Future Resilient Transport Networks

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(with thanks to Dr Andrew Quinn)
Change is normal

- EU roadmap Future of Transport 2050
  - Modal shift – “business as usual” not an option

- Over past 50 years in UK
  - 800% increase in road traffic
  - 1:1 → 8:1 road : rail tonne kilometers of freight moved

- Changing climate
  - Warmer wetter winters
  - Hotter drier summers
  - More extremes

- Changing social environment
  - Travel more and for different reasons
Contents

• FUTURENET and MOWE-IT
  • Two projects with very different methodologies
• Other road based resilience project at UOB
• Other rail based resilience projects at UOB
• Conclusions
FUTURENET

• EPSRC funded project – Universities of Birmingham, Nottingham and Loughborough, TRL, BGS, HR

• Tools to help define the shape of the transport network that will be most resilient

• Resilience calculation methodologies for
  • Complete routes
  • Specific infrastructure

• Identification of issues to be addressed
  • Where are the critical points of failure?
MOWE-IT

• EU funded project led by VTT in Finland
• To mitigate natural disasters and extreme weather phenomena on transport system performance
  • For transport operators, authorities and users
• To identify existing best practices
• To develop recommendations for mode-sectors and cross-modal, short and long-term
Two approaches

FUTURENET
- Modelling based
- Future focus
- ‘Resilience’ quantification
- Detailed, data driven

MOWE-IT
- Case-study based
- Historical focus
- Impacts and recovery
- Broad recommendations

www.arcc-futurenet.org
www.mowe-it.eu
FUTURENET

• Three viewpoints
  • Policy makers
  • Infrastructure manager
  • Traveller

• Quantitative and qualitative approaches
  • Numerical values of “resilience”
  • Consideration of different futures
Plausible Futures

• Although we don’t know the destination we know the factors that could change:
  • Social, Economic, Environment
  • These need to be included in any analysis
  • Not one future but many possible futures

• What is resilience?
  • Multiple perspectives required
  • Users, infrastructure operators, service providers
FUTURENET– model integration

• Integration of
  • Social scenario studies
  • Travel behaviour studies
  • Meteorological / climate studies
  • Transport modelling
  • Weather effects on infrastructure and vehicles
The approach

• Levels of calculation
  • Calculation of resilience of complete routes (London-Glasgow chosen as example)
  • Detailed calculations of local effects of different weather events (landslide, flooding etc)
• Ideal calculation would begin with local modelling and aggregate results for complete route
FUTURENET modelling

- Modal choices
- Numbers of users
- Types of users
- Attitudes to disruption
- Infrastructure condition
- Climate change
- Weather Generator
- Not one but many iterations

Calculating Resilience

Statistics of network behaviour

Delays and Recovery
• Definition of resilience
  • Resilience is the ability to provide and maintain an acceptable level of service in the face of challenges to normal operation
  • Acceptable service level different for different sectors
Calculating resilience

1000 journeys today

1000 journeys in 2050

Change in resilience

Measured as changing number of journeys considered to have ‘failed’
Percentage change of rain-related journey failures relative to baseline for 2050s and 2080s (central estimates)
FUTURENET corridor analyses

• Scaleable
  • Route
  • Section
• Weather vs Resilience
  • Quantified
• Visualisations
  • Fly-through
• Data can be interrogated
• Requires high quality data
FUTURENET Outputs

• Resilience calculation methodologies for
  • Complete routes
  • Specific infrastructure

• Identification of issues to be addressed
  • Spatial coherence of weather predictions
  • Requirement for high quality asset data
MOWE-IT (rail) case studies

- Weather types
  - Flooding / heavy rain
  - Wind
  - Snow / winter conditions
- Analysis
  - Meteorological situation
  - Impact on rail infrastructure and operations
  - Event management
  - Repairs
Flooding/heavy rain

UK 2007

UK June 2012

Saxony 2002

Alpine flooding 2005 (Switzerland, Austria, Germany)
Wind/storm

- Storm Kyrill 2006 (UK, Netherlands, Belgium, France, Germany, Poland, Austria, Czech republic, Denmark, Switzerland, Slovenia)
- Storm Gudrun, Sweden 2005
- Storms Lothar and Martin 1999 (France, Switzerland, Germany)
- Hurricane Sandy 2012
Snow/winter

Sweden, heavy snow 2009/2010

Channel Tunnel 2009

Stockholm 2001-2002

Southern Finland, extreme winter 2009-2010

Winter 2009-2010
Guidelines and Recommendations

Weather-specific
- Long-term preparation
- Before
- During
- After

Generalised
- Applicable in most cases
- Long term-preparation, event management, recovery
- Areas: weather forecasts, vehicles, infrastructure, equipment, operations, information, cooperation, staff
Other road based projects

- PhD - An investigation of the impact of climate change on road maintenance
- PhD - A risk based methodology to assess road drainage maintenance requirements in the light of climate change
- PhD - The Resilience of the Jamaican Road Network to the effects of extreme weather events
- DIFID - Promoting Sustainable Rural Access and Developing a Risk Based Vulnerability Assessment for Rural Communities in the Changing Climate of Sub Saharan Africa
- PhD - Road Pavement Deterioration Modelling Affected by Climate Change – HDM-4
Road Pavement Deterioration Modelling Affected by Climate Change – HDM-4
Other rail based projects

- **LivingRAIL**
  - Barriers (technical and policy) to modal shift to rail
  - Such modal shift must consider disruption

- **RSSB – TRaCCA**
  - Developing knowledge throughout the rail industry
  - Metrics and Systems thinking in disruption analysis

- **RSSB - Wind Alarm systems**
  - Using new NR weather data to improve preparedness, response and recovery to extreme events

- **REWARD**
  - NR risk mapping based on disruption and weather data
  - Novel ways of presenting information and decision support
The REWARD project
June 28th 2012
Conclusions

• ‘Risk’/’Resilience’ needs to be in context
  • risk of what? to who?
• History can be used – broadly
• Detailed models can be used – high quality data required
• Transport is a complex system
  • System approach is required
  • Broad recommendations are easy(!)
  • Detail requires significant investment
• Systems near capacity are not resilient