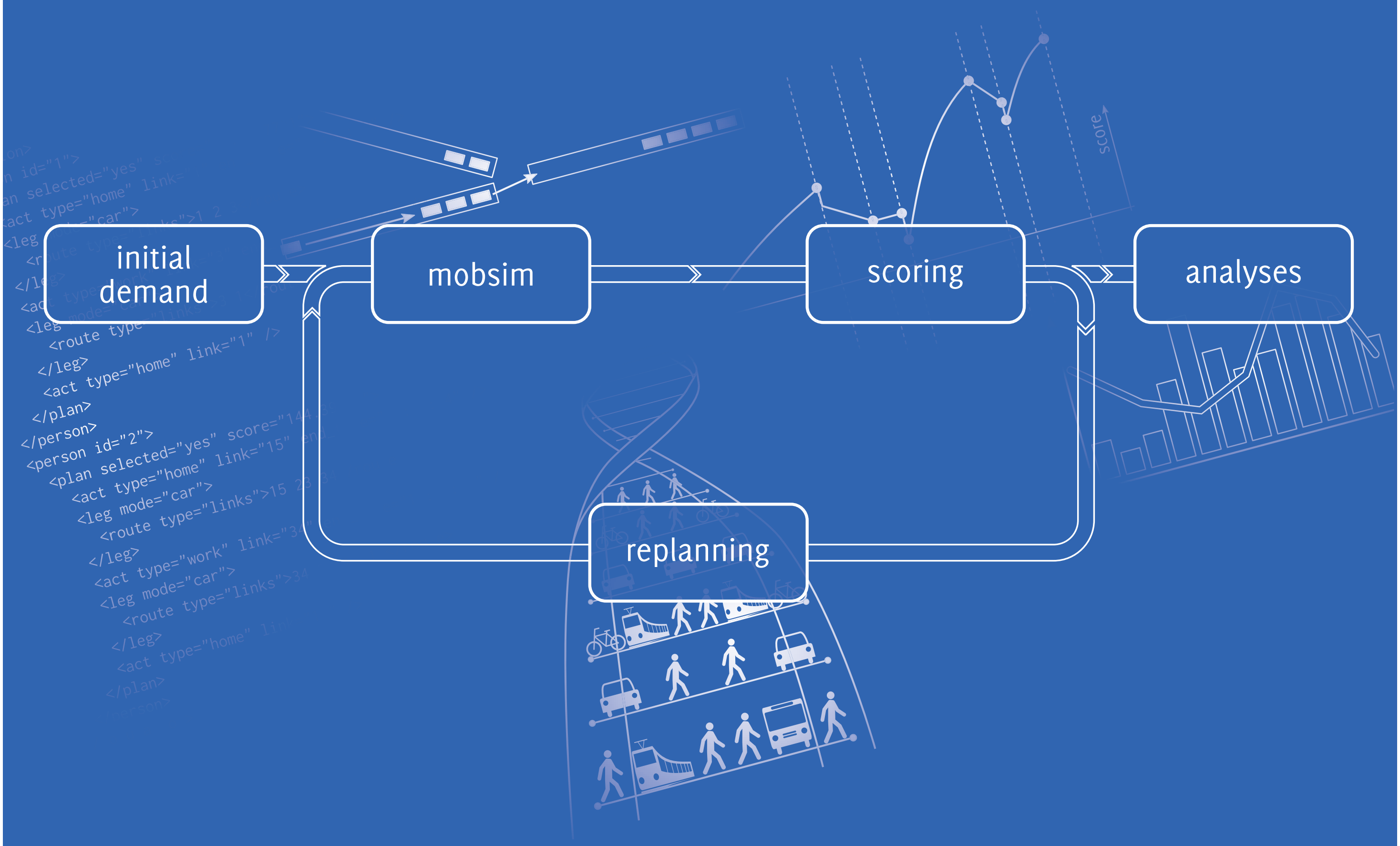
The Multi-Agent Transport Simulation MATSim

edited by

Andreas Horni, Kai Nagel, Kay W. Axhausen



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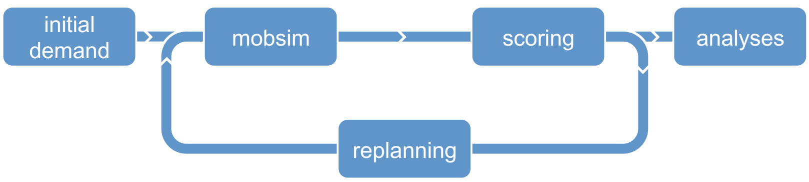

