



Putting the FUTURENET methodology into practice













Summary

Users' viewpoints Who are they? What might they want?





Futurenet OutputsThree examples

Potential uses

Including a topical possibility





Using FUTURENET Outputs

Three viewpoints:

>Users of the System

Travellers, Freight hauliers





Infrastructure managers

- Controllers, Maintainers
- Construction planners

>Policymakers

National and Local Government
 Planners, Regulators, IIC(...?)



Policymaker

Interest in long term strategies

- > e.g. where to prioritise investment, and when to invest
- A long term need
 - ➤ 30 to 50 years? (qv: IIC...)

FUTURENET simulations

- Forecasts, outcomes
- Range of inputs => options' analyses
- Quantification of future resilience
- Articulate concepts
 - Visualisations provide tools to influence Decision Makers
- Improved science and data over time
 - Confidence in Policy decisions in face of eg: uncertainty arcc



NF7

Infrastructure manager

Interested in impact of weather

> on specific infrastructure, on levels of service

Immediate to short term need

Today's disruption, tomorrow's maintenance priority?

Futurenet simulations

- Detailed assessment of local effects v/v different weather events
- Predict disruption reroute traffic?
- Learn and improve current data better future resilience
- Targetted plans
 - Service recovery, Maintenance, Renewal
 - Priorities => better vfm for constrained budgets





Traveller, Freight haulier

- Interested in journey modal choice?
 - Cost Timing Comfort Predictability Emissions Utility??
- > An immediate need (as opposed to...)
- Futurenet simulations
 - An enabler towards the informed User
 - Calculation of journey resilience of a route
 - Cost/ Time/ Quality can be analysed
- Informed travellers can optimise travel plans
 - Feedback into Policy decisions



* NOT available in your App Store. It's just an idea...for now...



FUTURENET methodology

How does this translate into an aid to the User?

Three Examples of Outputs...





FUTURENET example outputs

Journey resilience
 Rain-related delays
 Seasonal v annual
 Motorway example





- Delay projections
 - Weather event-related delays
 - Rail network example

Corridor analyses

- Weather event sequences
- > Multi-node, multi asset
- Motorway example



Journey resilience approach

• Example from Prof. Dixon's presentation:



Journey resilience projections

- Simplified model run between Glasgow and London, using relationships between rain, flow and speed
- Simulated journeys under baseline climate and under medium emissions for the 2050s and 2080s
- Simulated one journey a day for 30 years
- Repeated this 100 times for each emission scenario to give a range of different climate outcomes
- Calculated the percentage change in failed journeys (30 minute threshold) compared to baseline
- Determined the different trends in summer and winter transport disruption



Cross section of baseline and projected 2050s summer rainfall totals for London-Glasgow route





change for rain-related journey failures







Journey resilience projections

- Demonstrates the seasonality of climate change
- Net change in rain-related journey failures negligible over Year
- However, there are large projected divergences in seasonal failure rates
- Can be repeated for other failure types e.g. rail buckling
- With addition of greater level of infrastructural, geological and hydrological data it may be possible to identify critical links and locations

This links to other projects such as the Network Rail funded REWARD project which are looking at critical locations where delays have a propensity to propagate widely



Cumulative distribution function for projected journey failures



Plume plot for projected journey failures

Using resilience projections

Resilience projections:

- Predict trends over seasons, now and into the future
- Identifies seasonal differences for rainfall
- Help to focus
 - On critical parts of the infrastructure system
- Provide baseline data
 - Thresholds, inputs can be varied, to assess different futures and user needs

Example uses:

- Response planning
- Medium term improvement plans eg: drainage
- Short term maintenance
 planning

Immediate use by Infrastructure Managers and Policymakers

Development required to enable targetting of resources, information to end users

Delay Propagation

- Example similar to Prof. Baker's animation
- Two 'event' sites shown
 - > Tebay, Cumbria, West Coast Main Line
 - Birmingham New Street
- Illustrate wide dispersal of delays
- Note limitations
 - Recording of delays v line closures
- Result of 1960s Optimisation??
 - Redundancy removed => poor Resilience??



Probabilistic delay propagation 1



- Probability of delays projected across network
 - Wide spread

Birmingham New Street incidents

Probabilistic delay propagation 2

 Wider spread than those centred on Birmingham New Street



Tebay-Penrith incidents

Using delay projections

Delay projections:

- Can identify the most critical parts of network
- Quantified impacts
- Visualisation a powerful persuader
 - Joint planning system wide
 - Beneficiaries might not be those that incur costs
 - Regulators can step-in
- Fosters joined-up thinking

Example uses:

Prioritising long term infrastructure investment
Response planning – location of kit
Resilience planning

Infrastructure Managers and Policymakers



Corridor analyses

- Motorway example
- Scaleable
 - ➢ Route
 - Section
- Weather v Resilience
 - Quantified
- Visualisations
 Fly-through
- Data can be interrogated





Weather Event Sequencing (WESQS)

- > All 2050 (LMH) taken into account
- 16 WESQs for Garstang 2050 selected

Below four examples showing variations in weather years 02_029 used for further examples











Resilience v Weather and Futures



- Scaled weather from UKCP09 Weather generator
- Future traffic, Dingwall et al
- Capacity v Demand
- White space = Resilience



Corridor section and resilience for one node











Add serviceability and ultimate limit states

- Imbalance between demand and physical capacity drives resilience
- Plot into one graph
- Still just for one node









A day in the life of node 906

Hourly sequence

Capacity v demand change as situation is stressed by weather event

- Into and out of SLS/ ULS
- ➢ 2013 Plot
- Aggregate into 'tartans'



Multi-node, multi-temporal assessments physical capacity and resilience tartans

Taking forecasted physical capacity reduction (WESQ 02_029) as basis, and using annual demand forecasts for 2013 and 2050M, and expression of resilience can be achieved



Capacity 2050 (WESQ 02_029)

Resilience 2013 north-bound



DNA of individual processes CRFs



Illustrations of possible outputs local v. regional scale



Regional



Local

Scale of Resilience





Site specific resilience

Aggregated resilience



Illustrations of possible outputs – resilience N- v. S- bound





Window <u>H</u>elp Tools

overview flight bedrock25



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Using corridor analyses

Corridor analyses:

- Can identify the most critical parts of network down to asset/ component level
- Quantified impacts
- Scaleable
 - Route or Section
- Visualisation a powerful persuader
 - Easy to see the vulnerable nodes
 - Not just pretty pictures the data can be interrogated

Example uses:

- Prioritising long term infrastructure investment
- Medium term improvement plans eg: resilience building
- Planning down to asset or even component level

Immediate use by Infrastructure Managers and Policymakers

Potential use by Users

Potential? Great Western Route in Devon?





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Thank you

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