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Research article

Should we build a metaverse for the new capital of Indonesia?

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ABSTRACT

Moving the capital of Indonesia from the Jakarta area to the island of Kalimantan is an inevitable necessity due to economic, political, socio-cultural and environmental factors, which require other areas of the archipelago to be developed. It has been decided that the green city and smart city concepts will be applied in the development of the new capital, using a state-of-the-art approach, including metaverse technology. The methodology employed in this study includes in-depth interviews, focus group discussions, direct field observations, and documentation. The findings of this research consist of an analysis of the readiness of IKN and its surrounding area for the implementation of metaverse technology in IKN. This paper examines whether metaverse technology is needed in the construction of the new capital city. If so, what are the needs for the development of the new capital's metaverse, and what are the advantages (and disadvantages) of using the metaverse. The results are expected to provide a more comprehensive view of the use of metaverse technology in the new capital.

1. Background

Jakarta as Indonesia's capital and its center of trade and finance cannot be sufficiently redeveloped in a short period of time, so the role of the national capital city will be allocated to another region to reduce the current excessive burden on Jakarta, which at the same time serves as an effort to equalize development nationally. In hindsight, this should have been taken into consideration by the government after Indonesia declared its independence [1]. The current situation in Indonesia is characterized by economic progress supported by political stability and is seen as the right moment to move Ibu Kota Indonesia (IKN – National Capital of Indonesia), specifically to East Kalimantan Province. The new capital will be called Nusantara (see Tables 1-4).

The development of IKN has been started by clearing industrial forests, which are mostly managed by the local community. The development of the capital city will certainly have an impact on its surrounding areas, directly or indirectly. There are three areas that are satellite areas of IKN, i.e., Samarinda City, Balikpapan City, and Paser City. These three areas have been developing for a long time and have conditions that are in stark contrast to those in Jakarta. They are forested areas that are currently in the process of being developed both in terms of structure, infrastructure, and superstructure. These areas are expected to be able to support the development process and the implementation of IKN operations in the future [1].

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The transfer of the capital is officially being carried out since the enactment of the Law on the National Capital of Indonesia in 2022. Construction has officially started in the same year. Until now, the construction of IKN is being carried out progressively, with the presidential instruction to be able to hold the Birthday of the Republic of Indonesia in 2024 in the new capital of the archipelago, which means there is one year left to carry out this instruction. The development of the capital city is carried out through good planning and a process of the highest standard in terms of human resources, technology, and finances to support the realization of all goals for IKN by 2045. Based on estimates of the government, this will require a budget of approximately Rp. 480 trillion.

There is a development concept that forms the basis for the development of the capital, namely the sustainable city concept [6]. This is an effort to realize the new capital as a city that will be able to accommodate environmental issues as well as technological developments [1]. IKN is planned to be realized as a world-class city that is open to technological developments while still preserving its natural environment so as to create an integrated system that supports the convenience of the residents [7]. Under the sustainability city concept, the smart city concept and the green city concept are combined. The smart city concept focuses on technological developments [8], while the green city concept focuses on environmental preservation [9].

The population in the area will grow very rapidly, making the related problems increasingly complex, requiring efforts to solve them with a holistic approach. The digital technology that is currently being developed is one of the best platforms to realize holistic or comprehensive problem solving [10]. The use of technology is very important, especially in providing connectivity between various parties, both individually and in groups, who contribute to solving problems. Seeing these conditions, the Indonesian government has adopted a mission to create a city that represents technology as well as being environmentally friendly, so that its residents are able to feel comfortable, to develop themselves, and to innovate.

For a successful implementation of the green city concept and the smart city concept [11] in the development of IKN support is needed from the structure, infrastructure [12], and superstructure [13]. Here, structure refers to aspects of the availability of human resources, infrastructure refers to existing facilities, and superstructure refers to regulations and policies that support the implementation of the development of IKN [14]. These three aspects aim to ensure the sustainability of the development of IKN now and in the future as well as the successful implementation of the green city concept and the smart city concept. These concepts are important because they are considered to be the answer to current urban problems [15]. One of the most urgent aspects in the development of IKN that support the realization of these two concepts is the effort to involve state-of-the-art technology related to the metaverse concept and more specifically the digital twin concept. Information and communication technology is very diverse, making it capable of enhancing public services [16]. Furthermore, it is also considered as a solution in dealing with very dynamic population growth [17]. Referring to this, in the development of IKN great emphasis will be placed on efforts to involve technology in every process, especially in relation to efforts to ensure inclusiveness in society [18]. Furthermore, information and communication technology will support the goal of IKN to become a world-class city.

