



Understanding WAD in large scale operations

The case of rail engineering

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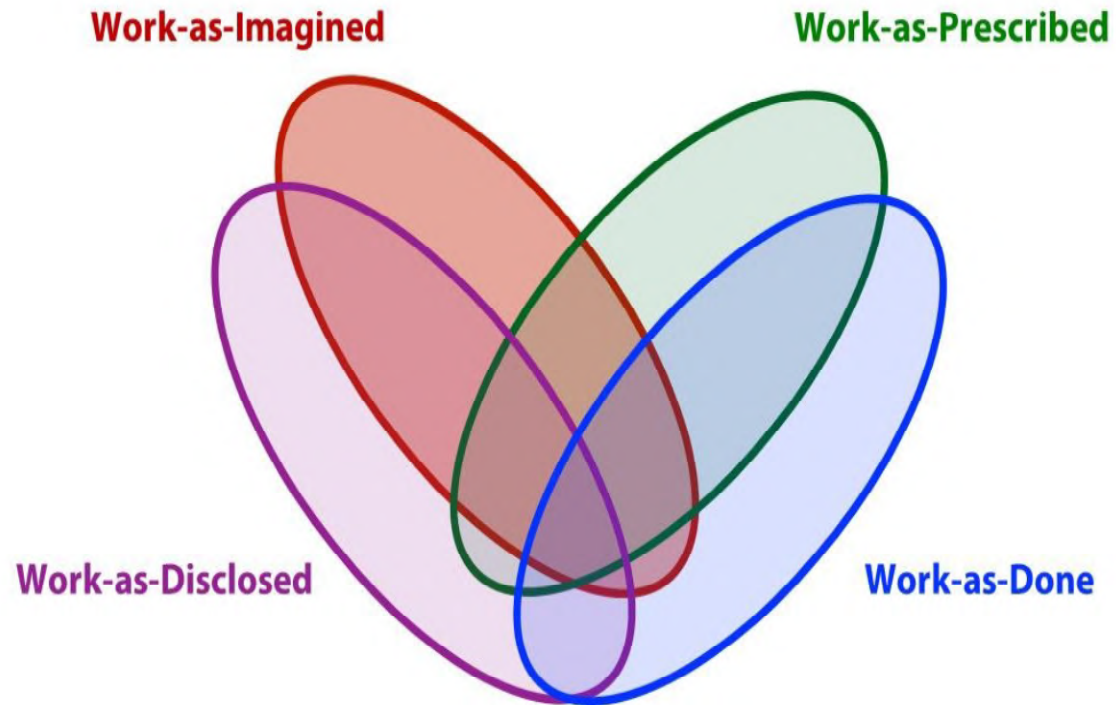
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1. Background

