

Keynote lecture on building railway research capabilities, network, and collaboration for industrial, scientific, and societal impacts

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A light blue silhouette of the University of Birmingham building and its clock tower, set against a white background. The building features several domes and a central tower with a clock face. The clock tower is white and stands out against the blue silhouette.

Building Railway Research Capabilities, Network and Collaboration for Industrial, Scientific, and Societal Impacts

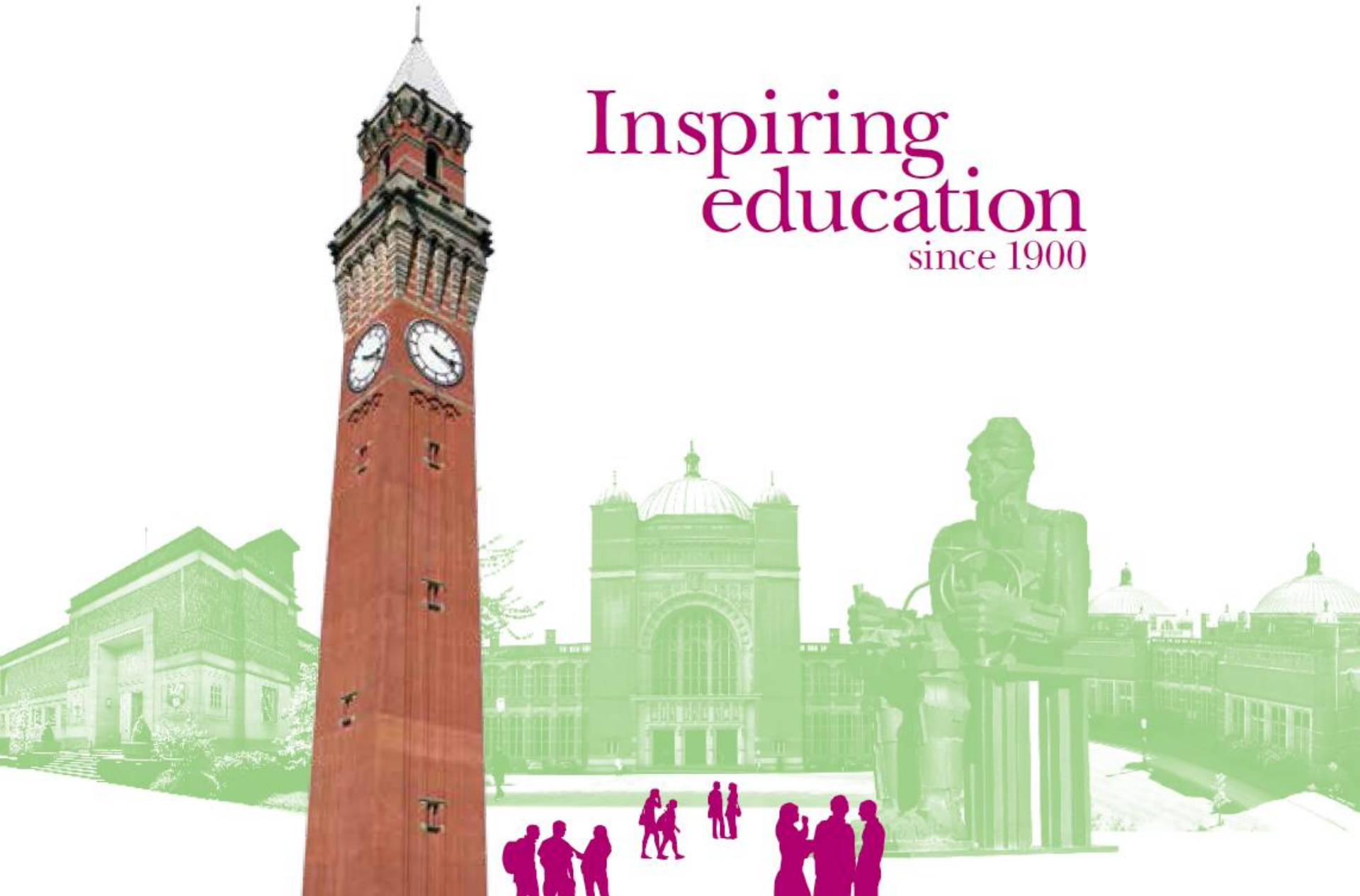
Dr Sakdirat Kaewunruen

School of Engineering, University of Birmingham

<http://scholar.google.com.au/citations?user=m5GY1TsAAAAJ&hl=en>

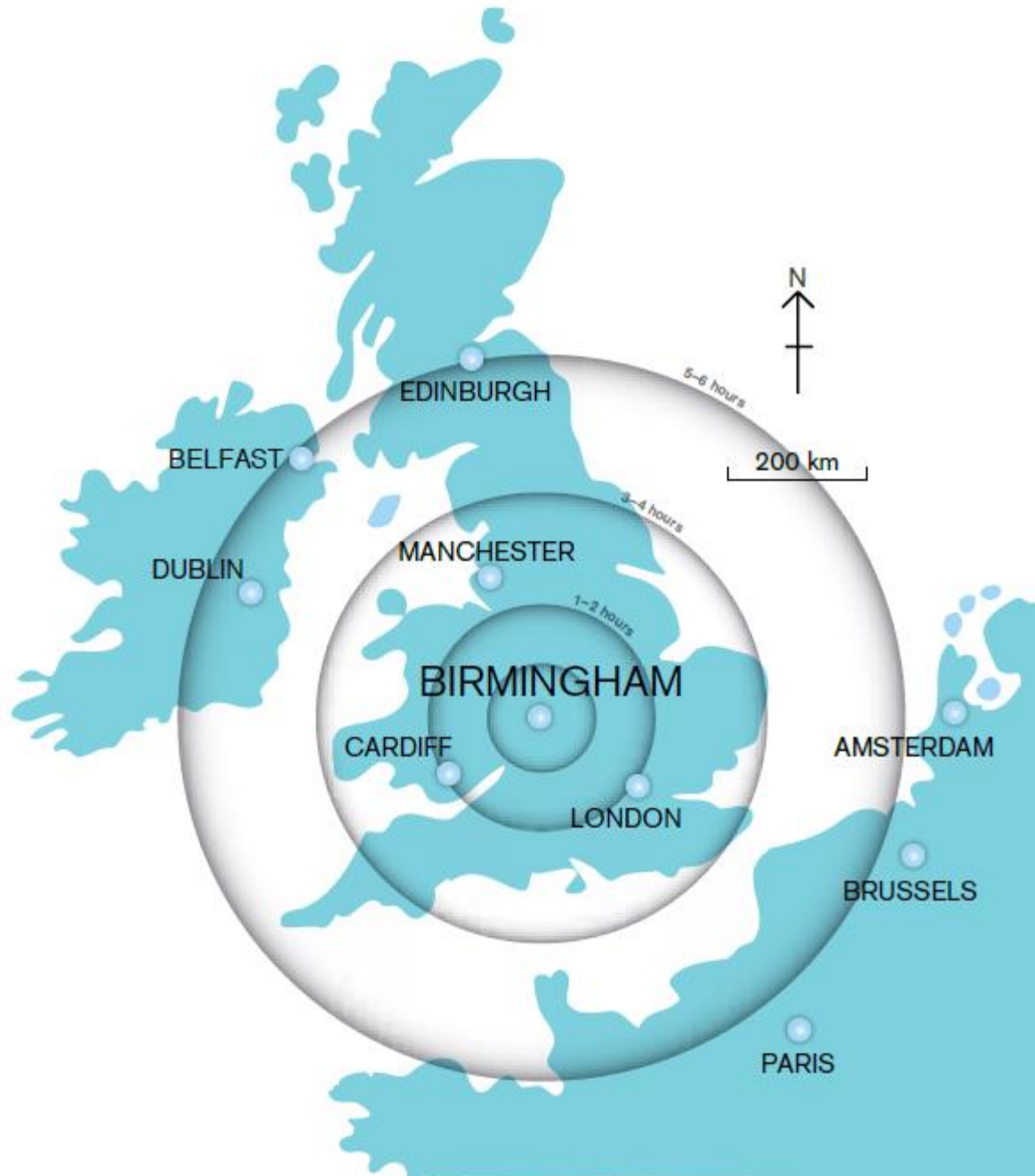
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<https://www.youtube.com/watch?v=nWF4anmzpow>



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Placed

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(Shanghai Jiao Tong University World Rankings)

