

Socializing with Artificial Intelligence (AI) on Spatial Development in Sub-Saharan Africa

Uchendu Eugene CHIGBU and Penehafo RICARDO (Namibia)

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SUMMARY

Visualization and imaging allude to visual thinking and image reflections, which contribute to the development of visual communication and graphical representation. The function of visualization image creation in the land sector cuts across geography, cartography, planning, geoinformation, remote sensing and photogrammetry (to mention a few). In spatial planning and development, the emergence of approaches based on geographic information systems (GIS) has significantly influenced visualization in spatial planning. However, the emergence of Artificial Intelligence has yet to have a similar influence. This paper focuses on the use of applications of artificial intelligence to “see” spatial planning and development. It presents the results of one-on-one interactions with Bing *Image Creator* on spatial planning and development in sub-Saharan Africa (SSA). The procedure involved identifying critical spatial planning and development (and associated) concepts and contexts, identifying their description or definition in literature, and converting the definitions into text prompts used to interact with *Image Creator*. The interaction involved giving a text prompt to the *Image Creator* for the AI to generate a set of images matching that prompt. In all cases, the AI produced more than 2-4 images subjectively aligned to the prompt. The prompt users (in this case, the researchers) objectively selected the most matching image for the given prompt. The images chosen were then interpreted in text within the context of spatial planning and development in SSA.

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1. INTRODUCTION

This paper is not about using innovative technologies in spatial planning and development. Instead, it is about using Artificial Intelligence (AI) as a visualization tool to produce pictorial depictions of real and futuristic spatial images to visualize what spaces, communities and development domains represent during decision-making in land governance (including land/spatial planning and development, policy, administration and management). Its focus is mainly on spatial planning and development (or simply spatial development -since there cannot be development without planning).

Nadin and Stead (2008) have described spatial planning as a planning system that conceptually characterizes the ensemble of territorial governance arrangements that seek to shape spatial development patterns in particular places. Taking this description further and factoring in the fundamental problems humanity faces today, this paper identifies spatial planning and development as two ends of one process. “Developing spatial plans describing the direction of future developments and choices made in that regard is a great means to guide spatial development” (Louwsma et al., 2020). Both processes involve making decisions (planning) and implementing activities (development) to organize spaces (including land and natural resources) such that their distributions enable access to and use of resources in a manner that is just, fair, inclusive and supports climatic and environmental conditions. They aim to “balance the interests of various policy domains and stakeholders in the pursuit of an overall sustainable development” (Louwsma et al., 2020).

“Thus, spatial planning may more appropriately be concerned with the planning of development, involving substantial changes and responding to questions of what changes should be made, how substantial those changes are, and comparing them to an existing situation aimed at feasible solutions for identified needs and problems” (Auzins & Chigbu, 2021: p. 1).

As solution-driven processes, problem and solution modelling, imaging, and visualization allow for visual thinking and image reflections—as visual languages of communication and graphical representation—in the analyses of problems and presentation of solutions. This use of visualization tools cuts across spatial planning and development disciplines (and sectors), such as geodesy, geography, cartography, planning, geoinformation, remote sensing and photogrammetry (to mention a few).

The emergence of Geographical Information Systems (GIS) based approaches in the land cum planning domain have significantly influenced visualization in spatial planning. However, the emergence of Artificial Intelligence (AI) is yet to have a similar influence. The field of GIS

started in the 1960s as computers and early concepts of quantitative and computational geography emerged. It evolved from the pioneering work of Roger Frank Tomlinson (17 November 1933 – 7 February 2014), an English-Canadian geographer. He is popularly acknowledged as the "father of GIS." For details on the history of GIS, see GISGeography (2024).

GIS might have played a crucial role (and still does) in digitalisation. However, in the digital transformation age, data is considered the new gold, and AI is now perceived as the value creator of data (Groover et al., 2022: p. 177). With the radical evolution of AI, spatial planning and development are now facing an era of digital transformation. Warner and Wäger (2019) identified digital transformation as using new digital technologies to improve human activities, optimize operations, and create new products. This transformation happens due to the various forms of evolved digital innovative technologies. These include blockchain, smart mobile devices, the cloud, the Internet of Things, and AI (Haenlein & Kaplan, 2019; Ameyaw & de Vries, 2023).

