

# Development and Usability Testing of the Participatory Urban Plan Monitoring Prototype for Indonesian Smart Cities Based on Digital Triplets

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## SUMMARY

Sustainable Development Goals (SDGs) prescribed justice, strong institutions, and partnerships to encourage citizens' participation and inclusion. Goal 11 addresses urban areas: "Make cities and human settlements inclusive, safe, resilient and sustainable." The SDGs are impossible to realize without the involvement of cities and municipalities. They must align their land-use plans to align to SDG indicators and measure their progress collaboratively. Therefore, developing an application for participative monitoring of the implementation of urban plans is crucial to detect challenges and evaluate alternative scenarios for intervention-making, achieving SDGs' targets and indicators. On the other hand, investments or disruption in a city, either physical or non-physical forms, should change the configuration of rights, restrictions, and responsibilities (RRRs) on a land parcel or 3D space. Therefore, monitoring the implementation of the urban plan is required to gauge the progress of a city moving towards fulfilling SDGs indicators. In the digital transformation and democracy era, cities may benefit from Geo-ICT to improve their capability to manage land information and establish spatially enabled societies to fulfill roles in land management. A combination of multidimensional representation, technology, and collaboration is believed to make a city and its society smarter. The developments presented in this article use the proposed Spatial Plan Information Package within ISO 19152:2012 on the Land Administration Domain Model (LADM) revision. LADM is used to construct a 3D representation of restrictions and responsibilities from land-use (urban) planning. The standardized land information is presented within a web-based prototype of Participatory Urban Plan Monitoring (PUPM), enabling two-way 3D information flows between all stakeholders in two Indonesian biggest cities: Jakarta and Bandung. This article presents the progress of the development of Digital Triplets, 3D representations of legal objects as an extension to Digital Twins (the real world, and synchronized 3D models of physical objects). Similar to a digital twin, a digital triplet requires an updating system. The two-way information flows between authorities, and local citizens can be an updating system to support PUPM. This

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article presents the first attempt to conceptualize the digital triplets concept from 3D RRRs and the development of a 3D user interface that enables two-way information flows and 3D web visualization for supporting participatory urban plan monitoring. An initial usability test is conducted in order to improve PUPM further. Set set-up, execution, and analyses of this usability test are presented in the article

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