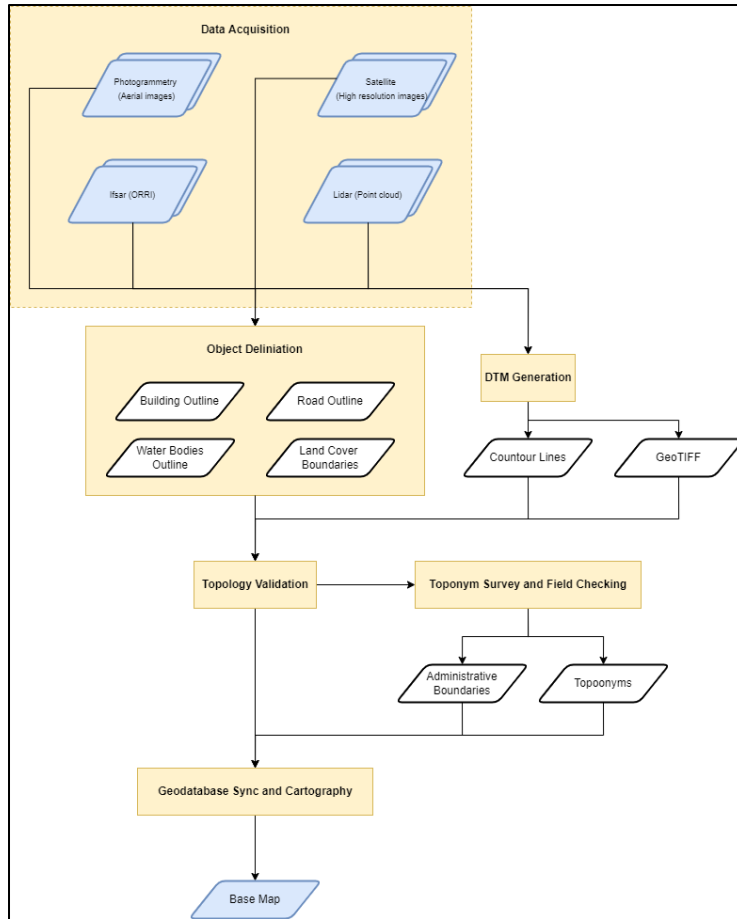
Figure 8. Methodology in large-scale (1:5.000) base map production (Badan Informasi Geospasial, 2021c)

The first step of the base map production methodology is data acquisition. Due to diverse area characteristics in Indonesia, the NMA used the combination of four data acquisition methods: Interferometric Synthetic Aperture Radar (Ifsar), photogrammetry, lidar and high-resolution satellite image remote sensing. Each method provides a different product for the next step, either object delineation or DTM generation, as shown in Table 2.

Table 2. Data acquisition method and their product to use for the next step (Badan Informasi Geospasial, 2021c)

Data acquisition method	Output	Usability for the following process
Photogrammetry	Aerial image orthophotos	Object Delineation
	Dense Image Matching	DTM Generation
Interferometric SAR	Orthorectified Radar Image (ORI)	DTM Generation
Lidar	Point cloud	DTM Generation
Satellite Remote Sensing	High-Resolution Satellite Images	Object Delineation

The second step is object delineation. In general, there are three methods of object delineation: manual, automatic, and semi-automatic or a combination of manual and automatic delineation. Practically, the NMA

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used manual object delineation, either with aerial image orthophotos or high-resolution satellite images as the data source. However, the aerial image orthophotos provide more detailed information with a minimum spatial resolution of 15 cm, while the high-resolution satellite images have a lower spatial resolution of 40 cm (Badan Informasi Geospasial, 2020b).

The third step is DTM generation. There are three data sources to create DTM: dense image matching from photogrammetry, point cloud from lidar acquisition and Orthorectified Radar Image (ORI) from Ifsar acquisition method (Badan Informasi Geospasial, 2020b). DTM from lidar acquisition provides higher accuracy than other data sources (Schmid, 2011; Stoker & Miller, 2022). DTM generation produced two data types: contour lines and the DTM in Geotiff format (Badan Informasi Geospasial, 2021c). The topology connection of contour line data is being assessed with other objects resulting from the object delineation step (Badan Informasi Geospasial, 2021c).

The fourth step is topology validation. The NMA of Indonesia adopts the ISO 19107:2019 about spatial data schema in conducting the topology validation. The process of topology validation can be done simultaneously with the field survey as the fifth step. The field survey has two main activities: toponym or geographical name collection and administrative boundary delineation (Badan Informasi Geospasial, 2021c). The last step is geodatabase sync, the process of compiling all the information results from the previous process into the Indonesian Geographic Feature Catalogue (KUGI) in a geodatabase format (Badan Informasi Geospasial, 2019b). KUGI was established using guidelines mentioned on ISO 19110:2015 about the methodology for creating the geographic feature catalogue. KUGI improve the digital base map utilization by users with the fit-for-purpose principles and easiness of data interoperability (Badan Informasi Geospasial, 2019b).

2.1.3.2. Standard Quality of Large-Scale (1:5,000) Base Map in Indonesia

The NMA adopts three levels of geometric accuracy to measure the standard quality of large-scale base maps (1:5.000) in Indonesia, as shown in Table 3. The level of geometric accuracy is measured towards each layer of base maps: building, transportation and utility network, land cover usage, hydrography, hypsography, administrative boundary, and toponyms or geographical names. There are two attributes of geometric accuracy: horizontal and vertical accuracy. The NMA adopt ISO 19157:2013 about spatial data quality in measuring the geometric accuracy of base maps. In practice, the geometric accuracy measurement process compares the horizontal and vertical coordinates between the selected object, which could be identified on base maps and reality. These selected objects are called Independent Check Points (ICPs). Moreover, 90% of ICPs should meet the minimum accuracy, called Circular Error (CE90) for horizontal

accuracy and Linear Error (LE90) for vertical accuracy. Moreover, the spatial reference for the horizontal dimension is SRGI2013 and for the vertical dimension is INAGEOID.

Table 3. The standard accuracy for a large-scale (1:5,000) base map in Indonesia (Badan Informasi Geospasial, 2020b)

	Level 1 (m)	Level 2 (m)	Level 3 (m)
Horizontal Accuracy (CE90)	1.5	3	4.5
Vertical Accuracy (LE90)	1	1.5	2

To achieve the standard quality of base maps within three levels, the NMA differentiates the output of data acquisition into three levels, as shown in Table 4. Furthermore, each data acquisition method provides a different quality of information based on the empirical result in Indonesia, as shown in Table 5. Hence, to achieve level 1 of standard geometric quality, the NMA proposes combining photogrammetry and Lidar data acquisition (Badan Informasi Geospasial, 2021c). Moreover, to achieve level 2 and 3, the NMA promote the combination of airborne SAR and high-resolution image (Badan Informasi Geospasial, 2021c).

Table 4. The specification needed for the data acquisition method between each level (Badan Informasi Geospasial, 2021c)

	Level 1 (m)	Level 2 (m)	Level 3 (m)
Orthophoto or orthoimage			
Spatial resolution	0.25	0.50	0.75
Horizontal Accuracy	1.0	2.0	3.0
Terrain model			
Spatial resolution	0.25	0.5	0.75
Vertical Accuracy	0.50	0.75	1.0

Table 5. The specification of the data acquisition method (Badan Informasi Geospasial, 2021c, 2022)

	Photogrammetry	Lidar	Airborne SAR	High-Resolution Images
Orthophoto or orthoimage				
Spatial resolution	0.05 – 0.30 m	N/A	N/A	0.30 m
Horizontal Accuracy	0.50 m	N/A	N/A	2.50 m
Terrain model				
Spatial resolution	N/A	0.50 m	2.0 m	N/A
Vertical Accuracy	N/A	0.50 m	1.5	N/A
Other characteristics				
Cloud penetration	No	No	Yes	No

Flight Altitude	1000 m	1000 m	10000 m	500 – 800 km
Capacity (km²/day)	33	50	2222	N/A

Since 2017, large-scale (1:5.000) base maps production program has been set as one of the national priorities, and the NMA follows a regular mechanism in planning and budgeting the program. The planning and budgeting process started the previous year before the execution year. During the previous year, the Ministry of National Development and Planning estimated the location to be mapped by the NMA, and the Ministry of Finance estimated the indicative ceiling budget for the base maps production program. The large-scale (1:5.000) base maps program and its indicative ceiling budget were delivered to the House of Representatives to be approved. Then by the end of the year, the final program and budget will be delivered to the NMA.

According to Table 1, most of the current large-scale base map's area is rural. Moreover, the chairman of One Map Policy mentioned that the focus of large-scale base maps is within the urban area. Hence, the Ministry of Public Works and Housing and the Ministry of Agraria and Spatial Planning mentioned four criteria to categorise urban areas: 1) capital city of Indonesia, 2) capital city of each province, 3) city administration level, and 4) metropolitan area. Table 6 shows the list of thirteen metropolitan areas in Indonesia.

Table 6. List of metropolitan areas in Indonesia (Ministry of Public Works, 2020)

Name	Regency or City Name
Mebidangpro	Medan, Binjai, Deli Serdang, Karo
Samba	Samarinda, Balikpapan, Bontang, Kukar, Kutai Timur, Penajam
Mataram Raya	Mataram
Palapa	Padang, Padang Pariaman, Pariaman
Patungraya Agung	Palembang, Banyuasin, Oganilir, Ogankomeringilir
Jabodetabekpunjur	Jakarta, Bogor, Depok, Bekasi, Puncak, Cianjur
Bandung basin	Cimahi, Bandung, West bandung, Sumedang
Kedungsepur	Semarang, Salatiga, Kendal, Semarang, Grobogan
Gerbangkertosusila	Mojokerto, Surabaya, Gresik, Bangkalan, Mojokerto, Sidoarjo, Lamongan
Sarbagita	Denpasar, Badung, Gianyar, Tabanan
Banjarbakula	Banjarmasin, Banjarbaru, Banjar, Barito Kuala, Tanah Laut
Bimindo	Bitung, Minahasa, North Minahasa, Manado, Tomohon

Mamminsata	Makasar, Takalar, Gowa, Maros

While the forest area is based on the categorization published by the Ministry of Forestry and Environment, in general, there are three types of forest area in Indonesia: production, conservation and protected forest. Therefore, according to the data compiled by the Ministry of Public Works and Housing, Ministry of Agraria and Spatial Planning, and Ministry of Forestry and Environment, the total urban area is 88.483 km^2, rural area is 841.772 km^2, and the forest area is 934.700 km^2 (Badan Informasi Geospasial, 2022). According to the NMA, achieving the best standard quality in level 1 for all area's characteristics is difficult. Therefore, each level of standard geometric quality is adjusted to different area characteristics, as shown in Table 7. Furthermore, each area has a different data acquisition methodology.

Table 7. The relation between area characteristic, level of accuracy and data acquisition method (Badan Informasi Geospasial, 2020b, 2022)

	Horizontal Accuracy (CE90)	Vertical Accuracy (CE90)	Area Characteristics	Data Acquisition Methodology
Level 1	1.5	1	Urban	Photogrammetry and Lidar
Level 2	3	1.5	Rural	High-resolution satellite images and Airborne SAR
Level 3	4.5	2	Forest	High-resolution satellite images and Airborne SAR

In general, the production cost of large-scale base maps can be divided into two main categories: data acquisition and digitization. Cost parameters needed within data acquisition are different between each methodology. Compared to other methods, the high-resolution satellite image resulted from sensors mounted on the satellite. While other methods, sensors are mounted on the airborne vehicle as can be seen on Table 8.

The NMA conducts the data acquisition process with the airborne survey, while the high-resolution satellite image is provided by the National Space and Aeronautical Agency of Indonesia (President Instruction About Satellite Images No. 6, 2012). However, the high-resolution image provided is still in a basic raw format. Hence, the NMA need to post-process to suit the needs of the mapping purpose. This post-process method is called orthorectification, which can be done in-house. Therefore, there is no cost to acquiring a high-resolution satellite image.

On the other hand, other data acquisition methods, including photogrammetry, Lidar and Airborne SAR, share similar costs. This similarity happens because these three methods use sensors mounted to the airborne vehicle. However, the Airborne SAR method is slightly different because the airborne vehicle can

have a higher flight altitude with sensors having more extensive swap areas. Moreover, its sensor also can penetrate the cloud. These differences affect the total budget needed within methods.

Table 8. Cost parameters in each data acquisition method (Badan Informasi Geospasial, 2022)

Data Acquisition method	Cost Parameters
High-resolution satellite images	• National Space and Aeronautical Agency is responsible for delivering the data to the NMA (No Cost) • The NMA is responsible for orthorectified the satellite images (In house process)
Photogrammetry	• Preparation and planning of flight plan • Sensor calibration (boresight and lever-arm) • Ground Control Point (GCP) and Independent Check Point (ICP) measurement • Sensor data acquisition (plane rental, plane ferry flight) • Sensor data processing
Lidar	
Airborne SAR	

In contrast, the data digitization process follows a similar process for all the outcomes of the data acquisition process. Even though the total area of the urban area is smaller than other areas, the urban area shows a higher price per km^2, as shown in Table 9. The price per km^2 in the urban area is 792.12 USD/ km^2, the rural area is 248.93 USD/ km^2, and the forest area is 251.19 USD/km^2 (Badan Informasi Geospasial, 2020b).

Table 9. Total price between urban, rural and forest areas based on the standard price (Badan Informasi Geospasial, 2018a)

		urban	rural	forest
Data Acquisition	Rupiah	Rp 461,704,294,000.00	Rp1,034,537,788,000.00	Rp1,148,746,300,000.00
	US Dollar	$ 31,003,000.00	$ 69,468,100.00	$ 77,137,100.00
Data Digitization	Rupiah	Rp 582,086,562,000.00	Rp2,085,978,001,000.00	Rp2,347,737,818,000.00
	US Dollar	$ 39,086,000.00	$ 140,071,000.00	$ 157,648,000.00
Total	Rupiah	Rp 1,043,790,856,000.20	Rp3,120,515,789,000.00	Rp3,496,484,118,000.00
	US Dollar	$ 70,089,000.00	$ 209,539,000.00	$ 234,785,000.00

2.1.3.4. Limitations in Funding Large-Scale (1:5,000) Base Maps Production in Indonesia

Until now, there has been no innovation in the funding model for producing large-scale base maps in Indonesia. The NMA follow a conventional mechanism to fund base map production dependent on national revenue. There are two main limitations identified within the traditional approach of the funding model: budget uncertainty and less providing data based on users' needs.

Budget uncertainty occurred due to two main reasons: the disconnection between planning and financing national programs and budget refocusing activity in the middle of the execution year. The Ministry of National Development and Planning is responsible for the planning process, while the Ministry of Finance for the financing process. Within the planning process is an indicative budget for the projects already mentioned. However, the finalization and approved budget that will be delivered to the government ministries occurs in the financing process. In practice, this situation leads to a different amount of budget delivered to the government ministry than mentioned in the planning process because the Ministry of Finance has the authority to specify the approved budget. Even though the government ministry or agency has national priority programs, Wasono (2018) mentioned that the number of an increased budget for the government ministry or agency is around 10% from the previous year.

Another limitation within the budget uncertainty is budget refocusing within the execution year. In a budget refocusing, a certain amount of budget may be reallocated to other activities between and inside government ministries and agencies (Indriyani & Sulistiyawati, 2020; Lestyowati & Kautsarina, 2020; Ministry of Finance, 2020).

For instance, in 2019, during force majeure incidents such as natural disasters or pandemic outbreaks that needed attention from the national government, a certain amount of budget was needed to reallocate to reduce the effect of force majeure incidents. Hence, all government ministries and agencies need to reduce the budget allocated for their program to a certain level, including the NMA. Therefore, the NMA needed to adjust the methodology in producing large-scale (1:5.000) base maps with the remaining budget allocated. The adjustment of the method impacted the quality of the base map produced or delayed the process of base map production. For instance, the NMA mentioned that in 2019 in the East Lombok area, the NMA changed from using high-resolution satellite images instead of aerial images orthophotos (Badan Informasi Geospasial, 2021b). However, technological changes still paid attention to the minimum standard quality needed. Due to the area characteristic being not urban, the changes in methodology remain reliable.

According to the National Development System Act, there are two types of medium-term plans: the national medium-term plan (RPJMN) and the local medium-term plan (RPJMD). As a national public agency, the focus of NMA is to reach the goals of the national government, as mentioned in the RPJMN document, including the large-scale (1:5.000) base map production. Even though local governments were involved during the creation of the RPJMN document, in practice, the needs of large-scale (1:5.000) base map data other than national priorities were not fulfilled. Until 2021, there were already sixty-one project areas that the NMA was already producing. However, only three areas accommodate local governments' needs:

Bandung and Bogor city and the eastern part of Timor Island (Badan Informasi Geospasial, 2021b). The other areas project was to fulfil the national agenda for developing a national strategy, border, remote and underdeveloped areas (Badan Informasi Geospasial, 2015; Bappenas, 2015, 2020a).

2.2.   Innovative Funding Model

The funding model could be defined as an approach to building a reliable revenue base that will support the organization's activity (P. Kim et al., 2011). Moreover, many public sector activities mainly rely upon the national government's revenue (Zelman et al., 2016). However, many countries, especially developing countries, are facing financial resource restrain in funding public sector activities (Zelman et al., 2016). Therefore, an innovation within the funding model for public sector activities is needed.

The development of an innovative funding model started in early 2000, as many countries were looking for alternative funding sources to achieve Millennium Development Goals (MDGs) (World Bank, 2009). At the time, developed countries promoted the use of foreign donors as a debt to finance the programs of MDGs (World Bank, 2009). On the other hand, developing countries were urged to have better capital flow from other alternative sources and better financial solutions, for example, collaboration and partnerships with non-public and non-national government entities to increase better public service delivery (World Bank, 2009). Moreover, the urge to promote a more innovative funding model got more attention after the economic crisis in 2008 (United Nations, 2014).

However, there is no internationally agreed definition of innovative funding models. World Bank (2009) defined innovative funding models as funding models that involve applications of multi-parties, including public, private and citizens, as new sources as well as stakeholders within the development of public or private sectors (World Bank, 2009). Furthermore, there are four types of innovative funding models mechanism: 1) pure private mechanism, 2) public-partnerships mechanism, 3) public-private partnerships mechanism, and 4) catalytic mechanism (World Bank, 2009). Figure 9 shows the four types of innovative funding models.

Furthermore, Hurley & Palli (2012) added that innovative funding models could be additional or complementary to traditional approaches, should be predictable and stable over time through multi-year commitments and address market failures issue as the innovative funding models are intended to deliver better public service. 2) can complement traditional approaches, 3) stable over long-term commitment, and 4) address market failure issues (Hurley & Palli, 2012).

Within the pure private mechanism, the capital flows within private-to-private entities. Hence, the pure private mechanism is unsuitable for the public sector responsible for delivering public services. Within the international landscape, three of these mechanisms (public partnerships, public-private partnerships and catalytic) are intended to be used to reduce the budget burdens in funding public sectors (World Bank, 2009).

Uses

	Public	*Private*
Private	**Public-Private Partnerships** Public and private finance for public service delivery	**Pure Private** Private finance
Public	**Public-Public Partnerships** Public to-public transfers based on solidarity	**Catalytic** Public support to boost the development of local activity

*(row label: **Sources**)*

Figure 9. Four mechanisms in innovative funding models (World Bank, 2009)

2.2.1. Public-Private Partnerships

Due to different perspectives, national contexts, and specific industry perspectives underscored, the definition of Public-Private Partnerships (PPP) might differ across countries (WGIC, 2021). Moreover, during the World Geospatial Information Conference in 2021, one committee stated, "if you see one PPP, you only see one form of PPP" (WGIC, 2021). However, the World Bank's definition of PPP is commonly used as the benchmark in many sectors in many countries. World Bank (2017) defined PPP as a long-term contract between a private party and a government entity for providing public assets or services. The private party bears significant risk and management responsibility, and remuneration is linked to performance.

Moreover, in 2020, the National Geospatial Advisory Committee (NGAC) of the United States formulated a definition of PPP as an agreement between one or more public agencies (federal, state, and local) and the private sector that includes shared risk and reward among the parties. Moreover, in this agreement, the private sector is legitimate for certain assets and responsible for its innovation in delivering a product, service, or infrastructure for use by the public. In 2020, World Bank (2020) published PPP operational frameworks to use in land administration and mentioned three pillars within PPP models:

1. Pillar 1: category of the project and asset under consideration

Within the PPP model, the government entity allocates a certain amount of project risk to the private sector. The purpose is straightforward: the risk is shared with the private partner to achieve better project management and efficiency and reduce life-cycle costs (Välilä, 2020). Hence, government and private entities must understand the project and assets conducted under the PPP model. There are three categories of the project under the PPP model: 1) greenfield project, 2) brownfield project, and 3) yellowfield project. A Greenfield project is defined as an entirely new project and asset creation, a brownfield project as the upgrading or rehabilitation of a project or asset, and a yellowfield project as a continuous project after the concession period is over (World Bank, 2020).

Mainly the Net Present Value (NPV) of the projects and assets is measured to understand the long-term risk and benefits that the private sector will receive. The negative NPV means that the risk is higher than the benefits. Hence, the private sector is mainly interested in participating if the NPV is positive (World Bank, 2017). If the private sector is willing to share risk, mainly the private sector endures the internal risk that is mainly related to the iron triangle of project management (cost, quality and time), while the government entity is responsible for managing the external risk, for instance, political conditions and public demands (Caccamese & Bragantini, 2012; Pollack et al., 2018; Välilä, 2020).

2. Pillar 2: functions of the private party

Compared to the traditional model, the private partner is allowed to own the asset of the projects in a long-term commitment given by the government entity to have better and more efficient management (World Bank, 2017). Hence, the PPP model addresses specific functions of the private partner. In practice, the function of a private partner can be identified after both government and the private entity has already agreed regarding risks that will be shared and have a complete understanding of the project and asset that will conduct in the PPP model (World Bank, 2020). There are six main functions of a private partner within the PPP model: 1) design, 2) build or rehabilitate, 3) finance, 4) maintain, 5) operate, and 6) transfer. Table 10 shows the description of each function. Furthermore, a private partner may have more than one function or combination within several factors, for instance, Design-Build-Finance-Maintenance (DBFM), Build-Operate-Transfer (BOT) or Design-Build-Transfer (DBT) as shown in Figure 10.

Table 10. the function of private entity in the PPP model (World Bank, 2017)

Function	Description
Design	Involves developing the project from initial concept and output requirements to construction-ready design specifications
Build or rehabilitate	Construct assets and install all equipment. If assets already exist, the private partner is responsible for rehabilitating or extending the asset.
Finance	Funding all or part of the necessary capital expenditure
Maintain	Maintaining assets to a specified standard over the life of the contract.
Operate	Technical operation and deliver service directly or indirectly to the public as users.
Transfer	Transfer assets to the government after the contract finish
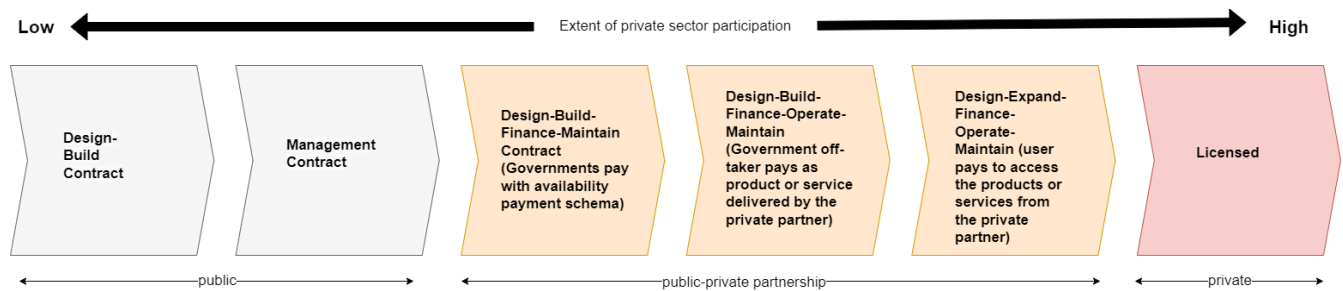
Figure 10. Example of private sector level participation (World Bank, 2017)

3. Pillar 3: payment mechanism

Even though the government entity and private partner share project risks, they have different interests within the project (Jacob et al., 2014; Verweij & van Meerkerk, 2021). The government entity focuses on delivering public service while the private partner strives to maximize profits within the project (Verweij & van Meerkerk, 2021). Therefore, the profit of the private partner is described in the PPP payment mechanism (World Bank, 2017). There are two options in the PPP payment mechanism: under user-pays and in government-pays (World Bank, 2017, 2020).

- Under the user-pays mechanism, the private partner provides a service to users and generates revenue by charging users for that service (World Bank, 2017). However, the government may subsidize the user's payment to provide low-income users access to services or assets (World Bank, 2017).

- On the other hand, in government-pays mechanism, the private partner relies on the government as the only source of revenue (World Bank, 2017). The government entity makes a periodic payment to the private partner depending on the asset or service delivered according to the contract, and this periodic payment is called availability payments (World Bank, 2017).

Even though the recent PPP definition mainly relies upon the private sector participation where they share the project's risk with the government entity, World Bank (2009) also defined that PPP emphasizes the implementation of risk sharing and cost-sharing between public and private entities. Hence, the following section will explain more about the current practice of PPP implementation that is benchmarked to the recent definition related to the term risk sharing and PPP mode that emphasize the cost-sharing between public and private partners.