91th

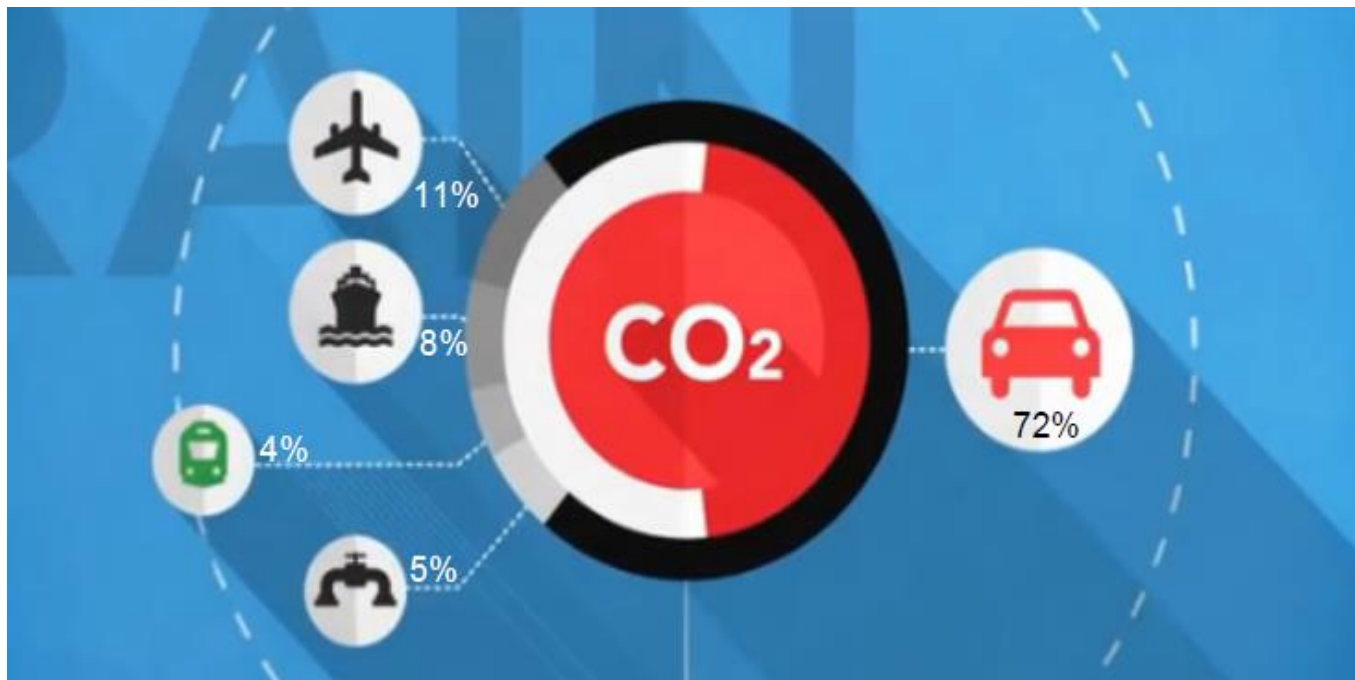


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PHYSICAL SCIENCES

TRANSPORT

CO₂



Technology Readiness Level (TRL)

TECHNOLOGY READINESS LEVEL (TRL)

RESEARCH	9	ACTUAL SYSTEM PROVEN IN OPERATIONAL ENVIRONMENT
	8	SYSTEM COMPLETE AND QUALIFIED
	7	SYSTEM PROTOTYPE DEMONSTRATION IN OPERATIONAL ENVIRONMENT
DEVELOPMENT	6	TECHNOLOGY DEMONSTRATED IN RELEVANT ENVIRONMENT
	5	TECHNOLOGY VALIDATED IN RELEVANT ENVIRONMENT
	4	TECHNOLOGY VALIDATED IN LAB
DEPLOYMENT	3	EXPERIMENTAL PROOF OF CONCEPT
	2	TECHNOLOGY CONCEPT FORMULATED
	1	BASIC PRINCIPLES OBSERVED