IKN will not only become a capital city. IKN will also be a symbol of the progress of the Indonesian nation will make over the coming years, which will be full of development and advancement in various aspects of life, especially technology. The progress of a society driven by rapid technological development must be expected to create very strong dynamics. High mobility has an impact in the form of a need for technology that supports civil servants to be able to continue serving the community wherever and whatever the situation and conditions of the community [19], thus supporting the achievement of community welfare [20]. Therefore, metaverse technology to support the realization of a digital twin of IKN is necessary in response to the current and future situation of development and progress.

The metaverse is a concept that is often raised in discussions related to the development of IKN as a world-class city, implemented by involving innovative technology. There are several things that are considerations for metaverse technology to be implemented in IKN. Furthermore, the metaverse is considered capable of representing the technological development of a country. Thus, it is expected to be implemented in IKN as a form of concrete evidence that Indonesia is a country that is capable of utilizing advanced technology.

Indonesia geographical consist of thousand islands Metaverse would be enhancing the societal of Republic of Indonesia to accelerate the connection, minimizing the gap accessibility of information, and distributing the development. The circumstance of Indonesia geographical is relevant to enhance efficiency and effective of the national development.

The realization of the digital twin concept is one of the priorities in the development of IKN as a city that is well adjusted to the dynamics of public services and supports the adoption of technological developments in society [21]. At the moment, there are several challenging requirements that need to be fulfilled before the metaverse can be realized in IKN related to accessibility, employment, communication and coordination, development and planning, services [22], tourism and storefronts, and economic development. The totality of these requirements will be met in the future, as there will be developments in the situation, technology, and habits of society itself.

Table 1
Methodology of research.

No	Methodology	Source
1	In-depth interviews	Interviewed 24 informants with questions to get deeper answers
2	Interviews	Interviewed 26 informants with general questions
3	Focus Group Discussions	30 informants from civil servants, local leaders, religious leaders, and indigenous representatives
4	Direct field observations	Direct visits to Samarinda City, Balikpapan City, and North Penajam Paser Regency (PPU) locations
5	Documentation	Literature studies from journals, books, reports, regulations, and several other resources related to research issue

Source: Result of author's analysis, 2023 [2,3,4].

In addition The strengths of this study are (1) This study is the inaugural examination addressing the preparedness for employing metaverse technology in constructing a new capital within the archipelago; and (2) The research involves directly assessing the preparedness of the designated capital area and its vicinity. In-depth interviews with residents and local officials, along with accessing official documents pertaining to the new capital's construction, are conducted to ensure the validity of results and obtain firsthand data. Meanwhile the limitations of this study, it was conducted in three locations near the IKN site, namely Balikpapan City, Samarinda City, and Penajam Paser Utara Regency. However, the utilization of the metaverse requires connections and interactions with distant places through virtual Internet connections. Further research is needed to examine the readiness of other regions regarding the utilization of the metaverse in The New Capital City of Indonesia (IKN).

Referring to the data and facts obtained in this study, there were three main research questions: (1) What is the readiness of IKN for the metaverse? (2) What needs to be prepared in support of the implementation of the metaverse in IKN? (3) What are the advantages and disadvantages of metaverse implementation in IKN?

Table 2

Existing and expected contribution of metaverse implementation in IKN.