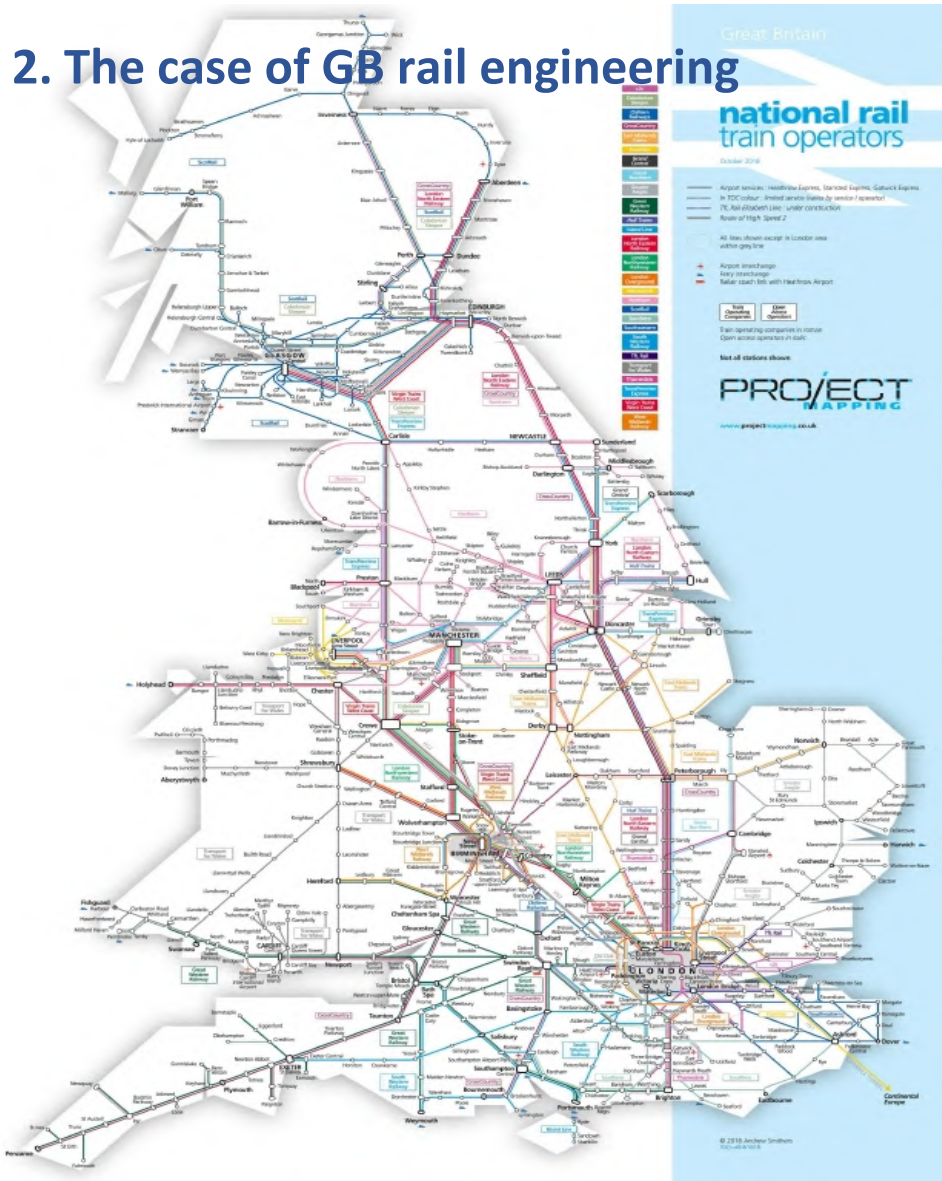
- The study of gaps between WAI/WAP and WAD has a long tradition in human factors practices
- This has mainly addressed the workplace as a situation for which time and spatial boundaries tend to be relatively easy to determine
- The ability to recognise these boundaries is fundamental to understand the boundaries of WAD itself (generate meaningfulness) and to place it in the context of WAI/WAP



- Highly distributed work
- Time and spatial dispersion
- Underspecified and fast-pace changing operations
- Increasing cognitive nature of human work that challenges the ability to capture WADone and blurs its boundaries with WADisclosed



2. The case of GB rail engineering



The rail network

Diversity of track & assets

Diversity of traffic

- Passenger
- Highspeed
- freight

Different degrees of aging and wear down

Diversity of engineering requirements

Engineering planning - WAI
How much WAD is there in planning?

Work delivery - WAD
How much WAI is there in delivery?

Rail infrastructure

- Access to the infrastructure as the most critical resource
- Must be made as much as possible available for train services (ops)
- Increasing access for train services, decreases access for maintenance, but maintenance needs tend to increase

2. The case of GB rail engineering

The methods

Interviews

- Overall understanding of planning organisation
- Critical role of change management
- Identification of factors that influence planning decision making processes

Analysis of planning, work delivery and infrastructure archival data

- Systematic and integrated data analysis
- Identification and understanding of planning interdependencies

National Planning questionnaire

- Understanding and assessing resilience in planning
- Assessing planning performance
- Identify potential sources of performance variability
- Understand couplings within planning

FRAM and modelling activities

- Systematic and integrated data analysis
- Identification and understanding of planning interdependencies

