Snakegrid and Network Rail

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Presentation Review

Railway Industry and NR - Chris Preston
ORR and ORBIS - Chris Preston
Survey grids and Snakegrid - Chris Preston & Jonathan Iliffe
Business benefits for NR – Chris Preston
Railway Industry Structure

- Secretary of State:
  - Sets strategy
  - Determines rail budget
  - Lets franchises

- Network Rail
  - Delivering an efficient Network
  - Accountable for reliability
  - Leads industry planning

- ORR
  - Prices rail outputs
  - Safety regulation

- TOCs
  - Delivering services for customers
Rail Statistics

Britain’s railway:

- 4 million+ passengers every weekday - that's over 1.5 billion per year
- 500,000 London commuters every week
- £1.84m spent daily operating, maintaining and renewing the railway
- Rail travel continues to be the safest form of public transport in Britain
- 1 million more trains, carrying 1 billion more passengers compared to 10 years ago
- Railway not designed for these numbers and even though huge investment much of network running at 100% capacity
- High passenger expectation
- Need to deliver more for less money while being more trustworthy and transparent
What is Network Rail?

Network Rail is the owner and operator of Britain's railway infrastructure

Our Mission is to provide a safe, reliable and efficient railway fit for the 21st century

Infrastructure maintainer, manager and improver.

17 major stations (with train companies managing the remaining 2,500+)

6,700 level crossings, 820 signal boxes, 37,000 bridges and tunnels and around 20,000 miles of track – ¾ of the earth's circumference!

Our website: www.networkrail.co.uk

Network Rail's 17 Strategic Routes are the foundation of the rail industry planning process

Route Utilisation Strategies (RUS) seek to balance capacity, demand, performance and costs.
The future

- Assets management linked to performance and safety
- Linked with costs over next 5 years and long term and provision for customers
- ORR says NR need to enhance quality of asset information
- ORR set mandatory targets for data quality
- ORR monitoring progress
Projects and survey grids

Topographic surveys undertaken for NR projects everyday

BUT:
Could they be used to enhance AI data?
Consistent survey grid?
## Grid choices

<table>
<thead>
<tr>
<th>Grid</th>
<th>When</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>WGS84/ETRF89</td>
<td>Establishment of new grid for an area</td>
<td>Based on GNSS observations giving Latitude and longitude values</td>
</tr>
<tr>
<td>Ordnance Survey national grid (OSGB36)</td>
<td>Allows linking to existing OS mapping and National framework</td>
<td>Need to apply a Scale factor</td>
</tr>
<tr>
<td>Absolute project grid (APG)</td>
<td>Bespoke grid for specified purpose</td>
<td>Example is “Snakegrid” for a long thin project like a railway with high accuracy needs and length greater than 10 Km</td>
</tr>
<tr>
<td>Existing survey grid</td>
<td>New project abuts an existing project with pre-existing grid that may be extended</td>
<td>Care needed if grid extended that additional errors are not introduced as not working from “whole to part”</td>
</tr>
<tr>
<td>Local project grid (LPG)</td>
<td>Simple grid based on abridged OSNG values but with unity scale factor. Use when away from areas with APG</td>
<td>Prudent to alter origin values so they are not confused with OSNG co-ordinates</td>
</tr>
</tbody>
</table>
Continuous, or low distortion grids?
**Height distortion**

Scale effect of 1 ppm per 6.4 m height change
Continuous and low distortion?

Special case:

Build this railway with a Transverse Mercator projection
Continuous and low distortion?

Special case:

Build this railway with a Lambert Conformal Conic projection
Continuous and low distortion?
SnakeGrid concept

To achieve unity scale factor on this track is impossible.

To achieve it on this trend line is feasible.

Distortion within this corridor is at acceptable level (< 20 ppm)
Height distortion

To achieve unity scale factor at each project height is impossible.

To achieve it on this trend line is feasible.

Results acceptable within this band.
Process

Create SnakeGrid with true scale on trend line.

Test – output distortion statistics.

Export parameter file.

Describe route with 3D seed points.
Test and report

Route description.

Usage notes, distortion statistics, relationship to other grids, test values, etc.
Example: Crossrail

Fitted SnakeGrid XRail09 has RMS distortion of 6.3 ppm on the track.

Within the band shown it is within 10 ppm.
Reading, Bath, Exeter, Plymouth, Penzance

RBEPP12 has RMS distortion of 5.0 ppm

Band shown is 20 ppm limit
Merged grids
Northern Hub

TPENN11: RMS 4.0 ppm
MOLEUX11: RMS 2.2 ppm
MOLDOR11: RMS 3.7 ppm

WCG05
Implementation

XRail09.dat

SnakeGrid algorithm

$\phi, \lambda$

$E, N$
Implementation

SnakeGrid Transformer

XRail09.dat

SnakeGrid algorithm

OSNG

XRail09
Partnerships

Agreement in place since 2011 on use of DLL. Extended 2013 to cover use on machine guidance systems in Caterpillar plant.

Agreement in place 2014. Cross-platform compatibility with Viva Smartworx, Icon field products, LGO, etc.

Partners in the development of SnakeGrid Transformer since 2009. Continuing development of the software.

Other software applications…
**Legacy grids**

Initially: RailGrid v2 in 2005.

Hard wired to the West Coast Grid WCG05

SnakeGrid v4 from 2008.

Faster algorithms, ability to merge grids…

*SnakeGrid Transformer designed for this.*
Where?
Business benefits

- Bridging gap between Engineering design data and AI data
- Survey data needs to be multi-disciplinary
- Aligns with BIM aspirations
- Provides consistent Asset Information for use by all
- Benefits for Route asset managers, track, projects, maintenance
- Route Survey strategies need to be developed for buy in from Stakeholders with business case
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