

A nighttime cityscape with a road in the foreground showing light trails from traffic. The background features several tall, illuminated skyscrapers and a modern building with a curved roof. The sky is dark with some clouds.

# Issues in measuring city resilience: network externalities, time and inertia

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Measuring the Resilience of Cities: the Role of Big Data  
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# Future Cities – A System of Systems (SoS)

- Future cities will be critically dependent on greater connectivity, dynamic evolution of their infrastructure, transport, business, energy, water, security, other city wide services and social inclusion
- New city wide SoS architectures will be required to ensure optimal quality of life and efficiency of services
- Ubiquitous sensing will be required to provide accurate and reliable monitoring of critical resources
- Intelligent autonomous decision making environments will be key to support and manage the transition from current state to future state cities
- New modelling techniques to architect, design, implement and maintain future cities whilst maximising positive emergent behaviours
- 
- Methods of detecting outliers (Schmidt / Binner)




# SoS implies looking beyond the additive



- Additive: From input-output analysis; stockpiling; infrastructure mapping (city as sum of its parts)
  - Cumulative: From positive externalities; feedback mechanisms (city as more than sum of its parts)
  - Networked: From positive (networked) externalities; network theory. One may consider that networked (smart) cities are most resilient....BUT
- 




# However resilience is not (always) more than it's parts

1. Negative network externalities
  2. Temporal as well as geographical resilience
  3. Inertia (sub-optimality) can be *positive*
- 

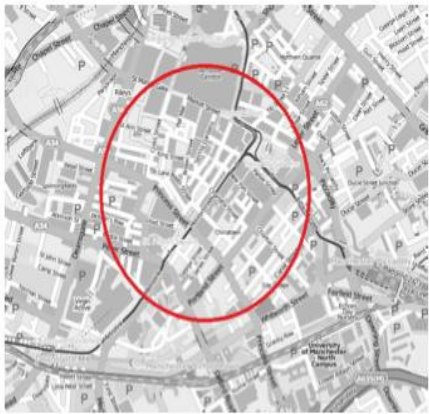


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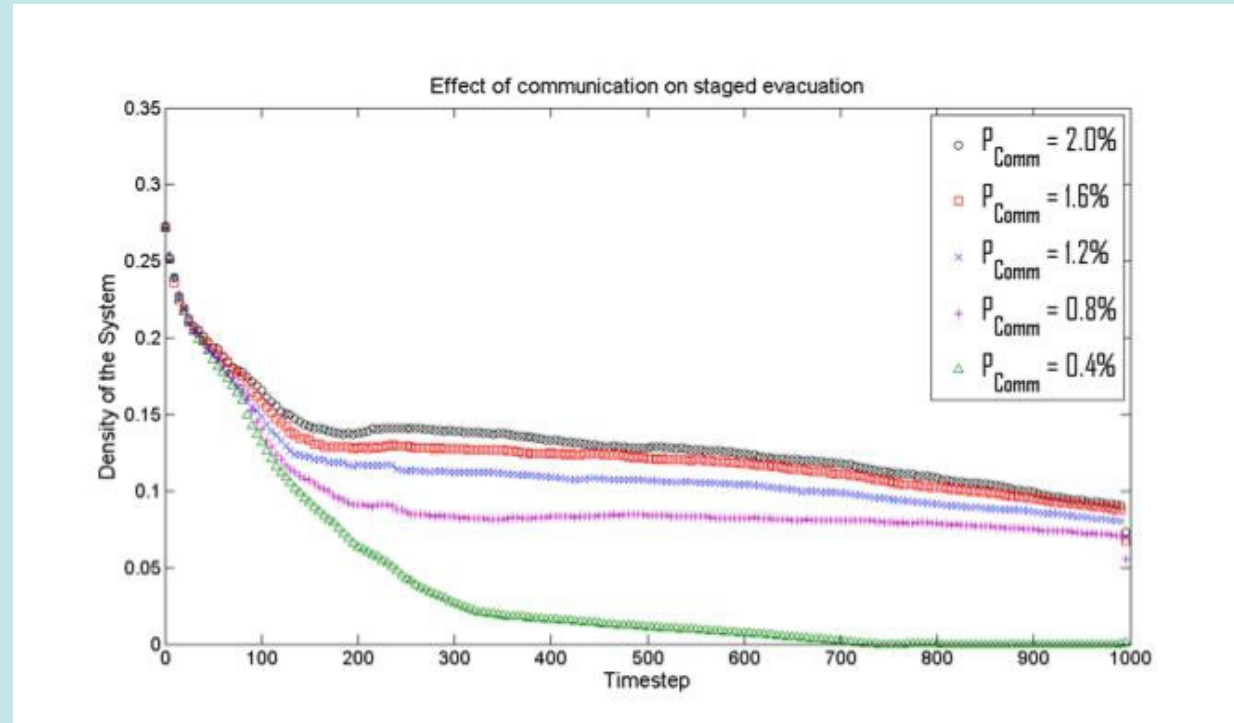
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- 