AI is the most recent technology to be leveraged across all sectors. It has entered the land sector, especially in activities usually reserved for human skills. However, to deliver valuable results in this sector, it must be frequently subjected to software testing for consistent improvements that can lead to more quality outcomes. AI planning will lead to transformation changes in the speed and accuracy of activities (including models, scenarios, etc.). Chigbu (2019: p. 3) identified that "the use of visual communication techniques in scientific research can manifest in the use of maps, symbols, pictorial images, photography or video (or an expressional combination of any or all of these), with or without texts." There is potential for AI-based applications to do all of these using better-pixelated images and capturing more details using one-off texts or voice commands.

Therefore, this paper aims to present the simple use of AI applications to visualize spatial planning and development concepts and commands. As an AI-testing study, it shows how textual descriptions can transform into image visualizations using AI while reflecting on concepts and scenarios of spatial planning and development in the context of SSA. The paper is structured into four sections. The next part (section 2) briefly presents what AI socialization or interactions entail in the briefest way possible. Section 3 presents the methods used to visualize spatial planning and development concepts and scenarios using a specific AI. Section 4 presents the prompts, outputs and interpretations of the AI testing. Section 5 is the conclusion of the paper.

2. SOCIALIZING WITH AI: WHY SSA LAND PROFESSIONALS SHOULD

Artificial intelligence (AI) relates to the intelligence embodied in software or hardware. AI is not human. It is not an animal. As part of digital transformation, AI platforms influence how we can do everything in all professions. For instance, non-poets can now create beautiful verses using AI. Those who have always wanted to become musicians but lack the voice can now use AI to make their music. Many who tried to become the most fabulous designers and printmakers but lacked the skill in painting can now use AI for their masterpieces.

Most importantly, poor writers within academia are now embracing AI (courtesy of ChatGPT) to produce more refined pieces. The list of what humans can do with AI is a never-ending one. Nevertheless, the use of AI comes with consequences. According to Wu (2024):

“All kinds of people in the creative community are at odds with artificial intelligence. Some are suing top AI companies for feeding their work to computer models without permission, compensation or even notification. Others criticize the quality of the material it produces and worry that it could be used to create knockoffs, threatening millions of jobs.”

While all of these may be its downside, it has an upside too. It presents new opportunities for innovations in arts, science and all forms of creativity. The skill for interacting with AI lies in prompt engineering.

2.1 Prompting: the language for socializing with AI

If anyone assumes creating AI content requires no skill, they should think twice. The means of interaction between a person and an AI-driven platform is prompt. Prompts represent the text one must use to demand an AI model to perform a task. It is the natural language that describes what the AI should do (Pearson, 2023). Prompts can be in the form of text-to-text, text-to-image, text-to-speech/audio and text-to-video models. A prompt for a text-to-text model can be a query such as *“What is the origin of GIS?”* A prompt for a text-to-image model can be a query such as *“Produce a realistic image of what the Ashanti communities of Ghana looked like between 1789 and 1799.”*

When prompting AI to produce images, mentioning artistic styles, patterns, names, places, genres, periods (e.g., years), media or specific techniques significantly influence the outcomes. The use of specific terms can help users take better control of their interactions with the AI and produce more representative or accurate prompt outcomes. “Developing effective prompts requires trial and error, and it can often feel random and unprincipled” (Wu, 2024). Prompting may involve patterning, emphasizing and (re)arranging words and phrases to achieve a desired output (Zamfirescu-Pereira et al., 2023). There are distinct types of prompts. They include question-answer, dialogue prompts, conditional single-shot and inference prompts. For details on types of prompts, see Liu & Chilton (2022) and Wang et al. (2023). What matters is to know that prompt engineering (i.e., how a prompt is constructed) is vital to producing accurate feedback from AI. Like any computer-based model, garbage-in-garbage-out (i.e., input quality directly correlates to output quality) applies to AI interactions with humans. This is crucial because extracting detailed output depends on the capacity to give a prompt requesting the exact details.

