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Application of Digital Twins for Low Carbon Development and Resilience: A Comparative Analysis of Smart City Evolution in New Delhi, New York and Jakarta

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Abstract: This paper examines the application of Digital Twin (DT) technology in three major urban contexts—New Delhi, New York City, and Jakarta—highlighting their diverse pathways of adoption and unique governance challenges. DTs, distinguished from static models by their dynamic data integration and two-way communication, are increasingly employed as urban management tools. Beyond these case studies, the paper engages with the concept of *deep sustainability*, questioning whether DTs can contribute to systemic transformations rather than incremental efficiency gains. While DTs hold promise for simulating policy interventions, reducing environmental harms, and fostering transparency, challenges of cost, trust, and the risk of remaining mere “digital shadows” persist. Overall, this comparative study highlights both the opportunities as well as limitations of DTs as tools for advancing equitable and sustainable urban governance.

Keywords: Applications of Digital Twins, Deep Sustainability, Internet of Things