31st Annual INCOSE international symposium

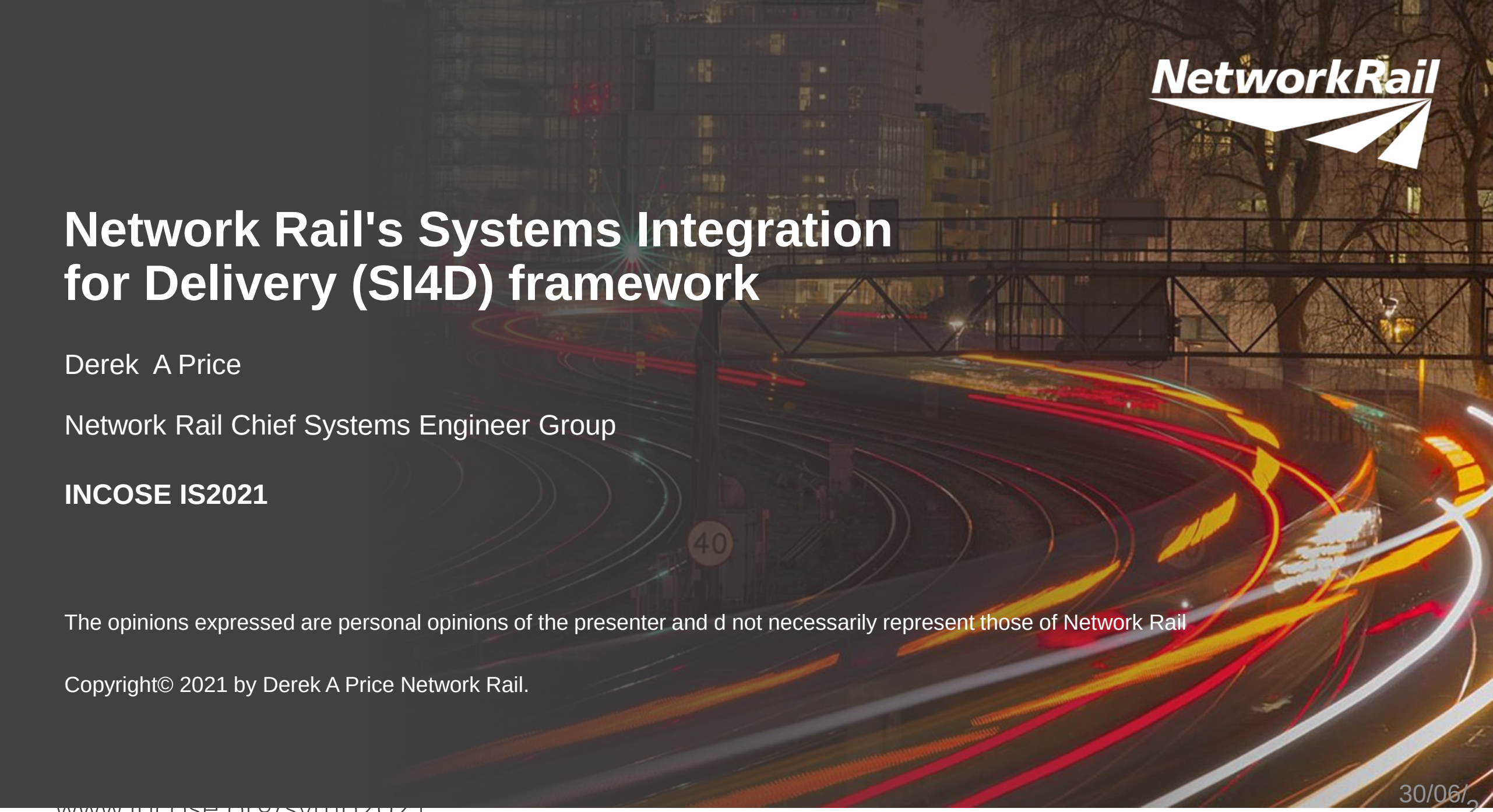
virtual event

July 17 - 22, 2021

NetworkRail

Derek A Price, Network Rail Chief Systems Engineer Group

Network Rail's Systems Integration for Delivery (SI4D) framework



Network Rail's Systems Integration for Delivery (SI4D) framework

Derek A Price

Network Rail Chief Systems Engineer Group

INCOSE IS2021

The opinions expressed are personal opinions of the presenter and d not necessarily represent those of Network Rail

Introduction – A Case Study

The Integration Challenge

Products Processes People

The SI4D Framework

Looking Back

Implementation & Communication

The Integration Challenge

Drivers for change

Project demographic

Regulated public facing industry

Railway sector systems community practices and capability

Enterprise Risk Mitigation

level 1 Enterprise	*"Failure to operate an effective systems engineering approach leading to an inability to deliver the client's outcomes robustly (impacting on Operations, Governance, Systems Assurance, Verification & Validation, Reliability, Availability, Maintainability, Security and Safety)".*
level 2 risk IP-ENG-116	*There is a threat that a lack of clear Systems Integration vision, strategy plans and the appropriate quantity of skilled resource within IP engineering encumbers delivery of systems integration resulting in suboptimal delivery of projects' scopes within IP*
Level 2 IP-ENG-003	*" A Systems Engineering approach may not be applied to Network Change"*
Level 2 IP-ENG-002:	*"There is a risk that project outputs may not satisfy project requirements"*

Review Findings

McNulty 2011

- Focus on “whole system approaches”
- Integration of different elements of project design

Hendy 2015

- Inadequate planning and scope definition of a number of projects in their early phase
- Some large projects should have been managed on a holistic basis rather than piecemeal
- Projects to be better developed before funding commitments are made and project delivery starts

