



Toward integrated land use and transport planning in fast-growing cities: The case of Jeddah, Saudi Arabia



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A B S T R A C T

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Integrated land use and transportation planning is vital in rapidly growing cities, such as Jeddah, Saudi Arabia. The current land use and transport planning policies and practice in Jeddah focus on different visions, such that neither land use nor transport issues are managed effectively or efficiently. To prevent managing these issues in isolation, Jeddah's urban planners require methods of integrated land use and transport planning that can contend with the dynamics of Jeddah's urban growth. Dynamic land use and transport interaction models are a valuable method to address this growth. This study uses a cellular automata-based Land-Use Transport Interaction (LUTI) model to assess and simulate different (proposed) land use and transport policy interventions in Jeddah over a 20 year period (2011–2031). The impact of both isolated and integrated policy interventions on land use and transportation were explicitly simulated in the model. Local planners and experts assessed the results of the model. The results show that the dynamic model provides a useful tool for simulating the various planning visions in the city. As such, the model provides a new, valid, proactive land use and transport planning approach to address land use and transportation challenges in the early planning stages and facilitates shared visions of planners. Policies and integrated strategies that stem from this model may provide a sustainable land use and transportation future for Jeddah.

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Introduction

Transportation planners need to forecast how future travel demand is affected by land use. Similarly, they must be able to estimate how new transportation policies will modify land use (Greca, Barbarossa, Ignaccolo, Inturri, & Martinico, 2011). In rapidly growing cities with conventional land use and transportation planning practices, this process is typically difficult. The conventional practice focuses on separate visions, scenarios, plans, policies and projects related to a specific land use or transport issue (Te Brommelstroet & Bertolini, 2008). The consequences of these scenarios, plans and policies on land use and transport at the larger level have received little attention (Geurs, 2006). Moreover, the spatial and temporal consequences of these scenarios, plans and policies cannot be fully foreseen with conventional practice.

In rapidly growing countries, such as Saudi Arabia, this issue is vital. Major cities in Saudi Arabia, such as Riyadh, Jeddah and Dammam, have experienced rapid urban growth that has consistently caused complex urban planning challenges for the local authorities. Jeddah in particular has experienced rapid urban growth,

spatial expansion and transportation infrastructure expansion over the past 40 years, with a wide variability across space and complex urban dynamics. Jeddah's population grew from 147,900 in 1964 to 3,247,134 in 2007. The Jeddah urban area has also expanded dramatically from 18,315 ha in 1964 to 54,175 ha in 2007 (Aljoufie, Zuidgeest, Brussel, & Van Maarseveen, 2013). This expansion has coincided with the use of conventional urban planning practices and a lack of an appropriate and coordinated policy (Mandeli, 2008), which has led to haphazard land use and transportation issues. Jeddah's dramatic transportation infrastructure expansion has stimulated urban sprawl and lop-sided development (Aljoufie, Zuidgeest, Brussel, & Van Maarseveen, 2013). However, this expansion in infrastructure has not been able to accommodate increases in travel demand, causing high levels of congestion. Jeddah's enormous spatial expansion has caused significant changes in travel behaviour and the modes of transportation used throughout the city.

Current land use and transport planning practices in Jeddah cannot keep pace with the rapid urban growth and consequent land use and transport interaction issues. Planning and policy practice have separate visions. Therefore, specific land use or transport issues are managed in isolation. On the one hand, transport planners focus on solving transport problems and improving the transportation system. Transport planners pay little attention to

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the spatial distribution of land use. On the other hand, land use planners focus on confronting urban growth and land use without considering the effects on transport demand. The use of integrated land use and transport decision support tools for policy intervention analysis, scenario-building and prediction in the early land use and transport planning stages may improve this situation. Yet, an effective and efficient integrated land use and transport planning process is still absent in Jeddah's municipal planning and policy analysis practice.

Land use transport interaction (LUTI) models facilitate the study of the complicated interaction between land use change and transportation and the future impact of different urban development policies on the urban environment. Recently, urban cellular automata (CA) models of land use have been coupled with transportation models and have been integrated into larger urban simulation models (Jacono & Levinson, 2009; RIKS, 2010). CA provides a dynamic modelling environment that can model complex land use and transportation changes and their mutual interaction. Because of its simplicity, flexibility, intuitiveness, and its ability to incorporate the spatial and temporal dimensions of the various land use processes (Santé, García, Miranda, & Crecente, 2010), this approach has been extensively utilised to study the spatial temporal process of land use changes (e.g., Al-Ahmadi, See, Heppenstall, & Hogg, 2009; Batty, 2000; Liu & Phinn, 2003; White, Engelen, & Uljee, 1997). CA has the capability to mimic the spatial processes of the urban systems, including land use. In this study, the CA-based

LUTI model Metronamica-LUTI has been applied, calibrated and validated to the case of Jeddah, as reported in a previous research paper (Aljoufie, Zuidgeest, Brussel, Van Vliet, & Van Maarseveen, 2013). This model can replicate historical and current urban growth, land use and transportation changes and their interactions.

