SMART Buildings: A way forward for evacuation safety?

DANIEL NILSSON, DEP. OF FIRE SAFETY ENGINEERING, LUND UNIVERSITY
CENTRE FOR SOCIETAL RESILIENCE, LUND UNIVERSITY
Challenges and opportunities

- Challenges
  - Increasing complexity – difficult to evacuate
  - Larger buildings – more people

- Opportunities
  - Sensor technology – measuring fire and crowd parameters
  - Egress modelling – real-time simulation
  - Evacuation systems – dynamic notification and way-finding systems
Complexity and size

Stockholm Metro – Station Fridhemsplan
(simple station – 2 metro lines)
Complexity and size

Photo by Nicolas Lannuzel

Photo by Mirko Junge
Dynamic crowd management: Adaption to changing conditions

SENSORS – PREDICTION – STRATEGIES – DYNAMIC EVACUATION SYSTEMS
Dynamic crowd management

[Diagram showing the cycle of dynamic crowd management:
- Sensor technology (fire or threat)
- Prediction of crowd movement (real-time modelling)
- Evacuation strategies
- Sensor technology (crowd)
- Dynamic evacuation systems
- Crowd movement]
Dynamic crowd management

- Sensor technology (fire or threat)
  - Prediction of crowd movement (real-time modelling)
    - Evacuation strategies
      - Dynamic evacuation systems
        - Crowd movement
          - Sensor technology (crowd)
Dynamic crowd management
Sensor technology (crowd)

- Monitoring location and movement of people
  - Existing sensors
    » CCTV
    » Ventilation, etc.
  - Novel sensor technologies
    » Laser scanners
    » Mobile phones
    » Identity cards (RFID)
Dynamic crowd management
Prediction of crowd movement

- Prediction of crowd parameters
  - Location, crowding, bottlenecks, etc.
- Real-time modelling (or faster)
  - Existing models
    » Simple models (Cellular automata)
  - Possible way forward
    » Remote computational resources
    » New (more advanced) approaches
Dynamic crowd management

1. Sensor technology (fire or threat)
2. Evacuation strategies
3. Prediction of crowd movement (real-time modelling)
4. Sensor technology (crowd)
5. Dynamic evacuation systems
6. Crowd movement
Dynamic crowd management

Sensor technology (fire or threat)

Prediction of crowd movement (real-time modelling) → Evacuation strategies

Sensor technology (crowd) → Dynamic evacuation systems

Crowd movement
Dynamic crowd management
Dynamic evacuation systems

- Evacuation systems that change depending on the chosen strategy
  - Notification systems
  - Way-finding systems
- Design is not a simple and straightforward process
Dynamic evacuation systems

- Evacuation systems that change depending on the chosen strategy
  - Notification systems
  - Way-finding systems
- Design is **not** a simple and straightforward process
Dynamic evacuation systems

• Example – Way-finding system
  – How can people be influenced to use an exit?
  – How can people be influenced not to use an exit?
  – Can exit choice be influenced during movement?
Dynamic crowd management

- Sensor technology (fire or threat)
  - Prediction of crowd movement (real-time modelling)
  - Evacuation strategies
- Sensor technology (crowd)
- Dynamic evacuation systems
- Crowd movement

Diagram illustrating the process of dynamic crowd management.
SMART Buildings: A way forward for evacuation safety?

DANIEL NILSSON, DEP. OF FIRE SAFETY ENGINEERING, LUND UNIVERSITY
CENTRE FOR SOCIETAL RESILIENCE, LUND UNIVERSITY