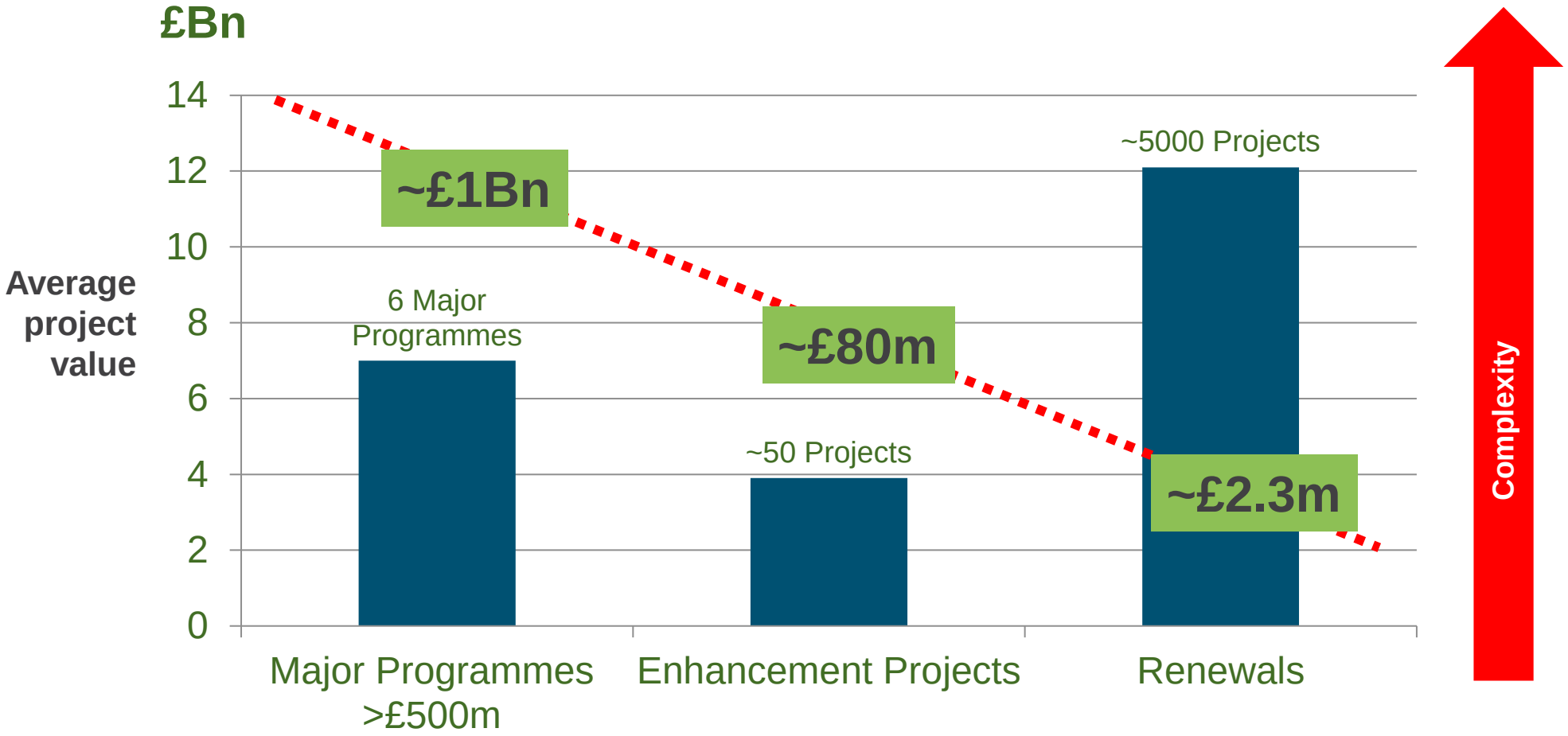
Bowe 2015

- Complex portfolio of schemes, subject to poor scope definition from the outset, and ongoing ‘scope creep’, leading to cost increases;
- Obvious exceptions to this are Crossrail and the Thameslink Programme

IPA Lessons from transport for the sponsorship of major projects, 2019

- 5 themes - Theme D) “Deal with systems integration risk “
- “… Systems Integration …” quoted 47 times

Infrastructure Project Demographic



- *Source: ORR CN/025 Independent Reporter (Part C) Project and Programme Management Capability Improvement Study Summary Report 2013*

Regulated Public facing industry

Current Practices

"We already do more Systems Engineering today than we realise …"

Requirements Management	CRD, RRD, DRRD, Remits, Asset Standards CR-Ts, Consents & Commitments, SISA
Risk management	"Risk Management"
Lifecycle Management	GRIP, Asset Eng. Assurance Standards, i-ELC
Interface Management	TIMPs, Asset Specifications, IDR, IDC, Stakeholder Agreements
Verification & Validation	GRIP SGRs, DRP / EVRP, DCVrs, EVRS Eng Ass Forms 1-5, A-E, EA-, T&C, EIS, SOIa, Form X, SISA, HCI System Integration Lab, ENIF
System Architectures	Context Diagrams, Scheme Plans, CSM System Definition, the Quayle maps, Line Diagrams, 2D / 3D Cad, BIM, "System Architectures"
Modelling	PEDROUTE, TRAIL, AVSIM, RAILSYS, FEA, 3d cad Visualisations & Clash Detections
Humans in the System	IOCS – UML, Human Factors process, The Rule Book, C27, 3D CAD, Training Simulators

"Systems Engineering / Integration" is a label for all of us to do these things better, and in a more joined up way as an enterprise.

What is SI4D?

The SI4D framework takes the generic language of Systems Engineering and presents a framework which is more immediately related to railway infrastructure projects

- The Seven Systems Integration Themes
- Embedded in existing management systems
- Tailoring to areas of (systems integration) importance
- Scalable to project size & complexity
- Communications campaign examples
- SI4D Framework details available on the SI Hub site

Why are we doing it?

- We need to deliver a safe, secure, operable, maintainable, reliable and performing railway
- We need to optimise new infrastructure performance
- We need to improve services for passengers and freight
- We need to deliver an integrated railway system

What is SI?

Systems Integration (SI) for Delivery is a framework designed to optimise the performance of new infrastructure delivered by Network Rail and provide improved services for passengers and freight.

The framework consists of a suite of processes, products and tools that have been embedded within existing systems (GRIP, IELCP and IMS) to support a consistent and cohesive approach to delivery of capital projects.

A dedicated SI Centre of Excellence has been established to support colleagues with adoption of the framework. There are also SI champions in each of the regions and major/national programmes

How does it work?

SI facilitates a more cohesive approach to the delivery of capital projects – ensuring all components of the railway system are working well and integrated together.

Focusses on six key components:

1. **System safety** – making sure people aren't hurt as result of the changes we make to the railway.
2. **Maintenance readiness** - making sure people have the right skills, tools and regimes to preserve the delivered assets over their life.
3. **Operational readiness** – making sure we supply the necessary capability and processes for new and modified infrastructure to facilitate continued operation of the railway.
4. **Security** – making sure we identify and protect the railway against cyber and physical security risks.
5. **Reliability** – making sure the changes we make to the railway deliver the expected reliability of the new infrastructure and wider railway.
6. **Railway performance** – making sure projects maintain or where required improve the overall performance of the railway – service, timetable and quality.

How does it work?