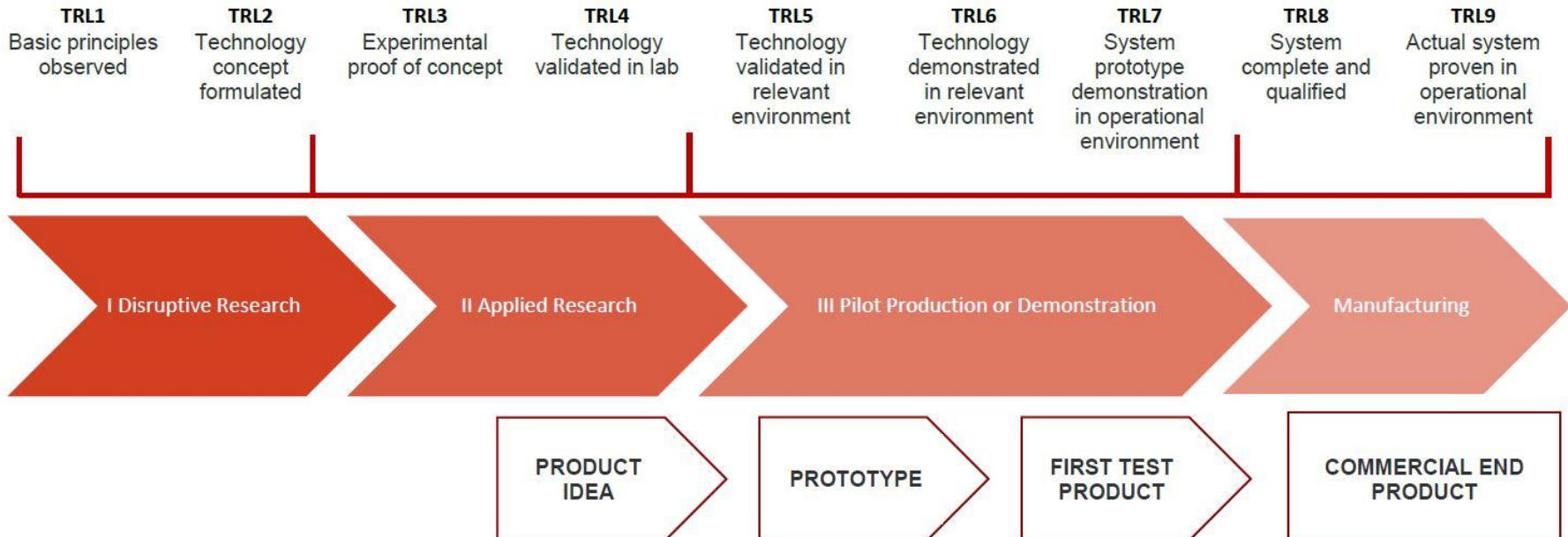
Note: Technology readiness levels (TRLs) are a method for estimating the **maturity** of technologies during the acquisition phase of a program. TRLs enable consistent and uniform discussions of technical maturity across different types of technology (ISO 16290:2013)

Technology Readiness Level (TRL)

Research universities,
Science foundations

Technical universities, Research Institutes,
R&D Labs, Engineering Standards
Development, Spin-out companies

SMEs,
Industry,
Consulting
services,
Government.
Society



Technology Readiness Level (TRL)

Research universities,
Science foundations

Technical universities, Research Institutes,
R&D Labs, Engineering Standards Dev.,
Spin-out companies, Start-ups

SMEs,
Industry,
Consulting
services,
Government.
Society



World Top 200 (Top 1%)

World Top 200+

Outputs

High-impact publications

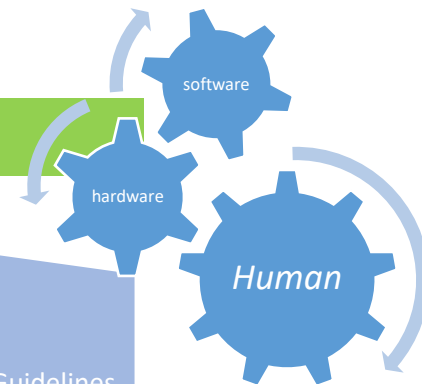
- Highly-cited journal articles
- Prestige conferences
- Research-led education