Area comparison: planning, delivery and infrastructure trends

- Impacts and support of planning in view of work delivery requirements
- Level of response of work delivery in view of infrastructure maintenance needs and renewal plans
- Demands imposed on planning by the infrastructure

Investigation of planning system

- Planning performance trends
- Levels of planning activity (volume of work planned per possession)
- Planning performance indicators

Infrastructure

- Equated track miles
- Asset counts
- Asset incidents trends

Planning

- Meeting records
- Management system

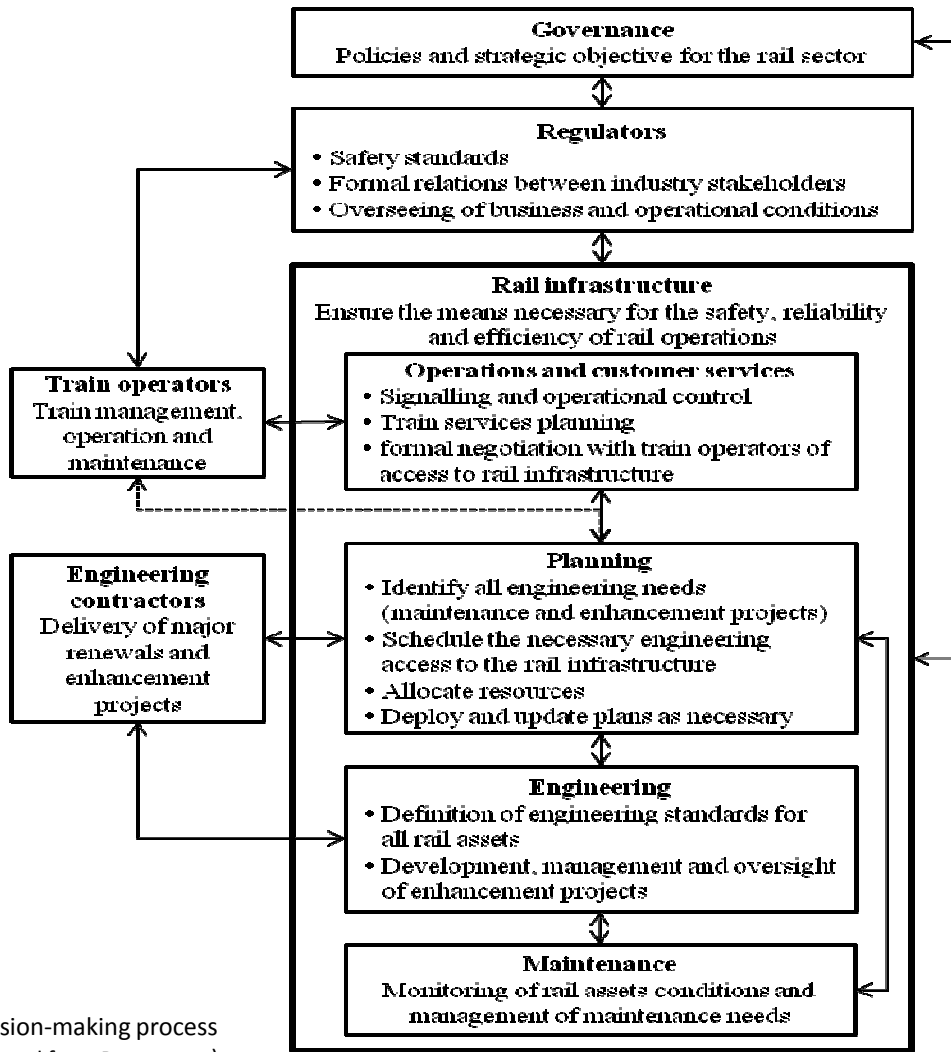
Work delivery

- Control logs
- Asset incident trends

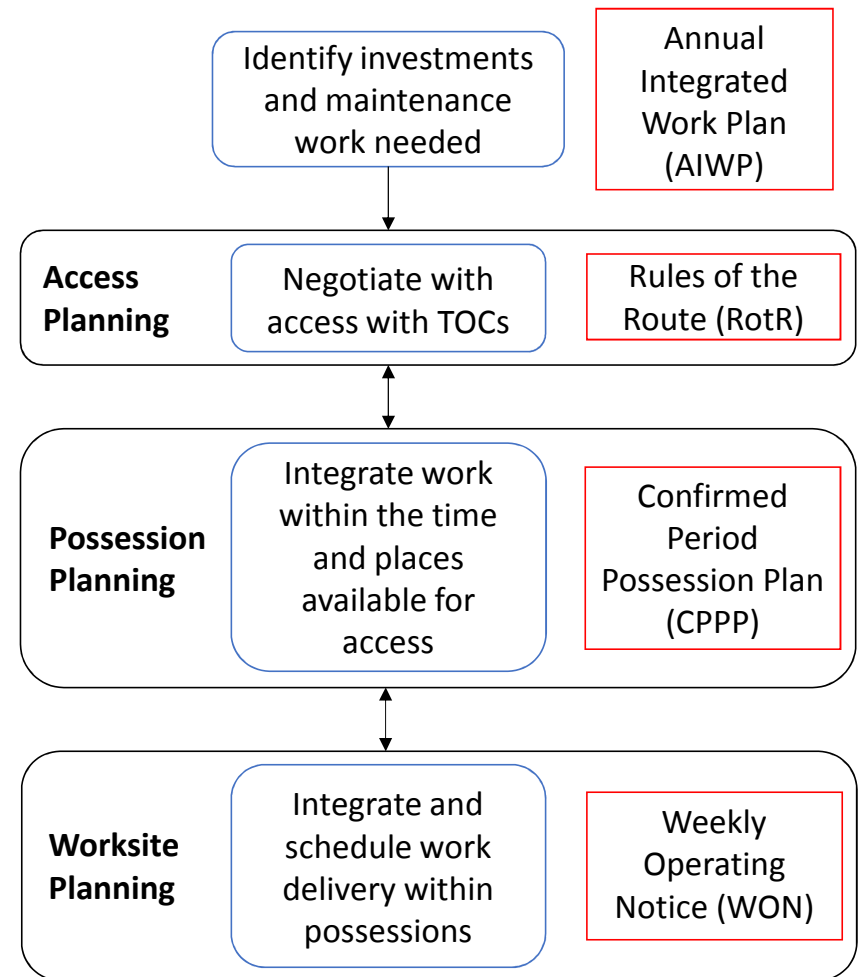
Resilience engineering

- Indicators for resilience
- Relation between resilience and planning performance