2.2.1.1. Risk-Sharing PPP

Risk-sharing PPP is also characterized by the movement of the asset from public to private sectors in a long-term duration as agreed on the contract between public and private sectors (Jacob et al., 2014; Kurniawan, 2014; Välilä, 2020; World Bank, 2017). Moreover, these characteristics are identified in many projects within many sectors, such as transportation infrastructure and climate change issues (World Bank, 2017). Within the infrastructure sectors, Verweij and Meerkerk (2021) mentioned that the risk-sharing PPP model shows a more efficient allocation of overall construction costs compared to the traditional approach. World Bank (2017) developed a typical model which used as a benchmark of risk-sharing PPP, shown in Figure 11. Verweij and Meerkerk (2021) mentioned that in the traditional approach, the private sector participates as a project's contractor in an annual contract agreement. Hence, in the traditional approach, the private sector does not endure any long-term risk, and the project's assets remain for the government (Välilä, 2020). Verweij and Meerkerk (2021) compared sixty-six highway projects in the Netherlands, where nine of them were conducted with the PPP model and fifty-seven with the traditional model. The result was that projects with the PPP model had cost overruns of 6.24% on average, while projects with the traditional approach were 24.72% (Verweij & van Meerkerk, 2021).
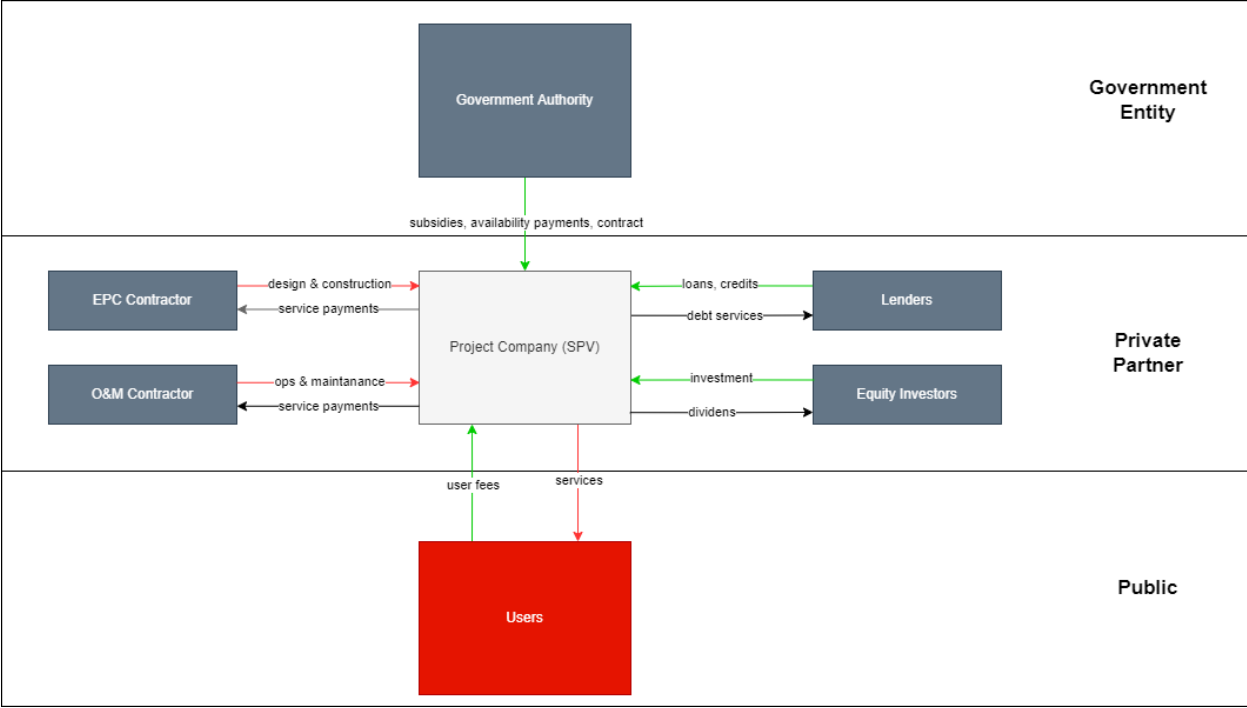
Figure 11. A typical model of PPP developed by the World Bank (World Bank, 2017)

Within the land administration sector, World Bank (2020) published the operational framework of PPP to use as a guideline for the public sector. Moreover, World Bank (2020) mentioned four use cases of PPP in land administration: 1) Electronic Land Registrations System (Ontario, Canada), 2) Land and Property Information Concession (New South Wales, Australia), 3) Land Titling Computerization Project (Philippines), 4) eLand or eTanah (Kuala Lumpur, Malaysia).

Table 11. Use cases mentioned in the land administration activity that uses PPP (World Bank, 2020)

Use cases	Duration	Financial structure	Parties involved
Ontario, Canada (Electronic Land Registration System)	30 years (continue) Start in the 1990s	High investment from the private partner then after the 2000s, shared 50/50 budget within government and private partner	Public: Government of Ontario Private: Teranet Inc.
New South Wales, Australia (Land and Property Information Concession)	35 years Start in 2017	In 2017, The consortium, Australian Registry Investments (ARI), provided 2.6 billion AUD (USD 2 billion USD) to the state	Public: NSW Government, Land and Property Information Private: Australian Registry Investments

		government for the concession of titling and registry services.	(ARI) trading as NSW Land Registry Services (LRS).
Philippines (Land Titling Computerization Project)	13 years Start in 2017	The total budget needed 82 million USD. The government provided 20 million USD, the rest from the private partner	Public Sector: Land Registration Authority (LRA), under the Ministry of Justice Private Sector: Land Registration Inc. (LARES, Philippines)
Kuala Lumpur, Malaysia (eLand or eTanah)	14 years Start in 2016	Full private partner, but they only can charge users within nine states of Kuala Lumpur	Public Sector: Kuala Lumpur Land Office, Ministry of Water, Land and Natural Resources, UKAS (PPP Unit) Private Sector: Operator - Puncak Tegap Sdn Bhd (PTSB)

Table 11 shows the current practice of the PPP model within the land administration. The current practice of the PPP model within the land administration shows that cooperation between public and private entities occurs in long-term duration. Furthermore, the financial structure of each use case is different, yet the private sector mostly takes a significant part of the financial contribution. According to World Bank (2020), the public sector should consider four points before applying PPP: 1) preparedness of project application, 2) clear roles and responsibilities within stakeholders, 3) proper allocation of risk, and 4) ownership of data.

In 2020, the National Geospatial Advisory Committee (NGAC) of the United States assessed eight innovative partnerships in producing spatial data. According to NGAC (2020), Alberta Data Partnership in Alberta Province, Canada, was considered an innovative partnership model closer to the definition of PPP stated by the World Bank. Moreover, Alberta Data Partnership was established as a not-for-profit corporation even though the Government of Alberta pushed to privatize the operation of spatial data from production until dissemination (Altalis, 2017). The Government of Alberta believes the privatization operation will improve the project efficiency and scale up the data usability. The Government of Alberta initialized the Alberta Data Partnership with the PPP model to solve the base mapping problem. At the time, there were four main problems within the base mapping activity in Alberta: 1) lack of data availability, 2) data available was difficult to access and not affordable, 3) budget constraints from the provincial

government, and 4) lack of innovation from cadaster and mapping division of Alberta province (Altalis, 2017).

In 1998, Alberta Data Partnership was established in a Joint Venture (JV) format where the Government of Alberta is the representative of the government entity, and Altalis represents the private entity. Altalis is a consortium company across many sectors, including forestry, utility and energy industries. In this PPP model, the Altalis has the function of Build – Own – Operate (BOT) and Altalis endured all the risk of production and data dissemination within the Alberta Data Partnership system (Altalis, 2017). During the early implementation of the PPP model, the financial structure is dependent on three sources: data and access fees, project grants and Altalis capital (Altalis, 2017). The project grant was coming from the municipality's association within Alberta province. The overall budget gap relied solely on Altalis's capital to build and operate the Alberta Data Partnership system (Altalis, 2017). Currently, the profit sharing in the Alberta Data Partnership is in the ratio of 80:20 between the Government of Alberta and Altalis (Altalis, 2017). The concept of the PPP model within the Alberta Data Partnership can be well established now because of the well-balanced board of directors comprised of the Government of Alberta and Altalis. Within this board, each stakeholder holds specific roles and responsibilities and maintains a high mutual trust.

2.2.1.2.   Cost-Sharing PPP

Within the cost-sharing schema, public and private entities share a matching fund that contributes to the total cost of an agreement (McGuire et al., 2019). There are two types of cost-sharing schema: integrative cost-sharing and promotion cost-sharing (McGuire et al., 2019). The integrative models engaged parties in a relatively similar sector to coordinate and integrate their financial resources. At the same time, the promotion models promote the financial contribution of one sector to invest in another sector. Moreover, within the promotion model, the party willing to share intended to leverage its overall resources.

In spatial data production, the government of Norway implement a similar mechanism as cost-sharing, where public and private parties are involved in a joint funding mechanism. The Norwegian SDI is known as Norway Digital. Within Norway Digital, the NMA of Norway named Statents Kartverket is responsible for managing Norway Digital. Norway Digital is a nationwide program for coordination and cooperation in developing, maintaining, and disseminating geographic data to enhance the availability, access and use of high-quality geographic information among a broad range of users (Vandenbroucke, 2010). In Norway Digital, geographic data is divided into reference and thematic data.

Reference data comprise topography, hydrography, roads and other building infrastructure. Moreover, thematic data includes various types of information produced by multiple parties within the public institutions, including municipalities and national government agencies. Within the production of reference data, multi-parties have a joint funding mechanism. A system of partnership fees has been elaborated, called the "Digital Norway calculator", which is a flexible pricing mechanism based on the type of datasets needed (and related interest factor), base value, and other parameters, such as the importance of the data set for the users, the intensity of use based on service requests Vandenbroucke (2010). Moreover, Vandenbroucke (2010) mentioned that at the time, it was argued that the cost-sharing schema applied in Norway in the form of absolute PPP because private sectors involved were limited to only shared cost and development of technology. Figure 12 shows the amount of sharing budget between multi government and private entities based on "Digital Norway calculator". Moreover, in the production of reference data, the projects are still contracted to private sectors or companies in the surveying industries (Vandenbroucke, 2010).
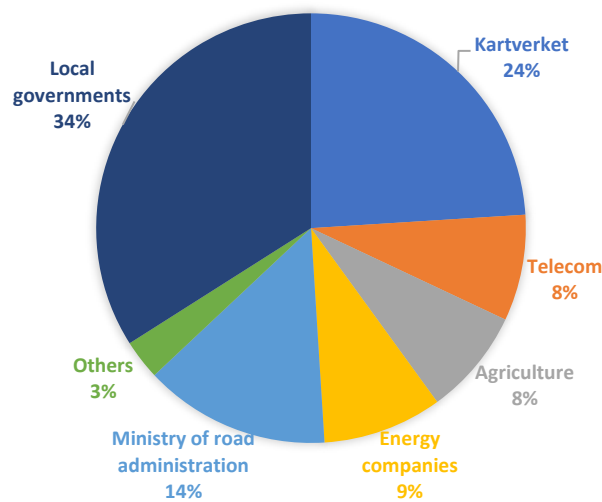
Figure 12. Percentage of cost sharing between multiple parties (Vandenbroucke, 2010)

2.2.2. Public-Public Partnerships

The Public-Public Partnerships (PUP) schema is established with the principle of solidarity between a public authority and similar authorities to provide and improve public services to citizens (World Bank, 2009). The PUP model exists in a contradictory manner to the PPP model. The partnership within public sectors is based on a principle of the same values and mutual objectives, which exclude profit-seeking (TNI, 2020). (World Bank, 2016) mentioned that even though the PPP model is known to improve public service, however PPP model is focused on increasing the economic value of public service or asset instead of its

social value. Moreover, partnership within public sectors is intended to also increase the social value of projects or assets by improving the community's wellbeing (Obe, 2016).

Battaglio & Khankarli (2008) mentioned that public sentiment plays a significant role because it can affect politicians and public sectors to choose between PPP or Public-Public Partnerships as a funding model to improve the efficiency of public services. Moreover, in some cases, private sector participation failed to meet the expectation of the agreed PPP contract. Hukka & Vinnari (2007) stated that since the private sector's inadequate human and financial capacity, public sectors within local and national authorities in Finland have started collaborating and partnering for water services. Furthermore, this was an anticipated action due to a lack of progress regarding the declaration of private sector participation started in 1990 within the water sector (Hukka & Vinnari, 2007). Therefore, the PUP model must be assessed before conducting the PPP model (World Bank, 2016).

The PUP model has two main parties: Intra and Extra governmental (Hall et al., 2005). Within the intra-governmental, public sectors at the national level create partnership models with public sectors at the local authority level. Moreover, in the extra-governmental, public sectors at the national level cooperate with other countries. This cooperation generally comprises sharing resources and capacity, including human, technology and financial (Hall et al., 2005; Manzoor et al., 2017). Sharing financial resources is mainly conducted in a debt financing format (Manzoor et al., 2017). Debt financing is mainly used to fund a large-scale, high-cost and long-term projects (Manzoor et al., 2017). Generally, there are two instruments of debt financing: foreign loans and government bonds (Cordero et al., 2008).

2.2.2.1. Foreign Donor Loan

Since 1970, the United Nations has promoted the transfer of financial resources from high-income countries to low-income countries to increase economic growth, improve population wellbeing and facilitate institutional development (Qian, 2015). Furthermore, the United Nations urged that the minimum transfer of financial resources is 0.7% of their Gross National Product total in the form of Official Development Assistance (ODA) (Qian, 2015). ODA consists of loans or grants to low-income countries from developed countries undertaken by the official sector (Lawson, 2013). There is no repayment obligation from the recipient country for grant aid, whereas loan aid requires the recipient country to pay the principal amount of financial transferred and its interest payment (Lawson, 2013).

In the implementation of development assistance, foreign donor institutions deliver financial resources based on the fiscal capacity of recipient countries, resulting in an equal distribution of financial resources

among recipient countries (Brech & Potrafke, 2014). The United Nations Economic and Social Council regularly published the classification groups of recipient nations, including low-income countries, lower-middle income countries, and upper-middle income countries. Furthermore, the World Trade Organization published a classification of countries that includes developed, least developed, and developing countries. Both classifications are commonly used as benchmarks for foreign donor organizations in determining the appropriate transfer quantity of financial resources (Brech & Potrafke, 2014).

Globally, until 2012, the number of loan schema continued to increase by around 40% compared to grants (Brech & Potrafke, 2014). Moreover, the loan schema is commonly used in lower-income countries to fund large projects with high costs. Within the loan schema, the lower-income countries requested a specific budget to fund their national's project (Brech & Potrafke, 2014). The bargaining process between donor and recipient countries can be challenging as they have different motives (Brech & Potrafke, 2014). The recipient country's primary motivation is to support its needs, such as fulfilling its budget gap for specific projects, whereas the donor country's motive is based on its interests (Brech & Potrafke, 2014). Therefore, financial resources can be provided if there is a balance between donor interests and the recipient's needs (Brech & Potrafke, 2014). Mainly, six sectors use the foreign loan as the source of funding: agriculture, education, energy, social protection, water and transportation (World Bank, 2022b). Moreover, the use of foreign loans for spatial data production is mostly part of more significant projects (Davis Jr & Fonseca, 2010). For instance, in Brazil, the base map data collection of small metropolitan areas is part of foreign loan funding for road development and repavement (Davis Jr & Fonseca, 2010).

2.2.2.2.   Government Bond

A government bond is used as an instrument for the national government to fill the gap in the national state budget. The national government generally published the government bond as a project-based finance (Claessens et al., 2003). Hence the investor in the international community will join the investment if they are interested in the project. Moreover, within the government bond, the national government will share a periodic interest with the investor called coupon payments (Claessens et al., 2003). Generally, the financial authority within certain countries is responsible for issuing government bonds. These financial authorities comprise a ministry or agency related to the financial activity and the country's central bank. Moreover, compared to foreign loans, the government bond is relatively less complicated since it does not need the involvement of official development assistance (Gruber & Kamin, 2012). However, in general, the government bond is mostly to fund the infrastructure of national projects in important sectors within the countries, such as transportation, utilities, and energy (Gruber & Kamin, 2012).

2.2.2.3. Local – National Authority Matching Fund

Recently many countries, especially developing countries, are promoting more decentralized governments (Obe, 2016). Local governments have shared responsibility with the national government in a decentralised government. Furthermore, local governments are thought to have a significant role, and with the national government, they mainly aim to increase citizen wellbeing (Obe, 2016). Therefore, local and national governments must cooperate to deliver better public services (Obe, 2016).

The global phenomenon of cooperation between local and national governments is seen in the water service sector (Cornell University & Food and Water Watch, 2012). The cooperation between local and national governments has been promoted since the late 2000s due to the difficulty of water service privatization (Cornell University & Food and Water Watch, 2012). In 1995, during the United Nations World Water Conference, the participation of private sectors was considered to boost the service and quality of water provision globally (Cornell University & Food and Water Watch, 2012). Since then, private sector participation has been promoted in many countries to deliver water services. However, different motives and interests between the public and private sectors lead to bottlenecks in providing citizens with water access (Hukka & Vinnari, 2007). The motive of the private sector is to commercialize the service of water provision, but the public sector demands affordable water access for all citizens (Hukka & Vinnari, 2007). Since then, public sectors at the local and national levels have tended to build cooperation to deliver better water service to the citizen (Cornell University & Food and Water Watch, 2012).

Obe (2016) mentioned that this partnership could also be executed in other sectors, including roads and electricity. Furthermore, the government of South Korea established the local–national matching fund to produce spatial data (Hyung, 2011). The initiation started in 1995 when the government of South Korea established the National Geospatial Information Strategy (NGIS) masterplan in a four-phase, where each phase was planned for five years (NGII, 2017; No, 2019). The first phase of the NGIS master plan was focused on data production, including base map production. There are three base map-scale types: 1:1.000, 1:5.000 and 1:25.000 scale maps in South Korea. The 1:1.000 and 1:5.000 scale map was to supply the needs of urban or cities area, while the 1:25.000 scale map was for the mountainous area (NGII, 2017). The National Geographic Information Institute (NGII) was responsible for producing national base map data.

The primary purpose of creating the NGIS master plan was because two gas pipes ruptured during the construction of building and transportation infrastructure in Daegu city (Hyung, 2011; Kyuri, 2020). The Ministry of Construction and Transportation of South Korea, which led the investigation, mentioned that the main cause of these incidents was the poor management of topographic maps that contain information

about transportation and utilization network above and below ground (Kyuri, 2020). Hence, the national government of South Korea requested the local governments to collaborate in the production of base maps, especially in providing the needed budget (Hyung, 2011).

The implementation of the NGIS master plan followed the combination of top-down and bottom-up approaches (Hyung, 2011). Regarding the funding issue, the combination of top-down and bottom-up approaches allows other stakeholders, especially the local governments at the city level, to be involved in the funding model by operating the matching funds between national and local governments (Hyung, 2011; Ju & Kelm, 2020a). NGII, as the national government representatives and specific local government directorates, were responsible for harmonizing the amount of matching funds (Ju & Kelm, 2020b; E. H. Kim, 2011). During the early implementation of matching funds, NGII conducted a trial-and-error regarding the amount of ratio between national and local governments (E. H. Kim, 2011).

At first, only two metropolitan cities were involved, namely Daegu and Incheon. Daegu city has high motivation because of the gas pipe explosion in the area, while Incheon city was interested as the city wanted to prevent a similar disaster occurred in the city. Local and national governments conducted an ex-ante Benefit-Cost Analysis to reference other cities adopting similar matching-funds mechanisms (E. H. Kim, 2011). Moreover, the national government paid more attention to the local governments with weak financial conditions. Hyung (2011) mentioned that from 1995 to 2010, the national government provided around 52.833 trillion won while the local government provided around 17.242 trillion won. The significant amount of budget the national government provides means that the national government has a significant role in a realizing funding model (Hyung, 2011; Kyuri, 2020; Yoo & Kim, 2021).

2.2.3. Catalytic Mechanism

The definition of catalytic mechanism is evolved over time (World Bank, 2009). The catalytic mechanism involves the public's mobilization to catalyze the area's development by reducing the involvement of private sectors (World Bank, 2009). The catalytic mechanism aims to catalyze the involvement of the public as funders, especially in the domestic area (Morris & Shin, 2006; World Bank, 2009). Furthermore, (Harrison, 2013; Martínez-Climent et al., 2019) mentioned that the catalytic mechanism catalyzes the flow of capital within and between communities and the public. In general, the current practice of this catalyzation is seen in the crowdfunding model (World Bank, 2009).

There are numerous definitions of crowdfunding. Bouncken & Komorek (2015) mentioned that crowdfunding comprises crowd and funding, which refers to the idea that individuals with limited access

to conventional financing are focused on raising public funding by using some platform based. Hossain & Oparaocha (2017) said that crowdfunding is a platform-based funding model that allows financial contributions from a large pool of people in a limited timeframe. Miglo (2021) defined crowdfunding as a form of financing or fundraising offered by an entrepreneurial firm to support its projects or ideas where many investors pool their individual financial contributions. In many cases, crowdfunding is used to reduce the funding gap during the early stages of the project activity (Lenart-Gansiniec, 2021; Moritz & Block, 2016). Currently, the crowdfunding model can be clustered into four groups: charity, creative, start-up and civic crowdfunding, as shown in Table 12 (Davies, 2014; van Veelen, 2015a).

Table 12. Four groups of crowdfunding (van Veelen, 2015b)

	1st group: charity	2nd group: creative	3rd group: start-up	4th group: civic
Description	Non-commercial initiatives from a charity perspective	Non-commercial motives for creative and cultural events	Commercial motives for start-up projects	Focused on developing community or public assets
Targeted activities	Charity and social events	Art, music and cultural events	Commercial entrepreneurs related with the technology innovations	Local public assets developments, infrastructure, agriculture

2.2.3.1.   Civic Crowdfunding

Davies (2014) defined civic crowdfunding as a funding model to fund projects or products that are accessible to the public either as public or club assets where the concept of crowdfunding and public participation meets, and the government may involve directly. Charbit & Desmoulins (2017a) defined civic crowdfunding as an innovative and collective option for the public to contribute to producing local public goods that can be initiated either between non-profit organizations or governments. Civic crowdfunding can provide opportunities for government ministries and agencies as their funding model alternative to funding public projects, simultaneously developing collaboration between citizens and government (Charbit & Desmoulins, 2017a).

The crowdfunding model has three main actors: capital seekers, capital providers and intermediaries (Charbit & Desmoulins, 2017a; Hossain & Oparaocha, 2017; Moritz & Block, 2016a). Capital seekers are

also known as fundraisers who try to collect funds from the public or crowd to fund their projects (Moritz & Block, 2016b). Other reasons for crowdfunding seekers to use crowdfunding besides collecting funds are attracting public attention and receiving feedback for their products or services (Moritz & Block, 2016b). Capital providers are also known as the investor, whose motive is not only limited to financial benefit but also to interact with other investors and have a connection with the project (Moritz & Block, 2016b). Agrawal (2011) and Belleflamme (2014) said that social and geographic motivations as the main purpose for the investors to fund the project. The intermediary is defined as the crowdfunding platform that acts as a portal for information, communication, and execution. Wash & Solomon (2014) mention that there are two designs in the crowdfunding platforms: the return rule ("all-or-nothing") and the direct donation model ("keep-what-you-get"). In the return rule model, the payments from capital providers to capital seekers are only made within a predefined threshold. The direct donation model pool all payments from capital providers to capital seekers. The flow diagram of civic crowdfunding is shown in Figure 13.
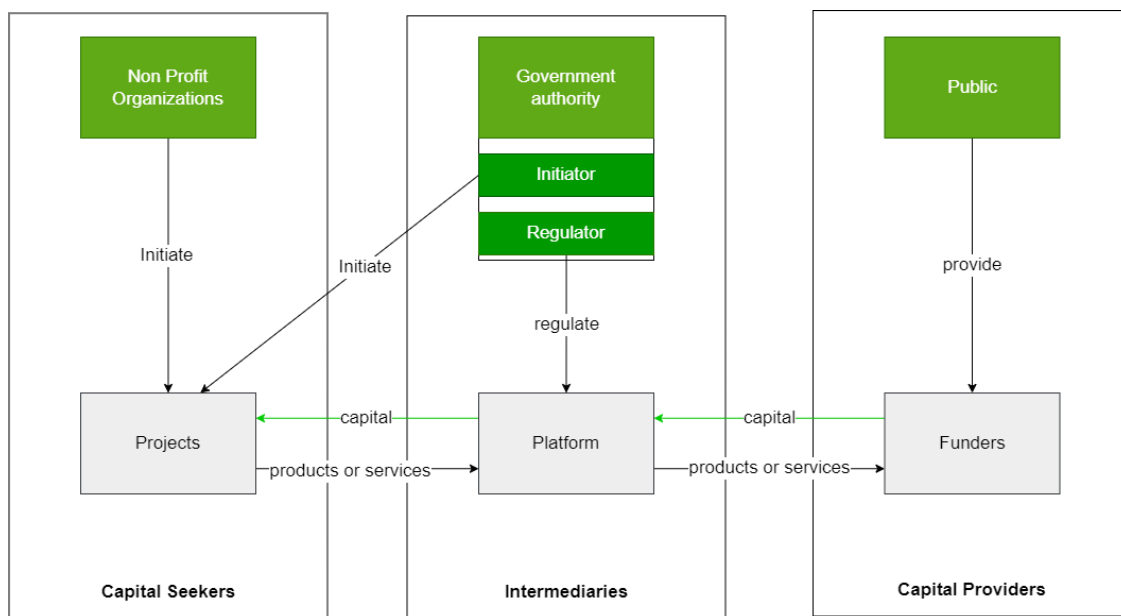
Figure 13. The typical model of civic crowdfunding (Miglo, 2021)

However, there are several limitations that governments need to pay attention to: project attractiveness and location, amount of the budget and duration of the project, and information asymmetry between capital providers within the platform (Miglo, 2021; Moritz & Block, 2016a). The crowdfunding model depends on the eagerness of the public to participate. Therefore, the project financially needs to be more engage the public, and, in many cases, civic crowdfunding is a location-based funding model where the public or citizens are living relatively close to the project (Charbit & Desmoulins, 2017b; Moritz & Block, 2016a) . Moritz & Block (2016a) mentioned that as the amount and duration of the project increases, the probability

of successful civic crowdfunding decreases. This creates a psychological barrier for the public to participate in funding the project. Empirically, the information asymmetry in the civic crowdfunding model occurred because of the crowdfunding platform's first come, first served principle(Mäschle, 2012). In this principle, early capital providers or investors are more informed than subsequent ones, especially if there is an excess of capital providers and the budgets are estimated to be reached (Mäschle, 2012).

Chapter 3. Methodology

This chapter provides an overview of the research methodology used to meet the research objectives of this study. In summary, the research methodology commences with strategies corresponding to each sub-question. It is then followed by data collection and data analysis. In order to provide answers to the research questions, this research utilises a desk study, semi-structured interviews, as well as secondary data pertaining to the research.

3.1. Research Stages

Several research stages are required to answer the sub-questions and the main research question mentioned in Section 1.3. This research incorporates an analysis of qualitative and quantitative information. Moreover, this research has three stages, each representing different sub-research questions. Figure 14 shows the research design used in this thesis project.

The first stage focuses on answering sub-research questions 1 and 2 by using the literature review and desk study about the current funding model implementation to produce large-scale (1:5.000) base maps in Indonesia and assess other funding models to be used in base map production. In this stage, the overview of the current funding model applied in the production of large-scale base maps and the issues and limitations are explained. The explanations consist of the national policy of planning and financing projects of government institutions and the current practice of large-scale (1:5.000) base map production. Moreover, Duffield et al. (2019) mentioned that the Indonesian government can only provide approximately 35% of the required funds and that local and international institutions are being sought to develop innovative funding models. Furthermore, World Bank (2009) mentioned four mechanism dimensions of innovative funding models: Public-Public Partnerships (PUP), Public-Private Partnerships (PPP), Catalytic, and Pure Private mechanisms. Hence, the overview of innovative funding models is explained within this stage. Furthermore, the innovative funding models should be able to tackle one of the issues and limitations within the traditional approach of the funding model used in the base map production in Indonesia. Therefore, innovative funding models within these four feasible mechanisms will be used as alternatives in Stage 2, where the multi-criteria analysis is conducted.

The second stage pertains to answering sub-research question 3 using multi-criteria decision analysis, spesifically Analytical Hierarchy Process (AHP) methods. In the AHP method, three factors must be identified: experts, criteria and alternatives. The data collection of this method using a survey form

addressed to the selected experts. In the survey form, experts compare each criterion and alternative in a pairwise comparison. Moreover, criteria and alternatives are identified from stage 1.