2.2 Spatial development in sub-Saharan Africa: what are the key elements?

Sub-Saharan Africa (SSA) is racially, geographically, linguistically and culturally diverse. With much written about spatial planning and development in recent years, their associated theory and practices embody multiple interpretations in SSA. Spatial planning, being a Euro-English, is also practised under various names in various parts of Africa, including town and

country planning, urban and rural planning, urban and regional planning, physical planning and land use planning (to mention a few). To everyday folks, spatial planning (irrespective of whatever name it is called in a particular country) relates to strategies for developing people have with their place —whether native or adopted place). Hence, community development is a key element in regional spatial development (Chigbu et al., 2018). It is not only about improving the physical aspect of a group of people but also includes the cultural, social, environmental, economic and political scenarios. Culture and land are intertwined in all the SSA communities and play a key role in their identity and sustainability (Abebe 2013).

The diversity and similarities of communities in urban SSA are shaped not only by their nativity but also by their colonial experience. Concerning the role of its colonial experience on diversity and similarities, Chigbu (2020: p. 156) has argued that this has been influenced by “Centuries of Arabisation and Europeanisation of Africa —followed by decades of post-independence Americanisation.” Due to these experiences, the multiple stakeholders involved, their goals, and their forms processes—especially how land and natural resources are used, inherited and transferred between community members—Spatial development produces different outcomes at the community level. However, these forms can be analyzed as imposed, directed, and self-help (Matarrita-Cascante & Brennan, 2012).

Within the context of SSA, there are various concepts and practices that, together, shape spatial development outcomes. Within the land-focused disciplines, literature on this subject can be summarised to recognize some key elements contributing to spatial development outcomes. These include urban areas, rural areas, peri-urban areas, informal settlements, and community development (and its various forms). These embedded elements of spatial development are defined in Table 1.

Table 1: Definitions and descriptions of some spatial development-related concepts

Elements of Spatial Development in SSA	Definitions or descriptions
Spatial development	A process that focuses on turning decisions related to the coordination and spatial distribution of land use into development outcomes through coordinated activities (Auzins & Chigbu, 2021).
Land administration	Land administration provides the basic infrastructure for implementing land-related policies and land management strategies to ensure social equity, economic growth and environmental protection (Williamson et al., 2010).
Informal settlement	Human settlements located outside the planned areas or not recognized by the formal regulations as a place of habitation (Kohima et al. (2023).
Community	A community is a group of people with a shared socially significant characteristic, such as place, set of values, culture, values, traditions, or identity (Chigbu et al., 2018).
SSA community	SSA urban communities are characterized by people mostly connected within and across filial, inter and intra-ethnic ties, a shared language, shared geography, natural resources, distinct rules and customs, shared values and obligations, concern for improving their living conditions, and

	an inclusive perspective that encompasses catering for the needs of the dead, the living and the unborn (Walzer, 2010).
Community development	Community development in SSA relates to improving the physical aspect of a group of people but also includes the cultural, social, environmental, economic, and political scenarios (Abebe 2013).
Imposed community development	Imposed community development efforts seek to improve the living conditions of a community through physical and economic development, primarily by developing infrastructure and technology (Matarrita-Cascante & Brennan, 2011).
Self-help community development	A form of community development where members of the community self-conceive projects and lead in pursuance of their community vision (Azubuike et al., 2023).
Directed community development	This combines imposed and self-help community development (Ekowati et al., 2023).

The list of spatial development-associated terminologies can never be fully represented here. These terms have only been identified for illustration purposes in demonstrating the researchers-AI interaction in the later part of this paper.

3. METHODOLOGY

Several text-to-image generators use AI. Some of the most tested and reliable text-to-image creators that use AI are *DALL·E*, *Visme*, *Craiyon*, *Deep AI*, *Runway AI*, *Bing Image Creator*, *Midjourney*, *DreamStudio*, *Wombo Dream*, *Jasper Art* and *NightCafe*. Some of these AI platforms are free, and some are based on paid subscriptions.

The Bing Image Creator (simply called Image Creator) was used for this study. *Image Creator* is a Microsoft AI model built on DALL-E technology, which allows prompts to generate images (futuristic and realistic) from descriptions (prompts). The *Image Creator* was preferred for this study for distinct reasons. First, it applies to art and graphic designing and can transform any image into geometric representations. This makes it usable for spatial visualizations and scenario depictions. *Image Creator* comes along with a Microsoft subscription. This makes it freely and easily accessible if using Microsoft Edge, where it is installed (in-built) on the sidebar. Being a no-cost AI platform makes it practical for learning and experimentation and learning. The downside of using *Image Creator* is that its “style is specific and non-variable, which reduces the range of creative purposes” and being a free tool, it comes with no customer support (Khatri, 2023).