No.	Dimension	Existing	Expected
1	Environment	● Lack of good waste management ● Low understanding by the community and government regarding waste and its potential use ● Lack of adequate infrastructure related to waste utilization ● Policies related to waste have not been implemented properly ● Low use of waste for products of creativity	● Reduces the need for energy-intensive activities ● Better adaptation strategies ● Reduces emissions from the transport sector ● Reduces demand for some manufactured products like electronics ● Promotes conservation programs of heritage sites in the process of promoting virtual tourism ● Reduces the need for travel ● Decreases demand for physical infrastructure, minimizing waste ● Encourages the creation of new sustainable resources ● Minimizes the extraction and consumption of resources in some industries, such as the entertainment industry ● Provides open spaces for more interaction, hence promoting the participation of a majority in decision making on how resources can be utilized
2	Society	● Lack of institutions that provide good and equitable social services ● Policies to increase innovation have not been maximized ● Low ratio of human resources providing social services to potential beneficiaries	● Potential opportunities for improved social interactions ● Overcoming social barriers to human interactions ● Creates a feeling of presence ● Allows people to innovate and create social activities, events, and activities ● Reduces geographical barriers that inhibit physical social interactions
3	Living	● Accessibility to services has not been maximized ● Guaranteed health benefits are not evenly distributed ● Benefits of technology have not been maximized through policies ● Lack of efforts to develop urban communities with an orientation towards environmental development sustainability	● Equitable access to public services ● Health benefits ● Social benefits ● Potential to enhance urban security through improved surveillance ● Waste reduction through technologies based on the digital twin concept, which allow for prediction, hence allowing for optimal resource use ● Encourages the building of human-centric urban areas ● Allows the adoption of models like the 15-min city concept ● Promotes mixed use and multi-use of different urban assets ● Promotes the adoption of diverse green projects like the creation of green spaces ● Promotes the creation of compact urban areas
4	Governance	● The use of technology is still limited ● Limited number of human resources ● The quality of human resources has not been maximized	● Enhances efficiency of service provision ● Enhances accountability and transparency ● Encourages equity in resource allocation and monetization ● May open new ways of interaction between different urban stakeholders ● Catalyzes democracy, cooperation, and equality
5	Branding	● Lack of use of technology for sustainable tourism development ● Access to potential tourism facilities has not been maximized	● Provides better access for all to tourist attractions ● Enhances the possibility of attracting tourists through advertising ● Enhances conservation of heritage sites ● Enhances financial revenues ● Emergence of new products that are only possible in the metaverse
6	Economy	● Economic disparities ● Unemployment ● Low use of technology in minimizing economic problems	● Provides new job opportunities leading to increased disposable income ● Provides good quantity and quality of economic growth ● Enhances the sustainability of the economy ● Provides equal economic opportunities

Source: Modified by model of Allam et al., 2022 [5].

2. Literature study

2.1. Relocation of the State Capital

Moving the capital city from Jakarta to Kalimantan is, among other things, an effort to accommodate equitable development by applying innovative technology [23]. The relocation of a state capital is nothing new in the course of world history. Currently, there are several countries that have moved their capital cities in recent history, such as the USA, Brazil, Japan, Australia, Malaysia, Myanmar, and Turkey.

2.1.1. United States of America

The capital of the United States was moved from New York to Washington DC in 1800. This was intended to separate the centers of government activities and trade activities. Since New York was founded, it had been the gateway for immigrants to enter the US and a center for business, culture, transportation, and manufacturing. Currently Washington DC was developed into the center of government and is now filled with monuments and historic buildings. Meanwhile, New York is now mainly the center of finance, trade and culture [24].

2.1.2. Brazil

From 1549 to 1763 the capital of Brazil was located in Salvador, Bahia state. It was moved to Rio de Janeiro due to considerations of economic development and trade. Due to Rio de Janeiro's growing density, the capital was once again moved in 1960, to a newly

Table 3
Satellite city existing infrastructure.

