

LEVERAGING ARTIFICIAL INTELLIGENCE (AI) AND GEOGRAPHIC INFORMATION SYSTEMS (GIS) FOR COMMUNITY ENGAGEMENT IN URBAN DEVELOPMENT IN SARAWAK

Prepared by:

Saiful Bahari Bin Amra Ramly & Khairul Hisyam Bin Abdullah

Land Custody and Development Authority (LCDA) Sarawak, Malaysia

1. Introduction

This paper presents LCDA's ongoing efforts to harness the power of Geographic Information Systems (GIS) and Artificial Intelligence (AI) as part of a strategic approach to enhance community engagement in urban redevelopment projects. As global urbanization trends intensify, the need for inclusive, data-driven, and sustainable planning becomes increasingly essential—especially in rapidly evolving regions like Sarawak. This project highlights how smart technologies can be embedded in urban policy and planning frameworks to bridge information gaps, empower communities, and achieve long-term sustainable outcomes.

2. Sarawak's Urban Development Context

Sarawak, the largest state in Malaysia, spans over 124,000 square kilometers but maintains the nation's lowest population density, averaging only about 20 persons per square kilometer. Despite this, the state's urban centers are rapidly growing. With a current population of approximately 2.93 million and a projected rise to 3.58 million by the year 2040, Sarawak is experiencing intensified urban pressure, particularly in and around cities such as Kuching, Sibu, Bintulu, and Miri.

This rapid urban expansion, while necessary to drive economic growth and modernization, has also resulted in unintended consequences. Among them is the emergence of informal settlements due to rural-to-urban migration. Many of these communities are located on marginal lands without proper tenure, infrastructure, or access to basic amenities. These dynamics have complicated urban planning and presented challenges in delivering equitable and sustainable urban services to all residents.

3. Case Study: Darul Hana – A Model of Urban Transformation

One of the most prominent examples of urban transformation in Sarawak is the Darul Hana Redevelopment Project. This large-scale, multi-phase initiative was implemented between 2014 and 2024 for phase I and aimed to resettle fragmented kampung settlements located along riverbanks into a more organized and sustainable neighbourhood. The use of GIS played a crucial role in this project, enabling planners and stakeholders to visualize existing conditions, simulate redevelopment scenarios and align infrastructure upgrades with long-term spatial planning goals.

Through this initiative, Darul Hana has evolved into an integrated and connected community, offering modern housing, road networks, utility systems and socio-economic infrastructure. The success of this transformation underscores the potential of strategic urban redevelopment when supported by digital planning tools and strong community involvement.

4. Strategic Purpose of Urban Redevelopment

Urban redevelopment in Sarawak is more than just a physical makeover; it is a comprehensive intervention aimed at revitalizing underutilized or degraded areas to create more inclusive, resilient, and vibrant urban environments. These efforts focus on improving not just the built environment, but also the economic, social, and ecological aspects of urban life.

Redevelopment initiatives are carefully designed to improve access to basic services, increase mobility, foster a sense of community, and reduce vulnerability to environmental risks. The overarching objective is to ensure that these benefits are distributed equitably across all socio-economic groups, particularly vulnerable and low-income populations. The commitment to inclusivity is evident in the planning and design processes, which emphasize the need to prevent displacement and marginalization of existing residents.

5. The Role of Community Engagement in Urban Redevelopment

Community engagement lies at the heart of every successful urban redevelopment initiative. In Sarawak, it is recognized that the active involvement of residents from the earliest planning stages significantly enhances project outcomes. Engagement is not merely about information dissemination; it is about building partnerships with the community to understand their needs, concerns, and aspirations.

By adopting participatory approaches, planners are able to co-create solutions that are contextually relevant and socially acceptable. Early engagement also allows communities to voice their opinions on potential negative impacts, propose mitigations, and offer local insights that enrich project design. Such dialogue fosters ownership and trust, while also reducing the risk of opposition or conflict during project implementation.

6. The Integration of GIS and AI: A Game-Changer for Urban Planning

The integration of Geographic Information Systems and Artificial Intelligence an approach increasingly referred to as “GeoAI”—has revolutionized how Sarawak approaches urban redevelopment. GIS has long been used as a spatial planning tool, but its integration with AI has unlocked new possibilities for predictive analysis, automation, and real-time decision-making.

GIS allows planners to overlay multiple layers of spatial data ranging from land use and cadastral maps to topographical data thus enabling a comprehensive understanding of urban dynamics. In parallel, AI provides the analytical engine that processes vast datasets, identifies patterns, predicts outcomes, and recommends interventions. This synergy enables a shift from reactive to proactive urban planning.