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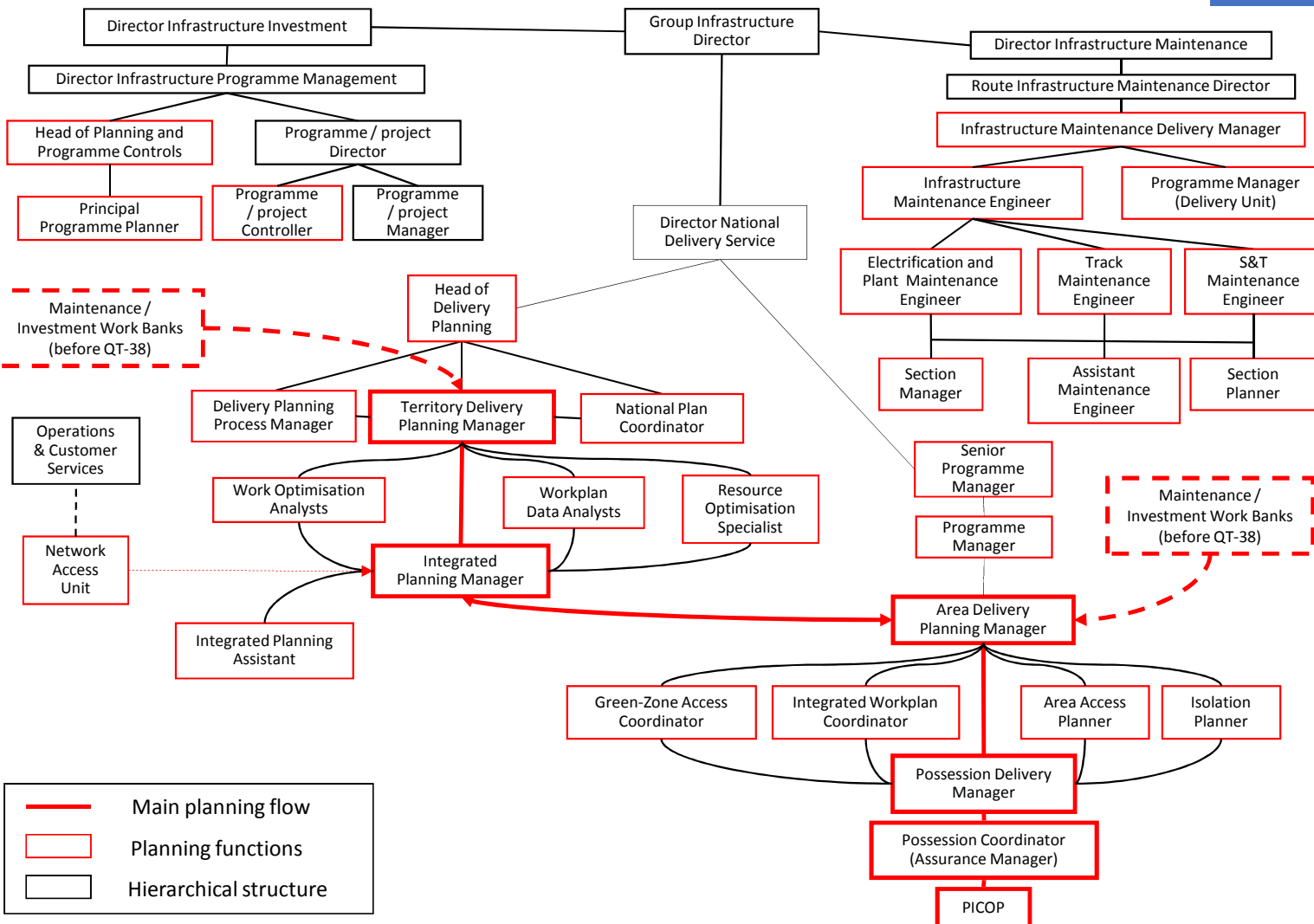
Rail engineering planning - WAI



Decision-making process
(adapted from Rasmussen)

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Rail engineering planning - WAP



- Average duration of 90 weeks, going from the identification of a basic scope of work, down to all the necessary details of work delivery
- Involving nearly 2000 staff and other stakeholders (i.e. contractors)
- From a centralised national planning unit to, 5 territories and 13 engineering planning areas, 34 delivery units...