Intellectual Properties

- Patents
- Copyrights
- Technical trainings

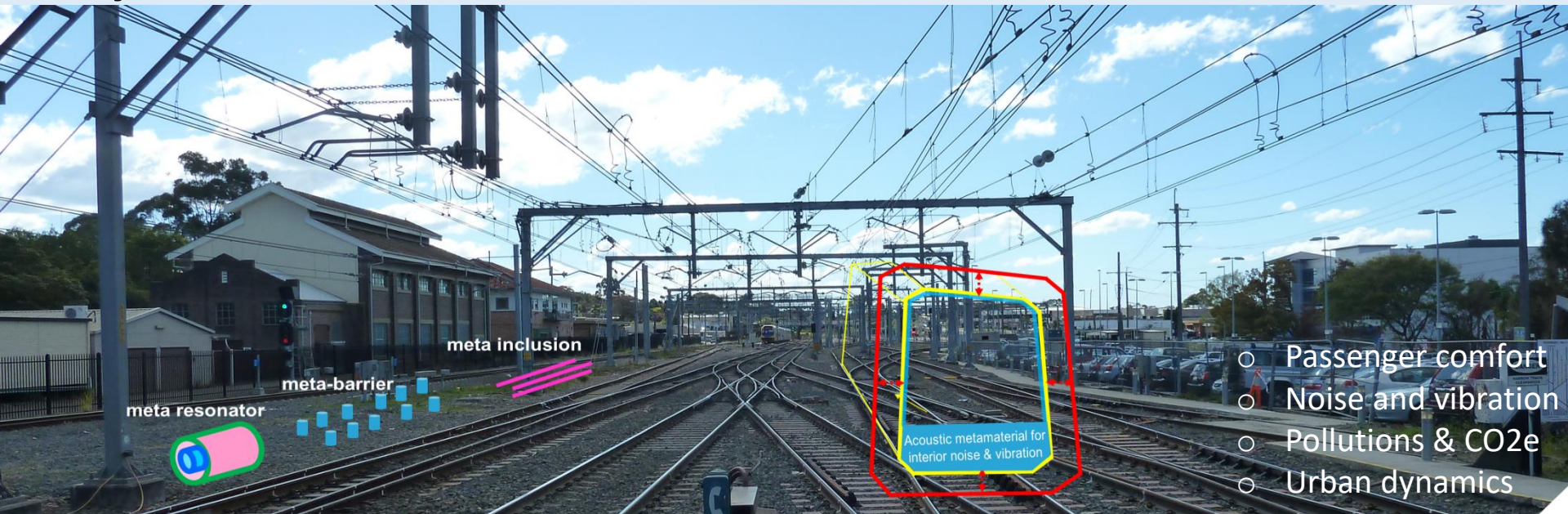
Products / Services

- Prototypes / Products
- Engineering Standards / Guidelines / Handbooks / Codes / Policy
- Consulting services / Advices



Railway as a 'System of Systems'

