A05.1 The Unified Railway Model

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The model

Recent developments in the UK railway sector have brought to the fore the industry's longstanding difficulties in unifying and correlating the many sets of data which define and regulate its assets and operations. The Unified Railway Model is the result of the railway industry's push to resolve this problem and has been the first to address and resolve these issues.

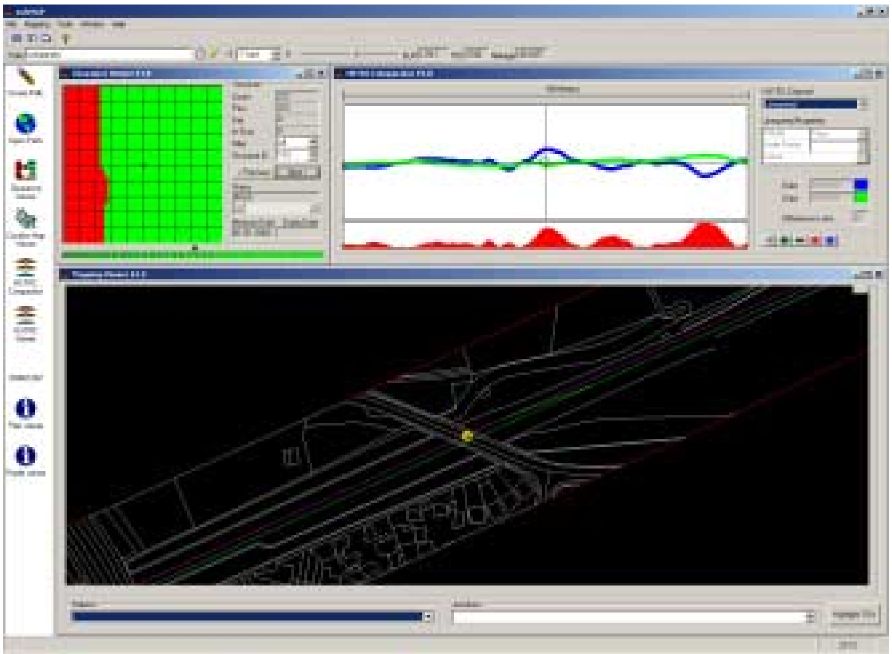
In 1998 a working group, set up to review vehicle and infrastructure gauging management, recommended that a National Gauging Project (NGP) should be established to address data management and configuration deficiencies. The aim was to ensure optimum use of existing physical capacity, provide reliable route-specific information to customers, deliver RailTrack's public commitment, ensure compliance with safety procedures and codes of practice and to eliminate the need for costly repetitive re-measurement of the network.

The National Gauging Project commenced in 1999. Underpinning the project is an extended 4D network model referencing the ELR's (Engineers Line Reference) expanded through to a link-node model of every track in the UK rail network defined from highly detailed engineering data. The 4th. Dimension of change over time allows for complete control of track retirement.

Numerous engineering components relating to the track are the geometrically registered against the network model before a 50m corridor of 3D Ordnance Survey Land-Line data is added as an external reference.

NGP data included SGT (structure gauging train) measurements; EDM/aerial survey; laser profiling data; ClearRoute™ data on the kinematic envelopes for various vehicle types; HSTRC and other train-borne measurement data such as six-foot, or OLE records; direct surveys such as datum plate measurements; asset record systems such as GEOGIS and RAR; and Advanced Warning System (AWS) can then be brought into automatic longitudinal registration to initial accuracy of 50 cm before fine tuning to précis registration.