# Manchester evacuation simulation

- Greater use of mobile / social media communication the slower the evacuation
- Congestion is greater in longer evacuation procedures than shorter ones



F  
1  
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c  
b









Emergency Broadcast

**BBC**







**#leavemanchester**





**BuzzFeed**

@buzzfeed

Princess street is closed - use alternative evacuation routes

12563

RETWEETS

149

FAVORITES



9:38 AM - 7 Jun 2023 - via Twitter · Embed this Tweet

Reply Delete Favorite



**Domino's Pizza**

@dominos

Public service announcement - all outlets in Manchester are CLOSED, heavy congestion in Princess street. #getoutmanchester

3

RETWEETS

567

FAVORITES



9:38 AM - 7 Jun 2023 - via Twitter · Embed this Tweet

Reply Delete Favorite



**HIPSTER RUNOFF**

@hipsterrunoff

Stuck in traffic in Princess street - help!

65

RETWEETS

12

FAVORITES



2023 - via Twitter · Embed this Tweet

delete Favorite







# Conspiracy theories.....



Police car at explosion scene.....

False flag operation.....

Secret arrests and detentions.....

Water supply contaminated.....




# What happened?

A nighttime cityscape with light trails from traffic and illuminated buildings, serving as a background for the slide.

- Explosion of a real, or simulated, dirty bomb
- Hacking old media through broadcast signal intrusion
- Multiple twitter accounts sending hashtag #leavemanchester
- Sock puppet accounts confirming message
- Sock puppet accounts mis-directing traffic
- Exposure and / or secondary attack
- Recovery hampered by multiple, pre-prepared conspiracy blogs