3.1. Image creation

The procedure involved identifying critical spatial planning and development (and associated) concepts and contexts, identifying their description or definition in literature, and converting the definitions into text prompts used to interact with *Image Creator*. The interaction involved giving a text prompt to the *Image Creator* for the AI to generate a set of images matching that prompt. In all cases, the AI produced more than 2-4 images subjectively aligned to the prompt. The prompt user (in this case, the researchers) objectively selected the most matching

image for the given prompt. The chosen image was then interpreted in text and discussed within spatial planning and development in SSA.

This study presents twelve images. Six were produced on the 22nd of January 2024, while the last six were created on the 20th of January 2024.

3.2. Image interpretation

Interpreting images generated by an AI can be difficult depending on the type of image because different AI models are used to generate them. For instance, DALL·E (the model for *Image Creator*) created images of a wide range of concepts expressible in written texts. Language. To interpret the images, the researchers identified objects and features that are shown in the images and then observed the patterns, natural features, shapes, and emotional expressions in the images. In this study, as the images were supposed to illustrate real-world scenarios or clearly defined concepts, they were related to the actual referenced world, and the accuracy of depiction and details of the features were considered in the interpretation. Contexts were considered when interpreting the images.

3.3. Process limitation

Prompting is a skill. The AI expects A good prompt to be clear, concise, and easily understandable. The prompts used in this study may have been better constructed. It is possible that, with better prompts, the outputs produced could have been more detailed. McGee (2023) advised that in writing a good prompt, one could also use another AI-based application, such as “ChatGPT” to create “good commands, which can be used to create images using Bing *Image Creator*, although ChatGPT cannot create the images itself.” For this study, neither ChatGPT nor any other text-creating AI was used. The researchers formulated all prompts applied in this study.