In summary, SI consists of the following:

- Consistent, clear and simple framework
- Scalable approach depending on complexity of the change to the railway
- New tool to determine required action(s) and deliverables based on complexity and risk
- Processes and products embedded within existing Network Rail systems (i.e. GRIP, IELCP and IMS)
- Associated competency management framework
- Standardised approach for project, programmes and portfolios of work
- Dedicated CoE with training and support available
- Metrics to measure effectiveness of the framework
- Continuous improvement process with quarterly reviews to ensure effectiveness.

The SI4D Framework as a model

Embedded in existing management systems

Process, Products and People

SI4D Process: Characterise (Triage), Plan, Deliver, Report

Scalability, Tailoring

Embedded in existing management systems

Process

Products

People

Programme Management

Safety Management

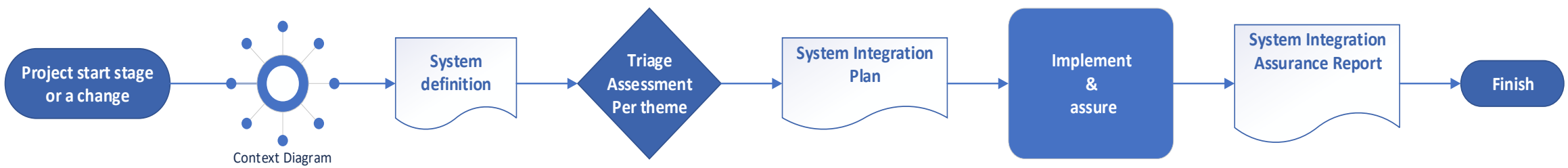
Engineering Management

SI4D Resources

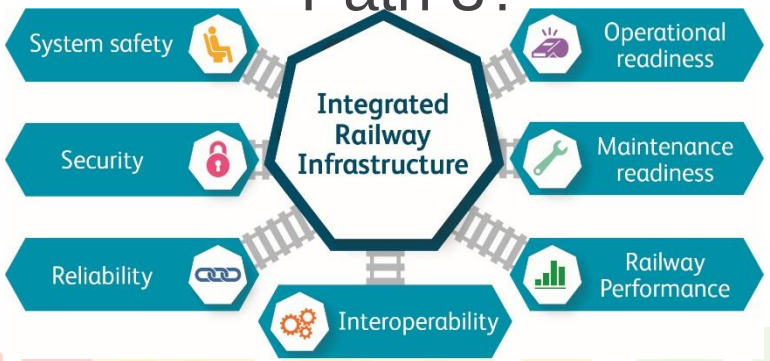
Process, Products and People

Viewpoint	Deliverables	Repository
Processes	Process Description Documents Swim lane diagrams, Flowcharts	Internal Integrated Management System Public Website, “SI Hub”[SI Hub]
Products	Product Descriptions Product Templates Product Guidance Contract requirements	Governance Standards Project Lifecycle Management System [GRIP] Engineering Lifecycle [IELCP] Project Engineering Deliverables List “MDL” Procurement Contract Templates Internal Integrated Management System Public Website, “SI Hub” [SI Hub]
People	Competency Framework (based Assessment governance process Systems Integration Engineer Role Profiles Project Engineer Role Profiles Project Manager Role Profiles Sponsor Role Profiles Training Material	Governance Standards Competency Management E-Business Tool E-learning Classroom Courses Company SE handbook [SI Hub] Internal Integrated Management System Public Website, “SI Hub” [SI Hub

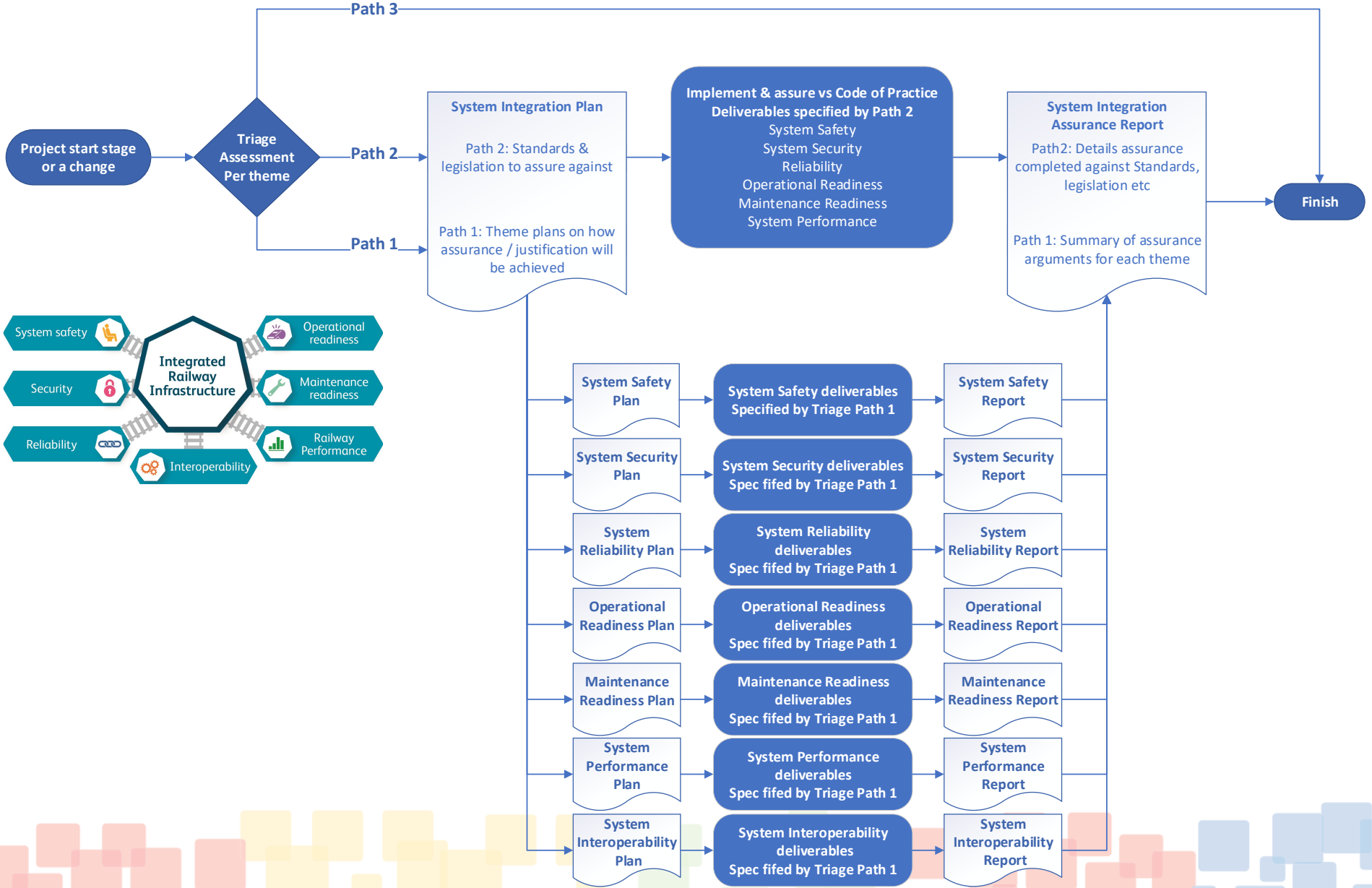
Lifecycle Phase Process



Path 1?
Path 2?
Path 3?