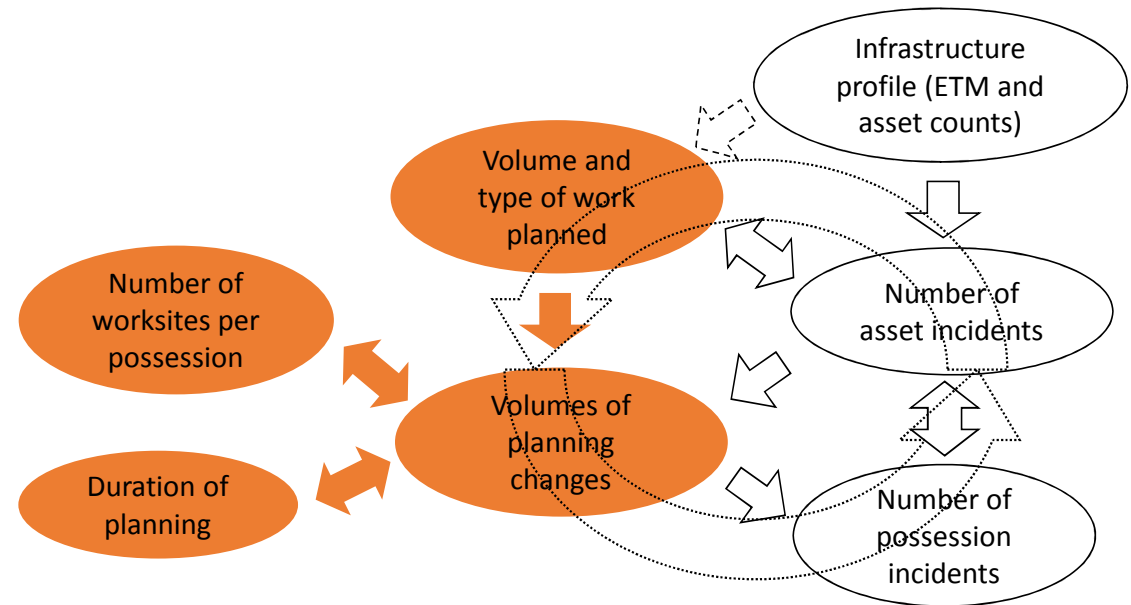


- Inspections
- Asset maintenance
- Track asset renewals
- Bridges and tunnels
- Major projects

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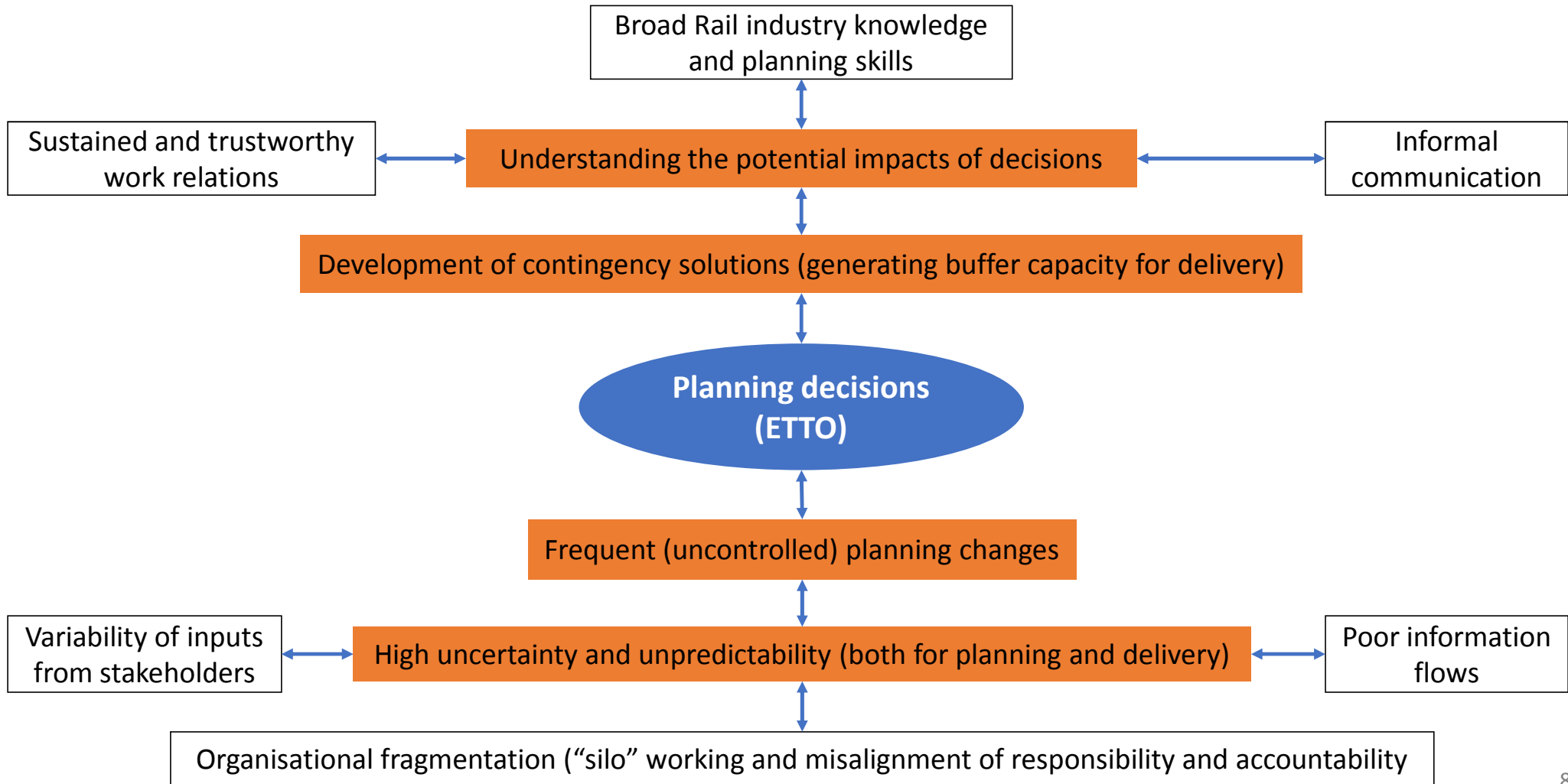
Rail engineering planning - WADisclosed / WADone