4. PROMPT CONVERSION, OUTPUTS AND INTERPRETATIONS

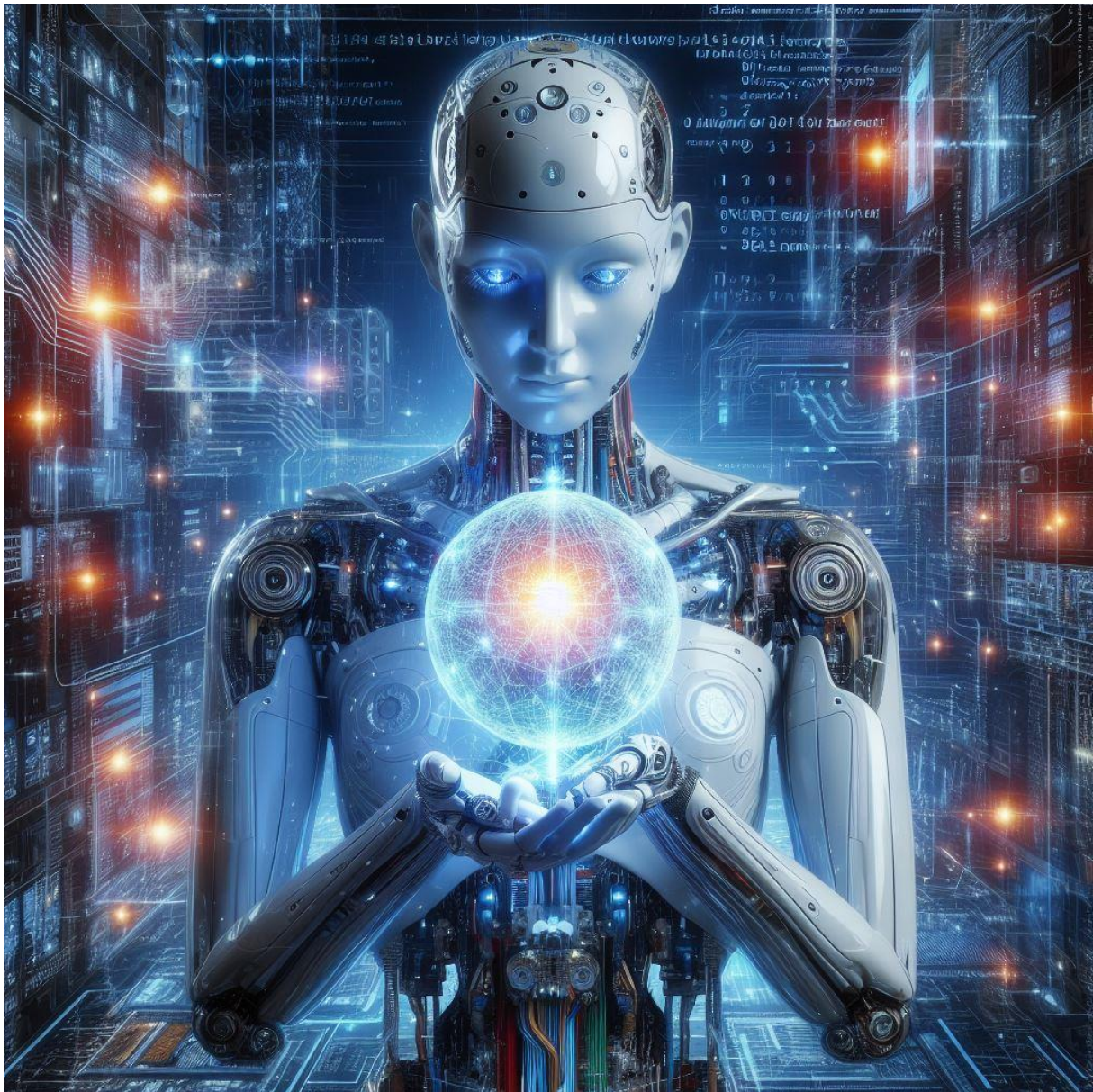
The following images were built using a texts-to-image generation approach. The images represent the descriptions of the terms earlier identified in Table 1. These terms were then converted into prompts and used for interaction with *Image Creator*, who generated the images in Table 2. The output of these prompts is presented in Figures 1-9 (with their interpretations provided below each image).

Table 2: Text-to-image prompt conversion table

Spatial development terms	Definitions or descriptions	Text-to-image prompt
Artificial Intelligence	Artificial intelligence (AI) is the intelligence embodied in software or software (McGee, 2023; Zamfirescu-Pereira et al., 2023).	Introduce yourself by showing me a photo of Artificial Intelligence.
Sub-Saharan Africa	Sub-Saharan Africa (SSA) is racially, geographically, linguistically and culturally diverse.	Show me an image description of the sub-Saharan African region.
Spatial development	A process that focuses on turning decisions related to the coordination and spatial distribution of land use into development outcomes through coordinated activities (Auzins & Chigbu, 2021).	Show me an image representing spatial development as a process used for making decisions about how to distribute people, natural resources and buildings in spaces so people can live a good life.
Land administration	Land administration provides the basic infrastructure for implementing land-related policies and land management strategies to ensure social equity, economic growth and environmental protection (Williamson et al., 2010).	Produce an image that represents land administration.
Informal settlement	Human settlements located outside the planned areas or not recognized by the formal regulations as a places of habitation (Kohima et al. (2023).	Give me a photo description of an informal settlement in sub-Saharan Africa.
Kumasi	A city in Ghana	Show me a land use plan for Kumasi city in Ghana, including a legend showing the various land uses and features.
Community	A community is a group of people with a shared socially significant characteristic, such as place, set of values, culture, values, traditions, or identity (Chigbu et al., 2018).	A community where men, women, girls and, boys and babies share the same settlement, culture, and identity.