	Existing Conditions of Digital Infrastructure	Expected Conditions of Digital Infrastructure
City of Samarinda	1. Inter-OPD FO network infrastructure with 2 GB bandwidth 2. Data center equivalent to tier-1 3. System integration using api.samarindakota.go.id based on population data/NIK 4. The websites of all OPDs, districts, sub-districts, community health centers, use the sub-domain Samarindakota.go.id 5. Samarinda Santer application pwa.santer.app (one integrated application) 6. Live CCTV through samarindakota.go.id and pwa.santer.app, which can be directly seen by the public; currently 79 social infrastructures have been installed 7. Installation of free Wifi points in public places 8. Installation of internet in places where it is difficult to get internet access (blank spots) 9. Samarinda City CCTV integrated command center and 112 emergency call service (emergency ambulance ready 24 h non-stop) 10. Social security number (SSN) application, which can provide data and match data on social assistance recipients for the city of Samarinda 11. Rehabilitation of district and sub-district service spaces based on digital services	• Internet devices • High speed internet connectivity • VR headsets • AR glasses • High-end computer systems • Blockchain • Artificial intelligence • Augmented reality
Balikpapan City	1. ICT infrastructure development for 28 SKPDs (Regional Work Units – secretariat, service agency & office), 100% FO 2. 6 districts, 100% use FO 3. 34 villages, 100% use FO 4. 27 community health centers, 100% use FO 5. Government hospitals, 100% use FO 6. Schools (SD, SMP, SMA/SMK, PT), 74% use FO 7. Internet connection from the provider to the Mayor's office, international bandwidth capacity/IIX 40/50 Mbps (1:1) and 3× up to 100 Mbps 8. FO route from Mayor's office to Gunung Pasir offices (6 offices) 9. FO line from the Mayor's office to Gedung Wanita (Women's Building), the local parliament, the municipal police, and the city district offices (7 offices) 10. FO line from the Mayor's office to the Ruhui Rahayu village office (10 offices + 10 offices on the route passed) 11. Internet connection from the provider to the Ruhui Rahayu village office, bandwidth capacity of 10 Mbps (1:1) and up to 100 Mbps 12. Internet connection from the provider to 56 SKPDs, each with a bandwidth of 1 Mbps (1:4) and up to 10 Mbps 13. Internet connection to 34 community health centers, bandwidth up to 5–10 Mbps 14. Internet connection to schools using Speedy or GSM modem 15. 15 ± 25 KM FO infrastructure was built by the Balikpapan City Government	
North Penajam Paser Regency	1. 51–75% of the total population has 4G/3G network infrastructure 2. 26–50% of households have fixed broadband access infrastructure 3. Network infrastructure that provides easy access to users, good service usage and capacity, and back-up of services in case of disruption 4. 26–50% of public areas have a free hotspot 5. There is a website and it is dynamic, the information presented is always updated	

Source: Author's analysis, 2023

developed modern city in the center of the country, which was named Brasilia. Until now, Brasilia is still the capital city of Brazil [25].

2.2. Smart cities

There are several examples of cities in the world that are considered cities that have well implemented the smart city concept, such as Barcelona (Spain), Singapore, Daegu (South Korea). A city that is a benchmark regarding implementation of the smart city concept is Shenzhen in China. In general, Shenzhen has succeeded in making quite significant improvements, especially in the technology sector, after two world-famous technology companies emerged in the region, namely Huawei and Tencent. This has made a significant contribution to the development of Shenzhen and accelerated the implementation of the smart city concept in its region [26]. The smart city concept is currently being implemented in many cities all over the world, although there are challenges in its implementation that are unique to developing countries.[21] [22] The smart city concept is considered to be one of the best solutions in dealing with population developments and community dynamics [27].

2.3. Metaverse

The term 'metaverse' generally refers to a significant pivot originating from the development of virtual, augmented, and mixed reality [28]. Furthermore, the term is also associated with technology, opportunities, development, trends, challenges, openness to issues, conceptual frameworks, and many other things [29].

2.4. Metaverse city

The word 'meta' means augmentation or transcendence in Greek, while the suffix 'verse' is derived from the word 'universe'. The metaverse concept represents users communicating with each other through the application of 3D software [19]. A metaverse city is an

Table 4
SWOT analysis.