Railway research needs to be **collaborative, transferable, and systemics.**



Sydney, Australia



Operational Systems

- Light rail
- Metro
- Suburban
- Highspeed
- Freights

Track Systems

- Ballasted tracks
- Ballastless tracks
- Guideway

Bridge Systems

Electrification Systems

Train Systems

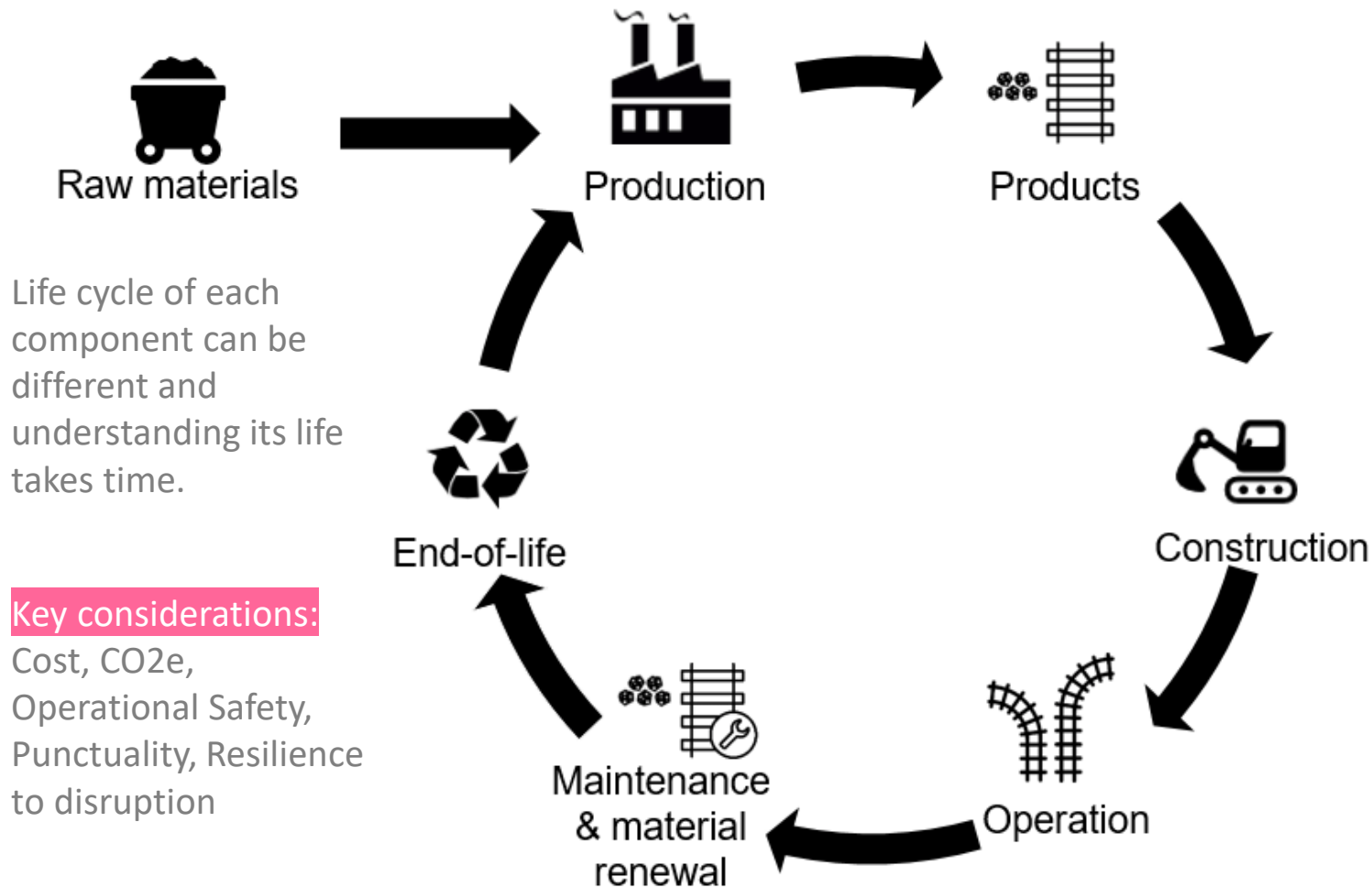
- Locomotive + Wagons
- EMU- Electric Multiple Unit trains
- DMU – Diesel Multiple Unit trains

Signalling Systems

- Block signals
- ATO
- ETCS
- Virtual Coupling

Railway Research through Life

Railway research can be at any stage of **life cycle**. Understanding fundamental limit states can take time.



Building Railway Research Capabilities

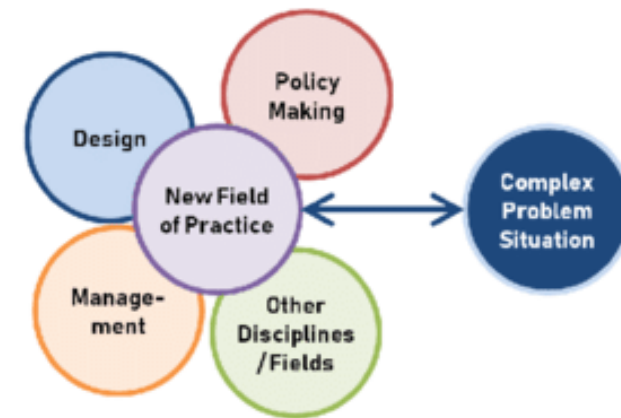
Railway research can often be either **interdisciplinary** or **transdisciplinary**.



Multidisciplinarity



Interdisciplinarity



Transdisciplinarity

Key considerations:

Collaboration for shared facilities, open data, funding scheme for networking, joint projects.