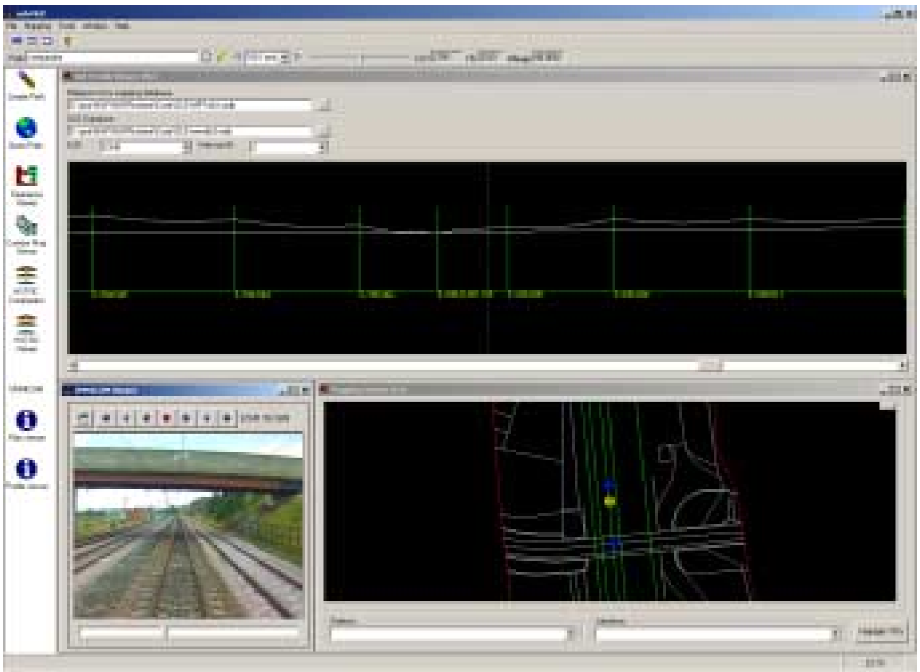
This process is achieved using 'state of the art' tools designed to manage the URM. During this process all data is assimilated in their native formats and are synchronised to all other datasets for visual cross-referencing anywhere on the 38000km network.



Gauging data such as HSTRC, Clearance Matrices and mapping is automatically brought into precise registration allowing cross-referencing of disparate data sets.

Today NGP represents a unique shared resource, which augments and complements existing data sources. The data is portable and can be accessed and utilised on site as easily as in the office. Data can be distributed on CDROM, or shared and transmitted by telemetry or by modem.

NGP demonstrates the wider application of the Unified Railway Model; it can be utilised across the broadest spectrum of projects, up to and including time-based applications such as possessions planning, continuous track quality monitoring, and operational management.

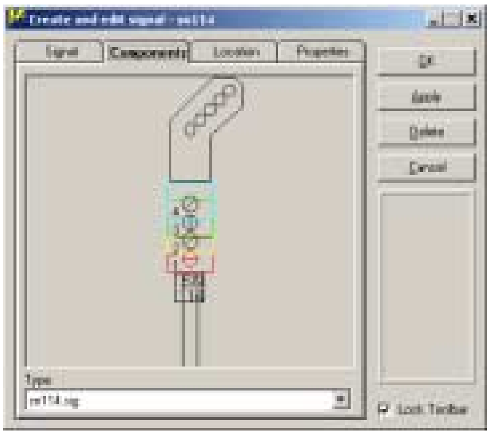


Open system design allows data such as OLE, digital video and other future data types to be cross-referenced against any other registered data

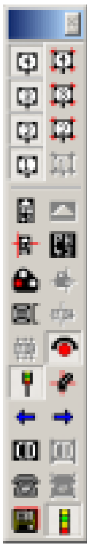
After the initial success of NGP, The Unified Railway Model addressed the problem of signal placement from the drivers' viewpoint.

Drawing on the physical 3D data embodied within the Unified Railway Model, a sighting application was built that generates a virtual world, where new layouts can be viewed in a 'real-life' scene to assess their workability.

As well as mathematically analyzing the signal visibility, the application allows the signal to be 'perceptually' assessed in a dynamic environment, using virtual reality techniques. The first step is for the signal engineer to compose a signal, identifying its various components and layout from a library of standard components. It is then possible to add other related items, for example, speed boards and cantilever signals.