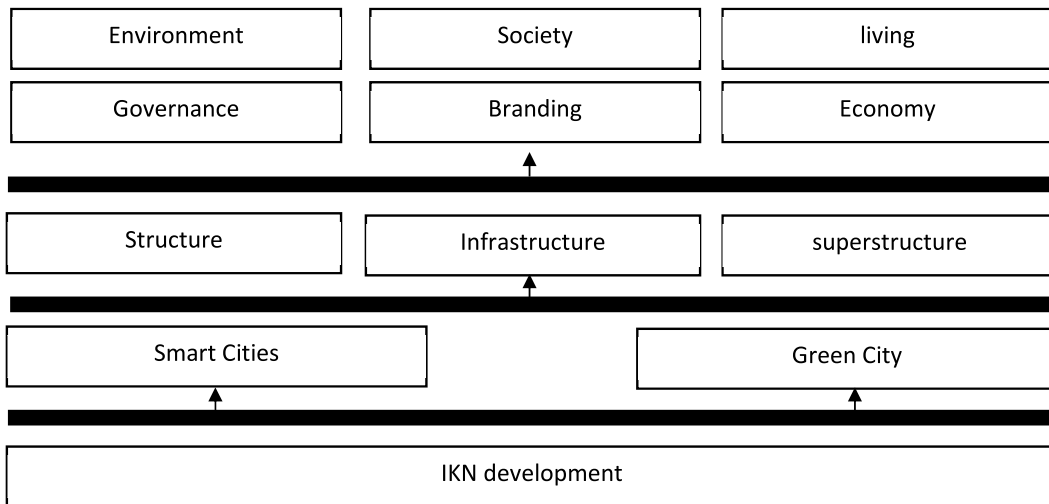|		Strengths	Weaknesses
Opportunity		● Policy ● Economic growth ● Indonesia investment rank ● Support from society/the public ● Government support ● Extensive land required for the construction of IKN ● Strategic geographic position ● As many as 70 state institutions will be transferred to IKN, therefore job opportunities and business opportunities will increase and develop in and around the IKN area ● The demand for land property has increased sharply, so its utilization is wide open and it has increased economic value ● Better access to education in line with the construction of more advanced educational facilities within IKN environment ● Access to better health services in line with the construction of more advanced health facilities within IKN ● Indigenous people around IKN are part of the target groups that have priority in the policies set by the government to be educated in line with the smart city concept	● National budget ● Additional effort of society ● Level of education and expertise, especially in the IT field, is still very low, making it difficult to compete with newcomers ● Level of welfare is still very low and most people live from farming with traditional methods ● Entrepreneurial spirit (entrepreneurship) is very low; people are consumers, not producers ● Most of the land still falls under customary ownership and does not yet have legality according to the agrarian law of the Republic of Indonesia ● Blank spots in accessibility to internet networks
Treats		● The quantity of human resources is not relevant to their quality ● Reallocation of communities ● Recruiting civil servants for the national government ● The Paser community is open to newcomers but the arrogance of newcomers who ignore local wisdom can lead to social vulnerability ● The land mafia will take advantage of the innocence of the Paser people with the intention of controlling land that is still owned traditionally and without adequate legal documents ● The arrival of competitors in the labor market and the business world in large numbers with very advanced skills and expertise ● The influx of urban culture, which tends to be individualistic compared to collectivist local cultural traditions that adhere to the principle of *gotong-royong* (togetherness/hand in hand), where many activities are carried out together ● Learning the concept of using vacant land; there will be many investors who want to build businesses around IKN and whose main interest is land property. Taking advantage of this situation with a cooperative approach referring to customary land management as is done by the Balinese traditional community	● Insufficient infrastructure ● Limited internet bandwidth

Source: Result of author's analysis, 2023

embodiment of this concept, referring to a virtual city that has a visualization similar to the city in real life. This is often called a digital twin.

2.5. Digital infrastructure

Digital infrastructure aims to support the operationalization of a digital platform [30]. Digital infrastructure has become essential for the process of implementing governance [31], especially related to efforts to improve the functioning of government regarding administration, performance, community engagement, and public services [32]. Furthermore, implementation of digital technology has a significant impact in terms of supporting learning processes, connectivity, infrastructure, guidelines, business processes in organizations, and efforts to support digital transformation as well as the development of skills [8].