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CHAPTER 76

Padang

Gregor Lämmel

The Padang scenario demonstrates the MATSim application to large-scale evacuation problems. The scenario has been created as part of the third party funded project "Last-Mile". Taubenböck et al. (2013) give a comprehensive overview. Padang is located on the west coast of Sumatra Island, Indonesia. In 2014, the city had a population of about 1 000 000 people. Because of its problematic location on the coast in a so-called "seismically locked" area (McCloskey et al., 2010), Padang is prone to earthquakes and subsequent tsunamis. In the "Last-Mile" project, a realistic tsunami scenario, triggered by an earthquake about 300 km off the coast, was identified (Goseberg and Schlurmann, 2009). The assumed tsunami would leave about 30 minutes for the evacuation. The flooding would reach as far as three kilometers inland, thus threatening up to 330 000 lives. Lämmel (2011) developed a MATSim scenario representing the city with its affected population. One unusual aspect of the Padang situation is the expected universal evacuation by foot; simulating pedestrians with MATSim was a novelty when this project started. The standard simulation model (see, e.g., Section 1.3) was thus adapted to deal with pedestrians. Details are discussed by Lämmel et al. (2009). Another important variation, contrary to most standard transport scenarios, is that network links would flood once the tsunami reached them. Thus, accessibility—flooded or not flooded—of the network links is time-dependent, which is modeled by a time-dependent network (Lämmel et al., 2010). In the time-dependent network concept, link attributes—like *freespeed*—can be changed, while the simulation is running, by precomputed network change events. For the Padang scenario, the network change events have been extracted from microscopic flooding simulation data.

Key Padang scenario facts:

- The network consists of about 6 000 nodes and 17 000 links.
- Synthetic populations for morning, afternoon, and night have been created, containing up to 330 000 agents.

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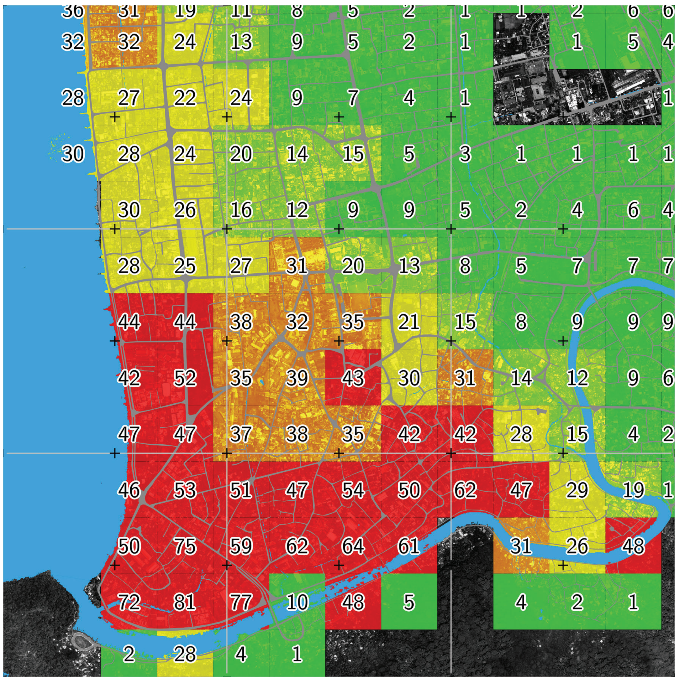

Figure 76.1: Evacuation time analysis for downtown Padang. Numbers showing average evacuation time in minutes, which are also indicated by the colors green, yellow, red.

- The flooding is modeled by a set of 109 network change events (one per minute), affecting 7 609 links.
- A set of 42 shelter buildings, which could be used for vertical evacuation, is also part of the scenario.

Based on the Padang scenario, various evacuation strategies have been investigated:

- A seemingly obvious evacuation strategy is the shortest path solution, where everyone is on the shortest path. This solution, however, ignores possible congestion and lead to unfeasible results.
- Shorter evacuation times are achieved with a Nash equilibrium approach, where everyone tries to find an optimal evacuation route through iterative learning (Lämmel et al., 2009).
- While the Nash equilibrium reduces individual evacuation time, total evacuation time might not be minimal. The marginal social cost-based simulation approach tries to minimize the total evacuation time (Lämmel and Flötteröd, 2009; Dressler et al., 2011).
- These three basic evacuation approaches are investigated in combination with flooding (Lämmel et al., 2010; Lämmel, 2011).
- Further, an evacuation strategy to reduce the exposure to risk has been developed by Lämmel et al. (2011).
- And finally, Flötteröd and Lämmel (2010) propose a method to integrate shelter buildings, which are evacuation sinks (i.e., safe places) with limited capacity, into the simulation.