LSE Works: LSE Complexity Group

An App That Can Save Lives

Professor Eve Mitleton-Kelly

Director, Complexity Research Group, LSE

Dr Paul Lukowicz

Scientific Director, Embedded Intelligence German Research Center for Artificial Intelligence (DFKI)

Nestor Alfonzo Santamaria

Lead in business resilience, City of London Corporation

Professor Paul Kelly

Chair, LSE

LSE events

Suggested hashtag for Twitter users: **#LSEworks**

LSE Works Seminar
24 January 2013 at LSE

An App That Can Save Lives

Eve Mitleton-Kelly
Director
Complexity Research Group
London School of Economics

LSE Works Seminar Programme

- Outline of SOCIONICAL EU FP7 project
- LSE contribution & research – EMK
- The science behind the app – PL
- A policy maker's perspective – NAS
- Q & A

LSE COMPLEXiTY research programme

The SOCIONICAL EU FP7 Project

- A 4-year EU project - 2009-2013
- Funded by FET
- 14 Partners
- 10 Countries

- Looking at evacuation following an emergency
- Traffic flows
- AmI technology to facilitate evacuation and traffic
- Underpinned by complexity theory

LSE Complexity Research Group

- Developed a theory of complex social systems
- An integrated methodology using both qualitative & quantitative approaches (e.g. ABM)
- To address apparently intractable problems
- By identifying the multi-dimensional problem space
  - (social, cultural, political, economic, technical, physical, etc. dimensions)
- & creating endogenous enabling environments that co-evolve with a changing exogenous external environment
- Based on analysis using the principles of complexity

Theories

Natural sciences

Dissipative structures
chemistry-physics (Prigogine)

Autocatalytic sets
evolutionary biology (Kauffman)

Autopoiesis (self-generation)
biology/cognition (Maturana)

Chaos theory

Social sciences

Increasing returns
economics (B. Arthur)

Generic characteristics of complex co-evolving systems

self-organisation

emergence
connectivity
interdependence
feedback

far from equilibrium

space of possibilities

co-evolution

historicity & time

path-dependence

creation of new order

The LSE Complexity Group Contribution

- Primarily work with policy makers in the UK and other countries (e.g. Malta, Germany & Italy, Spain (training))
- Set of face to face interviews with policy makers to understand their challenges when preparing and implementing contingency plans
- Meetings & workshops with:
  - Cabinet Office
  - Home Office
  - London Ambulance Service, London Fire Brigade
  - City of London & Metropolitan Police, British Transport Police
  - Transport for London, London Underground
  - LOCOG
  - Greater London Authority, City of London Corporation
  - Westminster Borough Council
  - Pageant Master, and others

The LSE Complexity Group Contribution

- Analysed 7/7 documents and looked at 9/11 literature
  - contribution to papers on trust and decision making
- Attended exercises by the LFB & a Local Authority
- Organised trials of the Socionical app during:
  - the Lord Mayor's Show in London, 2011 & 2012
    - Control Centre at Guildhall in 2012
  - during the 2012 Olympics within the City of Westminster
  - West End Live Festival, 2012
- Development of City of London Police app
  - for the City business community
  - with special warn & inform feature to be activated in case of emergency (future seminar)

SOCIONICAL Design Methodology

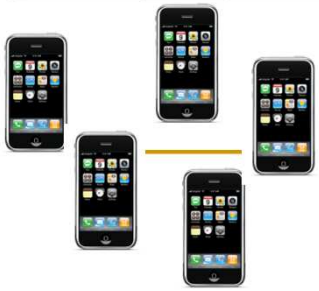
scenario boundary conditions

WP 11

sensing, information processing and spread

impact on human decision making and social dynamics

impact on physical dynamics (evacuation or traffic)



Lead on 2 Deliverables

- 1. Seminars for policy makers:
  - @ LSE in 2010
  - @ City Hall, jointly with GLA, 2012
  - @ Brussels jointly with Smartcare, Italy, 2012
  - @ Munich jointly with TUM, Germany, 2012
- 2. Set of Guidelines & Recommendations for Policy Makers
- + Organised and edited volume to be published by Springer in Spring 2013

SOCIONICAL APP

- For iPhones in 2011 & for Androids in 2012
- App provides the user with information about the event, e.g. Lord Mayor's Show
  - Transport advice on how to reach the location*
  - Information on the floats*
  - On historic buildings in the immediate location
  - Location of loos and St John's Ambulance
- Sends location-based information seen as a heat map superimposed on a Google map that shows the density, movement & direction of a crowd
- In an emergency or just serious overcrowding, emergency personnel can send a location-specific message to users