For example, using AI-powered image recognition tools such as ChatGPT and machine vision, planners can analyze photographs of houses and classify them according to housing quality standards (e.g., good, moderate, poor).

7. Digital Engagement and Communication Platforms

One of the notable innovations in Sarawak is the deployment of digital platforms such as **ComMap** prototype, which facilitates community engagement and data collection. This mobile-based tool allows residents to map their neighbourhoods, provide real-time feedback, and receive updates directly via mobile apps or SMS ensuring accessibility even among populations without consistent internet access.

This platform represents a paradigm shift in public engagement. Instead of relying on traditional town hall meetings or lengthy surveys, planners can now interact with communities in real time. AI systems further enhance this process by automatically analyzing responses and generating reports, which helps to streamline engagement efforts and support evidence-based planning.

8. Enhancing Disaster Preparedness and Risk Reduction

Beyond planning, GIS and AI also play a critical role in disaster risk reduction. Urban settlements, especially informal ones, are often located in areas prone to natural hazards such as floods or landslides. By combining community-reported data with geospatial inputs like slope analysis, soil stability and drainage patterns, authorities can create detailed risk maps.

AI algorithms help identify vulnerable households and simulate impact scenarios, allowing for the proactive design of safer housing layouts, evacuation routes, and early warning systems. In short, these technologies not only make cities smarter but also safer.

9. Challenges and Limitations of Digital Integration

Despite the transformative potential of GeoAI, several challenges remain. The digital divide is still a major barrier to inclusion, particularly in rural and low-income areas where internet access and device availability are limited. Moreover, data quality issues such as outdated maps or inconsistent records can hinder the effectiveness of AI-driven analysis.

Concerns about privacy and data protection also require careful governance, especially when collecting geolocation or personal data from residents. Additionally, some community members may lack the digital literacy required to engage meaningfully with online tools, while institutional silos and fragmented digital platforms among government agencies pose integration hurdles. Addressing these challenges will require sustained investment in digital infrastructure, capacity building, inter-agency collaboration, and community digital education.

10. Future Directions and Strategic Vision

Looking forward, LCDA aims to further enhance its smart planning capabilities by embedding AI into social impact assessments (SIAs). This includes the development of automated alert systems based on citizen reports, real-time dashboards to monitor project progress, and mobile applications for live community feedback.

AI-powered scoring models can help planners evaluate and prioritize redevelopment impacts quickly and equitably, while visual dashboards can present these insights to both decision-makers and the public. The long-term vision is to ensure that planning becomes a continuous, adaptive process—guided by data, shaped by community voices, and aligned with Sarawak’s commitment to sustainability as outlined in the Post COVID-19 Development Strategy (PCDS) 2030.

11. Conclusion

The integration of Geographic Information Systems (GIS) and Artificial Intelligence (AI) in Sarawak's urban redevelopment efforts marks a significant step toward a more inclusive, informed, and forward-looking model of urban governance. These technologies not only enhance the technical efficiency of planning and project execution but also strengthen the social contract between planners and the communities they serve.

Sarawak's experience, particularly through initiatives like ComMap and GeoAI, demonstrates how digital platforms can democratize urban planning by making information more accessible, engagement more inclusive, and decision-making more transparent. This digital transformation is not merely a technological upgrade—it is a reimagining of how development is conceived, executed, and sustained with community empowerment at its core.

Moreover, this approach strongly aligns with Sarawak's commitment to achieving the **United Nations Sustainable Development Goals (SDGs)** particularly Goal 11 (Sustainable Cities and Communities), Goal 9 (Industry, Innovation, and Infrastructure), and Goal 13 (Climate Action). By optimizing land use, enhancing resilience to climate risks, and fostering inclusive participation, GIS and AI applications contribute directly to these global objectives.

At the same time, the integration of these technologies supports the principles of **Environmental, Social, and Governance (ESG)**. Environmentally, they enable better resource management and environmental risk detection. Socially, they promote community engagement, equity, and inclusion. From a governance perspective, they improve transparency, accountability, and responsiveness in public sector planning and decision-making.

Yet, as we embrace these advancements, we must also confront the limitations—digital inequality, data gaps, privacy concerns, and institutional fragmentation. Addressing these challenges requires multi-stakeholder collaboration, investment in capacity building, and a deliberate focus on digital inclusivity.

In conclusion, LCDA is charting a bold path forward where technology serves not just as a tool, but as a catalyst for achieving meaningful, people-centric development. By embedding GIS and AI into the very fabric of urban redevelopment, and aligning these efforts with the SDGs and ESG imperatives, LCDA is positioning itself as a regional active player in sustainable, resilient and inclusive urban transformation.

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