The third stage encompasses the stakeholder analysis process using semi-structured interviews with the One Map Policy team. The third stage is intended to answer the fourth and fifth sub-question. The semi-structured interview results are analysed and quantified and then visualized in a stakeholder matrix.
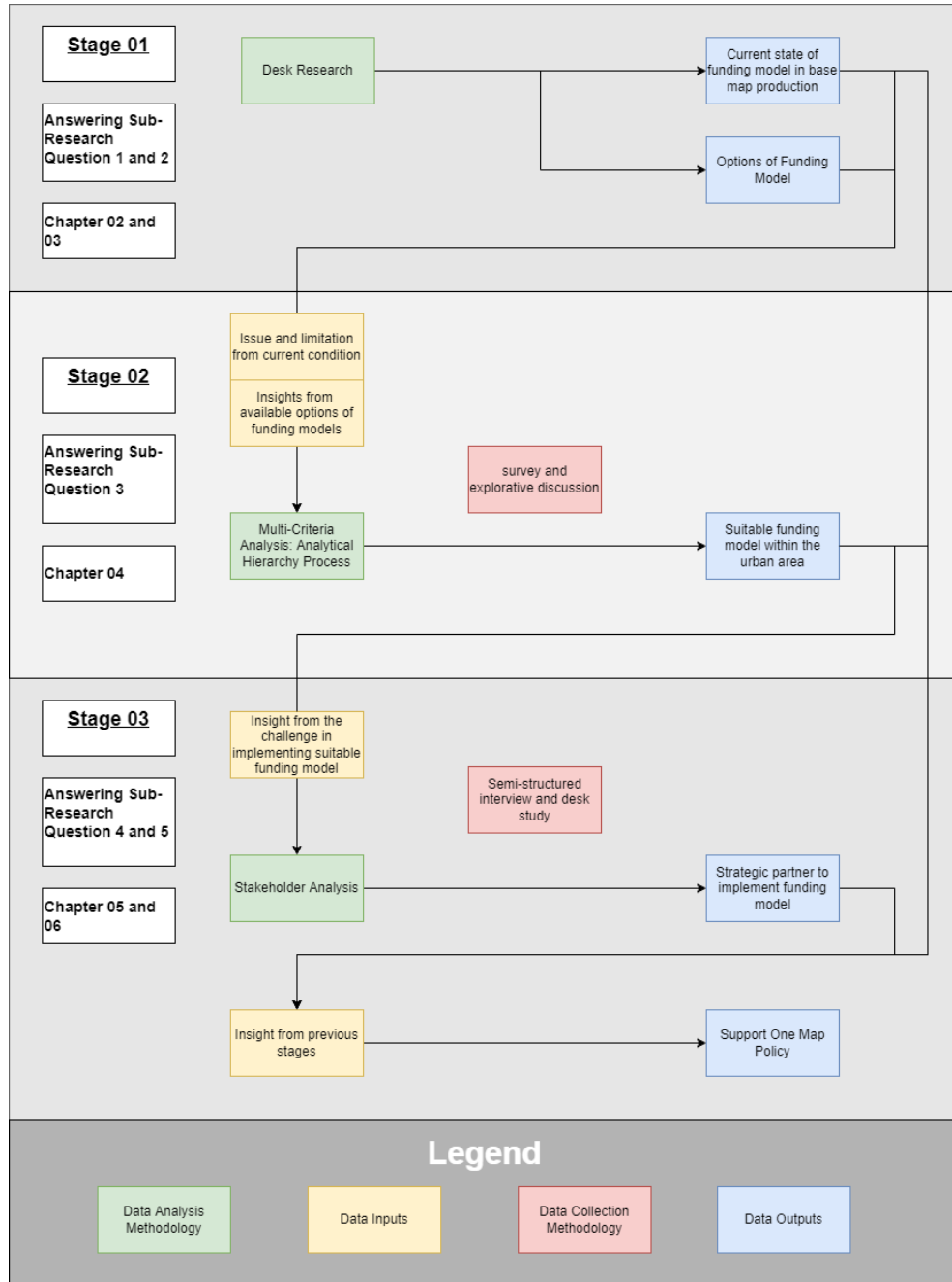
Figure 14. The research methodology used in this research

3.2. Data Collection

3.2.1. Desk Study

The process of desk study is mainly conducted during the first stage. Scientific journals, government reports and accessible laws and regulations are all used during desk study. Moreover, secondary data may be found on official websites and reports, such as those published by the World Band and the UN-GGIM. Even though desk study is conducted in the first stage, however, desk study is still utilised as guidelines during the AHP and stakeholder analysis process.

3.2.2. Survey Form

During the multi-criteria decision analysis, a form containing a set of criteria and alternatives is given to the experts (Appendix B). An individual discussion with each expert is conducted during the survey. In the individual discussion is conducted with direct observations from the researcher to experts, where each expert will judge criteria and alternatives individually with guidance from the researcher (Cheung et al., 2019). Furthermore, compared to other methods, such as focus group discussion, the individual discussion offers several advantages; for instance, experts can express their opinions without other experts' intervention. However, one drawback is that individual discussions may take more time because each expert's opinions are assessed individually.

3.2.2.1. Selecting experts

Experts involved in this research are experts related to the business process of large-scale base map production. According to the NMA, the business process of base map production comprises planning, financing, procurement and execution of base map production projects, as shown in Figure 15. There are six groups of experts identified within the business process: 1) Coordinating Ministry of Economic Affairs, 2) Ministry of National Development and Planning, 3) Ministry of Finance, 4) National Mapping Agency, 5) Surveying Industry, and 6) Local government.

Planning	Financing	Procurement	Execution
- Coordinating Ministry of Economic Affairs (CMOEA) - Ministry of National Planning and Development (MONDP) - Local Governments - National Mapping Agency (NMA)	- Ministry of Finance (MOF) - National Mapping Agency (NMA) - Ministry of National Planning and Development (MONDP)	- National Mapping Agency (NMA) - Surveying Industries	- National Mapping Agency (NMA) - Surveying Industries

Figure 15. Group of experts from the business process of base map production in Indonesia

From the six groups, ten experts are identified, as shown in Table 13. Each expert is directly involved with the problem addressed in this research: the funding gap in the base maps program. The expert from the CMOEA is part of the One Map Policy team's secretary that collects all base map needs from various ministries. The expert from MONDP involves in coordinating the national base maps needs and is responsible for developing innovation in public institutions' funding programs. There are two experts from MOF whom they both working as the deputy of the state budget. The deputy of the state budget has the authority to determine public institutions' funding models. Three experts from the NMA have responsibilities for all four-business process base maps production. Within local governments, specific divisions from cadaster and mapping also involve spatial data and information in the planning process. Surveying industries involve procurement, and the expert has a role as the coordinator of the surveying industries association.

Table 13. Number of experts involved in this research

Institution	Position
Coordinating Ministry of Economic Affairs	Coordinator of Public Policy Analyst
Ministry of National Development and Planning	Coordinator of Innovative Funding Development for Public Program
Ministry of Finance	Head of Budget Financing and Accounting
	Head of National Government Bond
National Mapping Agency	Head of GI Institutional Framework
	Head of Spatial Planning Map
	Head of Legal and Law
Surveying Industry	Chairman of Surveying Industry Association
Local government	Head of Cadaster and Mapping
	Head of Spatial Data and Information

3.2.2.2.   Survey steps

The survey process is carried out through the following steps:

1. Prepared the pre-survey process by delivering a formal letter requesting a survey session with the experts. Then scheduled, the survey session, either in an online or offline format. Within the online format, the interviewer prepared the application to use. The formal letter also contains the consent and survey form. Moreover, in the pre-survey process, a set of introductory questions were developed, and a pilot survey was conducted to test how the survey process would be conducted.

2. During the survey process, the purpose of the research, including criteria and alternatives used, is explained. Then, several introductory questioned were asked of the experts. Furthermore, the expert compared each criterion and alternative on one to nine scales. If the expert can not fill out the survey form during the survey session, then the expert may deliver the survey form at the latest one week after the session was conducted. Moreover, the survey session was recorded.

3. The typical process of a survey session is 45-60 minutes, depending on the availability of the experts. After finishing the survey session, the recording was transcribed to prevent information loss or misinterpretation.

3.2.3. Semi-structured interview

During exploratory research, a semi-structured interview is one approach that enables the interviewer to incorporate follow-up questions aside from the list of interview questions that have been pre-determined in advance (Edwards & Holland, 2013). In this regard, a semi-structured interview is conducted to collect information from the respondent for the third stage.

3.2.3.1. Selecting respondents

Five selected respondents were interviewed in this research, as shown in Table 14. These stakeholders were selected because they have an important role in the development of the One Map Policy and have more understanding of its current condition and expected results.

Table 14. Stakeholders interviewed during the stakeholder analysis

Stakeholder	Position	Role
Coordinating Ministry of Economic Affairs	Assistant Deputy of Regional Development and Spatial Planning	Chairman of OMP team
National Mapping Agency	Head of Topographic and Geographical Names Division	Chairman of OMP executive team
Ministry of National Development and Planning	Directorate of Spatial Planning, Cadaster and Disaster Management	Vice Chairman of OMP executive team
Ministry of Maritime and Investment	Assistant Deputy of Marine and Coastal Spatial Management	Vice Chairman of OMP executive team
Cabinet Secretary	Assistant Deputy of Regional and Industry Development	Vice Chairman of OMP executive team

Within the semi-structured interview, the typical questions asked are 1) what role is your organization have within the base map provision and to what extent it can affect the funding model, 2) whether there are other stakeholders have influence within the base map provision and the funding model, 3) what factors affect stakeholders influence, and 4) whether there are interests within stakeholders in the base map provision and the funding model.

3.2.3.2. Interview steps

The semi-structured interview process is generally similar to the survey process session. Moreover, the interview process is carried out through the following:

1. Before the interview, the interviewer explained the informed consent forms, requested permission to record the discussion, and anonymously quoted the interviewees' remarks in the thesis.
2. The interviewer introduced the study's background and objectives.
3. The interviewer presented interviewees with questions in advance to guide the discussion.
4. A typical interview is 45 – 60 minutes long, depending on the availability of the interviewees.
5. After the interview, the recording was transcribed to prevent information loss or misinterpretation.

3.3. Data Analysis

3.3.1. Multi-Criteria Decision Analysis

Multi-criteria Decision Analysis (MCDA) is a method to solve complex problems by identifying various solutions or alternatives and conflicting objectives or criteria (Gamper & Turcanu, 2007). MCDA is defined as formal or structured approaches for individuals or groups to determine overall preferences among alternative options by considering multiple criteria or indicators (Dodgson et al., 2009). AHP is one of the multi-Criteria Analyses which uses a pairwise comparison between selected criteria and alternatives in a survey format (Saaty, 1987). Criteria and alternatives are identified by combining a desk study and selected experts' feedback.

Each expert gives their opinion in a pairwise comparison from one to nine scale of each criterion and alternative. The process of calculating the pairwise comparison into the matrix and visualising the data uses Microsoft Excel software. The expert's opinion is transcripted and then put into the Atlas.ti software. Using Atlas.ti software, the opinion of experts is analysed. The detailed process of calculating and analysing the data can be seen in Appendix A.

3.3.2. Stakeholder Analysis

The goal of stakeholder analysis is to assess the stakeholder's capacity and influence regarding the decision that will be taken (Crosby, 1993). Generally, there are two common methods for stakeholder analysis: the salience model and the matrix model (Mitchell et al., 1997; Olander & Landin, 2005a). Mitchell (1997) developed the salience model, where stakeholders are divided according to power, urgency and legitimacy. In comparison, Olander and Landin (2005) introduce a stakeholder matrix to group the level of involvement between stakeholders that assess the power and interest among stakeholders. Yang et al. (2011) mentioned that the legitimacy attribute is imprecise, difficult to operationalise and preferred to focus on power and urgency attributes. While within the stakeholder matrix, there are many variations of combinations (Fageha & Aibinu, 2013; Wang et al., 2012). Olander and Landin (2005) mentioned that the stakeholder matrix is the fundamental method of assessing stakeholders, with two axes, either representing power and interest or power and urgency attributes.

Therefore, this research will combine three attributes: power, interest and urgency. Moreover, these attributes are visualized in a two-axis stakeholder matrix where the y-axis presents the power attributes, and the x-axis presents the combination of interest and urgency attributes. Results of semi-structured interviews with respondents are transcribed and analysed by using Atlas.ti software. Moreover, official documents gathered during the interview session are also used as additional information to achieve the end result of attributes (power, interest, and urgency) value. The detailed process of calculating and analysing the data can be seen in Appendix C and D.

Chapter 4. Results and Discussion

This chapter presents the results of Multi-criteria Decision Analysis (MCDA) using Analytical Hierarchy Process (AHP) and stakeholder analysis. Subchapter 4.1 shows the results of the selected funding model in the urban area using an expert's judgement (mentioned in Subchapter 3.2.2.1 Selecting Experts). Moreover, Subchapter 4.2 provides a category of stakeholders based on three attributes: power, interest and urgency. These attributes are mentioned to compare with the outcome of AHP.

4.1. Selecting Funding Model for Urban Areas

One MCDA, AHP, is used to select funding models for large-scale (1:5,000) base map production in urban areas. In the AHP method, criteria and alternatives were identified from the literature background in Chapter 2. Identified experts (Subchapter 3.2.2.1 Selecting Experts) are compared to each criterion and alternative in a pairwise comparison.

4.1.1. Criteria Selection

According to the NMA, one of the fundamental issues in the large-scale (1:5.000) base map production is the budget gap between the annual and needed budget (Section 2.4.4.). In managing the issue of geospatial information, UN-GGIM released Integrated Geospatial Framework (IGIF) as a basis and guided for developing, integrating, strengthening, and maximising geospatial information and related resources within UN member countries. IGIF consist of three parts and nine strategic pathways. The first part contains the strategic framework, which explains the vision, mission, principles, and strategic pathways. The second part provides the implementation guideline for every nine strategic pathways. The third part contains the action plan template for national and sub-national levels.

Within the IGIF, there are seven underpinning principles: 1) strategic enablement, 2) transparent and accountable, 3) reliable, accessible, and easily used, 4) collaboration and cooperation, 5) integrative solution, 6) sustainable and valued, and 7) leadership and commitment. These principles represent the key characteristics and values to be used as a guide when implementing the framework. The framework is anchored by nine strategic pathways elaborated from three scopes: governance, technology and people. Strategic pathway number three is financial, where the objective is to understand the funding model implemented to deliver geospatial information that is sustained and maintained in the long term.

Within the strategic pathway financial, there are nine guiding principles which should use as references for action plans of strategic pathway financial. There are six action plans in the strategic financial pathways: 1) setting direction, 2) situational assessment, 3) financial plan, 4) case for investment, 5) sources of funding, and 6) deriving value. These guiding principles and action plans are used as a reference in defining criteria, as shown in Figure 16.
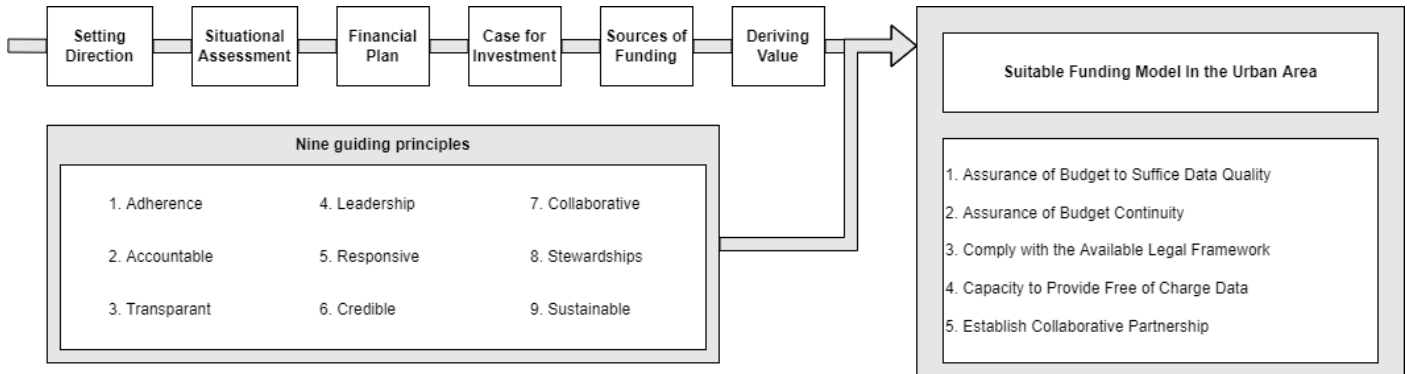
Figure 16. Process in defining criteria

Furthermore, according to the guiding principles and action plan, the present situation is better assessed before selecting a funding model. Hence, these criteria are derived based on the current practice situation. Criteria are:

1. Assurance of Budget to Suffice Data Quality

   The NMA adopt the ISO 19157:2015 about spatial data to define the quality of large-scale base maps in Indonesia. ISO 19157:2015 mentions six elements to define the quality of spatial data. To achieve the minimum quality, the NMA developed methodologies as the basic procedure in base map production (section 2.4.1.). According to the NMA, the data acquisition step significantly affects each element of spatial data quality. The NMA develop three different classes of data acquisition products standard for the data source in producing large-scale base maps, as shown in Table 7 (Section 2.4.4.). There are three parameters of the data source to define the level of accuracy: spatial resolution, horizontal accuracy, and vertical accuracy. Furthermore, each accuracy level is developed to align to meet the demand of different geographic characteristics, namely urban, rural and forest. Different combinations of data acquisition methodology can suffice each area's characteristics and class accuracy.

2. Assurance of Budget Continuity

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There are two conditions for budget continuity. First, the information quality of base maps will gradually decrease over time. The reduced quality happens because of land cover changes due to human or natural activities, for instance, infrastructure development or natural disaster. Hence, as the number of human or natural activities rapidly increases, the phenomena must be captured and presented on base maps. The NMA mentions that base maps need to be updated according to the level of detail. The more detailed the base map, the more frequently the base map needs to be updated. The NMA mentions that large-scale (1:5.000) base maps must be updated every five years or less (Badan Informasi Geospasial, 2021c). Therefore, a sustained budget must be established from the first initiation to fulfil the need for continuous data updating. Even though the highest budget happens during the first-time data production, stakeholders cannot neglect the importance of data updating to deliver better public services with up-to-date data.,

Second, the capacity of human and technology resources is still limited. The total area of urban areas is around 88 thousand km^2. To map these areas, sufficient human and technology resources need to be available. However, within the data acquisition step using photogrammetry and lidar methodology, the average capacity per day is 40 km^2 per day. Moreover, there are five airborne vehicles and sensors available in Indonesia. Therefore, the data acquisition process will take around 450 working days under ideal conditions, for instance, good weather conditions and no issue with the flight permission.

Moreover, the existing human capacity is around 1455 number of people registered in the surveying certification profession association (Badan Informasi Geospasial, 2019a, 2022a). According to the NMA, the actual working number is around 70% of 1455 people. Hence, it is around 1018 people actual people certified in surveying activities. (Amhar et al., 2015) mentioned that, on average, the human geospatial capacity per person in Indonesia is around 0.1 km^2 per day. This is the overall capacity of all steps in base maps production methodology in Figure 8. Therefore, the data production process will take around 790 working days or around three years.

3. Comply with the Available Legal Framework

As mentioned above, the sooner the base map production, the better it will be due to rapid land cover changes. However, as a public institution, any activities of the NMA should have a legal basis, including within the funding model selected. Osei-Kyei (2017) and Zakaria (2017) also mention that the infrastructure funding model's successful implementation depends on the availability of a legal framework. The main legal instrument for funding public institutions'

activities is National Finance Act. Within the National Finance Act, there are four standard instruments of the funding model: national government bonds, regular taxes, foreign loans and other possible innovative options. Generally, these four options have derivative regulations within the Ministry of Finance as government ministries have authority in governing national finance.

4. Capacity to Provide Free of Charge Data

Indonesia is one of the founding members of the Open Government Partnership in 2011. Hence, the Indonesian government is committed to developed a periodic National Action Plan starting in 2012. Within the National Action Plan, the open government agenda was meant to improve public service by developing more accessible public information to the public, including spatial information. Following this action, the Indonesian government established Government Regulation No. 49 / 2019 about the price of NMA products. Within this regulation, users are guaranteed to access the digital base map products with zero price. Public users only charge for an additional cost, for instance, the printed base map and delivery of data by using the post office. The zero-price condition to get the base map data mentioned in the Government Regulation No. 49 / 2019 was also meant to follow the Public Information Openness Act.

Moreover, products delivered by the NMA are categorised as state-owned assets. The Ministry of Finance and the National Audit Board have the authority to define and calculate all of the state-owned assets each year. According to them, base maps, including large-scale (1:5.000) maps, are one state-owned asset whose value is annually decreasing, and within five years, they will have no value or zero price asset. The regulation about the decreased value of the state-owned asset is mentioned in the Ministry of Finance regulation No. 81 / 2018 about the amortisation of state-owned intangible assets.

5. Establish Collaborative Partnerships

Afriyanie (2020) mentions that data users in Indonesia, especially local governments, are not satisfied with the current data being produced in terms of geometric and semantic accuracy and propose to have more collaboration activities within the large-scale (1:5.000) base map production. However, the collaboration format has not been decided yet, even though there is a spirit to do co-production activity between multiple parties (Afriyanie, 2020; Indrajit, 2022). In other sectors, collaboration among multiple parties is a critical success key in implementing the funding model (Harwardt, 2016; Osei-Kyei et al., 2017; Zakaria et al., 2017). Furthermore, the One Map Policy team urged building collaboration among actors in the base map production to accelerate the

production of large-scale base maps. Within the collaboration format, actors who share their resources have more power to achieve the data specification they need.

4.1.2. Alternatives Selection

Section 2 provides three mechanisms of innovative funding models to be implemented in the public sector: 1) Public-Private Partnership (PPP), 2) Public-Public Partnerships (PUP), and 3) Catalytic mechanism. In the PPP mechanism, there are two options where one is more emphasizes risk sharing while the other is limited to cost sharing. Moreover, in the PUP mechanism, cooperation could be divided into two categories: cooperation between countries, using a foreign loan or government bonds as an instrument, and local and national governments. Furthermore, within the catalytic mechanism, civic crowdfunding is the option of a funding model that can be used to fund the public sector. Therefore, there are six funding models identified: 1) PPP risk sharing, 2) PPP cost-sharing, 3) foreign government bond, 4) foreign loan, 5) local-national matching ratio, 6) civic crowdfunding.

Moreover, in Indonesia, the foreign government bond is conducted in the form of Sukuk, an Islamic finance instrument, and the revenue from the bond selling is used to fund long-term and high-cost national projects. Compared to conventional bonds, Sukuk is managed by Islamic law, named sharia (Zulkhibri, 2015). Klein & Weil (2016) mentioned that Sukuk has three main characteristics. First, interest defined as ex-ante required rate of return on capital is not allowed, so the return of Sukuk should stem from the profitability of underlying assets, second sectors financed are limited that comply with sharia law, excluding alcohol, pornography and the weapon industry, third profit and losses must be shared between contracting parties.

Similar to sukuk, foreign loan is meant to fund long-term and high-cost national projects. Furthermore, these two instruments follow a similar process, as shown in Figures 17 and 18. The Ministry of National Development and Planning and the Ministry of Finance are responsible for selecting or combining these two instruments. Therefore, these instruments are named multi-year state budgets that provide stable and predictable budgets for national projects.
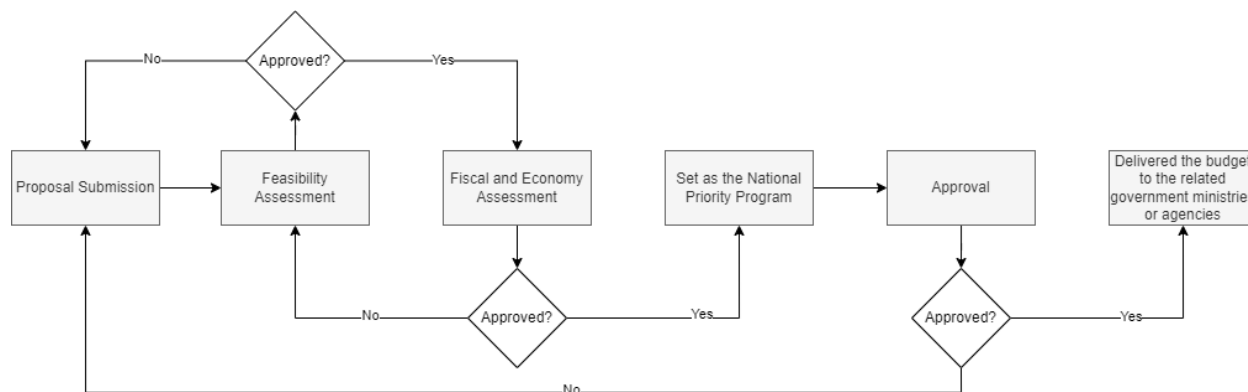
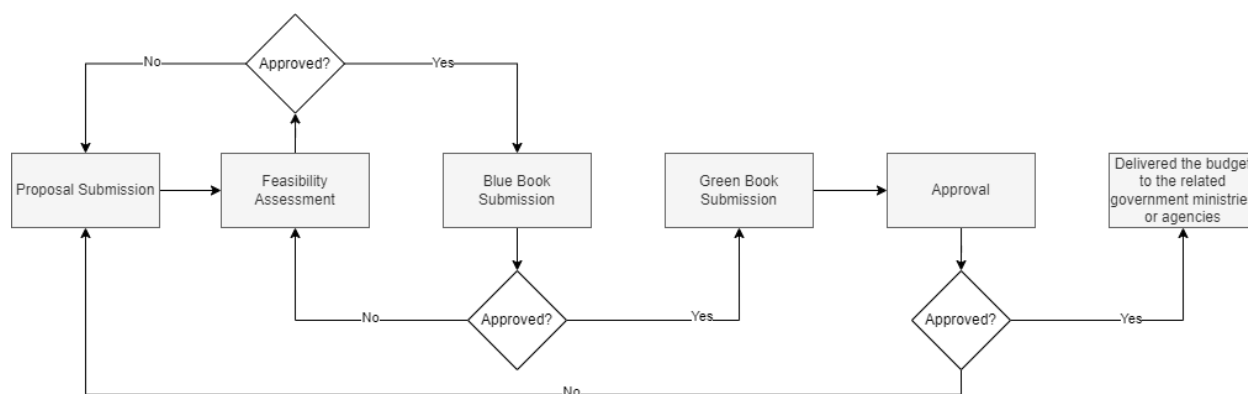Figure 17. Flowchart of foreign government bond submission in Indonesia

Figure 18. Flowchart of foreign loan proposal in Indonesia

Furthermore, Hurley & Palli (2012) mentioned four components of funding models for public sectors: 1) increase the number of parties involved, 2) can complement traditional approaches, 3) be stable over long-term commitment, and 4) address market failure issues. Therefore, within this research, alternatives that will be used are:1) PPP risk sharing, 2) PPP cost-sharing, 3) multi-year state budget, 4) local-national matching ratio, 5) civic crowdfunding.

4.1.3. Prioritizing Criteria and Alternatives

The output of this step is to have a list of the rank of criteria and alternatives after experts give their opinion in a pairwise comparison. Within this research, the process was calculated three times, and the first was to have the result from individual experts, the second compilation of experts within the same group and the third compilation of all groups. During this AHP method, the final result of all pairwise comparison matrices from experts is consistent, and it can be seen from all alternatives and criteria sensitivity results below 0.1 (the maximum tolerance value). However, some pairwise comparison needs to recheck and redo the survey to achieve consistent value. Table 15 shows the result of the AHP method.