SOCIONICAL App Ethical Considerations

- Only active during the day of the event
- & only within a geographic boundary around the event
- Clear explanation of the purpose of the app and how the data would be used
- Anonymous with no access to individual users' identity
- All data were amalgamated
- Observed European Commission regulations and cleared by SOCIONICAL Ethics Cttee

LSE team

- Organised the trials and were part of the Control Centre during both LMS trials
- Discussed impact with policy makers & conducted face to face/telephone, semi-structured, 1.5 hour interviews
- Designed a survey for LMS app users
- Conducted anonymous telephone interviews (73 in 2012)

Findings On LMS-app by Policy Makers

Purpose of crowd monitoring:

- To provide information on the density and movement of a crowd
- Use info to enhance security and safety
- Aid the appropriate deployment of resources
- Identify abnormal patterns in movement or density that may become critical

The LMS-app provided the following features of value to PMs:

- Provided an overview, not available by usual means of crowd monitoring
  - Better overview than CCTV
  - Can cover larger area at any one time, for longer and is cheaper than an helicopter

Findings On LMS-app by Policy Makers

- Especially valuable during the Fireworks display, at night, when CCTV cameras are not effective
  - Helicopters do have thermal imagery technology, but they are expensive and need highly trained personnel to fly them and on the ground
- The feature found to be most useful was the geographically targeted messaging service – to warn and advise app users in a very specific location
- A potential problem can be detected quickly and corrective action could be taken immediately
- It can be used to plan position of barriers, ambulance stations, loos, etc. more accurately

Findings On LMS-app by Policy Makers

- Using the heatmap was intuitive and did not need any training
  - but it would need a trained officer to identify potential critical issues and take appropriate action

"One of those pieces of kit that you do not realise its true potential until you use it"

Weaknesses:

- It does not provide actual numbers
- The heatmap only reflects the number of users and only those with an active app

Some Findings: Lord Mayor's Show Survey & Telephone Interviews

- 70% would consult iPhone app for advice during an emergency

- If they were running for their lives it would depend on:
  - Type of emergency
  - Whether official personnel were present

Lord Mayor's Show
Survey & Telephone Interviews

- Would take that advice if:
  - It came from an authoritative source they could trust (e.g. the police or emergency services)
  - The information was reliable and consistent with what they were experiencing
  - The technology was robust

- 30% specified that they would prefer to follow instructions from figures of authority who were present rather than from a mobile phone

Lord Mayor's Show
Survey & Telephone Interviews

Would communicate the information to others

- Face to face with those in the vicinity
- Using twitter and other social media for those further afield

Crowd Behaviour

- Overcrowding at exit periods, e.g. after the fireworks, combined with physical barriers, led to crowd frustration and potentially risky situation

Insight:

- Visualisation not enough to establish position of barriers
- Need additional information of context and understanding of crowd behaviour
- Provided through telephone interviews

Interviews with Policy Makers: Emergency Planning in 4 contexts

- Malta: Island-wide – major incidents e.g. flooding
- Munich: Event based emergency planning
- London 1: City-scale mass evacuation
- London 2: City transport infrastructure emergency

Malta: Island-Wide Major Incidents

Objective:

- Save lives, property and the environment, in that order of priority

Challenges:

- Gathering of up-to-date **data** when preparing for earthquakes
- Need to know about current **building materials** and how they react to stress
- **Demographics** and mobility of those who may be affected

Malta: Island-Wide Major Incidents

Challenges:

Flash floods happen very quickly and there is no time to warn citizens

- Malta Met Office studying how flash floods develop

Preparation:

- Work on modular design of common elements e.g. a bomb threat or an earthquake would involve the collapse of buildings or structural failure
- Table top and practical scenario exercises with actors

Munich: Event Based Emergency Planning

Challenges

- **Safety** of those attending an **event**
- Not standard formula but need to take a **combination of factors** into account
  - e.g. not just numbers but also type of event (at classical concert can have higher numbers without same risk), and what else is happening at the event (e.g. fireworks, etc)
  - Distribution, density and location of participants and potential pressure points (e.g. front of stage at concerts)
- **Communication** between Fire Brigade and Organisers or between the different Emergency Services

Munich: Event Based Emergency Planning

Challenges

- To **avoid panic**
  - Exits visible and not obstructed
  - **Communication** (may need to leave a different way to the way they came in)

- Need good **overview**, especially when open air (e.g. Oktoberfest)
  - Pictures from Policy helicopter not just-in-time
  - **Communication** with organisers, participants, other services, etc

London 1: City-Scale Mass Evacuation

Context

Support the 33 Local Authority in pan-London emergencies

Evacuation following an **emergency affecting more than 100,000** people and involving all emergency agencies – not event planning

- e.g. tidal flooding

London 1: City-Scale Mass Evacuation

Challenges

Accepting the need for a mass evacuation and preparing comprehensive plans

- Understanding the risk
- **What** and **who** would need evacuation & **why**?
- Within what **timeframe**?