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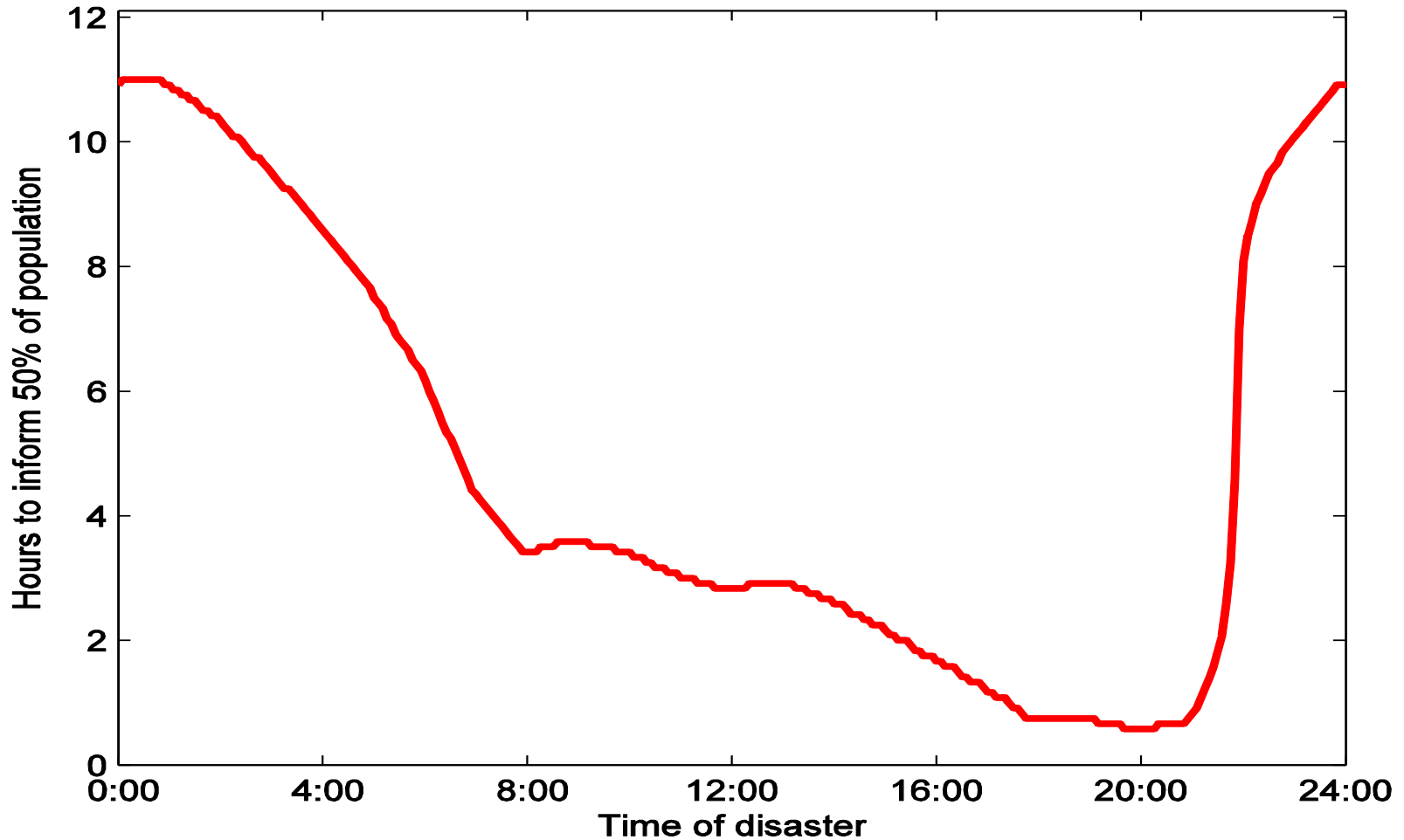
# Temporal factors

- City changes rapidly from day to day, moment to moment
  - Docklands bombing
  - Buncefield explosion
- ...both fortunate as low number of people in those areas at the time!




# Speed of Information Spread

Time to inform 50% of population vs. time of disaster






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# Path dependence

A nighttime photograph of a city skyline with light trails from traffic on a highway in the foreground. The lights are blurred, creating a sense of motion and energy.

- Inertia as the driving force behind city resilience!
  - Population protection strategies may be sub-optimal due to path dependence
- 
- A close-up, low-angle shot of a highway at night, showing long, curved light trails from cars moving through the frame. The colors are primarily red and white, indicating taillights and headlights respectively.



# Why hiatus in population preparedness (1963 – 2004)

- Political pressures from inside (MOD) and outside of government (CND, local government)
- Difficulty of additive approach to resilience (measuring PF of all buildings)
- Changed model of human behaviour from psychodynamic / behavioural to rational / cognitive
- ...but led to institutional changes in government that paved the way for significant changes (CCS, community resilience, abolition of the COI)



# Barriers to effective joint thinking and acting

- Clashes between professional cultures (Webb and Vulliamy, 2001: 315).
- Legislative frameworks, political accountability, funding regimes, agency norms, jurisdiction, means of data collection (Ambrose, 2001:18).
- Structures, procedures and languages (Eden and Huxham, 2001: 374).
- Lack of clarity about purpose (Goss, 2001: 95).
- Issues of trust ∴ historical competition ∴ problems of joint ground.
- Perverse and/ or unanticipated outcomes... the difference between realised and emergent strategy.

A nighttime photograph of a city skyline with several illuminated skyscrapers. In the foreground, a multi-lane road is shown with long-exposure light trails from cars, primarily in red and white. The sky is dark, and the overall scene is lit by city lights and street lamps.

# Conclusions

- wise cities not smart cities
- city can be more / less than sum of parts -  
redundancy can be useful, need to look at  
complex interdependencies
- temporal as well as geographical resilience  
is important