Table 15. Compilation of expert's judgement

		Multi-Year State Budget Funding	PPP	Local-National Matching Ratios	Cost-Sharing	Civic Crowdfunding
NMA	Score	0.465	0.199	0.185	0.079	0.07
	Rank	1	2	3	4	5
MOF	Score	0.247	0.192	0.328	0.119	0.114
	Rank	2	3	1	4	5
SI	Score	0.182	0.344	0.166	0.159	0.148
	Rank	2	1	3	4	5
CMOEA	Score	0.215	0.246	0.281	0.167	0.091
	Rank	3	2	1	4	5
MONDP	Score	0.198	0.303	0.218	0.155	0.127
	Rank	3	1	2	4	5
Jakarta	Score	0.285	0.171	0.285	0.127	0.132
	Rank	2	3	1	5	4

Figures 24 to 30 show results from six different groups. Each expert has different viewpoints on the suitable funding model for large-scale base maps in urban areas. The different viewpoint is shown by the different ranks of the first alternative from each expert. However, all of the experts had a similar perception about two funding models: cost-sharing and civic crowdfunding.

Rank of Alternatives		
Multi-Year State Budget Funding	0.465	1
Public-Private Partnerships (PPPs)	0.199	2
Local-National Matching Ratios	0.185	3
Cost-Sharing	0.079	4
Civic Crowdfunding	0.070	5
Sensitivity Analysis	0.090	

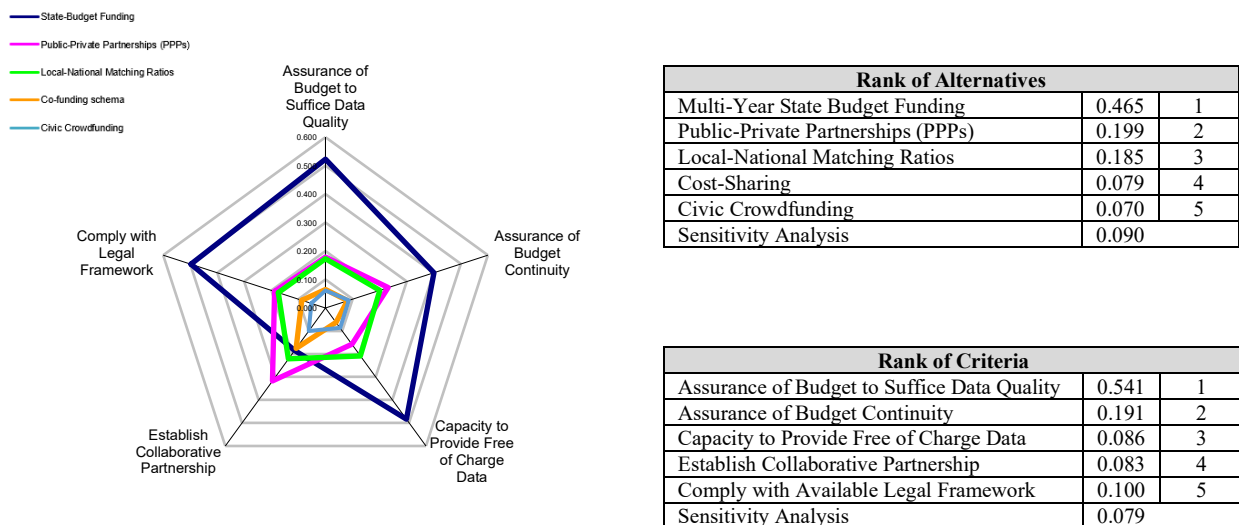| Rank of Criteria		
Assurance of Budget to Suffice Data Quality	0.541	1
Assurance of Budget Continuity	0.191	2
Capacity to Provide Free of Charge Data	0.086	3
Establish Collaborative Partnership	0.083	4
Comply with Available Legal Framework	0.100	5
Sensitivity Analysis	0.079	

Figure 19. Survey result from the NMA perspective

Figure 19 shows the result from the NMA perspective. Three people asked their opinion regarding the funding models showing that the national government should take the initiative in funding the large-scale

(1:5,000) base maps production. This is based on the current condition that all budgets were coming from the national government. These experts from the NMA evaded the risk of adopting new types of funding models. Risks include creating or updating new regulations for procurement activity or other regulations related to the products of base maps. The difference is modified from the annual budget into a multi-year budget delivered to the NMA. Moreover, in the multi-year budget using a combination of Sukuk and foreign loans, the national government's return to the international markets is the responsibility. Therefore, the national government needs to recognize the importance of base maps production and then be approved by the national government entities responsible for governing the national budget, especially the Ministry of Finance.

Rank of Alternatives		
Multi-Year State Budget Funding	0.247	2
Public-Private Partnerships (PPPs)	0.192	3
Local-National Matching Ratios	0.328	1
Cost-Sharing	0.119	4
Civic Crowdfunding	0.114	5
Sensitivity Analysis	0.030	

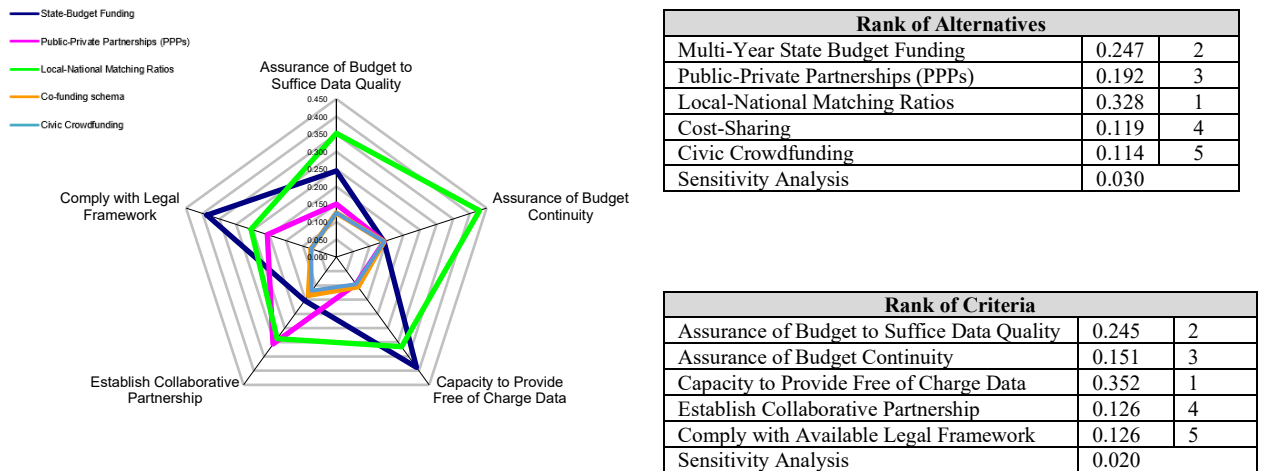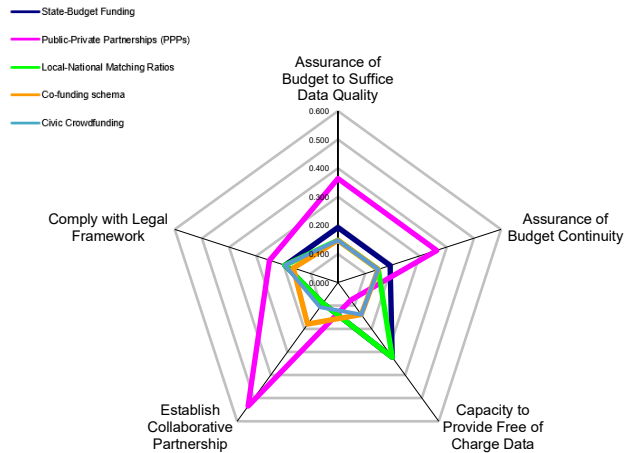| Rank of Criteria		
Assurance of Budget to Suffice Data Quality	0.245	2
Assurance of Budget Continuity	0.151	3
Capacity to Provide Free of Charge Data	0.352	1
Establish Collaborative Partnership	0.126	4
Comply with Available Legal Framework	0.126	5
Sensitivity Analysis	0.020	

Figure 20. Survey result from the Ministry of Finance perspective

Figure 20 shows the perception from the Ministry of Finance that comprises budget financing and government bond division. The Ministry of Finance mentioned the constraint of the national government because of the global economic conditions. Hence, it is uncertain whether the NMA will receive the needed budget in the upcoming years. Moreover, due to the responsibility of detailed spatial plan map creation is by the national and local governments, therefore mixed budget between national and local governments in producing large-scale base maps is a viable option. Moreover, the Ministry of Finance mentioned that since 2014 the Indonesian government has been encouraging the decentralization of government activities, including managing the budget. Therefore, local governments have more independence in governing local finance, especially with a high fiscal capacity index.
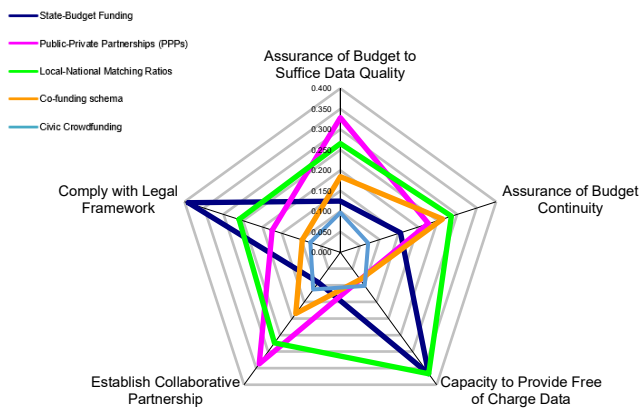
Rank of Alternatives		
Multi-Year State Budget Funding	0.182	2
Public-Private Partnerships (PPPs)	0.344	1
Local-National Matching Ratios	0.166	3
Cost-Sharing	0.159	4
Civic Crowdfunding	0.148	5
Sensitivity Analysis	0.0380	

Rank of Criteria		
Assurance of Budget to Suffice Data Quality	0.201	1
Assurance of Budget Continuity	0.162	4
Capacity to Provide Free of Charge Data	0.121	5
Establish Collaborative Partnership	0.258	2
Comply with Available Legal Framework	0.258	3
Sensitivity Analysis	0.002	

Figure 21. Survey result from the Surveying Industries perspective

Surveying industries mentioned that PPP is a feasible option, as shown in Figure 21. The surveying industries association mentioned the option of PPP by looking at the sample from infrastructure sectors. The involvement of surveying industries as private sectors in the base maps production projects could reduce the burden on financial resources. The surveying industries have more flexibility in managing their financial component than government entities, as they are attached to national regulations. However, regulations need to be established as the legal basis to establish the PPP model in the base map production. Moreover, the surveying industries also mentioned the opportunity for a return on investment.

Rank of Alternatives		
Multi-Year State Budget Funding	0.215	3
Public-Private Partnerships (PPPs)	0.246	2
Local-National Matching Ratios	0.281	1
Cost-Sharing	0.167	4
Civic Crowdfunding	0.091	5
Sensitivity Analysis	0.060	

Rank of Criteria		
Assurance of Budget to Suffice Data Quality	0.225	3
Assurance of Budget Continuity	0.194	4
Capacity to Provide Free of Charge Data	0.106	5
Establish Collaborative Partnership	0.225	2
Comply with Available Legal Framework	0.251	1
Sensitivity Analysis	0.002	

Figure 22. Survey result from the Coordinating Ministry of Economic Affairs perspective

Figure 22 and 23 shows the perception of the Coordinating Ministry of Economic Affairs and the Ministry of National Development and Planning. Both of these ministries have a mandate as the coordinator of the NMA. However, the CMOEA mentioned local-national matching ratios as the first rank option, while the Ministry of National Development and Planning mentioned PPP as the first option. The different perception is due to the Ministry of National Development and Planning's promotion to involve entities outside government to join investment in public sector programs. Moreover, the Ministry of National Development and Planning has specific mandates from the national government as the assessor of the PPP model implemented in public programs.

Rank of Alternatives		
Multi-Year State Budget Funding	0.198	3
Public-Private Partnerships (PPPs)	0.303	1
Local-National Matching Ratios	0.218	2
Cost-Sharing	0.155	4
Civic Crowdfunding	0.127	5
Sensitivity Analysis	0.057	

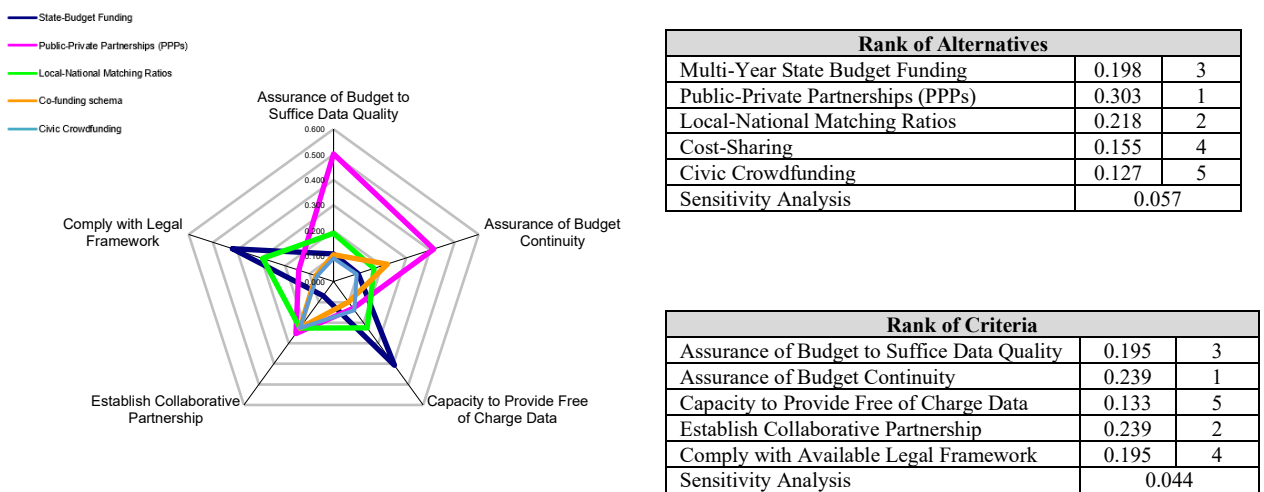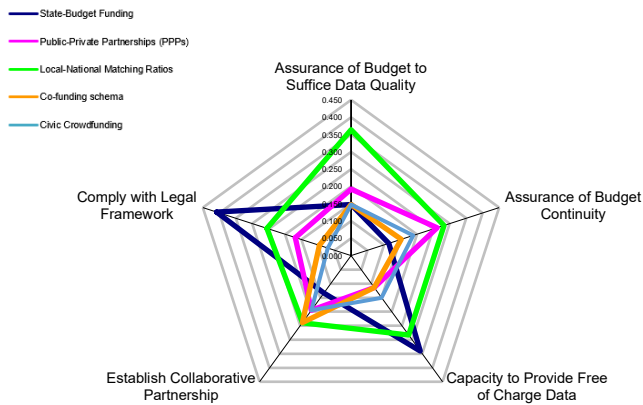| Rank of Criteria		
Assurance of Budget to Suffice Data Quality	0.195	3
Assurance of Budget Continuity	0.239	1
Capacity to Provide Free of Charge Data	0.133	5
Establish Collaborative Partnership	0.239	2
Comply with Available Legal Framework	0.195	4
Sensitivity Analysis	0.044	

Figure 23. Survey result from the Ministry of National Development and Planning perspective

Figure 24 shows the perception of the local government representation from Jakarta province. As becoming more decentralized, the local governments have more flexibility and authority in governing their financial activities. The local government (Jakarta province) mentioned the importance of having high-quality spatial information, including high vertical and horizontal accuracy. In this case, Jakarta province mentioned that with high fiscal capacity, the project of large-scale (1:5,000) base maps could be accomplished by using a mixed budget between local and national governments. Hence, government entities should consider sharing resources to achieve common goals in providing base maps. Figure 25 shows the overall perception of six different experts. The number is calculated by creating an average value from each calculation shown in Figures 19 to 24.

Rank of Alternatives		
Multi-Year State Budget Funding	0.285	2
Public-Private Partnerships (PPPs)	0.171	3
Local-National Matching Ratios	0.285	1
Cost-Sharing	0.127	4
Civic Crowdfunding	0.132	5
Sensitivity Analysis	0.033	

Rank of Criteria		
Assurance of Budget to Suffice Data Quality	0.174	3
Assurance of Budget Continuity	0.137	4
Capacity to Provide Free of Charge Data	0.294	2
Establish Collaborative Partnership	0.065	5
Comply with Available Legal Framework	0.330	1
Sensitivity Analysis	0.048	

Figure 24. Survey result from the Jakarta province perspective
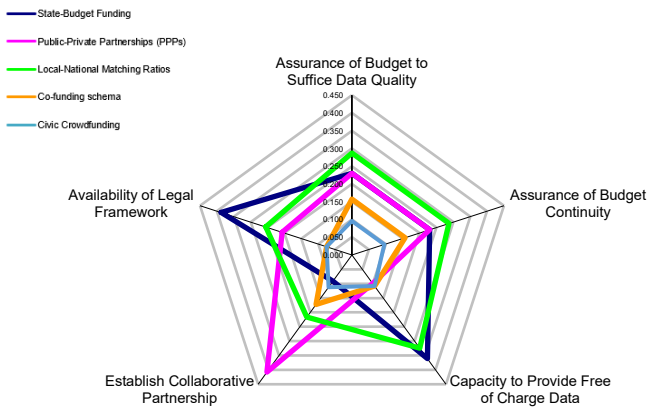
Rank of Alternatives		
Multi-Year State Budget Funding	0.256	2
Public-Private Partnerships (PPPs)	0.235	3
Local-National Matching Ratios	0.276	1
Cost-Sharing	0.138	4
Civic Crowdfunding	0.096	5
Sensitivity Analysis	0.034533	

Rank of Criteria		
Assurance of Budget to Suffice Data Quality	0.354	1
Assurance of Budget Continuity	0.189	2
Capacity to Provide Free of Charge Data	0.124	5
Establish Collaborative Partnership	0.145	4
Comply with Available Legal Framework	0.189	3
Sensitivity Analysis	0.066972	

Figure 25. Compilation from all experts

4.1.3.1.   Local-National Matching Ratio

The local-national matching ratio is ranked first by the Ministry of Finance, Coordinating Ministry of Economic Affairs and Jakarta province as the representation of local governments. Overall, from the average among all experts, the local-national matching ratio is also ranked first.. According to the MOF, the collaboration between national and local governments by sharing resources already established in several sectors, for instance, in managing the watershed of the Citarum river (Deltares, 2010). Because the Citarum river crosses three provinces (West Java, Banten and Jakarta), the national government is the main leader that governs many stakeholders. The national government acts as the main leader, where they govern

national and local public entities within these two provinces. While managing the Citarum river, all public entities are sharing resources, including financial resources.

Furthermore, according to the Ministry of Finance, the sharing of financial resources can be conducted by using a fiscal capacity index as a basis. Since 2014, the MOF has published every local government's annual fiscal capacity index. The fiscal capacity index is to measure the economic inequality between local governments. In practice, the fiscal capacity index measured the surplus revenue after being reduced by local government expenditure. The MOF classified the fiscal capacity of local governments into five levels: very low, low, medium, high and very high. On average, the surplus amount of revenue within very low and low levels is around 500 million rupiahs or 33 million USD, within the medium is around 700 million rupiahs or 47 million USD and within high and very high levels is around 1 trillion rupiahs or 67 million USD (Ministry of Internal Affairs, 2017). Figure 26 shows the distribution of the fiscal capacity index among local governments in Indonesia. As can be seen from Figure 26, around 70% of local governments have medium to very low fiscal capacity, and Jakarta has the highest fiscal capacity.
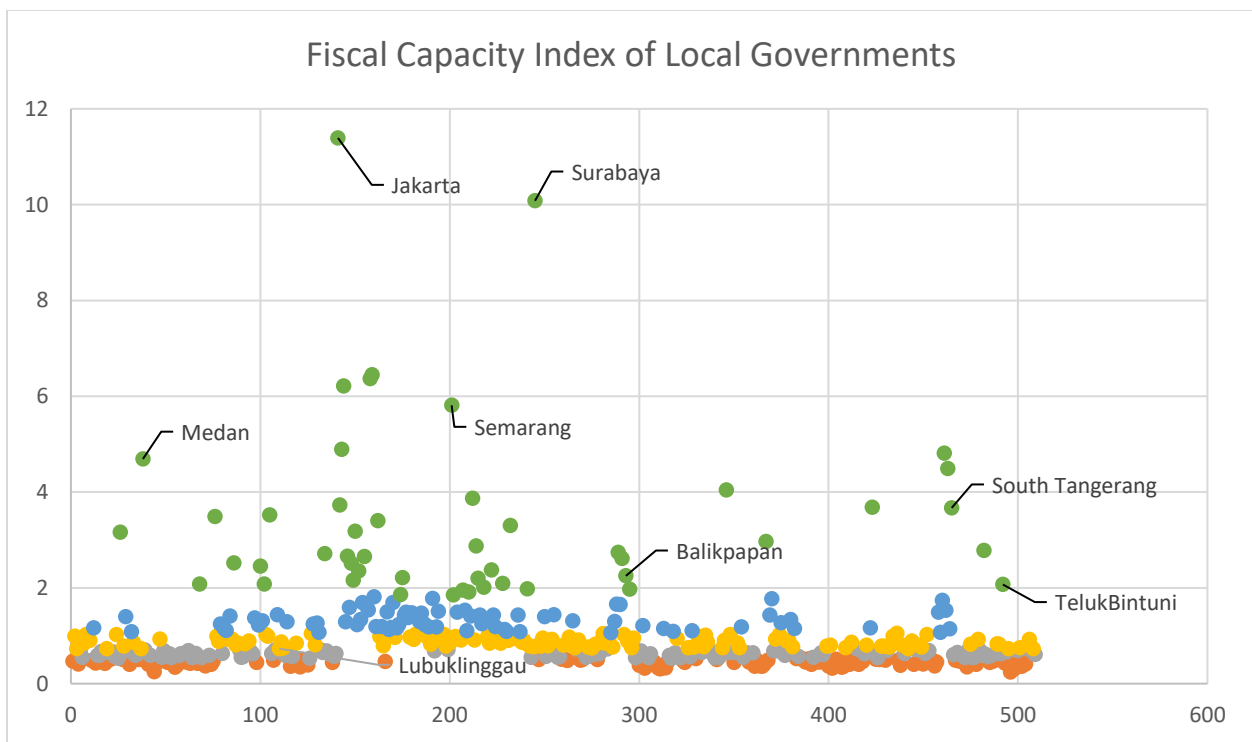
Figure 26. Map of Fiscal Capacity Index within municipalities (cities and districts). Green for very high, blue for high, yellow for medium, grey for low, and orange for very low fiscal capacity index.

There are 591 local governments (municipalities and cities) in Indonesia. Moreover, the Indonesian government categorized 98 cities and 86 municipalities as urban areas (Ministry of Agraria and Spatial Planning, 2010; Ministry of Public Works, 2020). Within these local authorities categorized as urban areas, around 70% have medium to very high fiscal capacity. Moreover, 21 areas already have large-scale (1:5,000) base maps, four municipalities and 17 cities. These 21 areas were mapped by the NMA (with the procurement to the surveying companies) using the annual budget delivered by the national government to fulfil the national agenda. The number of urban areas (municipalities and cities) can be seen in Appendix E.

According to the CMOEA, collaborating with local governments to accelerate large-scale base map production is the simplest and fastest solution, especially for urban areas. The financial sharing resources agreement can be executed by creating a memorandum of understanding between local and national governments instead of creating a particular new government regulation, which needs to be signed by the President and takes more time. Figure 27 shows the possible model of local-national authorities matching funds where they conduct a mixed budget and then establish a periodic contract with the survey companies. Both local and national governments are responsible for monitoring the budget and project progress. Moreover, with limited actual human capacity in geospatial information, local governments could manage the process of updating the base map. Local governments could hire a contractual employee to update the large-scale (1:5,000) base map. The process of updating the base map could be conducted in a partial method limited to the environment of the changing area.
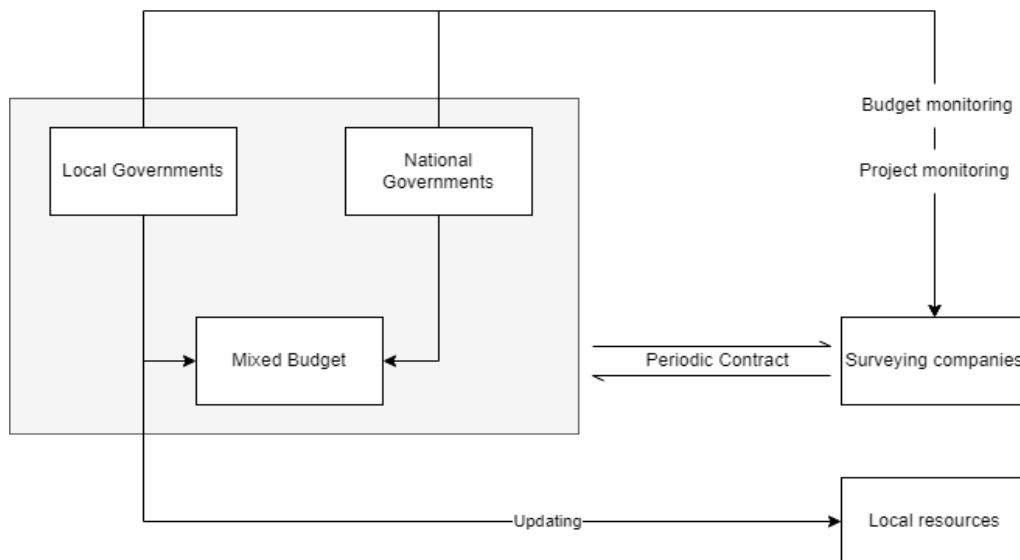

Figure 27. Local-national matching ratio funding model that is viable to be implemented

Furthermore, in 2018 the Governor of Jakarta put the creation of a sustainable detailed spatial plan map as one of the Jakarta province's priorities. Since then, the collaboration of cadaster and mapping division with national government entities occurred, for instance, collaboration with the Ministry of Public Works and Housing to collect and maintain the Building Information Model (BIM) of national-owned buildings and with the Ministry of Agraria and Spatial Planning to accelerate the program of national land registry. Moreover, the Jakarta province already spent around 800 million rupiahs or 53 million USD in 2018 for the cadastre and agrarian programs within the Jakarta province authority.

Moreover, the NMA also mentioned that in 2014, Lubuklinggau city collaborated with the NMA to produce large-scale (1:5.000) base maps within its authority. In Figure 30, Lubuklinggau city is coloured grey and has low fiscal capacity. At the time, the Lubuklinggau government provided all the financial needs, and the NMA supervised and checked the quality control of the data. The data acquisition methodology used in Lubuklinggau was photogrammetry and lidar data acquisition. The local government of Lubuklinggau insisted on having a high-quality base map to increase their income from tax revenue. Similar to local-national matching ratios in South Korea, the national government may conduct a cost-benefit analysis after implementing the local-national matching fund. The cost-benefit analysis result can be used as a reference and improvement for other municipalities.

However, strong leadership from the national government and local leaders is essential. The national government have first established a national master plan for the spatial data infrastructure where the first step is the creation of national large-scale base maps. It is similar to the NGIS master plan in South Korea. Then, local governments have more understanding of the nation's direction of spatial data. Moreover, compared to other countries, the NMA of Indonesia does not have a local representative; hence this could be a challenge in the communication to build the funding ratio.