This study introduces an integrated land use transport planning approach for Jeddah using the Jeddah Metronamica-LUTI model (Aljoufie, Zuidgeest, Brussel, Van Vliet, et al., 2013). The study begins by describing the challenges of urban growth, land use changes and transportation in Jeddah. Next, the study describes the methods used for an integrated land use transport planning approach that encompasses the Jeddah Metronamica-LUTI model and a land use and transportation policy interventions analysis. Next, the study focuses on Jeddah's planners' perceptions of the method and the results based on the following criteria: (1) the plausibility of the model predictions; (2) the relevance of the indicators produced by the model and (3) the relevance of the approach to the spatial and strategic planning, land use planning, transport planning and the decision making process.

The city of Jeddah

Geographical context

Originally, Jeddah began as a small fishing village surrounded by a wall. In 1947, the fortified wall of Jeddah city was destroyed

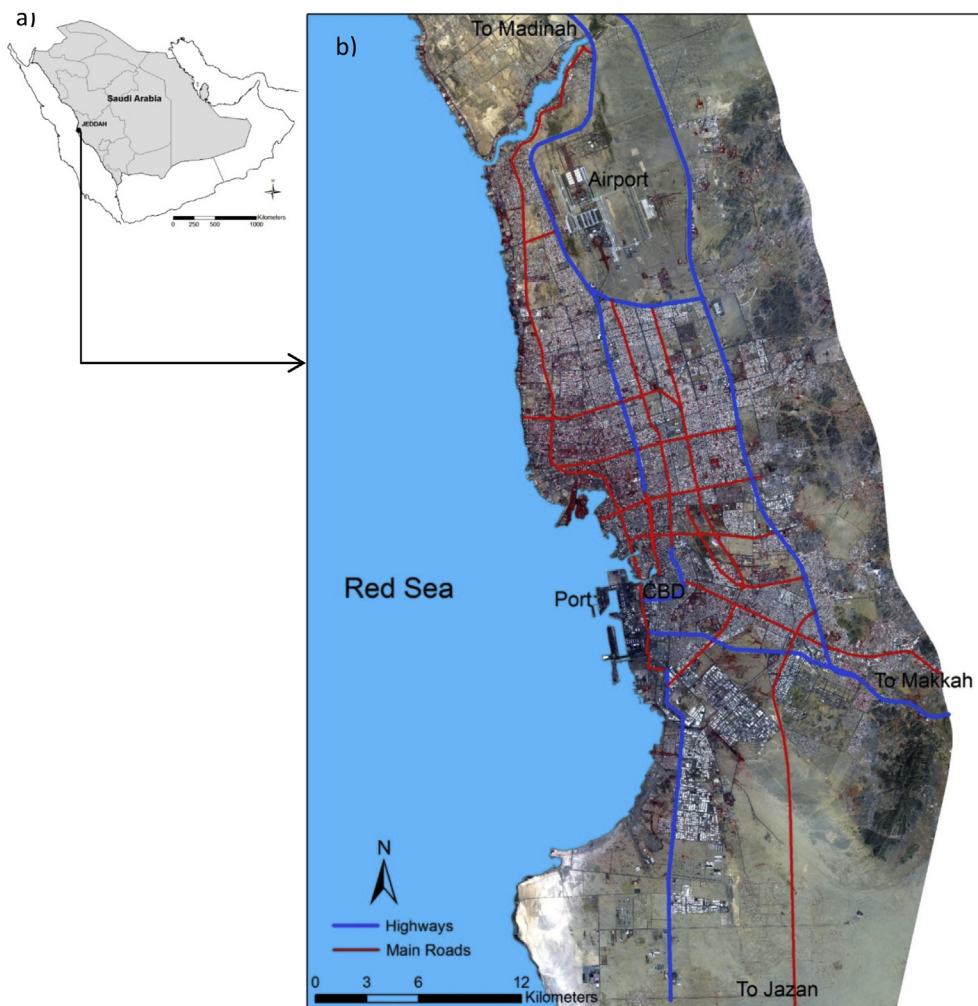


Fig. 1. a) Geographic location of Jeddah in Saudi Arabia; b) Jeddah city.

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