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HS2 and the Digital Revolution of our Railway Systems

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Overview



- Railways at Birmingham
- The Current State of the International Railway Industry
- HS2

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- Challenges
- Railway Technical Strategy
- Digital Railway Technologies



Birmingham Centre for Railway Research and Education



- Railway research at Birmingham begun in the 1970 through collaborations with London Underground and GEC Alsthom
- Nowadays we are a group of over 130 researchers and support staff with:
 - Sustained ~£5.5M/annum of income (research and teaching)
 - ~170 Undergraduate and Masters level students
 - Strategic Partnerships with Network Rail and FutureRailway
 - Key partner in the development of the National High Speed Rail College



The Current Railway



- Going through a period of significant growth, both in the UK and internationally
- International projects include:
 - Kuala Lumpur to Singapore High Speed
 - UAE and Saudia Arabian Freight Railways
 - Doha Metro in Qatar
 - Californian and Texan High Speed
 - JR-Central Maglev from Tokyo to Nagoya (178 miles in 40 mins)
 - Chinese High Speed and Metros....
- Large UK projects include:
 - CrossRail
 - London Underground upgrade
 - HS2....

China's Metro



China's High Speed



From April 2008 to December 2014 – 16,000km of lines operating over 200 km/h opened Over half of the world's high speed lines are now in China.....



"China high-speed rail network" by Yaohua2000. Licensed under CC BY-SA 3.0 via Wikimedia Commons - http://commons.wikimedia.owiki/File:China_high-speed_rail_network.png#/media/File:China_high-speed_rail_network.png

High Speed Rail in Europe

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- One of the biggest infrastructure project the country has ever seen
 - 330 miles of new track
 - 9 new stations

HS₂

- Phase 1 London to West Midlands
 - Opening 2026
 - £21.4 billion
- Phase 2 the 'Y' leading to Manchester and Leeds
 - Opening 2033
 - £21.2 billion
- Rolling Stock

- 180 x 8 car, 200m long trains
- £7.5 billion



HS2 Capability

- It is all about capacity....
 - 18 trains per hour in the core (24 trains per hour technically feasible)
- Designed for 400 km/h, although operated at 360 km/h
 - London to B'ham 49 mins
 - London to M'chester 68 mins
 - London to Leeds 88 mins
- A similar upgrade on the WCML would result in 14 year of weekend closures

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HS2 Challenges

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- Skills and education High Speed Rail College
- What will technology look like in 2026 and 2033?
- Capacity 18 tph for high speed rail will be best in class Shinkansen 14 tph
- Train control Automatic Train Operation N700 Shinkansen have implemented this
- Tunnelling skills developed during CrossRail Tunneling Academy
- Turnouts at 230 km/h at Birmingham Interchange 70 km/h in continental systems
- Viaducts and Cuttings

- Integration with existing transport systems key questions, particularly outside London
- Station design and redevelopment at Euston



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National High Speed Rail College BCRRE

- Birmingham will be the headquarters with Doncaster as a satellite site
- UoB is a founding partner in the Birmingham bid along with the City Council and Birmingham Metropolitan College
- Opening in September 2017 (intake of 1,100 student/year after 3 years)
- Students from post 16 through to PhD (focus of Level 4 and 5 initially)
- Primarily an engineering focus, but also other areas
- University of Birmingham are leading the curriculum development for the qualifications to be awarded



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Railway Technical Strategy



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Themes include:

- Control, Command and Communications
- Energy
- Infrastructure
- Rolling Stock
- Information
- Customer Experience



Network Rail's Digital Railway



- Championed by Mark Carne, Chief Executive of Network Rail
- Implementation of 'digital technology' throughout the railway system
- Enabling
 - Capacity increase (e.g. running trains closer together)
 - Customer services (e.g. ticketing, connectivity...)
 - Carbon reduction (e.g. energy efficient operations)
 - Cost reduction (whole life cost reduction)
- Implementation across the network by 2028

Digital Rail: Command, Control and Communications

A key impact of performance.....

- Train protection systems
- Cab signalling systems
- Operational Control
 - Rail traffic management / dispatch functions
 - Safe signalling control
 - Information systems
- Communications
 - Signalling, support and customer communications
- ATO and ATC
 - Automatic control of train traction demand and braking to meet safe driving profile

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Automation: BCRRE What performance can we achieve?



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System Integration Challenges

- There are a number of key challenges
 - 1. Understanding the requirements
 - What is required where?
 - What is the business (performance) benefit?
 - 2. Making it work first time
 - Integrating subsystems together
 - Verifying safety and robustness
 - Ensuring modularlity, extensibility, distributed functionality, responsivity

Simulation Lab Architecture





WE RAILWAY SCIENCE AND EDUCATION

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