SSA community	SSA urban communities are characterized by people mostly connected within and across filial, inter and intra-ethnic ties, a shared language, shared geography, natural resources, distinct rules and customs, shared values and obligations, concern for improving their living conditions, and an inclusive perspective that encompasses catering for the needs of the dead, the living and the unborn (Walzer, 2010).	Show community in urban sub-Saharan Africa, their culture, natural resources, rules, and where people consider the welfare of people past, living and unborn, including shared values and language.
Community development	Community development in SSA relates to improving the physical aspect of a group of people but also includes the cultural, social, environmental, economic, and political scenarios (Abebe 2013).	Depict community development in sub-Saharan Africa where people take actions to improve their living conditions, including the physical environment, economy, social infrastructure, and culture, so that they can live a life where basic needs are available.
Imposed community development	Imposed community development efforts seek to improve the living conditions of a community through physical and economic development, primarily by developing infrastructure and technology (Matarrita-Cascante & Brennan, 2011).	Show an image of community development in urban sub-Saharan Africa as “imposed actions” on people to improve their living conditions in their place.
Self-help community development	A form of community development where members of the community self-conceive projects and lead in pursuance of their community vision (Azubuike et al., 2023).	Show an image of community development in urban sub-Saharan Africa as “self-help actions” taken by people to improve their living conditions in their place.
Directed community development	This combines imposed and self-help community development (Ekowati et al., 2023).	Show an image of community development in urban sub-Saharan Africa using both “imposed” and “self-help” actions taken by people to improve their living conditions in their place.

Figure 1: AI image of “AI” using Image Creator



Interpretation 1: In introducing herself, Image Creator provided this photo identifying AI as a highly automated machine-wired female with a highly networked crystal ball that signifies knowledge and intelligence, while the background is a world of highly interlinked and interconnected strands of blurred images conveying data. Concerning why AIs chose to be represented as female, Borau et al. (221) noted that “female gendering increases humanness perceptions of bots and acceptance of AI.” This implies that the AI is aware that she is not human but has to take a form that appeals most to humans to be accepted by humans.

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Figure 2: AI image of “sub-Saharan Africa” using Image Creator



Interpretation 2: The AI clearly understands that SSA is a diversity of various urban, rural and natural developments. She also identified that wealth exists side-by-side in SSA and that culture is a component of the SSA communities. There is also a pattern of nature representation mainly emphasized in animal photos. Could this reflect the popular stereotypes that Africa is home to wildlife? Also interesting is that no emotions were shown on the faces of humans in the photo.

Figure 3: AI image of “spatial development” using Image Creator



Interpretation 3: The depiction of the definition of spatial development represents the idea of spatial development in real life -being a consequence of planning by humans (the hands) and conducted to ensure that activities and permanent objects (buildings, infrastructure, amenities, etc.) and strategically distributed and connected to link the natural and built environment.

Figure 4: AI image of “land administration” using Image Creator



Interpretation 4: This representation of “land administration” appears spot-on with contemporary definitions. Hence, the depiction of land of all types (agriculture, forest, residential, water bodies, etc.) is embodied with all kinds of data (the graphical lines identifying land parcels and permanent objects). This indicates that delivering land services and managing spatial data is critical to land administration.

Figure 5: AI image of “informal settlement” using Image Creator



Interpretation 5: This representation of “informal settlement” in SSA reflects AI’s generalization of the predominant form of informal settlement in SSA. She is aware of the overpopulation, high-density community, informal economy and business, lack of infrastructure and poor housing.

Figure 6: AI image of “Kumasi” using Image Creator



Interpretation 6: Kumasi is in the Ashanti Region of Ghana. It is among the largest metropolitan areas in Ghana. Kumasi is in a rainforest region and is known as the garden city. It is also located near Lake Bosomtwe. It is also the industrial, commercial, industrial, and cultural capital of the Ashanti region. All these details are reflected in the image. However, the level of accuracy (in illustration) is questionable.

Figure 7: AI image of “community” using Image Creator



Interpretation 7: The photo description of the term “community” (in general) by the AI indicates that a community comprises people who share a common purpose and work together to improve their living conditions.

Figure 8: AI image of “SSA community” using Image Creator



Interpretation 8: When prompted to define the same “community” in the context of SSA, the AI redesigned the housing and the natural features and introduced a sense of rurality or small-township (by way of imposition) in the picture while keeping the typical or strictly urban structures in the background. It is difficult to tell whether she relates “community” to mainly rural villages and small towns. However, she did capture the literature-identified SSA community features (Azubuike et al., 2023).