Full Model


Path 3
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Path 2
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System Integration Plan
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Path 1: Theme plans on how assurance / justification will be achieved
Implement & assure vs Code of Practice
Deliverables specified by Path 2
System Safety
System Security
Reliability
Operational Readiness
Maintenance Readiness
System Performance
System Integration Assurance Report
Path2: Details assurance completed against Standards, legislation etc
Path 1: Summary of assurance arguments for each theme
Finish
System safety
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Integrated Railway Infrastructure
Maintenance readiness
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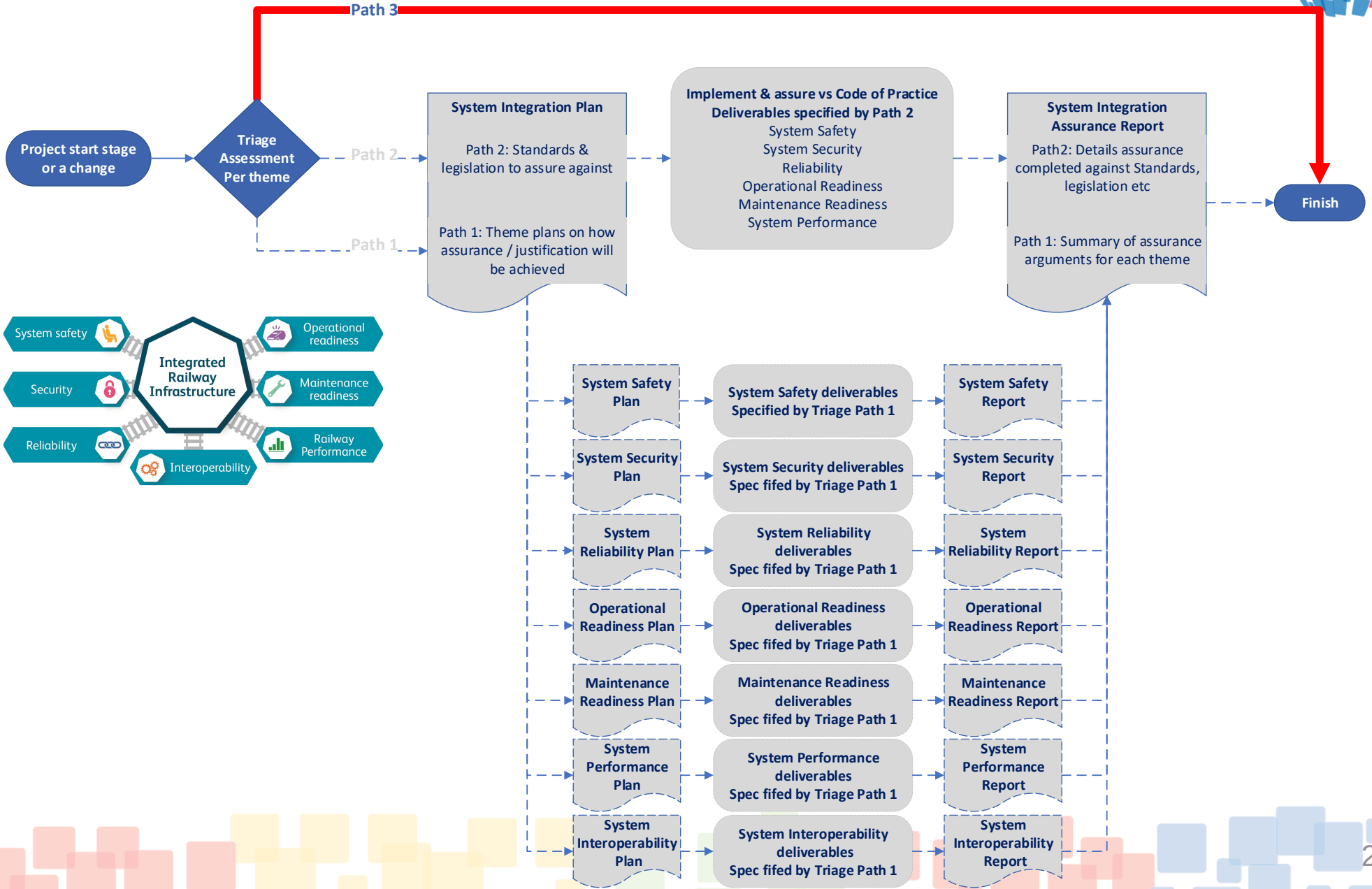