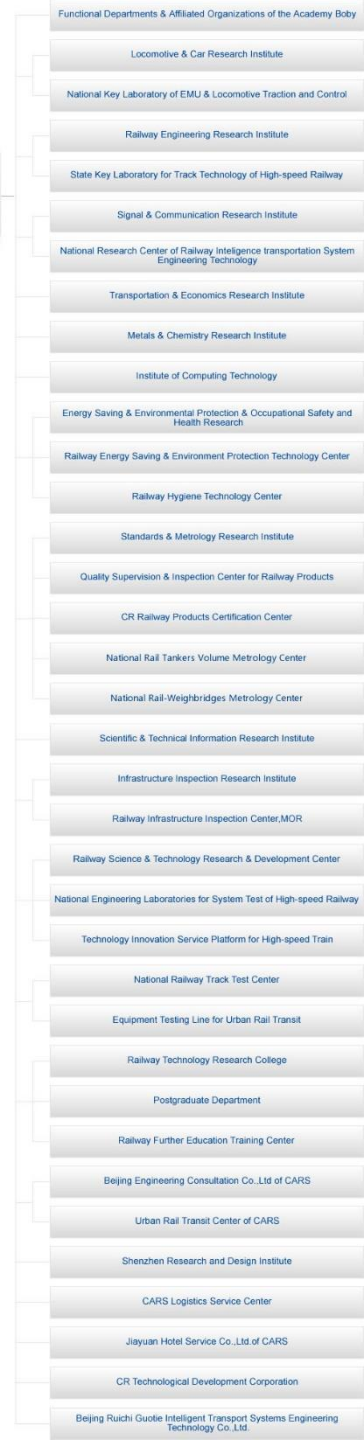
KRRI: Korea Railroad Research Institute



Railway Research – Comprehensive Review

CARS: China Academy of Railway Sciences

- Rail Transportation & Logistics
- Railway Civil Engineering
- Railway Mechanical Engineering
- Railway Signalling and Operations
- Railway Electrification
- Environmental Group
- Passenger Experiences
- Economics
- Risks and safety
- Standards & Trainings
- Climate and Metrology
- Certification and Test Centres





A network of centres
revolutionising innovation in rail

Centres of Excellence



Digital System >



Rolling Stock >



Infrastructure >



Testing >



Digital System >



Future Railway Operations and Control

- Simulator development
- Traffic management
- System optimisation
- Simulation and testing for integration
- Hardware and humans in-the-loop
- Next generation(s) of control systems and railway digitisation



Data integration and cyber security

- Controlled access to national and international data
- Data modelling and architecture
- Integration of operations and customer-facing systems
- Data-driven railway
- Security and analysis of cyber threats



Smart Monitoring and Autonomous Systems

- Next generations of smart condition monitoring
- Interconnected sensing systems
- Innovations in sensors and sensing
- Intelligent, robotic and autonomous systems
- Innovative self-learning systems
- Real-time scheduling systems
- Machine learning



Introducing Innovation

- Road-mapping of benefit realisation
- Alignment of stakeholders for rapid technology adoption
- Identification of benefits and structuring stakeholder incentives
- System integration testing to speed up approval



Rolling Stock >



High value rolling stock systems

- Lightweighting
- Propulsion systems



Whole life asset optimisation and through life management

- Remote condition monitoring
- Asset management systems
- Simulation and synthetics



Energy management

- Energy storage
- Energy systems management



Infrastructure >

- Geotechnical engineering
- Track systems
- Metallurgy, tribology and rail/wheel interface
- Noise and vibration
- Structural engineering and materials
- Asset management
- Risk and reliability
- Resilience engineering
- Human factors
- Economic and railway system modelling
- Hardware-in-the-loop
- Fluid dynamics
- High voltage

UKRRIN

UK RAIL RESEARCH AND
INNOVATION NETWORK

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revolutionising innovation in rail



Testing >



Where they are?