Figure 9: AI image of “SSA community development” using Image Creator



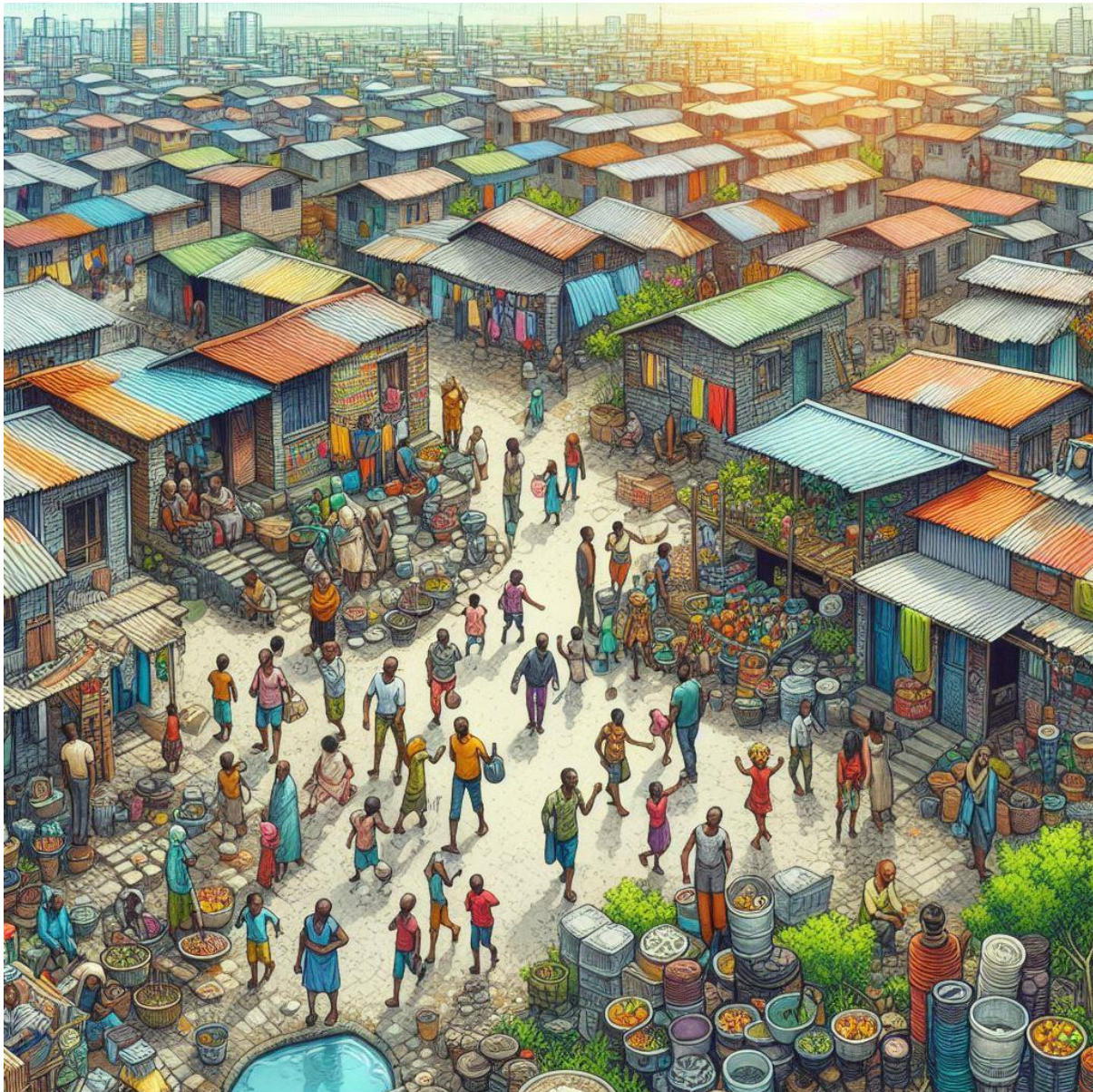
Interpretation 9: When prompted with “SSA community development” as a key phrase, the AI switched from a more passive (as previously shown) expression of community to that of an active environment. This indicates that her understanding of community development is about improving communities.