Theme Path 3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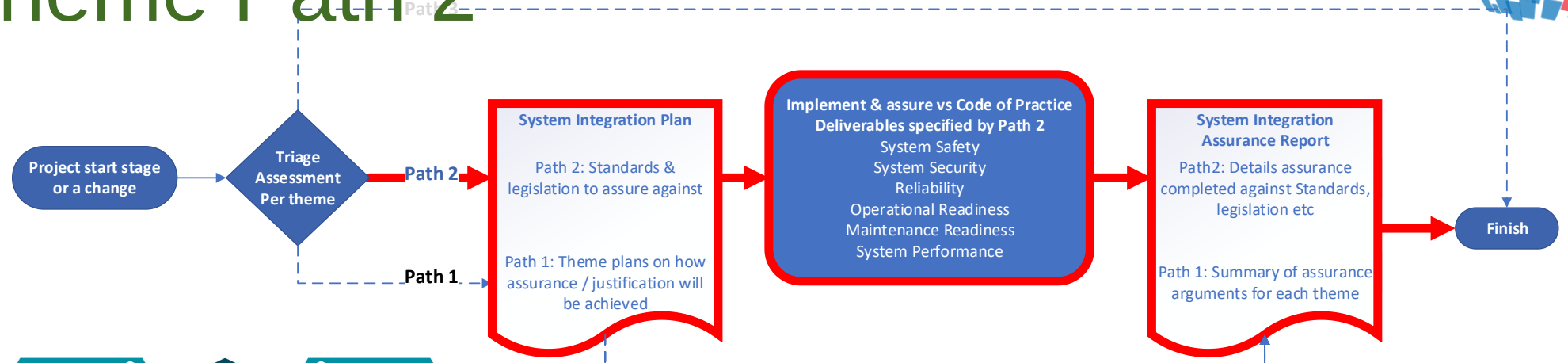
Theme Path 2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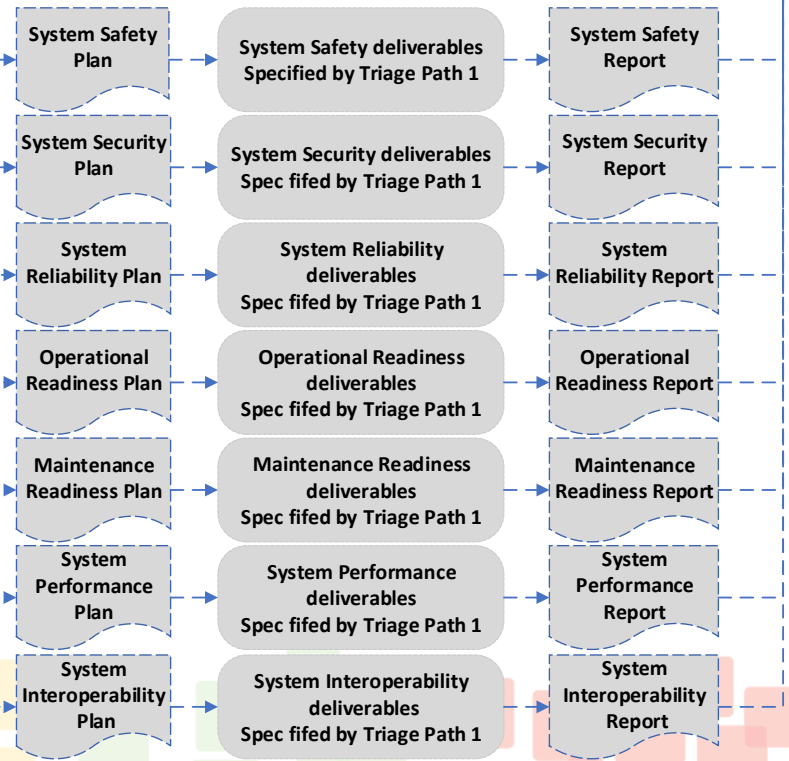
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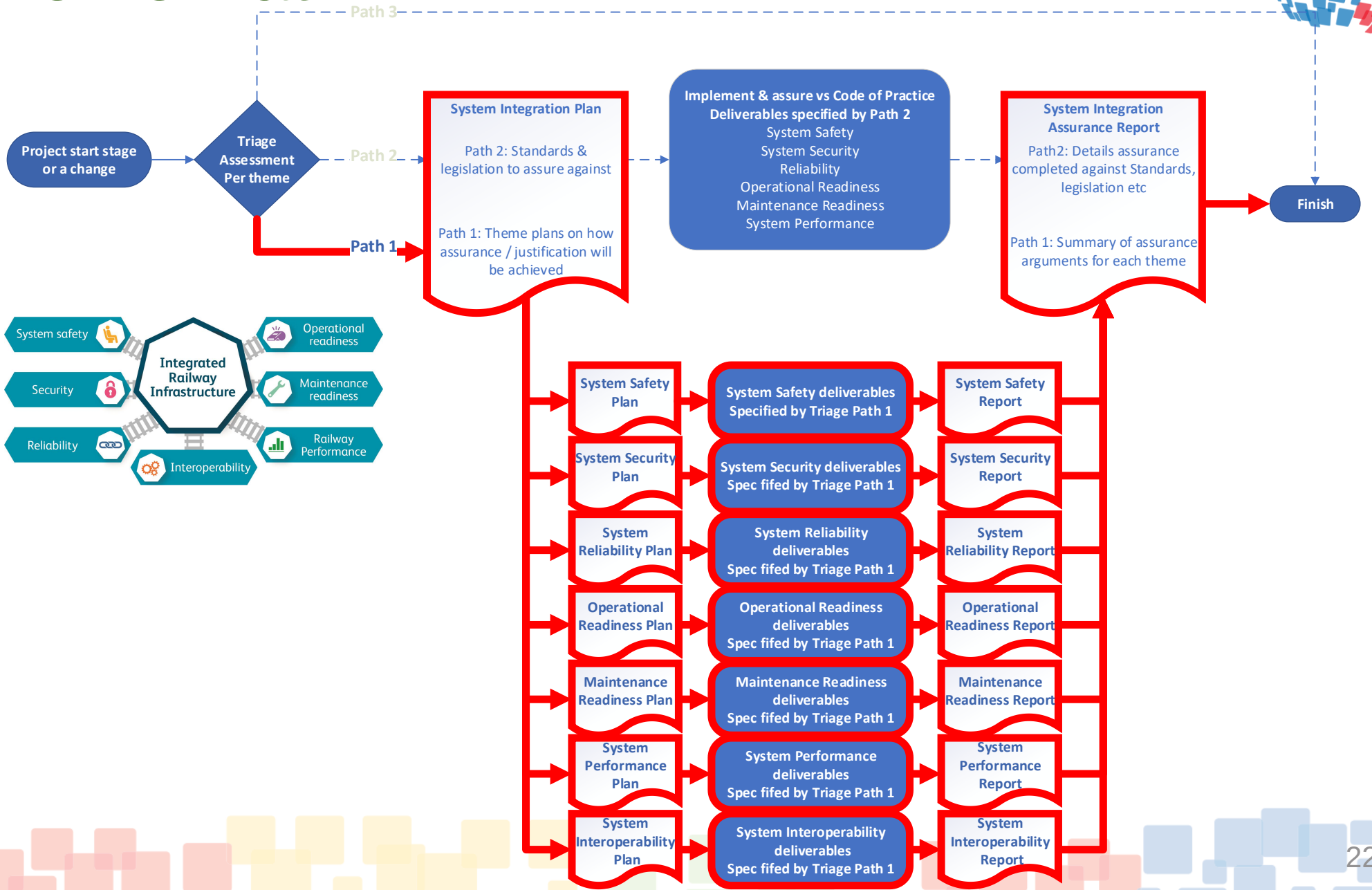
Theme Path 1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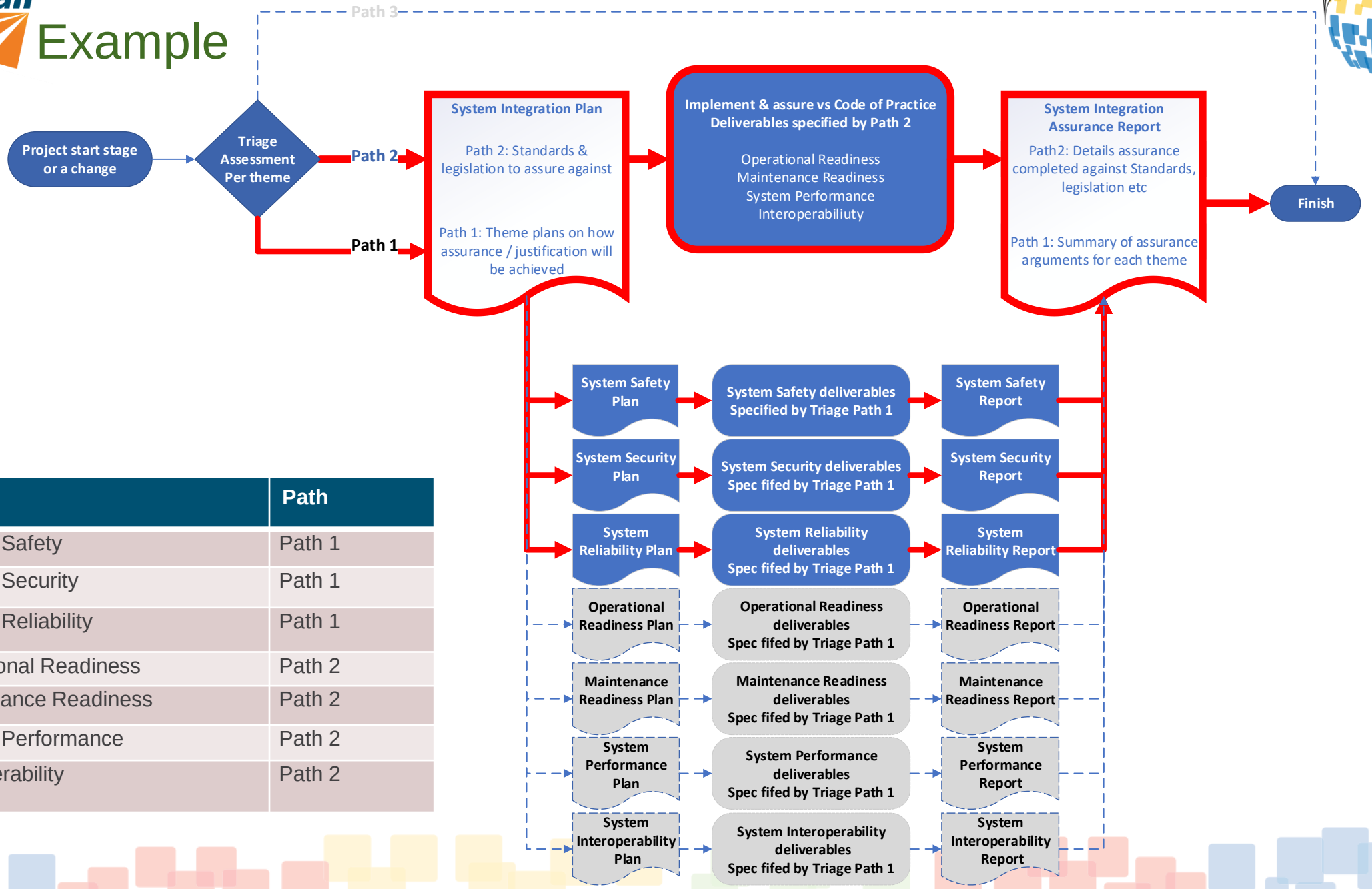
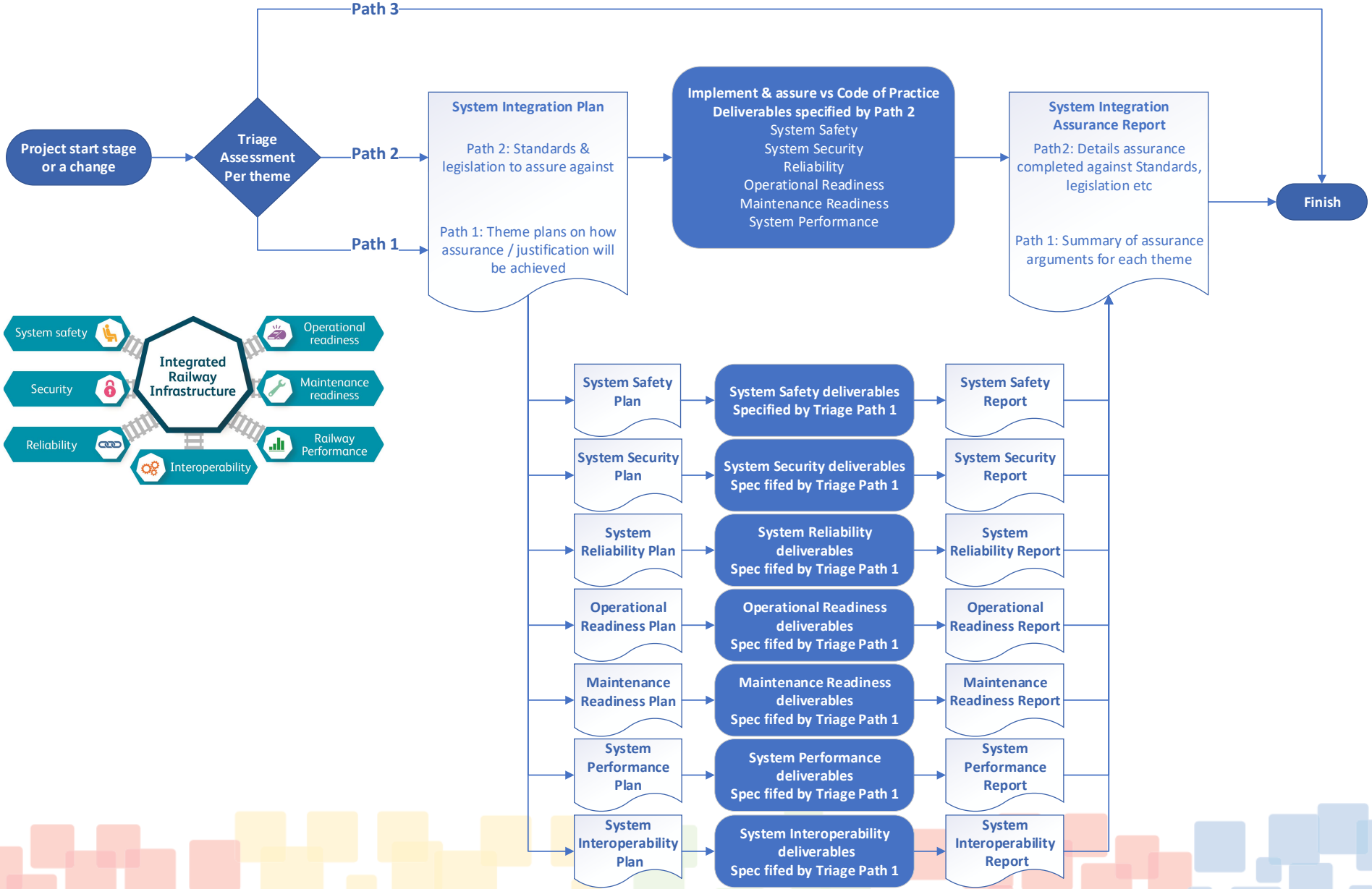
Example