4.1.3.2.   Multi-year State Budget Funding

Two channels within multi-year state budget funding exist foreign government bonds and foreign loans. These channels are instruments to fund project-based finance in Indonesia targeted to international communities. Moreover, according to the Ministry of Finance, Indonesia is the biggest publisher of foreign government bonds in SUKUK format. SUKUK is an Islamic financial instrument, mainly used in Islam countries. The combination of these instruments started to be used in 2015 and paid attention in 2019-2020 because, at the time, the World Trade Organization put Indonesia as a developed country. Hence, finding foreign donors willing to loan their financial resources at the time could not be easy.

The NMA mentioned multi-year state budget funding as a feasible option and ranked it first. Moreover, within this model, the adaptation process is less complicated because the process changes from an annual to a multi-year funding model, as mentioned in the National Finance Act. The legal instruments for national government ministries and agencies are already well established. The requirement to implement this model is a feasibility document of projects. The Ministry of National Development and Planning and the Ministry of Finance are responsible for assessing the document. Furthermore, procurement within this model could be done in a one-time process without the need for a renewed contract with the private sector as the contractor of the projects. In Figure 28, negotiating between investors and the national government could be challenging as it takes a long administrative and bureaucratic process. This process occurs until the feasibility document is approved and investors are willing to join the investment funding. Moreover, as the leading actors, national governments should maintain the project and budget monitoring.
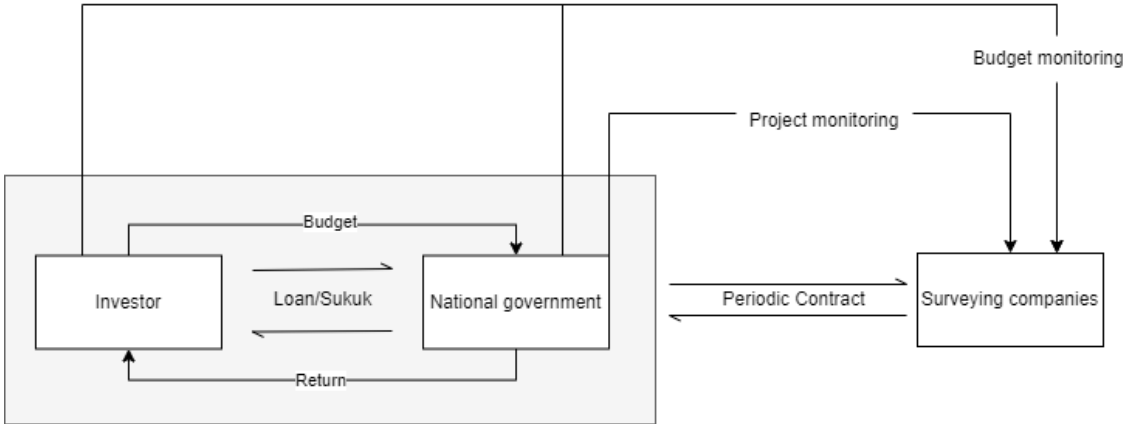
Figure 28. A model of a multi-year state budget, using a combination of foreign loans and Sukuk that leverage international markets

According to the Ministry of Finance, the budget provided by the national government from these instruments is stable. However, according to the National Finance Act, the maximum duration of the budget will be delivered in five years. However, the window of opportunity to implement this model is highly open after the new president is elected and during the creation of the national medium-term plan (RPJMD) document. Moreover, the large-scale base map project must be mentioned as a priority in the national medium-term plan (RPJMD) document. The combination of these instruments is mainly used in infrastructure sectors. Furthermore, on average, around 134 million USD each year since 2018 has been allocated to fund the national projects using this schema.

4.1.3.3. Public-Private Partnership (risk sharing)

PPP is ranked third after compilation from all six groups of experts. Moreover, experts from surveying industries and MONDP also stated that the PPP is suitable to implement as the funding model for large-scale (1:5.000) base map production in the urban area. Generally, the definition of PPP in Indonesia is mainly adopted from the definition of the World Bank. In Indonesia, the PPP model started to implement in 2015. The Indonesian government promote the PPP model to use in five sectors: transportation infrastructure, oil and gas, electricity, port management, water and sanitation services, and information technology infrastructure.

The Ministry of National Development and Planning publishes a PPP book comprising lists of national programs funded by the PPP schema. The PPP book mentioned the progress achieved by every national program. Until 2022, there are eighteen programs already operated by the PPP schema, where private partner within these programs benefits from two schemas: in government pay (availability payment) and in user pay. In detail, three programs were information technology infrastructure, one was the electricity sector, four were the water service sector, and eleven others were transportation infrastructure. Moreover, all water service and information technology infrastructure programs were used in government-pay schema. Within the government-pay or the availability payment schema, the national government must pay the private partner as their benefit during the concession period. According to the Ministry of National Development and Planning, the choice of government-pay schema is because the program was meant to develop the national state-owned enterprise's business activities. Hence, even though the national government must pay the private sector within a certain period, the national government revenue is predicted to increase because of the increasing share of dividends from the national state-owned enterprise, as shown in Figure 29. The national internet fibre optics was the information technology infrastructure built to support the national state-owned enterprise in the telecommunication sector and the electricity power plant to support the national electricity company. Therefore, in government-pay is only used to support the upstream business process of the national state-owned enterprise, which is to deliver their services to the public, for instance, electricity and internet connection. Furthermore, the lowest total project cost needed of eighteen national programs is around 34 million USD, and the highest is around 1718 million USD. Moreover, the contract period is 32 years on average.

Moreover, according to the surveying industries association, the PPP model can be a feasible option. In 2021, all national state-owned enterprises with similar activities were being downsized and merged, including surveying companies. Three big surveying companies (*Succofindo*, *Surveyor Indonesia*, and *BKI*) merged into one holding company named *ID Survey*. According to the Ministry of National Development

and Planning, the PPP model with government-pay can be used if it is meant to support the *ID Survey*. However, unlike other national state-owned enterprises, *ID Survey* is not focused on delivering services to the public. *ID Survey* focuses on providing service on surveying activities in many sectors, including topographic, mining, oil and gas. Therefore, it is still uncertain how the partnership with *ID Survey* will be conducted.
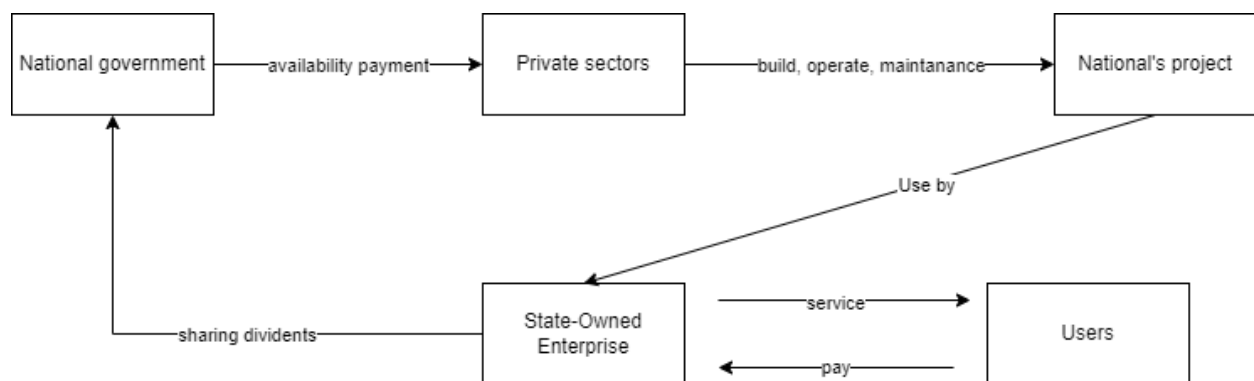

Figure 29. Regular PPP model with availability payment

Moreover, if the PPP model is conducted similarly with Alberta Data Partnership or within land administration as mentioned in the use cases of World Bank, the difficulty is measuring the willingness to pay of users. According to the Ministry of National Development and Planning in 2019, two national programs were planned to conduct in the PPP model: the land registration information system led by the Ministry of Agraria, and Spatial Planning and marine observation and modelling led by the Meteorological, Climatological and Geophysical Agency. However, only the land registration information system continued the planning process until 2021 and is still mentioned in the PPP book of 2022. At the time, the marine observation and modelling program was difficult to commercialise hence lack of interest from the private sector. Moreover, until now, the land registration information system is still in limited progress. According to the Ministry of National Development and Planning, there is a different perception of how to fund the project between the Ministry of Finance and the Ministry of National Development and Planning. Hence, both ministries are reluctant to create a legal basis to conduct the project in the PPP model.

Furthermore, the Ministry of Finance mentioned the difficulty in implementing the PPP model for large-scale base map production because of the existing regulation regarding the amortisation of spatial data. According to the Ministry of Finance, the value of an asset with amortisation will decrease related to time. The amortisation period of a large-scale base map is five years. Hence the value after five years will be zero or no value. Hence, it leads to difficulty in measuring the NPV of the large-scale base maps as assets. One

of the parameters in measuring the NPV is the Internal Rate of Return (IRR). Mainly, the positive IRR means an increasing value of assets, while a negative IRR means decreasing value of assets. Hence, the NPV may be either low or negative if the IRR is negative. Moreover, difficulty in measuring the NPV of assets leads to a lack of interest for the private sector in joining the investment. Otherwise, the term not-for-profit PPP model implemented in the Alberta Data Partnership can be seen as an alternative.

Moreover, If the large-scale base map production is intended to use the PPP model, the Ministry of Finance also mentioned the urge to measure the agency and transaction cost of implementing the PPP model. Agency cost in the PPP model refers to the cost of the principal (the national government) to monitor and control the agent (the private sector) during the implementation of the PPP model (Xiang et al., 2012). In reality, the agent has more information compared to the principal. Hence the agent may use the information to maximise profits opportunistically, for instance, in selecting other partners in EPC or operation and maintenance activities to support projects. However, the Ministry of Finance highlights that the project's main objective in the PPP model is to deliver better public service, which is not to seek profits from the project. Hence, the principal needs to monitor and evaluate the agent's behaviour.

Furthermore, the Ministry of Finance also highlights that the PPP model can succeed if the private sector has flexibility in innovation within the project. The flexibility is based on the role and function endured by the private sector as agreed in the contract. To achieve an agreed contract, cost expenses by principle and agenis named transaction cost (Soliño & Gago de Santos, 2016). The more complex the contract, the less flexibility the private sector will have within the project. The inflexibility of the private sector tends to reduce its innovation. However, the public sector tends to have a specific contract to reduce agency costs (Soliño & Gago de Santos, 2016). Therefore, due to its niche implementation of PPP in the base map production in Indonesia, the NMA should pay attention to this particular cost.

4.1.3.4. Public-Private Partnership (cost-sharing)

From all experts, cost sharing is ranked fourth among all the available funding models. Cost sharing is identified by collaborating with more public and private entities compared to the known PPP definition. Figure 30 shows the possible cost-sharing model between government and private entities. According to the Ministry of Finance, the cost-sharing schema is being promoted to use in the health sector to reduce the fiscal burden of the national state budget. Furthermore, two factors need to be considered: identifying the interested parties and specifying the amount of cost that will be shared. The interested parties must be national and local governments in the large-scale base maps production activity. The difficulty is identifying the non-government entities with the sufficient financial capacity to join the investment.

According to Jakarta province, within the urban environment, non-government entities that are possible to join the cost-sharing mechanism are within the electricity, water and transportation sectors. However, these are all private entities owned by either local or national governments. Hence, the local or national government must promote intense stimulation to establish a cost-sharing schema. For instance, in 2018 in Jakarta, groundwater usage is still high, around 46% of the total population, instead of pipe water. Then, The Jakarta province paid great attention to increasing the use of pipe water by doing all projects, including detailed topographic maps conducted by the cadaster and mapping division of Jakarta, to increase the use of pipe water.
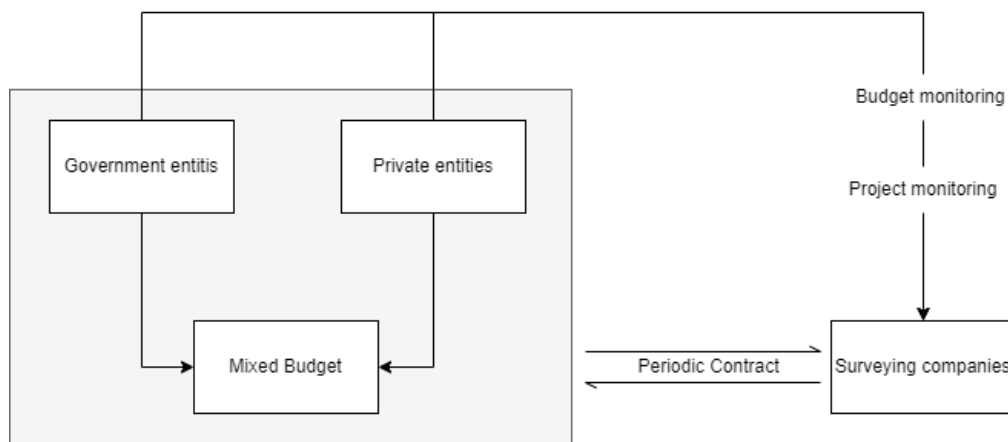
Figure 30. Possible model of cost-sharing between government and private entities

Furthermore, the NMA mentioned that during 1990-1991 there was a similar cost-sharing mechanism with three entities in the forestry area: the Ministry of Forestry, the NMA and the association of forestry entrepreneurs. At the time, the cost of medium-scale (1:25.000) base map production in all areas of Java Island is shared among these three entities. Hence, the NMA mentioned that a cost-sharing mechanism might be appropriate to use in forestry or rural areas where there are large-scale industries, for instance, production forest, mining, and oil and gas. Furthermore, according to the Ministry of Finance, the cost-sharing schema might be helpful to implement in the forestry area to monitor the progress of carbon trading in the forestry area where the number of large-scale industries occurred, including forestry, oil and gas and mining.

4.1.3.5. Civic Crowdfunding

All experts mentioned civic crowdfunding as the fifth-ranked. Moreover, the Ministry of Finance mentioned that there is less implementation of crowdfunding in Indonesia. This model was implemented twice during

natural disasters in Palu bay in 2018 and during the covid pandemic in 2020. However, the implementation is more similar to traditional or charity crowdfunding than civic crowdfunding. The Ministry of Finance governs the funding collected from citizens to help the needy and low-income people. However, governing the money collected from crowdfunding is difficult because there is a lack of legal instruments to manage it.

Moreover, according to the Jakarta province, a similar schema to civic crowdfunding occurred around 2013 when the flood disaster hit Jakarta. Then, the local governments pooled funding from the local citizens to fasten the repair of infrastructure around the river watershed. However, there is a lack of a legal framework for governing funding from the citizens. Hence, at the time, the local governments and the citizens' representatives agreed to transfer the money collected to a start-up company to create a local app named *Qlue*. It is an app to report environmental issues in the surrounding neighbourhood on a social media platform. During the early creation process of this app, the mapping division of Jakarta province was one of the data contributors.

4.1.4. Agenda setting in implementing the funding model

Dye (1984) defined public policy as something the government chooses to do or not to do. The process of the policy cycle, in general, can be defined as a continuous process of agenda setting, policy development, policy implementation, policy evaluation and return agenda setting (Jann & Wegrich, 2007). However, the policy creation process is not as simple as it looks. The dynamic factors within the policy environment influence the policy cycle process, such as time limitation, cultural coordination, interest and benefit trade-offs between stakeholders, and human and financial resources (Wasono & Maulana, 2018). Within the policy process, the process of agenda setting is the most substantial phase to consider (Widyatama, 2018). The agenda is the list of public problems and issues on the government's radar screen to be tackled based on priority (Birkland, 2007). Agenda setting is the process of searching and filtering problems where the agenda owner (government) organises activities to determine the level of each problem (Birkland, 2007). Therefore, various interests will compete to get priority within the agenda-setting process (Birkland, 2007).

Kingdon (1984) developed a theoretical framework of agenda setting named Kingdon's Multiple Streams. This framework explains how an issue can be considered a public agenda through three streams: problem, policy, and politic stream. There are three multiple streams in this framework: problem, policy and politic streams. This framework mentioned the importance of these streams converging at a critical point called the policy window. Then, the government may transform an issue into a concrete policy. Therefore, it is important for all stakeholders to get the message of budget gap in producing large-scale base map.

Since 2016, the One Map Policy's acceleration has already been included as part of the national economic policy package (Sekretariat Tim Kebijakan Satu Peta, 2022). Within this economic policy, the NMA is responsible for producing a digital medium-scale (1:50.000) scale base map to use as a reference for regional spatial planning and investment-related activities (Sekretariat Tim Kebijakan Satu Peta, 2022). As a result, around 40% of Indonesia's land area has overlapping issues within regional spatial planning maps (Abidin, 2020). Therefore, the Indonesian government committed to continuing the One Map Policy on a larger scale map. The One Map Policy for the large-scale map was planned to be finished by 2024. However, since 2020 the funding remains an issue.

From the national perspective, since the covid pandemic, the budget given by the national government for the base map production projects was cut by about 60% in the middle of the fiscal year 2021 (Ministry of Finance, 2022a). Furthermore, this issue was not only faced by the NMA but also by many public institutions (Muhyidin & Nugroho, 2021).Besides, from 2020 until 2022, the national government faces three years of state budget deficit with an average of 3% (Ministry of Finance, 2022c, 2022d). Moreover, the Ministry of Finance predicts that in the year 2023, there could still be a budget deficit by looking at the global economic condition because of the covid-19 pandemic and the current Ukraine-Russia war, which affected the food supply chain of developing countries, including Indonesia (Ministry of Finance, 2022c). Therefore, the Ministry of Finance instructed national government ministries and agencies to prepare budget savings for around 15% of the budget allocated in early 2022 (Ministry of Finance, 2022b). Another issue is that in 2024 the Indonesian government will hold a synchronised political election for the national president, provincial governors and cities major at one time (Tanjung, 2022). Hence, even though the national government already put serious concern regarding the large-scale (1:5.000) base map availability, the national financial capacity is facing a difficult situation because of the covid and global economic conditions.

The Ministry of Finance differentiates the fiscal capacity of local governments into low, medium and high fiscal capacity (Ministry of Finance, 2021). In 2021, forty-eight per cent of total municipalities had low fiscal capacity, while 24% were in the medium and 27% were in the high fiscal capacity (Ministry of Finance, 2021). Furthermore, Jakarta province has the highest fiscal capacity among others, with different significant scores (Ministry of Finance, 2021). Since the Decentralization Act in 2004, local governments have had more flexibility and independence in governing their budget. One of the spirits of the Decentralization Act was to increase regional and local development by optimising local governments'

resources. With high fiscal capacity, Jakarta province has more opportunities to improve its area development.

Jakarta province and the local representative of the Ministry of Agraria and Spatial Planning have already shared their resources in accelerating the land registry program. Within this program, Jakarta province also updates their spatial data information to be used in their local geoportal. From 2018 until now, according to the cadaster and mapping division of Jakarta province, they already spend around 54 million USD in a joined funding schema with the Ministry of Agraria and Spatial Planning, not only for the land registry program but also for updating and managing the spatial data (Cadaster and Mapping Division of Jakarta, 2021). This initiative shows that Jakarta province is highly interested in managing spatial data.

6.1.4.2. Policy stream: Local and National Policies

There are two perspectives within the policy streams: local and national perspectives. From the local perspective, the new governor of Jakarta province already mentioned that his second agenda was to improve spatial planning management (Cadastre and Mapping Division of Jakarta, 2018). Because of the strong commitment and followed by good leadership, the Jakarta province started to accelerate their spatial data management. By 2018, the governor established Jakarta province regulation No. 34 / 2018 about Spatial Data. This policy was used as a basis for the cadaster and mapping division of Jakarta province to collaborate with other government ministries and agencies within the administrative boundary of Jakarta province. Since then, Jakarta province has been sharing resources with other public institutions regarding spatial data management. For instance, in establishing a land registry within the Jakarta administrative boundary with the local representative of the Ministry of Agrarian and Spatial Planning. During this collaboration, both parties shared financial resources committed to integrating the data produced (Cadaster and Mapping Division of Jakarta, 2021).

However, within the national perspective, the limited budget availability made the NMA innovate their funding schema. The NMA is keen to implement PPP as the solution for budget shortages; however, this implementation is still in the early phase (Badan Informasi Geospasial, 2022). Besides, the implementation of PPP contradicts Government Regulation No. 49 / 2019, which mentions that users should provide spatial data free of charge. Furthermore, the Ministry of Finance categorised spatial data as intangible assets that it should be amortised after five years since production time.

6.1.4.3. Political stream: Local and National Mood

The national and local leaders are highly committed to improving spatial data management. Within the national leaders, it can be seen that the acceleration program of the One Map Policy was continued to large-scale data in 2021. Moreover, the local leaders in Jakarta province even mention a specific agenda to improve the detailed spatial plan map quality. Their current detailed spatial plan map is already out of date since it was first published in 2014.

However, the main issue within the commitment of national and local leaders is a disconnection between the five-year local medium-term plan (RPJMD) and the national medium-term plan (RPJMN). Since the Decentralization Act was established in 2004, local governments have had the authority to create their five-year planning agenda as long as it is consistent with the long-term national plan (RPJPN). The RPJMD of Jakarta province was established within 2018-2022, while the RPJMN within 2020-2024. It can be seen that there is a slightly different between two years between the medium-term plan of the local (RPJMD) and national government (RPJMN). According to Wasono & Maulana (2018), the time difference leads to difficulty in harmonising the local and national agenda.

The main factor in harmonising the local and national agenda is the lack of vertical coordination between local and national governments and horizontal coordination between government ministries and agencies. Duplication of budgeting and activities posed problems to both local and national governments. Even though local and national governments should share resources to increase public services efficiently. However, government ministries or agencies with local representatives may reduce this barrier. The physical existence of local representatives creates more effective and efficient communication. This can be seen by implementing the acceleration program of the land registry within the Jakarta province. This was a national program led by the Ministry of Agraria and Spatial Planning. The cadaster and mapping division of Jakarta province saw an opportunity to collaborate with the local representative of the Ministry of Agraria and Spatial Planning, where they share a similar goal: to update and acquire spatial or non-spatial data related to land administration. Furthermore, to achieve this goal, they agreed to share financial resources.

4.2. Strategic Partners to Implement the Funding Model

In general, the process of stakeholder analysis comprises three main steps: 1) identify stakeholders, 2) categorize stakeholders, and 3) analyze the relationship between stakeholders (Bunn et al., 2002). Identified stakeholders (mentioned in Subchapter 3.2.3.1 Selecting Respondent) are interviewed and combined with official documents resulting in the range value from zero to ten of three attributes: power, interest and urgency.

4.2.1. Stakeholders Categorization

Stakeholders will be categorized into a stakeholder matrix. There are two axes in the stakeholder matrix: power and interest-urgency. Hence, these attributes (power, interest, and urgency) are measured towards each stakeholder. Two attributes (interest and urgency) will be visualized on one axis by averaging their value. To measure these attributes, this research followed a semi-structured interview as a data collection method for the selected stakeholders within the One Map Policy team. In addition, Atlas.ti software was used to analyze and categorize the transcript of a semi-structured interview.

The result of a semi-structured interview with the selected stakeholders quantifies power, interest and urgency attributes. The process of quantifying these attributes is based on the interview section's transcript and added with the desk study, as the number of valued information is increasing from the stakeholder.

There are four groups of power attributes identified: institutional, political, knowledge and financial. Each factor has a different component and weight on a scale of one to five, as mentioned in Table 16. The smallest scale is scaled one, meaning it has small power. While the largest scale is scaled five, which means it has the more prominent power compared to other factors. The process of defining the scale number of each factor is based on the combination of interviews and official documents. For instance, interviewees mentioned that knowledge of stakeholders is one of the factors in the power attribute. Moreover, they mentioned it could be measured by spatial data knowledge capacity published by the NMA periodically for all public sectors (https://simojang.big.go.id/). It consists of three levels: low, medium and high.

Table 16. Different factors of power attribute

Factors	Scale	Group
Chairman of One Map Policy Team	5	Institutional
One Data Steering Board	5	Institutional
Member of One Map Policy	5	Institutional
High Level of Spatial Data Management	5	Knowledge
Politically Elected	4	Political
Working Directly Under President	4	Political
Authority in Governing State Budget	4	Financial
Authority in Coordinating State Financial	4	Financial
Chairman of One Map Policy Execution Team	4	Institutional
Vice Chairman of One Map Policy Execution Team	4	Institutional
Having Financial Capacity	4	Financial

Medium Level of Spatial Data Management	3	Knowledge
Secretary of One Map Policy	3	Institutional
Member of One Map Policy Execution Team	2	Institutional
Low Level of Spatial Data Management	1	Knowledge

The other two attributes are interest and urgency. In general, stakeholders' roles are as data users of the base map. Moreover, they use the base map as their reference for creating their thematic map. Stakeholders within the One Map Policy team have limited access to the One Map Policy data portal. Each stakeholder has one registered official account to access the portal.

Moreover, each stakeholder has different specific layers they are interested in. Hence, the level of stakeholders' interest is grouped into four levels: not having, low, medium, and high interest as shown in Table 18. Each group has a specific value ranging from zero to ten. The information regarding the layer needed by each stakeholder is based on the reference in Table 17.

Table 17. References use to measure interest and urgency attributes

No	Stakeholders	Interest Within the Base Map Provision in Urban Area	References
1	Coordinating Ministry of Economic Affairs	Facilitate and coordinate the acceleration of large-scale base map activity among stakeholders	• Presidential Decree No. 23 / 2021 about One Map Policy
2	Ministry of Internal Affairs	Use large-scale base maps as their thematic map reference	• Ministry of Internal Affairs Regulation No 45 / 2016 • Geospatial Information Agency Regulation No. 15/2019
3	Ministry of Finance	Support the financial schema for the acceleration of large-scale base map activity	• Presidential Decree No. 23 / 2021 about One Map Policy
4	Ministry of Environment and Forestry	Use large-scale base maps as their thematic map reference	• Ministry of Environment and Forestry National Strategic Plan 2020 – 2030
5	Ministry of Agrarian and Spatial Planning	Use large-scale base maps as their thematic map reference	• Land Registration Regulation No. 24 / 1997 • National Development System Act No. 25/2004 • Government Regulation About Spatial Planning No. 21/2021 • Land Value Regulation No. 128 / 2015
6	Ministry of Energy and Natural Resources	Use large-scale base maps as their thematic map reference (not in urban areas)	-
7	Ministry of Public Works and Housing	Use large-scale base maps as their thematic map reference	• Natural Water Resources Act No. 17/2019 • Ministry of Public Works and Housing Regulation No. 8, 11, 12, 16, 23, 25, 29 / 2015 • Government Regulation About Residential Area No. 12/2021 • Housing and Residential Act No. 1/2011

			• Ministry of Public Works and Housing About Quality Development of Slum Residential Area No. 2 / 2016
8	Ministry of Village, Development of Disadvantaged Regions and Transmigration	Use large-scale base maps as their thematic map reference (not in urban areas)	-
9	Ministry of Agriculture	Use large-scale base maps as their thematic map reference	• Monitoring of Paddy Rice Fields Presidential Decree No. 59/2019
10	Ministry of Industry	Use large-scale base maps as their thematic map reference	• Ministry of Industry National Strategic Plan 2020 - 2030
11	Ministry of Marine Affairs and Fisheries	Use large-scale base maps as their thematic map reference (not in urban areas)	-
12	Ministry of Communication and Information	Use large-scale base maps as their thematic map reference	• Ministry of Communication and Informatics National Strategic Plan 2020 - 2030
13	Secretary of Cabinet	Support administrative activity of the acceleration of large-scale base map activity	• Presidential Decree No. 23 / 2021 about One Map Policy
14	Presidential Staff Office	Support administrative activity of the acceleration of large-scale base map activity	• Presidential Decree No. 23 / 2021 about One Map Policy
15	Geospatial Information Agency, as the NMA	Produce the large-scale base maps and define its standard quality	• Geospatial Information Act No. 4 / 2011 • Presidential Decree No. 23 / 2021 about One Map Policy
16	National Institute of Aeronautics and Space	Support the NMA during the data acquisition step	• Instruction President No. 6 / 2014 about high-resolution satellite images
17	Local Governments (Jakarta)	Use large-scale base maps as their thematic map reference	• Decentralization Government Act No. 14 /2015 • Government Regulation About Spatial Planning No. 21/2021
18	Private Sectors	Support the NMA in terms of sharing resources during the large-scale base map activity	-
19	Coordinating Ministry of Maritime and Investment	Use large-scale base maps as their thematic map reference	• Presidential Decree No. 23 / 2021 about One Map Policy
20	Ministry of Planning and National Development	Support and coordinate the large-scale base map activity	• Presidential Decree No. 23 / 2021 about One Map Policy • Presidential Decree No. 127 / 2015 about Geospatial Information Agency
21	Ministry of Transportation	Use large-scale base maps as their thematic map reference	• Aviation Act No. 1 / 2009 • Monitoring of National Transportation Asset Regulation No. 2017 / 2020
22	Ministry of Trade	Use large-scale base maps as their thematic map reference	• Ministry of Trade Regulation About Infrastructure Trading Facility No. 21/2021
23	National Army Institution	Use large-scale base maps as their thematic map reference	• National Army Institution Long Term Strategic Plan Towards 2045
24	National Police Institution	Use large-scale base maps as their thematic map reference	• National Army Institution Long Term Strategic Plan Towards 2045

While urgency, as the necessary degree of time, is assessed by the needs of the large-scale base map in the urban area as mentioned in Table 19. Similar to the interest attribute, the urgency attribute also divides into four levels: no urgency, low urgency, medium urgency and high urgency. If stakeholders mentioned the need for large-scale base maps within the next five years, they were classified as having a high level of urgency. Furthermore, stakeholders were classified as having a medium level of urgency if they mentioned

the need for large-scale base maps within the next five to twenty years. If stakeholders did not specify time constraints for completing their thematic map, they were classified as having a low level of interest.