Figure 10: AI image of “imposed community development” using Image Creator



Interpretation 10: she pictured “imposed” community development as a scenario where external designers direct the community development effort. This is well emphasized by the photo of a man sitting on a design stool while looking over the community with his plans and gesturing his hands towards the direction of the people. Here the prompt put emphasis on *imposed action* with the use of quotation marks (“”).

Figure 11: AI image of “self-help community development” using Image Creator



Interpretation 11: Her depiction of the “self-help” community situation shows the togetherness of a people with an enterprising spirit. For some reason, the photo shows this may be happening in an informal settlement. Self-help is a significant strategy for informal infrastructure development in informal settlements in SSA. Here the prompt put emphasis on *self-help action* by introducing quotation marks (“”).

Figure 12: AI image of “directed community development” using Image Creator



Interpretation 12: On the “directed” type of community development, she merged the “imposed” and “self-help”, showing that people are working together with an official and the planning is done by the people and someone who provides directives. Here the prompt put emphasis on *imposed action* and *self-help action* by using quotation marks (“”).

5. FINAL REMARKS

There are many people for and against the use of AI. Those who are against it have often described it as a mere data regurgitation performed with algorithms. Those who are for it have often described it to be the new path to data-driven innovations. However, many are embracing it. “Even New York’s Museum of Modern Art has started to embrace AI-generated artwork” (Wu, 2024). This paper has merely strived to show the actual (as presented in the prompt results) and the potential of AI (as argued in the context of its application to spatial development) to serve current needs in land sector activities.

Various AI applications can be used to enhance spatial development cum land administration tasks. These applications could be helpful instruments for AI-based spatial planning and development. The days of creating an interactive map through complicated point-to-point work are fast approaching. With AI, it is becoming possible for practitioners who are not tech-savvy to produce maps because with the use of AI-based tools GIS and cartography are no more prerequisites, and coding is no longer needed. With AI technologies, it is becoming possible to *map without mapping*. For instance, *MapsGPT* and a few other AI-based platforms (now at their early stage of development) can be used to build custom maps with the power of AI for indoor and outdoor needs.

This paper has not focused on the mapping aspect of spatial planning and development. It has presented the spatial development of imaginations produced during a two-day interaction with Image Creator. The paper sought to create awareness of the potential use of AI for planning and decision-support systems in spatial development. It demonstrated that AI allows for a quick-to-access and easy-to-use visualization tool for land sector activities, especially spatial development.

Using AI in spatial planning and development can change how planners and developers conceptualize complex urban and rural living scenarios. Urban designers can also use her to produce dummy designs for decision-making. She can also be used to visualize concepts and ideas under discussion in the planning and development process, especially in managing access and mobility spaces in physical and infrastructural planning. This makes her capable of being used as a land and environmental governance tool. Doing any of these (and many others) requires having the skill to prompt the AI to create details.

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BIOGRAPHICAL NOTES

Uchendu Eugene CHIGBU



Eugene is an Associate Professor in Land Administration. At the Namibia University of Science and Technology, Windhoek, Namibia; Global Land Tool Network Steering Committee member; (Co-) author of numerous publications on tenure responsive land use planning also linked to climate, including for UNCCD the UN agency dealing with land degradation/land restoration. He is the Associate Editor of the journal, [Land Use Policy](#).

CONTACTS

Namibia University of Science and Technology, Faculty of Engineering and the Built Environment, Department of Land and Spatial Sciences

No. 13 Jackson Kaujeua Street, Private Bag 13388, Windhoek, Namibia.

T.: +264612072470 | F: +264612079470 | E: echigbu@nust.na | W: www.nust.na

Penehafo RICARDO



Ms Penehafo Ricardo is a research assistant in the Department of land and Property Sciences at the Namibia University of Science and Technology (NUST). She is the co-manager of the Network of Excellence on Land Governance (NELGA) in the Southern African region. Currently, she is a registered master's candidate at NUST. Her research interests include land tenure, urban sanitation as well as tenure-related flexible approaches to informal settlements upgrading.

CONTACTS

Namibia University of Science and Technology, Faculty of Engineering and the Built Environment, Department of Land and Spatial Sciences

No. 13 Jackson Kaujeua Street, Private Bag 13388, Windhoek, Namibia.

T.: +264-61 207 2836 | F: +264612079470 | E: pricardo@nust.na | W: www.nust.na