Smart and the City: Is a Generalized Smart City Solution Optimal?

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1 Abstract

in order to deconstruct how the crisis trajectories of cities are affected by their initial conditions and intervention strategies, a simulation study of four city contexts under stress was conducted. Additionally, since the motivating problem of the crisis (a disease outbreak) is a symptom of rapid urbanization, the author asks: would the smart city (SC) design for each of those simplified model cities be the same? The analyzed answer was negative. This finding hints that any generalized SC framework would not be optimal in the real world. Lastly, a quantitative and holistic analysis framework for SC planning is also proposed.

2 Introduction

Research Problem	The foundations of the field of Smart Cities, and planning such cities, is **riddled with ambiguity** and is mostly **qualitatively defined**, making research **difficult, and neither reproducible nor interoperable**.
Research Gap	Many researchers are attempting to **converge the field** onto an agreed-upon smart city foundation, with a **generalizable framework, standards** and **definitions.** **This study aims to quantitatively analyze whether, based on city dynamics, such a one-size-fits-all, generalized smart city framework is optimal.**
Why does this matter?	Based on the answer, more resources can either be diverted to identifying that elusive one-size-fits-all smart city solution or, if such a generalization is implied to not be optimal, resources can be redirected to more promising research avenues

3 Agent-Based Model

- Cellular automata based model to simulate the effects of a city under crisis (i.e, a disease outbreak) along with its chosen intervention strategies
- 20 User-defined initial conditions: City, Outbreak and Intervention

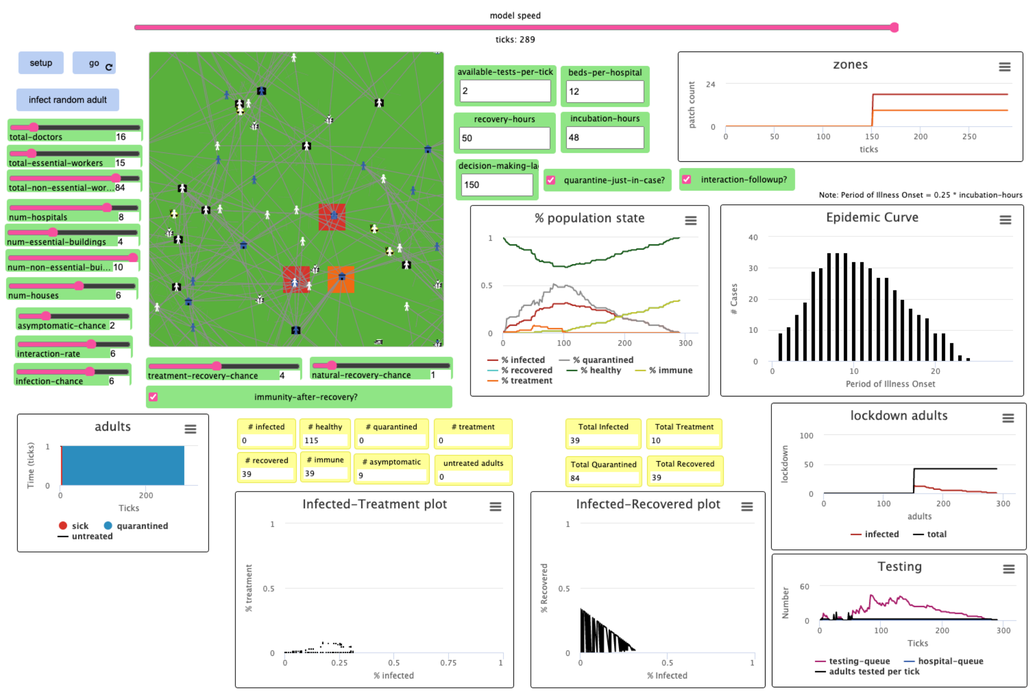

Figure 1: *Disease Outbreak Model Simulation using NetLogo: https://deekshasinghvs.github.io/disease-outbreak-model/*

4 Methodology

256 unique simulations x run 3 times per city scenario = 3072 total simulations

	Population A	*Population B (>A)*
High Resources	Case 1_1	Case 2_1
Low Resources	Case 1_2	Case 2_2

Input → **The Model** → Output → Ticks Dataset

- # Important Features: 1, 2, 3, *4*, 5
- # Clusters: 3, *4*, 5, *6*, *7*, 8, *9*, 10
- Tick Metric: ***Min-ticks***, ***Avg-ticks***, ***Max-ticks***

K-Means → XGBoost → XGBoost Model → **Accuracy Dataset**

5 Results

1. Initial conditions matter for analysis, best accuracy is found when considering k=3, max-ticks and # features = 3
2. Initial conditions affect optimal intervention strategies and the crisis trajectory (and that the three are, in fact, linked)
3. Many non-intuitive results arise (eg: reducing the decision-making-lag does not always result in a shorter simulation completion time)

Assuming the same socio-economic, cultural and political context within all four cities...

Is a "Smart" Healthcare Transformation Possible?

Low Resource Cities	**High Resource Cities**
Control Measures >> R&D	Control Measures << R&D
Vital Initial Testing Days	Data sensing and collection is vital
Social Security Backup	Crisis Apropos Policy-making
Priorities	
• **Early Detection + Treatment** • **Smart Community** • **Strict Control Measures**	• **Real-time Policies based on R&D** • **ICT for Data Sensing and Collection**

No. As a result, each case's smart city strategy too will differ

If such a unrealistically simply model is unable to converge to a one-size smart city solution. Then, a **generalized smart city solution for a real-world city, with all its nonlinearities and complexities, is <u>not</u> optimal.**

6 Contributions

1. An agent-based model which highlighted that initial conditions affect optimal intervention strategies and the crisis trajectory (and that the three are, in fact, linked)
2. A case-study led hypothesis, which posited that a one-size-fits-all generalised framework is not optimal when planning for smart cities, and lastly...
3. A key meta-result: an analysis methodology for **holistic** and **quantitative** identification, while reducing dimensionality, of important features in (smart) city planning models.

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