3. Theoretical framework

Environment	Society	living
Governance	Branding	Economy

Structure	Infrastructure	superstructure

Smart Cities	Green City

IKN development

Theoretical framework of IKN
Source: Author's analysis, 2023

The above figure explains the effort to enhance the future capital city of Indonesia by implementing the smart city concept and the green city concept. Furthermore, IKN must become representative of the merit and strength of Indonesia in all aspects of life through its structure, infrastructure, and superstructure. These three aspects of the city will be achieved in six dimensions, i.e., environment, society, living, governance, branding, and economy.

4. Methodology

In accordance with the objectives, this research used a qualitative descriptive method aimed at obtaining an overview of existing phenomena [2]. To support the achievement of the research objectives, primary data was collected through in-depth interviews, focus group discussions, direct field observations, and documentation. The characteristics of the informants for the three collected data groups were identical. In selecting informants for the in-depth interviews and the forum discussion groups (FDGs), the researchers carried out purposive sampling to ensure that the objectives of this research could be achieved. A total of 80 informants was involved, in 3 different locations, namely Samarinda City, Balikpapan City, and North Penajam Paser Regency (PPU). The informants were people who lived in and around IKN and were involved the development of IKN both directly and indirectly.

Based on the table number 1 above, the interviews and in-depth interview method involves interaction between the researcher and the respondent with the aim of gaining an in-depth understanding of the views, experiences, and attitudes of the respondent regarding the research topic [3]. The in-depth interviews were conducted using a semi-structured format, where key questions were prepared beforehand while there was also flexibility to explore more in-depth responses [3]. For this research, in total 26 informants were interviewed and 24 informants were in-depth interview.

The FDG method involves a group of participants having a structured discussion under the guidance of a moderator. Focus group discussions are aimed at gathering diverse views, perceptions, and understandings on a particular topic. Interaction between participants can result in a richer understanding of different viewpoints [33]. In this research, 30 informants participated in the focus group discussions. The participants were directly involved in the development of IKN, such as civil servants, local leaders, religious leaders, and representatives of indigenous people.

The field observation method involves direct observation by the researcher of activities, situations, or phenomena that are relevant to the research topic. Observations can be carried out in a participatory manner (the researcher is directly involved) or a non-

participatory manner (the researcher is not directly involved), depending on the objectives and characteristics of the research. This method allows researchers to collect valid contextual data [4]. Documentation methods involve collecting data from written documents, notes, archives, or other sources of information related to the research topic. The data is then analyzed to support or illustrate research arguments. This method is particularly useful when research involves content analysis of relevant documents.

Apart from this, the qualitative research method uses the collection of secondary data based on collecting relevant reference sources such as journals, books, reports, regulations, and other sources. In this study, a literature study was conducted involving searching, analyzing, and synthesizing existing literature in the form of books, scientific journals, articles, research reports and other sources related to the research topic. The aim of this method is to collect existing information and knowledge, so that the researcher can understand the theoretical framework relevant to the research topic, to identify knowledge gaps that can be filled, and to develop a theoretical foundation for the research to be conducted. In total, this research originally selected 100 publications based on relevance to the research topic. Finally, 24 publications were selected, consisting of 14 journals, 6 books, and 4 reports with most relevance to the research topic.

5. Results

After going through the process of data collection, data grouping, and data analysis, the following results were obtained. These show the readiness of IKN and its surrounding areas for the implementation of the metaverse in IKN.

5.1. Satellite City's existing infrastructure

Referring to the table number 2, currently there are three cities that are satellite cities of IKN: Samarinda City, Balikpapan City, and North Penanjam Paser Regency (PPU). The development of IKN will have a significant impact on these three cities. Based on the results of data collection, the following are the particular conditions of the infrastructure in the three cities.

Referring to the table number 3 above, there are several things that deserve more attention in supporting the development of IKN. There are several important factors that are required for the metaverse, i.e.:

1. **Internet Network** Connecting to the virtual world of the metaverse is not possible without a fast and stable internet network.
2. **Virtual Reality (VR)** VR technology can be a tool for people to connect to the metaverse. Several companies are developing VR devices, for example, Meta is developing AR glasses in Project Nazare.
3. **Augmented Reality** Augmented reality technology is technology that is able to project the virtual world onto real or real-time objects in digital images. Examples of AR are currently being used in Instagram and other social media features.
4. **Artificial Intelligence** This technology mimics human cognitive functions so that computers are able to function intelligently. Thus, AI can facilitate activities in the metaverse.
5. **Socioeconomic Support** Apart from all of this, the metaverse requires socioeconomic support, because building social life in the metaverse requires bringing together people who have the same interests.