Evacuation usually associated with an event

- Events have worked out systems of evacuation from a single location
- **Mass evacuation** would involve several locations and may have an element of randomness as to who would be affected

London 1: City-Scale Mass Evacuation

Communication

With public: warn & inform

Biggest difficulty would be getting the public to comprehend that risk and that imminent threat to life

- Primarily through radio & television
- Alerting tools (apps, emails, messaging, etc) have not been taken up widely by the public – they do not see the risk
- Opt-out rather than opt-in system using telephone landlines – can alert people within a postcode at risk
- Increasing use of social media

London 1: City-Scale Mass Evacuation

With other <u>emergency agencies</u>

- Airwave
- Face-to-face at strategic level through Strategic Coordination Group
- + email, telephone etc at operational levels

Convincing policy makers to **make the resources available**, for a relatively rare albeit catastrophic event, especially in a climate of financial constraint

- Not just capital investment, but also cultural investment (how many Twitter followers would a Borough Council have?)

City Transport Infrastructure Emergency Planning

London-wide overview on transport

- Tube, buses, DLR, rail, etc.
- Working with the Police and all emergency services + Local Authorities during an emergency

City transport infrastructures are highly interdependent and a breakdown in one will impact others

- e.g. if there is an emergency at an underground (tube) station, then it will impact bus operations, traffic, pedestrians, National Rail, etc. etc.
- Therefore need **integrated plans** to minimise the domino effect and to absorb the impact

City Transport Infrastructure Emergency Planning

- Need to both understand the risk and how to mitigate it, when risks are at multiple levels and of different types
  - e.g. societal, industrial, environmental (e.g. flooding, bad weather) risks

London Resilience Partnership – all agencies involved in an emergency – produce a London Strategic Emergency Plan for mass evacuation

Provides a framework for more detailed local plans for transport, by Local Authorities

- Need to allow for self organisation and exploration of the space of possibilities by citizens during an evacuation

City Transport Infrastructure Emergency Planning

Challenges

Understand the overall picture of the event & coordinate

- What are the emergency services, local authorities, businesses, etc. doing?
- What is the size, scope and likely length of the event (hours, days, longer)?

Get factual information quickly out to the public

- What messages is the community receiving via the media?
- Use technology and social networks to full effect
- Send out info via Twitter, Facebook, SMS texting, email, websites, hard copy maps, etc.

City Transport Infrastructure Emergency Planning

Accurate predictions on weather, when Met Office & Environment Agency are risk averse

- Repeated false alerts

Decide what needs to be done to provide a service and then return to normality

Before an incident:

- A challenge is to encourage people to **think about the future**
- Understand the likely **impact** and the associated **risks**
- What **can and cannot be done**
- Understand how **people** are likely to respond – talk to them
- **Learn** from other incidents what works and what does not work – use experiential learning techniques
- Need process for **passing on knowledge** and experience before people with expertise retire

Some Conclusions

- The challenges are multi-dimensional (physical, cultural, organisational, technical, power structures, etc.)
- One is common in all contexts: effective & timely communication
- The Socionical app could contribute as part of a tool kit, by sending immediate and **location targeted** information & advice
  - a. to the public
  - b. as an additional channel between the emergency services
- Research continuing on overcoming current problems with the comms infrastructure being overstretched or collapsing during an emergency

Thank you

Eve Mitleton-Kelly

E.Mitleton-Kelly@lse.ac.uk

www.lse.ac.uk/complexity

LSE Works: LSE Complexity Group

An App That Can Save Lives

Professor Eve Mitleton-Kelly

Director, Complexity Research Group, LSE

Dr Paul Lukowicz

Scientific Director, Embedded Intelligence German Research Center for Artificial Intelligence (DFKI)

Nestor Alfonzo Santamaria

Lead in business resilience, City of London Corporation

Professor Paul Kelly

Chair, LSE

LSE events

Suggested hashtag for Twitter users: **#LSEworks**