Theme	Path
System Safety	Path 1
System Security	Path 1
System Reliability	Path 1
Operational Readiness	Path 2
Maintenance Readiness	Path 2
System Performance	Path 2
Interoperability	Path 2

Full Model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Implementation & Communication

Project Approach

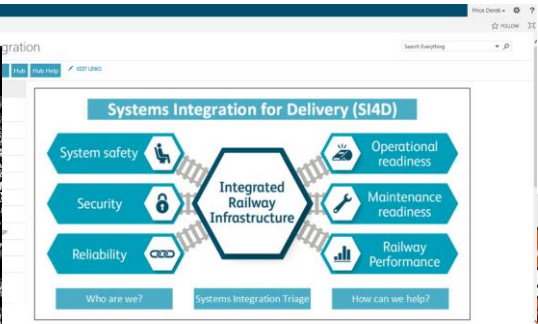
Communications Campaign

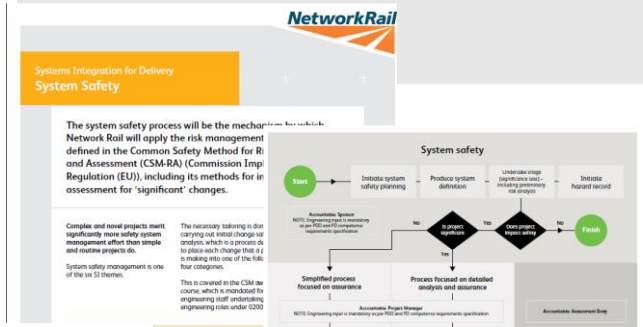
Project Approach

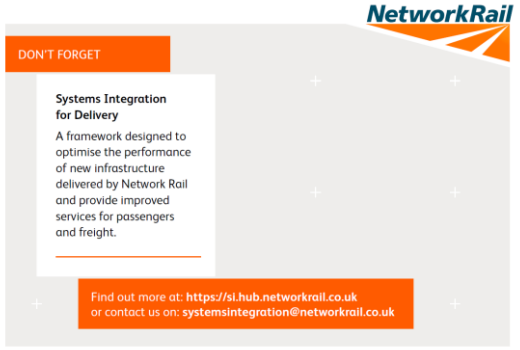
- Managed as a Change programme
  - PM, Business case, funded budget, Business Change Panel governance
  - Balance benefits realisation with schedule pressures
- Collaboration & partnership
  - With other business groups, Operator owners, **Suppliers**, Industry Bodies
- Centre of Excellence
  - Small core team, drawing on national & regional community of experts
- Managed as a project – work packages, agile
  - Create & embed SI products
  - Capability development material – for in house & supplier contracts
  - KPIs & Metrics
  - Comms Strategy , plan & products

Communications Campaign

- Roadshow events
- Hub site home
- Hub site theme page
- Video animation
- Video Interviews
- Online walkthroughs
- Brochure packs
- Post it notes
- Graphics
- Centre of Excellence support







*"**System Integration** is vital to improving passenger experience and to delivering a **reliable, safe, secure, operable and maintainable railway**. Our systems integration programme means that we can be joined-up when it comes to project delivery, helping us to make sure all the components of our railway are working well together. Where they have been designed in conjunction with the users, having common processes is an aid to deeper devolution. It's another reason why the use of the systems integration approach, planning early and considering the impact of our projects on the railway system **is not an opt in option** but fundamental to ensuring we deliver on our promises to passengers and freight users."*