6. Discussion

6.1. Superstructure of IKN

Currently the government has issued several legal documents to accommodate the current and future development of IKN. Legal and policy documents are crucial to be able to identify the right pathways in achieving the goals of a development [5]. Several of these legal or regulatory documents even accommodate sustainability-oriented development in areas around IKN. Some of the above-mentioned legal documents are.

1. Law Number 2 of 2022 concerning the National Capital [34].
2. Presidential Regulation Number 62 of 2022 concerning the Archipelago Capital Authority [35].
3. Regulation of the Head of the Archipelago Capital Authority Number 1 of 2022 concerning the Organization and Work Procedures of the Archipelago Capital Authority [36].
4. Circular Letter Number 009/SE/Kepala-Otorita IKN/VIII/2023 about Guidelines for the Construction of Smart Buildings in the Capital City [37].

Policy is a very important instrument in building a smart city to ensure the continuity of the effort [38]. Through these hierarchical rules, it is ensured that the development of IKN will be successfully realized until the full transfer of the capital city as well as the realization of IKN as a world-class city that is environmentally friendly by 2045.

6.2. Structure

To support the operations of the NKI, the central government established the Archipelago Capital Authority (ACA) in 2021, which has the task of carrying out government tasks in NKI. To follow up on the operations of ACA, the government has begun recruiting civil servants who have potential. At present, ACA already has several employees and prospective employees who have passed the selection

procedure. Most of these employees are civil servants who are active in the regional government around the IKN area, such as Samarinda City, Balikpapan City, and PPU City.

6.3. Full support but requires certainty about relocation

The local community has stated that they are very supportive of the existence of IKN in their area. People have even given up their homes and gardens in future IKN areas. Based on the results of the interviews and the collection of data, the community still feels confused and uncertain about their relocation, which was promised by the government. This has a large impact on economic activities, which are mostly carried out by local community members in gardens they own that have been taken over by the government for the development of IKN. This certainly has a negative impact on the community because they feel that they are not being paid attention to, even though the development of IKN has been going on for almost two years and they are still stuck in the middle of the project area.

6.4. Society's readiness for the metaverse

The local community feels proud that their region has been appointed as the location for the new capital city Nusantara. The public realizes that this new capital will be a symbol of the progress of the Indonesian nation, so that many new technologies will be used to support this goal. One technology that is currently often heard about by the public is related to the use of the metaverse, but people do not know much about it or still feel unfamiliar with it. The public has only heard some people use this term without providing any concrete information regarding the use of the metaverse in the IKN area.

6.5. Capacity building for local communities

Currently the government is starting to provide access for the community to benefit from the development related to the use of the metaverse in IKN, so the government has a plan to ensure that the community is willing to be educated, especially about the metaverse. This is still a plan because there is no certainty yet when the digital infrastructure for IKN will be built. Capacity building is currently being carried out by the government for the surrounding communities in the form of training related to job opportunities that exist in the development of IKN.

Based on the results above, we compared the results with the contributions and challenges of the metaverse listed by Allam [5].

6.6. Environment

The existing environmental conditions include the absence of good waste management. According to Allam, the metaverse can be used to reduce waste through technologies such as digital twin that enable predictions, but it could also increase the cost of living.

6.7. Society

The existing social conditions include the absence of institutions that provide good and equitable social services. According to Allam, metaverse's contribution can be used to increase potential opportunities for improved social interactions and overcoming social barriers to human interactions. However, there are potential issues related to ethics, privacy, and security.

6.8. Living

The existing condition is that accessibility to services has not been maximized. With the metaverse, it is possible to live better through better experiences [39], but there is a potential risk of increasing the cost of living.

6.9. Governance

The existing conditions for governance include limited use of technology. According to Allam, the metaverse can contribute to the efficiency of public service provision. However, the challenge is that large scale implementation could take time and be costly.