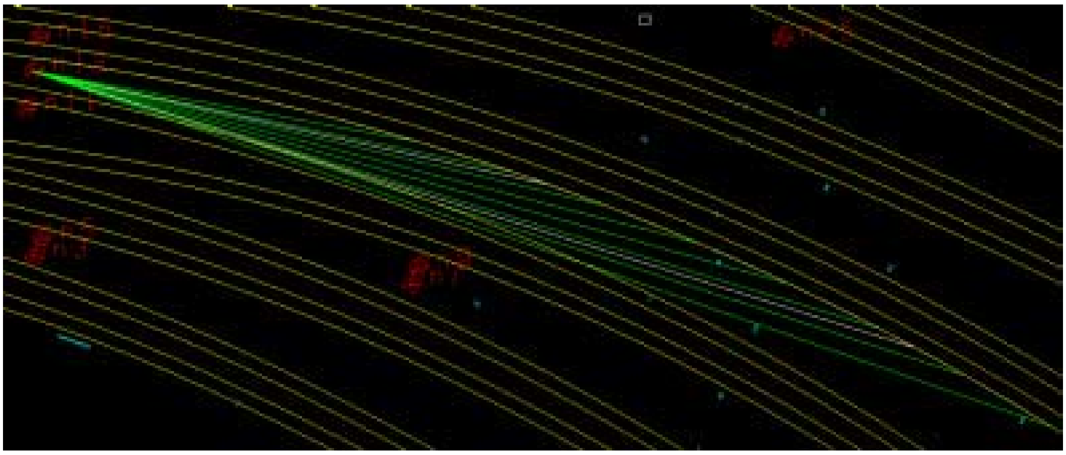


A built in editor allows signal engineers to compose signals from a library of standard components, including signal head type, route indicators, theatre indicators and subsidiary signals



Once the signal is composed it is then placed very accurately in the 3D model either by co-ordinate and level, or relative to a track. Likewise the azimuth and dip of the signal is specified.

As soon as a signal is placed, the software calculates and displays theoretical sight lines. It also instantaneously displays the new signal in the visualization system for subjective assessment in the built environment - this even includes trains on adjacent tracks, sun tracking and the effect of local street lighting. A standard Signal Sighting Form is also automatically produced.



SolvSIGHTING automatically assesses signals for driver visibility by performing and displaying line of sight calculations

Thus the design engineer can realistically 'optioneer' - interactively testing many options for the placement of the signal, viewed from any train path, and at any approaching speed, prior to a site visit to confirm its location. In this way any design constraints can be resolved at an early stage, and an early assessment made of human factors issues, including the potential for signals passed at danger.

Signalling designs can be 'pre-tested' in this real-world environment and the safest signal configuration adopted, prior to on-site confirmation as part of the statutory signal sighting requirements. This cuts down the number of site visits required, with both cost and safety benefits.

Route learning was a natural progression from the use of the Unified Railway Model in signal sighting. A new route learning application was developed which utilises the same Unified Railway Model data to provide drivers with a virtual reality representation of a proposed or existing route in the classroom, complete with its track layout and associated signalling, all geographically accurate.

SolvSIGHTING accurately models all signals, furniture, rail traffic, lighting and visibility conditions. The positioning of signals, structures and furniture can now be 'optioneered' during the design process, to minimise and sighting problems before on-site signal sighting reviews are undertaken.

Both commonly and rarely used routes can be learnt within the software's interactive viewer. The trainee can move along the selected path, halt and step back. Speed and acceleration is user controlled.

The data is acquired directly from the sighting application, and is therefore synchronized to the latest version of the design - all signals modeled are current, and accurately represented, with the correct depiction of the signal light, including intensity when within the focus of the beam. The simulation is totally dynamic, with signal status changing as in the real world. Different training scenarios can be set up by the instructor - the routes varied and lighting conditions manipulated to cover day or night driving, poor weather and fog.

SolvSIGHTING animates the view from a train on this foggy approach to Paddington. Note how the passing train obscures the overhead signal.

The driver's view in solvRL. All signaling is event-driven, with a realistic cab's-eye view of the approaching track and surrounding structures, seamlessly animated as the train moves forward. Behind solvRL sits the entire mapping base for the UK rail network; the lower display shows the 'virtual train's' real life position.

The technology embodied in the Unified Railway Model can extend the use of actual 3D track data into a virtual reality full driver training and assessment simulation - developments are already underway, with the first order for full driver training and assessment to a leading TOC soon to be announced. These training aids might also form the basis for the driver assessment and licensing scheme, currently under consideration following the report from the Ladbroke Grove Inquiry last year.

Conclusion

There is no doubt that Unified Railway Model will be fundamental in shaping the development of the UK's national rail resource. The data provides a common frame of reference for the whole railways industry, and remains so throughout the lifecycle of the railway track and associated structures. It is both scalable as new areas of data are integrated within its framework, and future-proof, developing alongside the railway asset itself.

Feedback is that these developments, and the concept of the Unified Railway Model will be fundamental to improving the rail infrastructure in the direction outlined as a result of the Ladbroke Grove Rail Inquiry.

Acknowledgements:

Andrew McNaughton, Chief Engineer RailTrack PLC
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References & Further Reading:

www.infrasoft-civil.com

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