Table 18. Different levels of interest attribute

Level of Interest	Factors	Score
Not having interest	- Does not need large-scale (1:5.000) base maps in the urban area	0
Low interest	- Support administrative and financial schema within the acceleration of large-scale (1:5.000) base map activity - Has specific interest with less than two layers of base maps for their thematic map according to the references	3
Medium interest	- Has specific interest with less than five layers of base maps for their thematic map according to the references	7
High interest	- Facilitate and coordinate the large-scale base map production - Has specific interest with less than five layers of base maps for their thematic map according to the references	10

Table 19. Different levels of urgency attribute

Level of Urgency	Factors	Score
Not having urgency	- Does not need large-scale (1:5.000) base map in urban area	0
Low urgency	- Not mentioning specific time duration to accomplish their large-scale thematic map - Plan to accomplish their large-scale thematic map in 20 years	3
Medium urgency	- Plan to accomplish their large-scale thematic map within 5 to 20 years	7
High urgency	- Plan to accomplish their large-scale thematic map in less 5 years	10

All scores from three attributes (power, interest, and urgency) are calculated and shown in Table 20. These three attributes range from zero to ten scale according to the score based on the factors mentioned in Tables 16, 18 and 19. The power attribute is calculated using the average of the total stakeholders' value. Moreover, the interest and urgency attributes are based on each level's score mentioned. A detailed calculation of these stakeholders' attributes is shown in Appendix D.

In Table 20, the Coordinating Ministry of Economic Affairs scored the highest on power, interest, and urgency. This is due to its responsibility as chairman of One Map Policy and also coordinator of economic activities in Indonesia. In contrast, National Police Institution and National Army Institution have the least amount of power attributes. The Ministry of Energy and Natural Resources and the Ministry of Village,

Development, and Remote Regions and Transmigration have little interest because no document mentions their need for large-scale base maps in urban areas. In the urgency attribute, stakeholders with zero scores are either not interested or have functions supporting and reducing administrative issues during the large-scale base map activities. Figure 31 shows the result of the stakeholder matrix. Within the stakeholder matrix, each stakeholder is differentiated into four groups between four quadrants: key stakeholders, keep informed stakeholders, keep satisfied stakeholders and monitor stakeholders.

Table 20. Result of different power, interest and urgency attributes

No	Stakeholders	Code	Power	Interest	Urgency	Avg I/U
1	Coordinating Ministry of Economic Affairs	CMOEA	10.00	10	10	10
2	Ministry of Internal Affairs	MOIA	6.47	7	10	8.5
3	Ministry of Finance	MOVES	10.00	3	0	1.5
4	Ministry of Environment and Forestry	MOEF	7.65	7	7	7
5	Ministry of Agrarian and Spatial Planning	MOASP	5.29	10	10	10
6	Ministry of Energy and Natural Resources	MOENR	7.65	0	0	0
7	Ministry of Public Works and Housing	MOPWH	7.65	7	7	7
8	Ministry of Village, Development of Remote Regions and Transmigration	MOVDRRT	5.29	0	0	0
9	Ministry of Agriculture	MOA	6.47	7	3	5
10	Ministry of Industry	MOI	5.29	3	3	3
11	Ministry of Marine Affairs and Fisheries	MOMAF	7.65	0	0	0
12	Ministry of Communication and Information	MOCI	6.47	3	3	3
13	Secretary of Cabinet	SC	4.12	3	0	1.5
14	Presidential Staff Office	PSO	3.53	3	0	1.5
15	Geospatial Information Agency	GIA	9.41	10	10	10
16	National Institute of Aeronautics and Space	NIAS	6.47	3	0	1.5
17	Local Governments (Jakarta)	Jakarta Province	7.65	10	10	10
18	Surveying Industries	Surveying Industries	2.35	10	3	6.5
19	Coordinating Ministry of Maritime and Investment	CMOMI	7.06	3	3	3
20	Ministry of Planning and National Development	MOPND	9.41	10	7	8.5
21	Ministry of Transportation	MOT	4.12	3	3	3
22	Ministry of Trade	MOTr	2.35	3	3	3
23	National Army Institution	NAI	1.76	10	3	6.5
24	National Police Institution	NPI	1.76	3	3	3
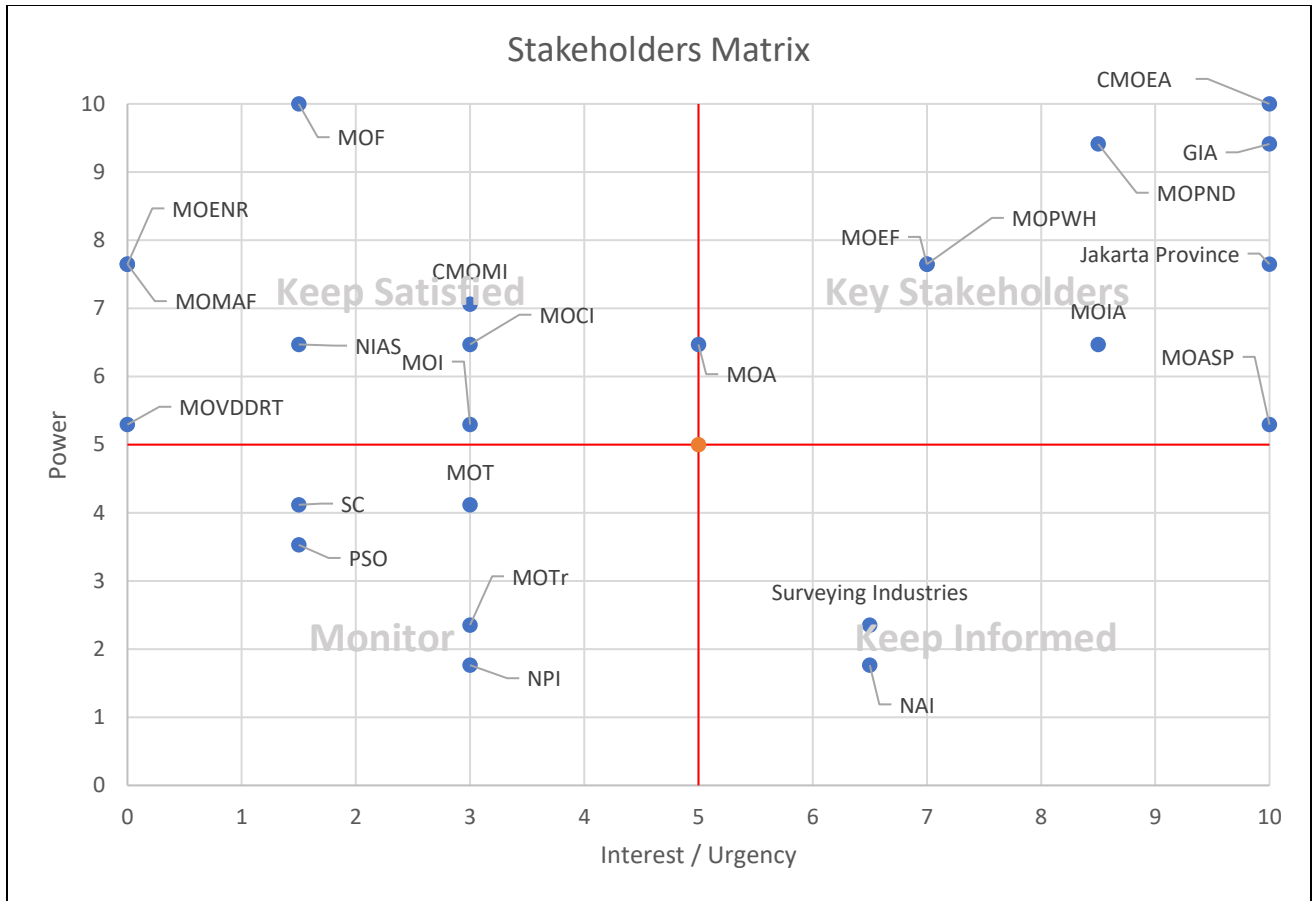
Figure 31. Stakeholder matrix of identified stakeholders

4.2.2. Relations Between Stakeholders

Table 21 shows five groups of the stakeholder matrix: key stakeholders, keep satisfied stakeholders, keep informed stakeholders, and monitor stakeholders. Within this research, it can be seen that stakeholders in the keep informed quadrant are the least number of stakeholders. In contrast, nine stakeholders are identified in the key stakeholder's quadrant. The second greatest number of stakeholders is in the keep satisfied quadrant with seven numbers, while the monitor quadrant has five stakeholders.

Table 21. Categorization of each stakeholder

Monitor	Keep Informed	Keep Satisfied	Key Stakeholders
1. Secretary Cabinet 2. President Staff Office 3. Ministry of Trade	1. Surveying Industries 2. National Army Institution	1. Ministry of Finance 2. Ministry of Energy and Natural Resources	1. Coordinating Ministry of Economic Affairs 2. Geospatial Information Agency as the NMA

		3. Ministry of Marine and Fisheries 4. Ministry of Village, Development of Remote Regions and Transmigration 5. National Institute and Aeronautical Space 6. Ministry of Communication and Information 7. Ministry of Industry	3. Ministry of National Planning and Development 4. Jakarta province as the local government 5. Ministry of Internal Affairs 6. Ministry of Environment and Forestry 7. Ministry of Public Works and Housing 8. Ministry of Agrarian and Spatial Planning 9. Ministry of Agriculture
4. Ministry of Transportation 5. National Police Institution			

Figure 32. Compilation of the average attribute's value of each stakeholder, based on the interviews with selected participants

There are two stakeholders within the keep informed quadrant: surveying industries and National Army Institution. Stakeholders in this quadrant can contribute by innovating in the production of large-scale base maps. The idea of innovation is to develop an effective and efficient project that considers the iron triangle of project management: cost, quality, and time. These two stakeholders have long worked with the NMA, especially the topographic division of the National Army Institution and the Surveying Industry Association (APSPIG). Moreover, an advanced initiative is shown from the surveying industries where they seek the opportunity into the new market of geospatial data users and not focus on traditional survey activities. The

pioneering activity is shown by merging three state-owned surveying companies into one holding group named ID Survey. This company increase their services not only in the upstream sectors, for instance, data acquisition, but also in downstream sectors, for instance, geospatial application.

There are five stakeholders in the monitor quadrant: the Ministry of Trade, the Ministry of Transportation, the National Police Institution, the Secretary Cabinet, and the President's Staff Office. Even though stakeholders in the monitor quadrant may be considered subjects and act as weak supporters, they play a vital role, particularly the Secretary Cabinet and President's Staff Office. These two stakeholders are critical since they facilitate communication among all government organizations and assist administrative activities.

In the keep satisfied quadrant, there are seven stakeholders. According to Olander & Landin (2005b), stakeholders in this quadrant are strong supporters with high power but low interest. Mostly, they ranged in the middle of Figure 32, which shows the average value of three attributes within stakeholders. However, efforts need to be held by the NMA to establish the funding model of local-national matching ratios as the Ministry of Finance is located in this quadrant. The Ministry of Finance is a crucial stakeholder in implementing the funding model as they are responsible for governing national finance.
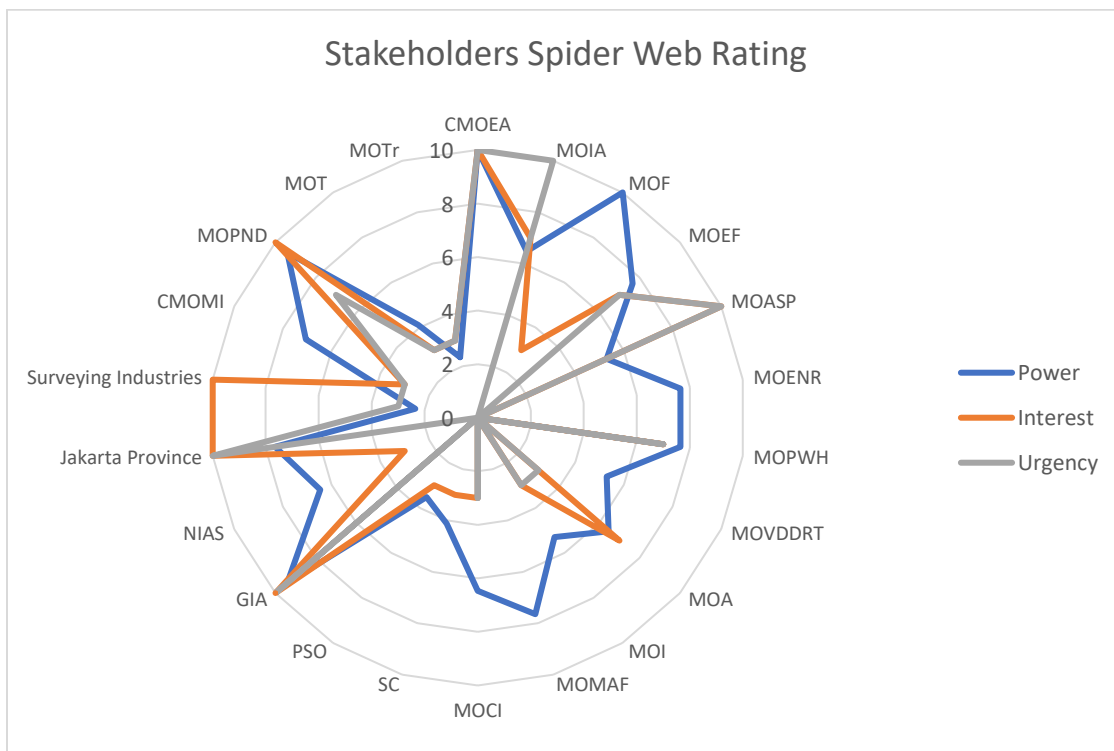
Figure 33. Visualization of stakeholder's attributes (power, interest, and urgency) in a spider web rating

Stakeholders in the key stakeholders' quadrant are the most important to be partnered with, where they can be involved as strategic partners and context setters. Table 21 shows nine key stakeholders, and the Coordinating Ministry of Economic Affairs has the highest score in three attributes among other stakeholders. Moreover, Figure 33 shows that the Coordinating Ministry of Economic Affairs, the NMA and the Ministry of National Development and Planning are the most significant stakeholders among three attributes. Moreover, the Coordinating Ministry of Economic Affairs can be regarded as a natural leader in implementing the funding model as its chairman of One Map Policy and has responsibility for coordinating eight other ministries related to economic activities. Besides, one of the challenges in implementing the local-national matching ratios is the lack of availability of local representatives of the NMA. Compared to other stakeholders in this quadrant, only the NMA does not have a local representative. Hence, the NMA may collaborate with other ministries in this quadrant to create local representatives. Furthermore, to have a successful funding model, it is essential to increase the power of local government with sufficient fiscal capacity. Local governments may increase their power by including them in the planning process of base map production or by creating a financial institution that is created in the collaboration format between local and national government entities.
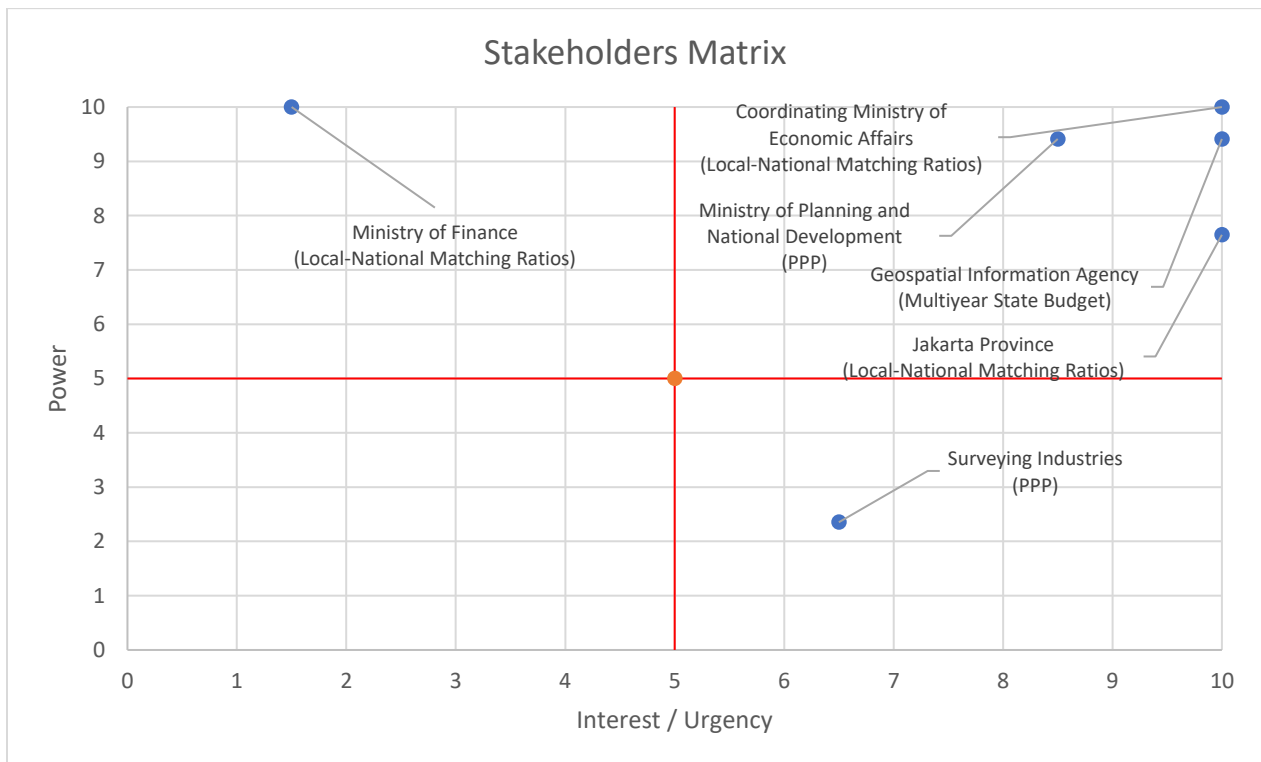
Figure 34. The preferences of experts in the stakeholder matrix

Regarding the rank of funding model alternatives, three stakeholders (the Ministry of Finance, the Coordinating Ministry of Economic Affairs, and the Jakarta province), considering having high power (more than 7.5 value), are showing preferences for local-national matching funds. Moreover, only the Ministry of National Development and Planning with high power chose the option of PPP. This can be seen as a local-national matching fund model as the most potent option chosen by stakeholders with high power. Furthermore, The NMA as the executing agency of base map production also needs to communicate with other stakeholders, especially between the Coordinating Ministry of Economic Affairs and the Ministry of National Development and Planning. Within the One Map Policy team, the Coordinating Ministry of Economic Affairs is the chairman, and the NMA should report the progress to the chairman of One Map Policy. However, since 2017 the NMA has been under the coordination of the Ministry of National Development and Planning. Furthermore, this research shows that the NMA and Coordinating Ministry of Economic Affairs have higher attribute scores than the Ministry of National Development and Planning. This may lead to an unharmonized situation between stakeholders.

Another issue that needs to be considered by the Indonesian government is what benefits may be achieved by key stakeholders if they are partnered and collaborate within the funding model. For instance, the reward and punishment of participant stakeholders if they are under or over-performed in implementing the funding model. Therefore, a financial institution might be a solution to measure the performance of stakeholders involved as a strategic partners in the funding model.

Chapter 5. Conclusion and Recommendation

This chapter provides the conclusion based on the findings from previous chapters. Overall, the end goal of this thesis has been achieved by understanding the current situation of the funding model for large-scale (1:5.000) base map production in Indonesia, exploring the option of funding models for base map production, assessing the suitability of funding model options based on experts' judgment, and finding strategic partners to implement funding model option. Moreover, this thesis has presented the importance of delivering the message of the budget gap in large-scale (1:5.000) base map production to the nationwide stakeholders.

5.1. Conclusions

In this section, concluding answers are presented in which the key takeaway of the research is firstly outlined in answering the main research question. It is then followed by a brief summary of answers to each research sub-question.

5.1.1. Key Takeaway of the Study

Developing countries are facing problems providing large-scale (1:5,000) base maps to support the development of SDGs and other purposes based on the countries' needs. Furthermore, this research explores funding model alternatives to be implemented in large-scale (1:5.000) base map production. The Indonesian government established Geospatial Information Act (2011) as the legal basis for geospatial information activities in Indonesia, including large-scale (1:5,000) base map production. According to the Geospatial Information Act (2011), the NMA is mandated to produce large-scale (1:5,000) base maps. As a public institution, the NMA follows the traditional approach of the funding model, which is mainly dependent on the national government. The One Map Policy 2.0 agenda stated to accelerate large-scale (1:5.000) base map production in Indonesia, especially in the urban area. However, the NMA is facing a budget gap in the current funding model. Therefore, this section will provide the key takeaway of the study in answering the main research question:

> **MRQ:** "Which funding model may allow the Indonesian government to fund the production of large-scale (1:5.000) base maps in urban areas in a financially durable manner?"

Large-scale (1:5.000) base maps are used as a reference for detailed spatial plan maps. Moreover, local governments have more responsibility in creating detailed spatial plan maps, which means they have more needs regarding large-scale (1:5.000) base maps. This research shows that the NMA should realize that there is no one-size-fits-all in implementing the funding model. This can be seen from different perspectives among experts involved in base map production. Even though in Jakarta province, as a case study for urban areas in Indonesia, local-national matching ratios with sharing financial resources between local and national governments could be a viable option, in other urban areas may not be feasible. Furthermore, three parameters should consider in implementing the local-national matching ratios: fiscal capacity, the commitment of local leaders and awareness of using spatial as a basis for local development. Moreover, the NMA should deliver the message of the budget gap in producing large-scale base maps and manage a proper relationship among different stakeholders by assessing their power, interest and urgency attributes. Therefore appropriate cooperation with multi-stakeholders could be created to accelerate the data production process, and the goal of providing the large-scale base map to the public can be achieved.

In the following section, answers to each research sub-question are briefly summarized.

5.1.2. Answering Sub-Research Question 1

SRQ-1: What is the current funding model for the production of large-scale (1:5.000) base maps in Indonesia?

The question is answered by conducting a literature study about the current situation of the funding model. The NMA is responsible for producing large-scale (1:5.000) base maps for all areas in Indonesia. Furthermore, the large-scale (1:5.000) base map is used as a reference for thematic maps, which need a high level of detail, including detailed spatial plan maps. Moreover, until now, the NMA has followed a traditional approach of a funding model that mainly depends on the annual national agenda. There are two main issues within this traditional approach: budget uncertainty and less considering the locations of user needs. The Ministry of Finance and the Ministry of National Development and Planning have the authority to allocate the budget needed for the national agenda. Moreover, the Ministry of National Development and Planning is primarily responsible for creating the indicative budget for government ministries and agencies.

Furthermore, the Ministry of Finance has the authority to finalize the allocated budget for the government ministries and agencies. Hence, the disconnection between these ministries during the financing of national

agendas leads to different budgets received by government ministries and agencies, including the NMA. Furthermore, the NMA is focused on producing base maps to support the national agenda. The national agenda mainly focuses on creating detailed spatial maps for developing remote and underdeveloped areas. Hence, the budget available is not flexible to fund areas not mentioned in the national agenda.

5.1.3. Answering Sub-Research Question 2

SRQ-2: What are the available funding models for large-scale (1:5.000) base map production?

World Bank (2009) developed four mechanisms within innovative funding models: Public-Private Partnership (PPP), Public-Public Partnership (PUP), Catalytic and Pure Private mechanism. There are four components of an innovative funding model within the public sector: 1) could complement the traditional approach, 2) be predictable and stable, 3) involve more parties, and 4) address market failure issues. Moreover, the pure private mechanism is unsuitable to use in the public sector because it is full privatization and cannot address market failure issues. The PPP mechanism emphasizes risk sharing and cost-sharing between the public and private sectors. The risk-sharing schema is more related to the current definition of PPP, which provides more chances for the private sector to be involved in project execution and delivery by moving assets from the public to the private sector. The recent PPP example, which underscores risk sharing, can be seen in the land administration and base map data production. For instance, the Alberta Data Partnership in Canada uses a pure PPP concept to provide base map data to the public. Moreover, the cost-sharing PPP schema is identified from the base map production in Norway country. The PUP mechanism emphasizes the involvement of public sectors within extra and intra-governmental. Within extra-governmental, there are two instruments identified: foreign loans and government bonds. Moreover, in the intra-governmental, the public sector within the national and local authorities are cooperated to deliver better public service. Furthermore, the catalytic mechanism is meant to catalyze the development of a small group of people in the domestic area. Hence, the definition is close to the definition of civic crowdfunding.

5.1.4. Answering Sub-Research Question 3

SRQ-3: Which funding model is suitable for large-scale (1:5.000) base map production in the urban area?