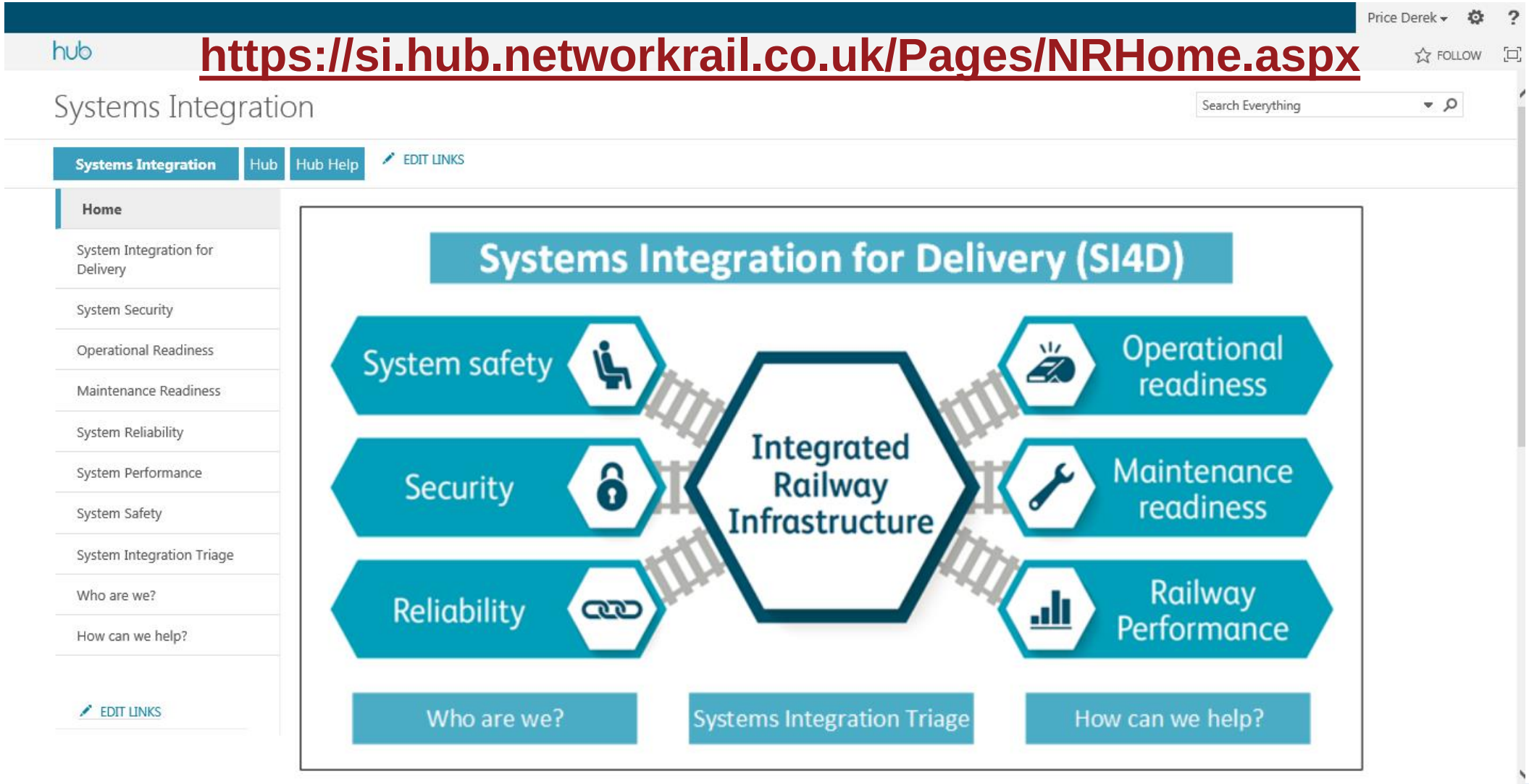
SI4D Video – 5 minutes

https://si.hub.networkrail.co.uk/Pages/NRHome.aspx

We all need to play our part in making SI4D a success.
Visit https://si.hub.networkrail.co.uk

Systems Integration HUB

https://si.hub.networkrail.co.uk/Pages/NRHome.aspx



Home
System Integration for Delivery
System Security
Operational Readiness
Maintenance Readiness
System Reliability
System Performance
System Safety
System Integration Triage
Interoperability
Who are we?
Help, Resources & Info
ESM Gauge
Feedback

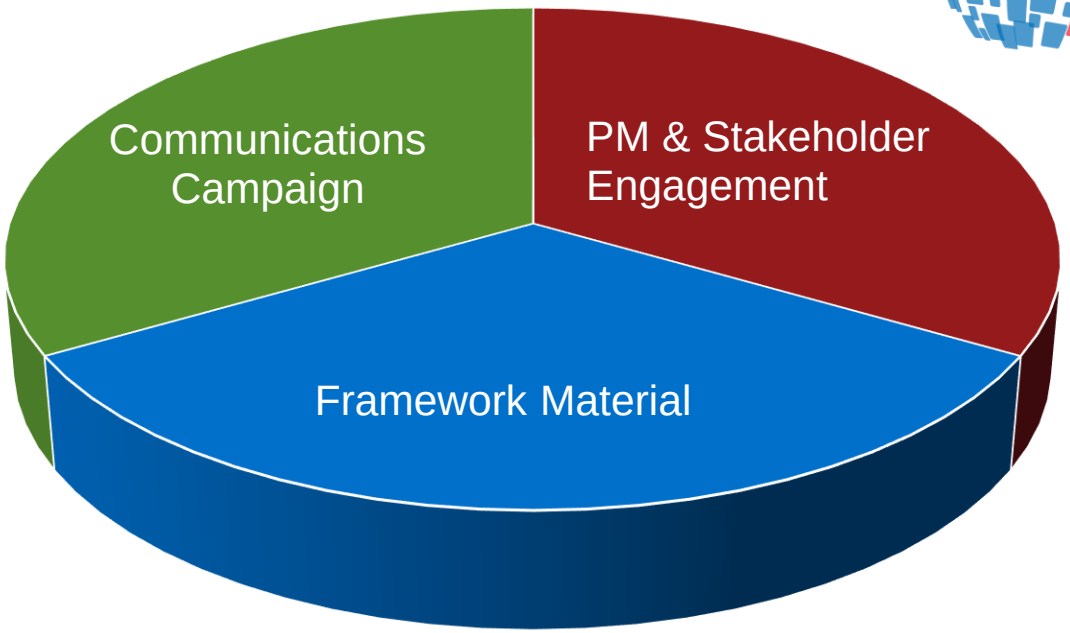
EDIT LINKS

How can we help?

Systems Information Communications		
	Systems Integration for Delivery - Overview Presentation	High level overview of the Systems Integration for Delivery framework, the reasons for it and what it consists of.
	Systems Integration for Delivery - Brochure Pack	Factsheets for each of the SI themes and the triage assessment, an FAQs sheet and contact information for the SI function support team
	Systems Integration for Delivery - Launch event slides	Powerpoint presentation (including videos) that was given at the SI launch event in Birmingham on the 25th June 2019.
	Systems Integration Triage - Example application presentation	Powerpoint presentation walking through the application of the SI triage process on an example project
	Systems Integration Overview Animation	5 minute animation providing an overview of the SI4D framework and what projects need to do to apply it.

Systems Integration Training Material		
	Systems Integration Awareness Briefing	Awareness briefing to present information on the Systems Integration for Delivery processes within Network Rail and the new processes introduced in CP6. Currently being updated with latest information.
	Systems Integration Awareness Briefing Notes	Awareness briefing notes to supporting information on the Systems Integration for Delivery processes within Network Rail and the new processes introduced in CP6. Updates in progress
	Systems Engineering Handbook	Contains a distillation of good systems engineering practice across Network Rail; and has benefitted from a detailed review by experienced practitioners within Network Rail and the wider industry.
	Systems Integration Classroom Training	Under development - Classroom training bookable via Oracle to cover the professional competencies within the IP Systems Integration Framework.

Looking Back



- Content messaging focussed on outcomes & benefits
- Understand & acknowledge existing constraints
- Agile worked well for development
- Centre of Excellence support critical for 1st applications
- Business as Usual transition – feedback, learn, respond
- Decoupling from organisation specifics (project delivery model)
- Resilient to changes

Looking Forward

- Scaling up for major programmes
- Bedding in the transition to Business as Usual
- Continuous Improvement – don’t stop here !
- Building Back Better – “Project Speed”
- KPIs, Maturity benchmarking

Thank You

https://si.hub.networkrail.co.uk/Pages/NRHome.aspx

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