RIDC Melton

Unit F, Melton
Commercial Park
Asfordby
Melton Mowbray
Leicestershire
LE14 3JL

RIDC Tuxford

Lodge Lane Industrial
Estate
Lodge Lane
Tuxford
Nottinghamshire
NG22 0NL

Transport for London – Hearne House (Acton, London)

118-120
Gunnersbury Lane,
London,
W3 9BQ

Transport for London (Stratford, London)

5 Endeavour Square,
International Quarter,
Stratford,
E15 2DU

Long Marston Rail Innovation Centre

Station Road
Long Marston
Stratford-On-Avon
Warwickshire
CV37 8PL

RISEN: collaborate for better

Period: 2016-2021



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TECHNOLOGY



U. PORTO



NTNU

Norwegian University of
Science and Technology



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UNIVERSITY
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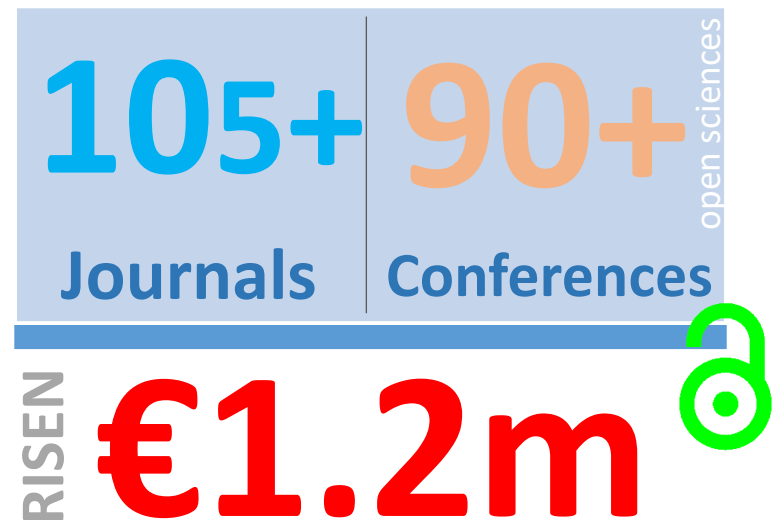
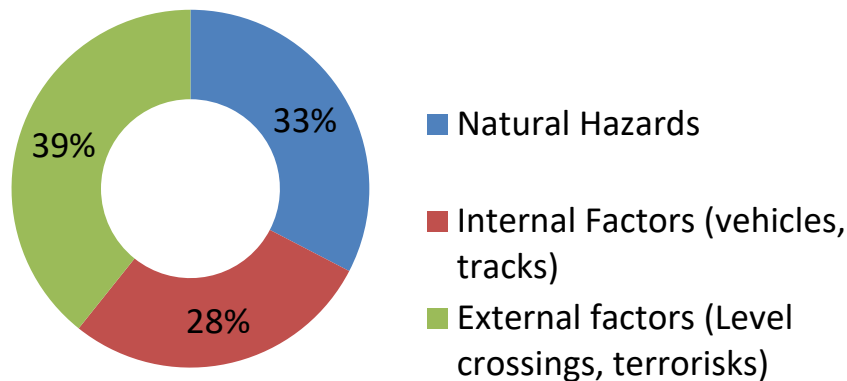


Impacts

<http://www.risen2rail.eu>

- More than 100 peer-reviewed journal papers and 96 peer-reviewed conference papers have already been published in permanent **open access platforms**. The output has already exceeded the targets proposed for over the duration of the project (WP6). All papers are archived on permanent open-access institutional servers in compliance with Art 29.2 of GA.
2020 Target: 25 journal papers and 16 seminars/conferences

Rail disruptions (JREast, 2010)



Ideas to Impact



Our research is a part of



COEST

EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY

- **Action TU1404** TOWARDS THE NEXT GENERATION OF STANDARDS FOR SERVICE LIFE OF CEMENT-BASED MATERIALS AND STRUCTURES
- **Action CA15125** Designs for Noise Reducing Materials and Structures (DENORMS)
- **Action CA15202** Self-healing As preventative Repair of Concrete Structures (SACOS)

Ideas to Impact



Our research contributes to



- British Standard Committee (BSI) and Rail Safety and Standard Board Committee (RSSB) for Railway Sleepers and Bearers
- ISO Standard Working Group (269/1) for Plastic and Composite Sleepers
- ISO Standard Working Group (269/4) for Recycling of Rolling Stocks

Conclusions



Summary

- This presentation will highlight collaborative research for improving safety, resilience, efficacy, sustainability and carbon footprint in railway systems.
- The collaborative research are aligned with United Nation's Sustainable Development Goals.
- Collaboration is the key to improve scientific, industrial and societal impacts.



Department
for Transport

**Thank you very much
for your kind attention**



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