To answer this question, the AHP method is conducted. Selected experts are involved during the AHP method. There are six groups identified as experts: 1) Coordinating Ministry of Economic Affairs, 2) Ministry of Finance, 3) Ministry of National Development and Planning, 4) Surveying Industries, 5) Local

Government (Jakarta Province), and 6) National Mapping Agency. Overall, ten people from these six experts are involved in the survey by the AHP method. Within these groups, there are five criteria identified: 1) assurance of budget to suffice data quality, 2) assurance of budget continuity, 3) capacity to provide free-of-charge data, 4) comply with the available legal framework, and 5) establish collaborative partnership. While alternatives are identified from sub-research question number two, due to their similarity within the process, foreign loans and government bonds are regarded as multi-year state budgets. Therefore, there are five alternative funding models: 1) local-national matching ratios, 2) cost sharing, 3) Public Private Partnership (PPP), 4) civic crowdfunding, and 5) multi-year state budget. Experts identified which funding model is suitable for urban areas with a pairwise comparison of criteria and alternatives. Experts use their theoretical and empirical knowledge in conducting pairwise comparisons. In this research, Jakarta province is used as a study case. Moreover, experts show different perspectives regarding the suitable funding model for large-scale base maps in the study area. The end result shows that sharing financial resources between national and local authorities to provide base map data is the best option based on the criteria mentioned. However, no single solution fits all conditions, including the funding model for base map production. This model suits Jakarta province well because they have a high value on these three conditions: commitment of local leaders, fiscal capacity and awareness of spatial data usability. Therefore, local particularities may affect the result.

5.1.5. Answering Sub-Research Question 4

SRQ-4: To what extent stakeholders need to be involved in the funding model of large-scale (1:5.000) base map production in the urban area?

Stakeholder analysis is conducted to answer this research question. There are three attributes to assess within this stakeholder analysis: power, interest, and urgency. In the stakeholder analysis, a semi-structured interview with selected stakeholders is conducted. Selected stakeholders are identified from the One Map Policy team: 1) Coordinating Ministry of Economic Affairs, 2) Ministry of National Development and Planning, 3) Coordinating Ministry of Maritime and Investment, 4) Cabinet Secretary, and 5) National Mapping Agency. The result is that stakeholders can be grouped into four categories: key stakeholders, keep informed, satisfied, and monitor. To successfully implement the funding model, the NMA must collaborate more with stakeholders in the key stakeholder quadrant. These stakeholders are Coordinating Ministry of Economic Affairs, Geospatial Information Agency as the NMA, Ministry of National Planning and Development, Jakarta province as the local government, Ministry of Internal Affairs, Ministry of

Environment and Forestry, Ministry of Public Works and Housing, Ministry of Agrarian and Spatial Planning, Ministry of Agriculture.

5.1.6.   Answering Sub-Research Question 5

SRQ-5: To what extent does the funding model schema support the One Map Policy in terms of data sharing and access to the public?

Data sharing will be added as the new activity in the One Map Policy agenda in 2021. However, there is an issue with data inconsistency within data sharing because three geoportals active in Indonesia now. The data inconsistency issue can be reduced by creating an association between local and national government entities using the One Data forum. At the same time, local governments have better knowledge of public users. Therefore, local governments know more about public users' needs, especially those living within their authoritative area.

5.2.   Recommendations

One Map Policy 2.0 is planned to be completed in five years since it was initiated in 2021. Hence, by 2025 One Map Policy 2.0 should already deliver large-scale spatial data to the public. Moreover, to accelerate the data provision, the NMA mentioned the refinement of technological, institutional and funding frameworks. This study supports the NMA in determining the suitable funding model by using evidence-based policy, which emphasizes the use of official documents, opinions from experts and stakeholders, and a use case from Jakarta province. The collaboration between local and national governments in providing large-scale (1:5.000) base maps by sharing their financial resources should be a viable option. Therefore, this research provides several recommendations for local and national governments, as shown in Figure 35.

Involve local governments within the One Map Policy agenda

Provide a strong regulation as a legal basis for implementing the funding model

Engage strategic stakeholders with high power, interest and urgency attributes in the large-scale base maps production
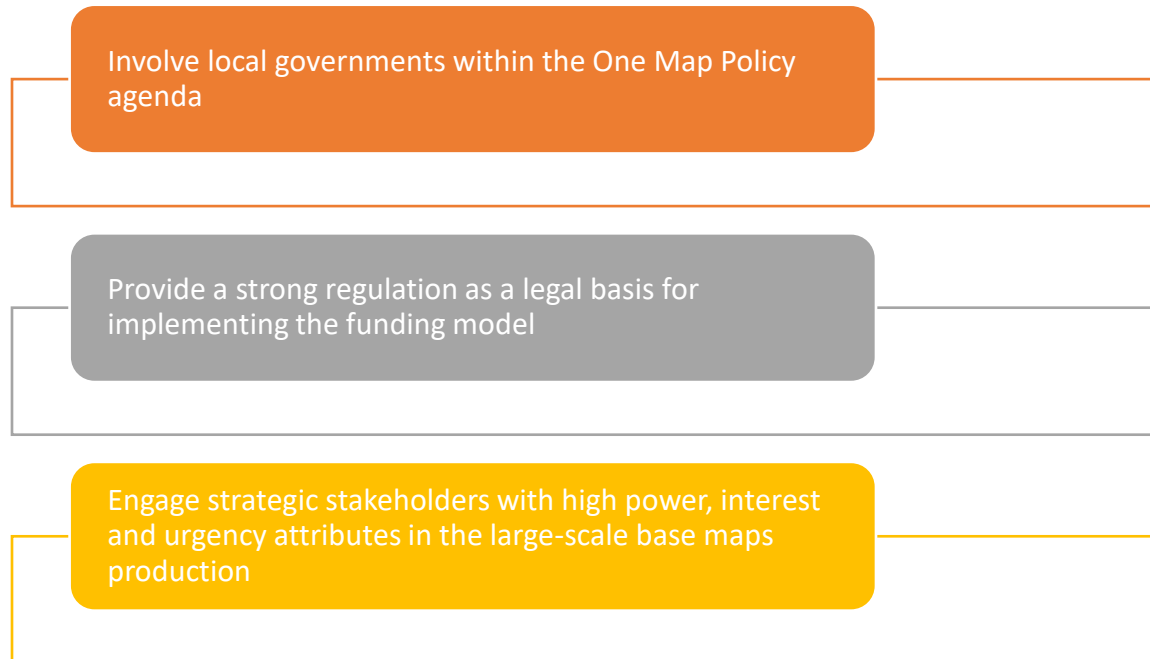
Figure 35. Recommendation for the local and national governments to accelerate the production of large-scale (1:5.000) base maps

5.3. Limitations and Future Research

Funding or finances is one of the elements of spatial data infrastructure. Moreover, UN-GGIM mentions that financial is one of the frameworks in maintaining geospatial information. However, research on funding models within geospatial information management is still limited. The first limitation pertains to the limited literature resources related to the funding models in the geospatial information management sectors, including base map production. Hence, this study explores the current practice of funding models that are not only implemented in the base map production but also in other sectors, for instance, transportation and water services infrastructure. It is then recommended for future research to focus on looking at the possibility of funding models in one sector to implement in the base map production.

The second limitation is that the multi-criteria analysis used in this research is AHP. The AHP method quantifies experts' qualitative opinions in a pairwise comparison among criteria and alternatives. Moreover, the AHP method balances the quantitative and qualitative approaches. Hence, other multi-criteria analyses that emphasize quantitative or qualitative approaches may have different results. Therefore, it is recommended for further research to compare and/or combine the AHP with other multi-criteria analysis methods, for instance, Multi-Actor Multi-Criteria Analysis (MAMCA) or Multi Level Perspective (MLP). However, doing more than one method may lead to the time needed to conduct the research.

The third limitation relates to the number of experts and stakeholders involved in this research. Moreover, the number of involved local governments is limited to Jakarta province. The idea is to get the opinion of high-level bureaucrats that understand the problems asked during AHP or stakeholder analysis. The opinion acquired range from detailed to helicopter view. However, some information could be missing because other stakeholders or experts are not involved, for instance, from the academia or authority from other local governments. Hence, for future research, getting the opinion of broader stakeholders is recommended to achieve wider perspectives.

The fourth limitation relates to the datasets of large-scale (1:5.000) base maps needed. This research did not mention specific datasets in the base map to be funded in a particular funding model. In practice, this is because a complete set of the dataset of large-scale (1:5.000) base maps is needed to create detailed spatial plan maps. However, each dataset could have varied priorities in creating detailed spatial plan maps. Therefore, it is recommended for future research focus on assessing the funding model for specific datasets. For example, the 3DEP program in the United States focuses on producing nationwide elevation datasets consisting of terrain models and contour lines led by the USGS.

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Appendix A. Brief Explanation of Analytical Hierarchy Process (AHP)

Example of structuring the problem that comprises of goal, criteria and alternatives
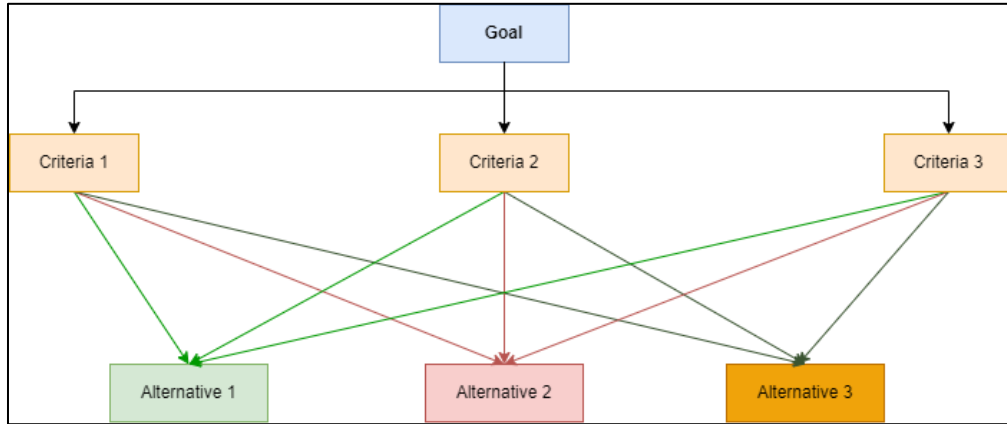
Iteration process of AHP
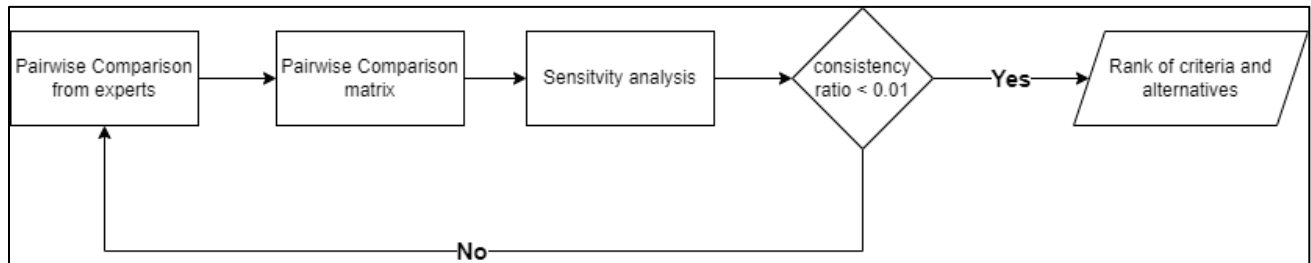
Pairwise comparison from one to nine scale explanation

Numerical rating	Verbal judgement
9	Extremely more important or preferred
8	Very strongly to extremely more important or preferred
7	Very strongly preferred more important or preferred
6	Strongly to very strongly more important or preferred
5	Strongly preferred more important or preferred
4	Moderately to strongly more important or preferred
3	Moderately preferred more important or preferred
2	Equally to moderately more important or preferred
1	Equally preferred more important or preferred
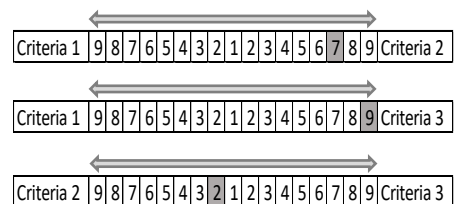
Example of prioritizing alternatives and criteria matrix pairwise and sensitivity analysis calculation

	Criteria 1	Criteria 2	Criteria 3
Criteria 1	1	7	9
Criteria 2	1/7	1	1/2
Criteria 3	1/9	2	1
Total :	1.253968	10	10.5

The number derived from experts' judgement

Example of steps to derive criteria weights for AHP method

	Criteria 1	Criteria 2	Criteria 3
Criteria 1	0.797468	0.7	0.857143
Criteria 2	0.113924	0.1	0.047619
Criteria 3	0.088608	0.2	0.095238

Each number above divides by total

	Criteria 1	Criteria 2	Criteria 3	criteria weights
Criteria 1	0.79747	0.7	0.85714	0.78487
Criteria 2	0.11392	0.1	0.04762	0.087181
Criteria 3	0.08861	0.2	0.09524	0.127949

Criteria weights is the average of the horizontal axis, example (0.79 + 0.7 + 0.85)/3 = 0.7848

	Criteria 1	Criteria 2	Criteria 3	weighted sum value	criteria weights	weighted sum value divide by criteria weights
Criteria 1	0.7848704	0.6102672	1.1515371	2.5466747	0.7848704	3.244707268
Criteria 2	0.1121243	0.087181	0.0639743	0.2632797	0.087181	3.019919007
Criteria 3	0.0872078	0.1743621	0.1279486	0.3895185	0.1279486	3.044336265

λ_{max} was achieved by average the total value of "weighted sum value divide by criteria weights" and the result is 3.10299

Size of matrix	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Random consistency	0,00	0,00	0,58	0,90	1,12	1,24	1,32	1,41	1,45	1,49	1,51	1,48	1,56	1,57	1,59

Random consistency index table, size of matrix is the number of criteria used (n)

$$Consistency\ Index\ (CI) = \frac{\lambda_{max} - n}{n - 1}$$

$$CI = \frac{3.10299 - 3}{3 - 1}$$
$$= 0.05149$$

$$Consistency\ Ratio\ (CR) = \frac{Consistency\ Index\ (CI)}{Random\ Index\ (RI)}$$

$$CR = \frac{0.05149}{0.58}$$
$$= 0.088782$$

If CR is less than 0.10 then the criteria weight is consistent, if not there might be bias in the judgement evaluation by the relevant experts

Appendix B. The AHP survey form

Funding Models in Production of Large-Scale Base Map (1:5.000) in Indonesia

Study case: Jakarta

Multi -Criteria Analysis for Funding Model Options Assesment in Production of National Large-Scale Base Map (1:5.000)

Respondent's profile

Name :

Organization :

Position :

Age :

Education Level : ☐ Graduate ☐ Master ☐ Doctoral

Introduction

One of the national priorities mentioned by the government is to build strong economic growth and reduce disparities and ensure equity between regional areas [1]. Therefore, national, and local governments intensively create national dan regional development programs by using data and information as the basis[2], [3]. There are three types of fundamental data and information as mandated by One Data Policy use a basis: finance, statistical and spatial data, and information[4]. The use of spatial data and information is highly important in ensuring the law certainty and ease of doing business which shows in the creation of spatial plan map, in addition to the zoning area regulation and strategic environmental map[5]. A spatial plan map is used as the development instrument that contains the spatial pattern and spatial structure by taking into account the environmental conditions of the area[5].

Until 2021, the availability of spatial plan maps is about 3% and according to Coordinating Ministry of Economic Affairs, one of obstacle is the lack availabitily of large-scale base map (1:5.000) which regard as the most essential data in creating spatial plan map[6]. Until 2021, the total availability of national large-scale base map (1:5.000) is 2.5% (9339 out of 372.858 large-scale map tile sheets)[7]. Respond to this matter, the national government establish the Presidential Decree No. 23/2021 about acceleration of one map policy in large-scale data where the National Mapping Agency (BIG) was mandate as the executive team leader. This is inline with the mandates mention in the Geospatial Information Act and Presidential Decree No. 94/2011 abour Geospatial Information Agency (BIG) that mandates BIG as the only supplier of national large-scale base map that produce reliable, transparant, accurate and up-to-date data.

Funding Models in Production of Large-Scale Base Map (1:5.000) in Indonesia
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Because of the urgency, BIG made the provision of national large-scale base map (1:5.000) as their priority[6]. To achieve this priority, BIG establish five-years action plan that consist of refinement on legal, institutional, and funding framework. However, related to the funding framework the assumption mades on funding model options was still limited to use state budget model[6]. Therefore, exploring other alternative funding models is useful to accelerate the production of national large-scale base map (1:5.000).

Globally, many National Mapping Agencies worldwide are facing budget shortage in conducting their activities, including the collection, curation, operation, and maintenance of their base maps, especially after the economy crisis in 2008 and covid pandemic[8]. Therefore, alternative funding models, especially to produce the base maps, is needed to fill the funding gaps. However, there is no one size fits all, there are spesific terms and conditions for each funding models that can be best applied for spesific dataset or area characteristic[9]. BIG also mentions that to adapt with different area characteritics, different geometric quality was implemented as regulate on the BIG regulation No. 6/2018 [11]. However, the higher the quality the more complex the technical production process.

Purpose of research

In this context, the purpose of this research project is to identify preferred funding model options that can be implement in the urban area, using Jakarta as a study case. With this research, relevant stakeholder's opinion and judgement are being analysed and explored by using Analytical Hierarchy Process (AHP).

Through a survey questionnaire, participants are comparing relative importance of alternatives with respect to the criteria and the goal explained below. Each participants are requested to enter his/her judgements and makes a distinct, identifiable contribution to the issue.

Goal, Criteria/Sub-criteria and Alternatives

Goal   : Suitable and sustainable funding models within area characteristics

Criteria   : five criteria were chosen

1. Assurance of Budget to Suffice Data Quality
   The amount of budget required within the area's characteristics (urban, rural, and forest) are different. Varying areas have different levels of standard quality, and each standard quality has a different budget.
2. Assurance of Budget Continuity
   Refers to the long-term budget continuity. Because of spatial data need to be updated periodically and limited availibaility of resources make the production of base-map can not be completed in a timely manner.
3. Capacity to Provide Free of Charge Data
   Currently spatial data is regarded as an intangible national asset where it the user can access the data in a free of charge manner. Therefore the funding model prefered suggested to provide the dataset in a non-rivalry manner.
4. Establish Partnership and Collaborative Governance
   One Map Policy establish the institutional arrangement in data sharing for basic and thematic geospatial information. While the basic geospatial information (base map and geodetic network) is the responsibility of the BIG. However, users are not satisfied with the large-scale

base map produced and proposed more collaboration in the production phase.

5. Comply With Legal and Institutional Framework

    As a government agency, BIG needs to comply with the current available legal and institutional framework including its funding model that will be applied in the production of base map

Alternatives   :   five funding models were identified

1. State-Budget Funding

    Definition: Traditionally, government agencies (including NMA) are being funded through national government revenue (international loan/grand, tax and non-tax, including government securities). The process is complicated and need to go through a lot of bureaucratic process. Some challenges that can be seen are changes in budget allocation during the fiscal year and limited duration of budget availability.

2. Public-Private Partnerships

    Definition: Due to limited budget availibitiliy from the national government, therefore another model is provided namely Public-Private Partnerships. This model is joint operation between public agency and private entity, mostly to tackle three main issues during project activities: insufficient of budget availability, limited innovation in technology and lack of improvement in project management. PPPs provide private sector space to tackle these three issues.

3. Local-National Matching Ratios

    Definition: Refers to the funding agreement between local and national authorities as shown in South Korea during their first and second NGIS phase. This model is successfully implemented, especially in urban and rural area where most of the local authorities are having more interest.

4. Cost Sharing schema

    Definition: An example of co-funding model is shown in Norway, where their mapping agency leverage their Geovekst (SDI network) into a joint funding regime with a long-term cooperation between municipalities, National Mapping Agency, road authorities, agriculutural authoritiy and several private sectors. Each of the participants contribute to certain amount of budget.

5. Civic Crowdfunding

    Definition: refers to an alternative funding model where it allows citizen to contribute in providing the budget needed. There are limited number of study case for this model, for instance Bristol City allows the contribution of their citizen to provide budgets for energy efficiency of council-owned building.

Respondent's level of knowledge
Level of awareness

	Not all aware	Slightly aware	Somewhat aware	Moderately aware	Extremely aware
Are you aware of the funding gaps occurred in the production of large-scale base map (1:5.000) in Indonesia?	☐	☐	☐	☐	☐

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Level of expertise

	Poor	Fair	Good	Very Good	Excellent
What is your level of expertise in finances?	☐	☐	☐	☐	☐

In the following sheets, we would like to explore and elicit your opinion in order to select amongst the alternatives. The pairwise comparison scale is used to express the importance of one element over another (table 3)

Table 1. Comparison scale explanation

Explanation	Numeric Values
If Option A and Option B are equally important : Mark/Insert	1
If Option A is moderately more important than Option B : Mark/Insert	3
If Option A is strongly more important than Option B : Mark/Insert	5
If Option A is very strongly more important than Option B : Mark/Insert	7
If Option A is extremely more important than Option B : Mark/Insert	9
Use even numbers for intermediate judgements	2, 4, 6, 8

Example:

Give options A and B, you can judge their relative importance as shown below example:

if you think the option 'Partnership' in column A is strongly more important than the option 'Product Ownership' in column B, then you mark 5 with (X) on the left hand side.

if you think the option 'Budget Availability' in column B is very strongly more important than the option 'Partnership' in column A, then you mark 7 with (X) on the right hand side.

A Option	Extremely	Very Strongly	Strongly	Moderately	Equality	Moderately	Strongly	Very Strongly	Extremely	B Option
Partnership	9 8 7 6		X	4 3 2	1	2 3	4 5	6 7	8 9	Product ownership
Partnership	9 8 7 6 5 4 3 2				1	2 3	4 5	6 X	8 9	Budget availability
Partnership	9 8 7 6 5 4 3 2				1	2 3	4 5	6 7	8 9	Capability of executing agency
Product ownership	9 8 7 6 5 4 3 2				1	2 3	4 5	6 7	8 9	Budget availability
Product ownership	9 8 7 6 5 4 3 2				1	2 3	4 5	6 7	8 9	Capability of executing agency
Budget availability	9 8 7 6 5 4 3 2				1	2 3	4 5	6 7	8 9	Capability of executing agency

Comparison in urban area characteristics

With respect to Urban Area																		
Using the scale from 1 to 9 (where 9 is extremely and 1 es equally important), please indicate (X) the relative importance of options A (left column) to options B (right column)																		
A Option	Extremely		Very Strongly		Strongly		Moderately		Equality		Moderately		Strongly		Very Strongly		Extremely	B Option
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	

Funding Models in Production of Large-Scale Base Map (1:5.000) in Indonesia

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A Option																		B Option
Assurance of Budget to Suffice Data Quality	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Assurance of Budget Continuity
Assurance of Budget to Suffice Data Quality	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Capacity to Provide Free of Charge Data
Assurance of Budget to Suffice Data Quality	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Establish Partnership and Collaborative Governance
Assurance of Budget to Suffice Data Quality	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Availability of Legal and Institutional Framework
Assurance of Budget Continuity	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Capacity to Provide Free of Charge Data
Assurance of Budget Continuity	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Establish Partnership and Collaborative Governance
Assurance of Budget Continuity	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Availability of Legal and Institutional Framework
Capacity to Provide Free of Charge Data	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Establish Partnership and Collaborative Governance
Capacity to Provide Free of Charge Data	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Availability of Legal and Institutional Framework
Establish Partnership and Collaborative Governance	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Availability of Legal and Institutional Framework

Comparison between first criteria: Assurance of Budget to Suffice Data Quality

Assurance of Budget to Suffice Data Quality

Using the scale from 1 to 9 (where 9 is extremely and 1 es equally important),

plese indicate (X) the relative importance of options A (left column) to options B (right column)

A Option	Extremely		Very Strongly		Strongly		Moderately		Equality		Moderately		Strongly		Very Strongly		Extremely	B Option
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
State-Budget Funding	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Public-Private Partnerships
State-Budget Funding	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Local-National Matching Ratios
State-Budget Funding	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Cost Sharing schema
State-Budget Funding	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Civic Crowdfunding
Public-Private Partnerships	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Local-National Matching Ratios
Public-Private Partnerships	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Cost Sharing schema
Public-Private Partnerships	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Civic Crowdfunding
Local-National Matching Ratios	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Cost Sharing schema
Local-National Matching Ratios	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Civic Crowdfunding
Cost Sharing schema	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Civic Crowdfunding

Comparison between second criteria: Assurance of Budget Continuity

Assurance of Budget Continuity

Using the scale from 1 to 9 (where 9 is extremely and 1 es equally important),

plese indicate (X) the relative importance of options A (left column) to options B (right column)

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A Option	Extremely		Very Strongly		Strongly		Moderately		Equality		Moderately		Strongly		Very Strongly		Extremely	B Option
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
State-Budget Funding	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Public-Private Partnerships
State-Budget Funding	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Local-National Matching Ratios
State-Budget Funding	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Cost Sharing schema
State-Budget Funding	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Civic Crowdfunding
Public-Private Partnerships	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Local-National Matching Ratios
Public-Private Partnerships	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Cost Sharing schema
Public-Private Partnerships	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Civic Crowdfunding
Local-National Matching Ratios	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Cost Sharing schema
Local-National Matching Ratios	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Civic Crowdfunding
Cost Sharing schema	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Civic Crowdfunding

Comparison between third criteria: Capacity to Provide Free of Charge Data

Capacity to Provide Free of Charge Data

Using the scale from 1 to 9 (where 9 is extremely and 1 es equally important),

plese indicate (X) the relative importance of options A (left column) to options B (right column)

A Option	Extremely		Very Strongly		Strongly		Moderately		Equality		Moderately		Strongly		Very Strongly		Extremely	B Option
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
State-Budget Funding	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Public-Private Partnerships
State-Budget Funding	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Local-National Matching Ratios
State-Budget Funding	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Cost Sharing schema
State-Budget Funding	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Civic Crowdfunding
Public-Private Partnerships	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Local-National Matching Ratios
Public-Private Partnerships	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Cost Sharing schema
Public-Private Partnerships	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Civic Crowdfunding
Local-National Matching Ratios	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Cost Sharing schema
Local-National Matching Ratios	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Civic Crowdfunding
Cost Sharing schema	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Civic Crowdfunding

Comparison between fourth criteria: Establish Partnership and Collaborative Governance

Establish Partnership and Collaborative Governance

Using the scale from 1 to 9 (where 9 is extremely and 1 es equally important),

plese indicate (X) the relative importance of options A (left column) to options B (right column)

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A Option	Extremely		Very Strongly		Strongly		Moderately		Equality		Moderately		Strongly		Very Strongly		Extremely	B Option
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
State-Budget Funding	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Public-Private Partnerships
State-Budget Funding	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Local-National Matching Ratios
State-Budget Funding	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Cost Sharing schema
State-Budget Funding	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Civic Crowdfunding
Public-Private Partnerships	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Local-National Matching Ratios
Public-Private Partnerships	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Cost Sharing schema
Public-Private Partnerships	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Civic Crowdfunding
Local-National Matching Ratios	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Cost Sharing schema
Local-National Matching Ratios	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Civic Crowdfunding
Cost Sharing schema	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Civic Crowdfunding

Comparison between fifth criteria: Availability of Legal and Institutional Framework

Availability of Legal and Institutional Framework

Using the scale from 1 to 9 (where 9 is extremely and 1 es equally important),

plese indicate (X) the relative importance of options A (left column) to options B (right column)

A Option	Extremely		Very Strongly		Strongly		Moderately		Equality		Moderately		Strongly		Very Strongly		Extremely	B Option
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
State-Budget Funding	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Public-Private Partnerships
State-Budget Funding	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Local-National Matching Ratios
State-Budget Funding	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Cost Sharing schema
State-Budget Funding	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Civic Crowdfunding
Public-Private Partnerships	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Local-National Matching Ratios
Public-Private Partnerships	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Cost Sharing schema
Public-Private Partnerships	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Civic Crowdfunding
Local-National Matching Ratios	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Cost Sharing schema
Local-National Matching Ratios	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Civic Crowdfunding
Cost Sharing schema	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Civic Crowdfunding

List of question during semi-structure interview:

One Map Policy (OMP) has an essential role in many aspects, including giving law certainty and easiness for investors to invest in some locations, which leads to local and national economic development. However, the first important step in conducting one map policy is the availability of a large-scale base map (1:5.000).