6.10. Branding

The existing conditions for branding include a lack of the use of technology for sustainable tourism development. According to the table number 2 modified by Allam [5], the metaverse can provide better accessibility to touristic attractions for all. However, it could also create problems for small businesses due to competition from virtual products.

6.11. Economy

The existing conditions of the economy include a high unemployment number. According to Allam, the metaverse can provide new job opportunities leading to increased disposable income. However, a challenge is the potential risk of increasing the cost of living.

7. Conclusion

According to the table number 4 the development of the new national capital city of Indonesia is a mega project and priority to carried out by the Indonesian government. The target is to move the national capital city in full by 2045, or exactly 100 years after the Republic of Indonesia declared its independence. IKN is an important symbol for Indonesia towards the whole world, representing balanced development that synergizes technology and is environmentally friendly. One of the technologies that will be used in IKN in the future is the metaverse. The development of IKN involving the metaverse must also be accompanied by the ability of human resources to utilize the metaverse as part of the technology that will provide guarantees in reducing obstacles to carrying out tasks.

Furthermore, even though it offers a variety of more sophisticated and advanced benefits, the application of the metaverse concept in IKN is also expected to have drawbacks that should be considered. The first thing that is a concern in IKN and its surrounding buffer zones (Balikpapan, Samarinda, and North Penajam Paser) is the problem of internet accessibility, where the buffer zones are lagging far behind. The metaverse is only accessible via internet devices, VR headsets and AR glasses, which are unaffordable for under-privileged communities. Access would be available only for a small group of rich people and not for the majority of the population.

Through the process of collecting, grouping, and analyzing data, it was determined that the integration of metaverse technology is essential for the development, implementation, and operational aspects of IKN. Given Indonesia's geographical composition of islands, there is a requirement for the adoption of information technology, specifically the metaverse, to facilitate enhanced interactive communication among ministries, institutions, and regions. However, certain conditions must be in place to enable the actualization and integration of metaverse technology within IKN.

8. Recommendations

Referring to the results of data collection, data management and analysis of the results of this research, the recommendations from this research are the following:

1. There needs to be an effort to provide the local community with an empirical understanding of the importance of IKN's position at the national and the international level.
2. The public needs to understand the importance of using metaverse technology in the IKN region.
3. The government needs to prepare regulations related to the use of metaverse technology in the IKN region.
4. Government efforts are needed to increase society's ability to access metaverse technology.
5. The role of the local customary institutions is to routinely consolidate through associations of immigrant ethnic groups so that mutual respect arises, which actions are taboo or which ones are good when done. It is no different from when one goes to Thailand, Japan, Singapore, or other countries; there will be taboo things that one must know not to do.
6. The blocking of land buying and selling carried out by BPN is still very likely to escape control by the land mafia, namely by applying for a permanent land ownership certificate in the name of the first owner, namely members of the local community. Even though this is every individual's right, it is important to provide education so that they are not tempted by offers to sell their land or transfer their land ownership status. This is where the role of local village officials and traditional institutions is very important.
7. There is a policy from all stakeholders to prioritize labor recruitment quotas for the Paser community.
8. The role of the local traditional institutions is to develop and modernize local arts and cultural traditions so that they become more popular with the younger generation and remain sustainable.
9. All stakeholders make efforts to minimize the sharp social gap between native residents and immigrant residents.
10. All stakeholders should help economic development for local communities in the field of modern agriculture, including marketing.

Ethic declaration

Informed consent was not required for this study because the data for this article was obtained from documents and presentations of the authorities, in this case from the Balikpapan City Government, Samarinda City Government, and North Penajam Paser Regency Government.

Additional information

No additional information is available for this paper.

Study limitation

This study conducted in 4 months and need more time for conducting in-depth processing to collect the data particularly for in-depth interview, and FGD.

Data availability statements

The data is encapsulated within the article.

CRediT authorship contribution statement

Wikan Danar Sunindyo: Writing – review & editing, Conceptualization. **Alfrojems:** Writing – original draft. **Doddi Septian:** Writing – original draft, Formal analysis. **Rini Rachmawati:** Project administration, Conceptualization. **Dana Indra Sensuse:** Conceptualization.

Declaration of competing interest

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