1. What is your role in the process of providing this base map?
2. What is the current progress of the large-scale base map (1:5.000) availability? Is this according to a plan one-map policy? Do you see any issue(s) or problem(s) in this programme?
3. Do you see funding as one of the issues? If it is yes, how do you see this issue?
4. What is your role in the funding issue?
5. Since the availability of a base map is an essential part of the OMP, what is the role of the OMP team regarding the provision of a base map in general and funding issues in particular?
6. OMP is part of improving spatial data governance, which is part of the One Data Policy to support the E-Government Policy. One of the principles in this policy is cohesiveness which requires a spirit of collaboration among the stakeholders involved. Is there any spirit of collaboration in the One Map Policy team in general and the provision of a base map in particular?
7. If there is a spirit of collaboration, is there any concrete action to implement the collaboration?
8. Is there any spirit of collaboration in overcoming funding issues?
9. How do you see the other stakeholder's role in the OMP activities and specifically in the provision of the large-scale base map (1:5.000)?
10. Which organization has a significant role in the OMP activities and specifically in the provision of the large-scale base map (1:5.000)?
11. Why this organization has a more significant role? What are the factors?
12. Who, within or outside the OMP team, will suffer if there is a delay in the process of providing base maps?
13. Why will these organizations suffer? To what extent they need the base maps?
14. What makes the organizations interested in the base maps? is there any specific factors?
15. The provision of the large-scale base map (1:5.000) is closely related to the making of the detailed spatial plan map, which is the obligation of the regional government. How is communication being built with the local governments? Are there any specific needs they mentioned regarding the level of accuracy and information?

16. Have there been comparisons with cases in other countries regarding the funding issue and how to deal with them?

17. Is there already a funding strategy for base map production? If not, would it be possible to create a funding strategy in the future, and who are the stakeholders you consider important in creating a funding strategy?

18. Regarding your opinion, will the funding strategy support the goal of OMP? Also, the One Data Policy and E-Government Policy?

Appendix D. Calculation of stakeholder analysis

Diagram of defining the value of three attributes: power, interest and urgency
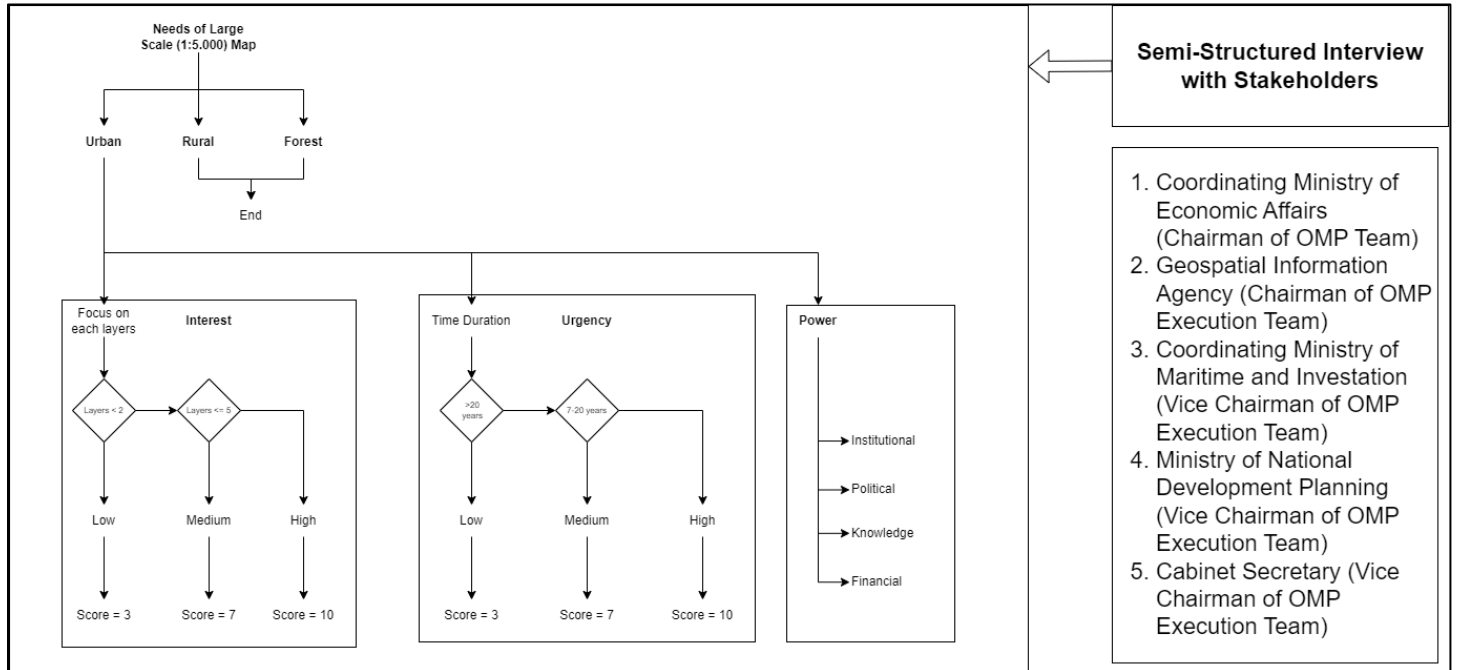
Official documents as references for interest and urgency attributes

Needs Large Scale Map (1:5.000)	Data Users	Urban	Rural	Forest	References
Aviation Operational Security Area	Ministry of Transportation	x	-	-	Aviation Act No. 1 / 2009
National Transportation Asset		x	x	x	Monitoring of National Transportation Asset Regulation No. 2017 / 2020
Land Value Zone	Ministry of Agraria and Spatial Planning	x	x	-	Land Value Regulation No. 128 / 2015
Land Tenure and Ownership		x	x	x	Agrarian Act No. 5 / 1960 Land Registration Regulation No. 24 / 1997
Spatial Planning (National Strategic Area)		x	x	x	- National Development System Act No. 25/2004 - Government Regulation About Spatial Planning No. 21/2021
Protected Paddy Rice Fields		-	x	-	- Monitoring of Paddy Rice Fields Presidential Decree No. 59/2019 - Protected Paddy Rice Fields Verification Methods Ministry of Agraria Regulation No. 12/2020 - Protected Paddy Rice Fields Execution Team Coordinating

					Ministy of Economic Regulation No. 18/2020
Economic Area Market Zone	Ministry of Trade	x	x	-	- Ministry of Trade Regulation About Infrastructure Trading Facility No. 21/2021
Paddy Rice Fields	Ministry of Agriculture	-	x	-	- Paddy Rice Fields Act No 54 / 2980 - Monitoring of Paddy Rice Fields Presidential Decree No. 59/2019 - Ministry of Agriculture Strategic Plan
Urban Irrigation Area	Ministry of Public Works and Housing	x		-	- Natural Water Resources Act No. 17/2019 - Ministry of Public Works and Housing Regulation No. 8, 11, 12, 16, 23, 25, 29 / 2015
Swamp Irrigation Area		-	x	-	- Natural Water Resources Act No. 17/2019 - Ministry of Public Works and Housing Regulation No. 8, 11, 12, 16, 23, 25, 29 / 2016
Pond Irrigation Area		-	x	-	- Natural Water Resources Act No. 17/2019 - Ministry of Public Works and Housing Regulation No. 8, 11, 12, 16, 23, 25, 29 / 2017
Slum Residential Area		x	-	-	- Government Regulation About Residential Area No. 12/2021 '- Housing and Residential Act No. 1/2011 - Ministry of Public Works and Housing About Quality Development of Slum Residential Area No. 2 / 2016
Administrative Boundary	Ministry of Internal Affairs	x	x	x	- Ministry of Internal Affairs Regulation No 45 / 2016 - Geospatial Information Agency Regulation No. 15/2019
Climate Change Risk	Ministry Environment and Forestry	x	x	-	- Ministry of Environment and Forestry National Strategic Plan
Forestry Area		-	-	x	- Ministry of Environment and Forestry National Strategic Plan
Industrial Economic Zone	Ministry of Industry	x	-	-	- Ministry of Industry National Strategic Plan
Flood Prone Coastal Area	Ministry of Marine and Fisheries	-	x	-	- Ministry of Marine and Fisheries National Strategic Plan
Outermost Small Islands Area		-	x	x	- Ministry of Marine and Fisheries National Strategic Plan
Underground and Upperground Fiber Optic Cable	Ministry of Communication and Informatics	-	-	-	- Ministry of Communication and Informatics National Strategic Plan

Spatial Planning	Local Governments	x	x	x	- Decentralization Government Act No. 14 /2015 - National Development System Act No. 25/2004 - Government Regulation About Spatial Planning No. 21/2021

Calculation of interest attribute based on layers necessity mentioned in references

	Buildings	Transportation And Utility	Hydrography	Administrative Boundary	Land Cover (Natural)	Geographical Names	Hypsography	Total	Grade	Score
Ministry of Transportation	x	-	-	-	-		x	2	Low	3
Ministry of Agraria and Spatial Planning	x	x	x	x	x	x	x	7	High	10
Ministry of Internal Affairs	-	-	-	x	-	x	x	3	Medium	7
Ministry of Public Works and Housing	x	x	x	x	-	-	x	5	Medium	7
Ministry of Trade	x	x	-	-	-	-	-	2	Low	3
Ministry of Agriculture	-	-	-	x	x	x	-	3	Medium	7
Local Governments	x	x	x	x	x	x	x	7	High	10
Ministry of Environment and Forestry	x	-	x	-	x	-	-	3	Medium	7
Ministry of Industry	x	-	-	-	x	-	-	2	Low	3
Ministry of Communication and Informatics	-	x	-	-	-	-	-	1	Low	3
Coordinating Ministry of Economic Affairs	x	x	x	x	x	x	x	7	High	10
Ministry of Finance	-	-	-	x	-	-	-	1	Low	3
Ministry of Energy and Natural Resources	-	-	-	-	-	-	-	0	No	0
Ministry of Village, Development of Disadvantaged Regions And Transmigration	-	-	-	-	-	-	-	0	No	0
Ministry of Marine Affairs and Fisheries	-	-	-	-	-	-	-	0	No	0
Secretary of Cabinet	-	-	-	x	-	-	-	1	Low	3
Presidential Staff Office	-	-	-	x	-	-	-	1	Low	3
Geospatial Information Agency	x	x	x	x	x	x	x	7	High	10
National Institute of Aeronautics and Space	-	-	-	-	x	-	-	1	Low	3
Surveying Industries	x	x	x	-	x	-	x	6	High	10
Coordinating Ministry of Maritime and Investation	-	-	x	-	-	-	x	2	Low	3
Ministry of Planning and National Development	x	x	x	x	x	x	x	7	High	10

Calculation of urgency attribute based on time duration necessity mentioned in references

	Time (years)	Grade	Score
Ministry of Transportation	No	Low	3
Ministry of Agraria and Spatial Planning	5	High	10
Ministry of Internal Affairs	5	High	10
Ministry of Public Works and Housing	10	Medium	7

Ministry of Trade	No	Low	3
Ministry of Agriculture	No	Low	3
Local Governments	5	High	10
Ministy Environment and Forestry	10	Medium	7
Ministry of Industry	20	Low	3
Ministry of Communication and Informatics	25	Low	3
Coordinating Ministry of Economic Affairs	5	High	10
Ministry of Finance	No	No	0
Ministry of Energy and Natural Resources	No	No	0
Ministry of Village, Development of Disadvantaged Regions And Transmigration	No	No	0
Ministry of Marine Affairs and Fisheries	No	No	0
Secretary of Cabinet	No	No	0
Presidential Staff Office	No	No	0
Geospatial Information Agency	5	High	10
National Institute of Aeronautics and Space	No	No	0
Surveying Industries	25	Low	3
Coordinating Ministry of Maritime and Investation	25	Low	3
Ministry of Planning and National Development	10	Medium	7

Calculation of urgency attribute based on time duration necessity mentioned in references

Factors	Scale	Group
Chairman of One Map Policy Team	5	Institutional
One Data Steering Board	5	Institutional
Member of One Map Policy	5	Institutional
High Level of Spatial Data Management	5	Knowledge
Politically Elected	4	Political
Working Directly Under President	4	Political
Authority in Governing State Budget	4	Financial
Authority in Coordinating State Financial	4	Financial
Chairman of One Map Policy Execution Team	4	Institutional
Vice Chairman of One Map Policy Execution Team	4	Institutional
Having Financial Capacity	4	Financial
Medium Level of Spatial Data Management	3	Knowledge
Secretary of One Map Policy	3	Institutional
Member of One Map Policy Execution Team	2	Institutional
Low Level of Spatial Data Management	1	Knowledge

Calculation of urgency attribute based on time duration necessity mentioned in references

No	Stakeholders	Chairman of OMP	One Data Steering Board	Member of OMP	Politically Elected	Working Directly Under President	Govern State Budget Allocation	Coordinate State Budget Allocation	Chairman of OMP Execution Team	Vice Chairman of OMP Execution Team	Secretary of OMP	Having Financial Capacity	Member of OMP Execution Team	Performance Level of Spatial Data Infrastructure	Total	Total in Scale 1-10
1	Coordinating Ministry of Economic Affairs	5	0	0	4	4	0	0	0	0	3	0	0	1	17	10
2	Ministry of Internal Affairs	0	0	4	4	0	0	0	0	0	0	0	2	1	11	6.470588
3	Ministry of Finance	0	5	4	4	0	4	0	0	0	0	0	0	0	17	10
4	Ministry of Environment and Forestry	0	0	4	4	0	0	0	0	0	0	0	0	5	13	7.647059
5	Ministry of Agraria and Spatial Planning	0	0	4	4	0	0	0	0	0	0	0	0	1	9	5.294118
6	Ministry of Energy and Natural Resources	0	0	4	4	0	0	0	0	0	0	0	0	5	13	7.647059
7	Ministry of Public Works and Housing	0	0	4	4	0	0	0	0	0	0	0	0	5	13	7.647059
8	Ministy of Village, Development of Disadvantaged Regions And Transmigration	0	0	4	4	0	0	0	0	0	0	0	0	1	9	5.294118
9	Ministry of Agriculture	0	0	4	4	0	0	0	0	0	0	0	0	3	11	6.470588
10	Ministry of Industry	0	0	4	4	0	0	0	0	0	0	0	0	1	9	5.294118
11	Ministry of Marine Affairs and Fisheries	0	0	4	4	0	0	0	0	0	0	0	0	5	13	7.647059
12	Ministry of Communication and Information	0	0	4	4	0	0	0	0	0	0	0	2	1	11	6.470588
13	Secretary of Cabinet	0	0	4	0	0	0	0	0	3	0	0	0	0	7	4.117647
14	Presidential Staff Office	0	0	4	0	0	0	0	0	0	0	0	2	0	6	3.529412
15	Geospatial Information Agency	0	5	4	0	0	0	0	4	0	0	0	0	3	16	9.411765
16	National Institute of Aeronautics and Space	0	0	4	0	0	0	0	0	0	0	0	2	5	11	6.470588
17	Local Governments (Jakarta)	0	0	0	4	0	0	0	0	0	0	4	0	5	13	7.647059
18	Surveying Industries	0	0	0	0	0	0	0	0	0	0	4	0	0	4	2.352941
19	Coordinating Ministry of Maritime and Investation	0	0	0	4	4	0	0	0	3	0	0	0	1	12	7.058824
20	Ministry of Planning and National Development	0	0	0	4	4	0	4	0	3	0	0	0	1	16	9.411765
21	Ministry of Transportation	0	0	0	4	0	0	0	0	0	0	0	0	3	7	4.117647
22	Ministry of Trade	0	0	0	4	0	0	0	0	0	0	0	0	0	4	2.352941
23	National Army Institution	0	0	0	0	0	0	0	0	0	0	0	0	3	3	1.764706
24	National Police Institution	0	0	0	0	0	0	0	0	0	0	0	0	3	3	1.764706

Appendix E. List of Local Authority in Urban Area Fiscal Capacity

No	Level	Name	Category	Availability of Large-Scale Base Map	Index Value	Index Level
1	Municipality	AcehBesar	urban	-	0.99	Medium
2	City	BandaAceh	urban	✓	1.16	High
3	City	Sabang	urban	✓	0.43	Very Low
4	City	Langsa	urban	-	0.59	Low
5	City	Lhokseumawe	urban	✓	0.59	Low
6	City	Subulussalam	urban	-	0.57	Low
7	Municipality	DeliSerdang	urban	-	3.16	Very High
8	Municipality	Karo	urban	-	0.51	Very Low
9	City	Binjai	urban	✓	0.73	Medium
10	City	Medan	urban	-	4.69	Very High
11	City	PematangSiantar	urban	-	0.7	Low
12	City	Sibolga	urban	-	0.47	Very Low
13	City	TanjungBalai	urban	-	0.4	Very Low
14	City	PadangSidempuan	urban	-	0.46	Very Low
15	City	Gunungsitoli	urban	-	0.38	Very Low
16	Municipality	Limapuluh	urban	-	0.58	Low
17	Municipality	Agam	urban	-	0.62	Low
18	Municipality	PadangPariaman	urban	-	0.51	Very Low
19	City	Bukittinggi	urban	-	0.63	Low
20	City	Padang	urban	-	2.08	Very High
21	City	Payakumbuh	urban	-	0.54	Low
22	City	Sawahlunto	urban	-	0.41	Very Low
23	City	Pariaman	urban	-	0.42	Very Low
24	Municipality	Kampar	urban	-	1.24	High
25	City	Dumai	urban	-	0.93	Medium
26	City	Pekanbaru	urban	-	2.52	Very High
27	Municipality	MuaroJambi	urban	-	0.83	Medium
28	City	Jambi	urban	-	1.37	High
29	City	SungaiPenuh	urban	-	0.44	Very Low
30	Municipality	MusiBanyuasin	urban	-	2.45	Very High
31	Municipality	MuaraEnim	urban	-	2.08	Very High
32	Municipality	OganKomeringIlir	urban	-	1.02	Medium
33	City	Palembang	urban	-	3.52	Very High
34	City	Prabumulih	urban	-	0.63	Low
35	City	PagarAlam	urban	-	0.49	Very Low
36	Municipality	Banyuasin	urban	-	1.44	High
37	Municipality	OganIlir	urban	-	0.73	Medium
38	City	Bengkulu	urban	-	0.84	Medium

39	City	BandarLampung	urban	-	2.71	Very High
40	City	Jakarta	urban	-	11.391	Very High
41	Municipality	Ciamis	urban	-	1.29	High
42	Municipality	Cianjur	urban	-	2.66	Very High
43	Municipality	Karawang	urban	-	3.18	Very High
44	Municipality	Majalengka	urban	-	2.35	Very High
45	Municipality	Sumedang	urban	-	1.63	High
46	City	Bandung	urban	✓	6.37	Very High
47	City	Bekasi	urban	✓	6.45	Very High
48	City	Bogor	urban	✓	1.81	High
49	City	Cirebon	urban	-	1.19	High
50	City	Depok	urban	✓	3.4	Very High
51	City	Sukabumi	urban	-	0.98	Medium
52	City	Tasikmalaya	urban	-	1.19	High
53	City	Cimahi	urban	-	0.79	Medium
54	City	Banjar	urban	-	0.46	Very Low
55	Municipality	BandungBarat	urban	-	1.5	High
56	Municipality	Banjarnegara	urban	-	1.17	High
57	Municipality	Banyumas	urban	-	1.69	High
58	Municipality	Batang	urban	-	0.96	Medium
59	Municipality	Boyolali	urban	-	1.23	High
60	Municipality	Brebes	urban	-	1.86	Very High
61	Municipality	Cilacap	urban	-	2.21	Very High
62	Municipality	Demak	urban	-	1.43	High
63	Municipality	Grobogan	urban	-	1.49	High
64	Municipality	Jepara	urban	-	1.38	High
65	Municipality	Karanganyar	urban	-	0.97	Medium
66	Municipality	Kebumen	urban	-	1.48	High
67	Municipality	Kendal	urban	-	0.92	Medium
68	Municipality	Klaten	urban	-	1.03	Medium
69	Municipality	Kudus	urban	-	1.04	Medium
70	Municipality	Pati	urban	-	1.47	High
71	Municipality	Pekalongan	urban	-	1.26	High
72	Municipality	Pemalang	urban	-	1.22	High
73	Municipality	Sragen	urban	-	0.68	Low
74	Municipality	Sukoharjo	urban	-	1.18	High
75	Municipality	Wonogiri	urban	-	0.92	Medium
76	Municipality	Wonosobo	urban	-	1.02	Medium
77	City	Magelang	urban	-	0.78	Medium
78	City	Pekalongan	urban	-	0.71	Low
79	City	Salatiga	urban	-	0.85	Medium

80	City	Semarang	urban	-	5.81	Very High
81	City	Surakarta	urban	-	1.85	Very High
82	City	Tegal	urban	-	0.98	Medium
83	Municipality	Bantul	urban	-	1.49	High
84	Municipality	GunungKidul	urban	-	0.93	Medium
85	Municipality	Kulonprogo	urban	-	0.91	Medium
86	Municipality	Sleman	urban	-	1.95	Very High
87	City	Yogyakarta	urban	-	1.53	High
88	Municipality	Bangkalan	urban	-	1.1	High
89	Municipality	Banyuwangi	urban	-	1.91	Very High
90	Municipality	Bojonegoro	urban	-	3.87	Very High
91	Municipality	Bondowoso	urban	-	0.91	Medium
92	Municipality	Gresik	urban	-	2.87	Very High
93	Municipality	Jember	urban	-	2.2	Very High
94	Municipality	Jombang	urban	-	1.43	High
95	Municipality	Kediri	urban	-	1.25	High
96	Municipality	Lamongan	urban	-	2.01	Very High
97	Municipality	Lumajang	urban	-	1.34	High
98	Municipality	Magetan	urban	-	0.84	Medium
99	Municipality	Nganjuk	urban	-	1.19	High
100	Municipality	Ngawi	urban	-	0.89	Medium
101	Municipality	Pacitan	urban	-	0.92	Medium
102	Municipality	Pamekasan	urban	-	0.84	Medium
103	Municipality	Ponorogo	urban	-	1.13	High
104	Municipality	Sumenep	urban	-	0.97	Medium
105	Municipality	Tuban	urban	-	1.43	High
106	Municipality	Tulungagung	urban	-	1.08	High
107	City	Blitar	urban	-	0.86	Medium
108	City	Kediri	urban	-	0.91	Medium
109	City	Madiun	urban	-	0.85	Medium
110	City	Malang	urban	-	1.98	Very High
111	City	Mojokerto	urban	-	0.79	Medium
112	City	Pasuruan	urban	-	0.55	Low
113	City	Probolinggo	urban	-	0.77	Medium
114	City	Surabaya	urban	-	10.08	Very High
115	City	Batu	urban	-	0.79	Medium
116	City	Pontianak	urban	-	1.44	High
117	City	Singkawang	urban	-	0.61	Low
118	Municipality	Kapuas	urban	-	0.97	Medium
119	City	PalangkaRaya	urban	✓	0.75	Medium
120	Municipality	BaritoKuala	urban	-	0.6	Low

121	Municipality	TanahLaut	urban	-	0.84	Medium
122	City	Banjarbaru	urban	-	0.9	Medium
123	City	Banjarmasin	urban	✓	1.06	High
124	Municipality	TanahBumbu	urban	-	1.3	High
125	Municipality	KutaiKartanegara	urban	✓	2.74	Very High
126	Municipality	KutaiTimur	urban	-	2.61	Very High
127	City	Balikpapan	urban	-	2.25	Very High
128	City	Bontang	urban	-	0.88	Medium
129	Municipality	PenajarnPaserUtara	urban	✓	0.75	Medium
130	Municipality	Minahasa	urban	-	0.56	Low
131	City	Bitung	urban	✓	0.68	Low
132	City	Manado	urban	-	1.21	High
133	City	Tomohon	urban	-	0.54	Low
134	Municipality	MinahasaUtara	urban	-	0.62	Low
135	City	Palu	urban	-	0.94	Medium
136	Municipality	ParigiMoutong	urban	-	0.54	Low
137	Municipality	Gowa	urban	-	0.99	Medium
138	Municipality	Luwu	urban	-	0.65	Low
139	Municipality	Maros	urban	-	1.01	Medium
140	Municipality	Pinrang	urban	-	0.68	Low
141	Municipality	Takalar	urban	-	0.54	Low
142	City	Parepare	urban	-	0.9	Medium
143	City	Makassar	urban	-	4.04	Very High
144	City	Palopo	urban	-	0.65	Low
145	Municipality	Kolaka	urban	-	0.85	Medium
146	City	Kendari	urban	-	1.18	High
147	Municipality	KonaweSelatan	urban	✓	0.6	Low
148	Municipality	KolakaTimur	urban	-	0.49	Very Low
149	Municipality	Badung	urban	-	2.97	Very High
150	Municipality	Bangli	urban	-	0.49	Very Low
151	Municipality	Buleleng	urban	-	1.43	High
152	Municipality	Gianyar	urban	-	1.77	High
153	Municipality	Klungkung	urban	-	0.68	Low
154	Municipality	Tabanan	urban	-	1.02	Medium
155	City	Denpasar	urban	-	1.27	High
156	Municipality	LombokBarat	urban	-	0.89	Medium
157	Municipality	LombokTengah	urban	-	0.9	Medium
158	Municipality	LombokTimur	urban	✓	1.34	High
159	City	Mataram	urban	-	1.15	High
160	City	Bima	urban	-	0.52	Very Low
161	City	Kupang	urban	✓	0.78	Medium

162	City	Ambon	urban	-	0.86	Medium
163	City	Tual	urban	-	0.4	Very Low
164	City	Jayapura	urban	✓	0.78	Medium
165	City	Ternate	urban	✓	0.76	Medium
166	City	TidoreKepulauan	urban	-	0.48	Very Low
167	City	Cilegon	urban	-	1.53	High
168	City	Tangerang	urban	-	4.49	Very High
169	City	Serang	urban	-	1.14	High
170	City	South Tangerang	urban	-	3.67	Very High
171	Municipality	Bangka	urban	-	0.6	Low
172	City	PangkalPinang	urban	✓	0.65	Low
173	Municipality	BangkaTengah	urban	-	0.6	Low
174	City	Gorontalo	urban	-	0.82	Medium
175	Municipality	BoneBolango	urban	-	0.55	Low
176	City	Batam	urban	-	2.78	Very High
177	City	TanjungPinang	urban	-	0.61	Low
178	Municipality	Manokwari	urban	-	0.47	Very Low
179	City	Sarong	urban	✓	0.83	Medium
180	Municipality	Mamuju	urban	-	0.69	Low
181	Municipality	PolewaliMandar	urban	-	0.75	Medium
182	Municipality	Mamasa	urban	-	0.36	Very Low
183	Municipality	Bulungan	urban	-	0.72	Low
184	City	Tarakan	urban	✓	0.73	Medium