- The majority of pressures (and therefore of the ETTOing) imposed on planning fall on to those who are responsible for integrating work items into possessions
- Most of such pressures emanate from conflicting / misaligned priorities between major projects and maintenance
- A great volume of planning changes are undertaken beyond the established milestones (WAP) and frequently go as far as a few hours before the possession is taken
- The considerable diversity of infrastructure profiles and of traffic across the network is not necessarily compatible with the principle of “one way of doing things” that is imposed by the planning business process
- Difficulties in retaining and developing planning skills and expertise due to frequent team and process reorganisations
- Contacts and trustworthy relations with stakeholders (both in-house and outside the organisation) are a key resource
- Most planners have little visibility of how their work is taken forward down to work delivery
- The planning management system only records the formal outcome of planning decisions, offering little support to the actual decision-making processes



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Rail engineering planning - WADisclosed / WADone



3. The varieties of human work

From WAlmaged to WADone

Work As Perceived

Work As Imagined

Work As Prescribed

Work As Disclosed

Work As Done

Literature (Ergonomics & HF, Safety & risk, Systems theory, planning and scheduling, industry sector, engineering...)

Organisational documents – prescriptive
(policies, business and operation processes, procedures...)

Organisational documents - retrospective

- Archival data (safety & performance indicators)
- Planning management system
- Operations and safety reports

Modelling, data systemisation and sense-making

Diagrams and process flows

FRAM modelling

On-site evidence and ethnographic work

Interviews with planning and work delivery subject matter experts

Questionnaire for the assessment of resilience related factors

Observations of planning meetings and of work delivery

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Literature (Ergonomics & HF, Safety & risk, Systems theory, planning and scheduling, industry sector, engineering...)

Although evidence of WADone and WADisclosed may be available, its transfer across contexts presents limitations

3. The varieties of human work

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Work As Done

Organisational documents – prescriptive
(policies, business and operation processes, procedures...)

Tend to provide clear description and boundaries for WAP but its understanding requires some degree of knowledge of real work

3. The varieties of human work

From WAlmaged to WADone

Work As Perceived

Work As Imagined

Work As Prescribed

Work As Disclosed

Work As Done

Organisational documents - retrospective

- Archival data (safety & performance indicators)
- Planning management system
- Operations and safety reports

Organisations tend to have vast repositories of archival data but they tend to be difficult to apply to specific needs other than those for which they were design and they also tend to be bounded by WAP

3. The varieties of human work

From WAIImagined to WADone

Work As Perceived

Work As Imagined

Work As Prescribed

Work As Disclosed

Work As Done

- Useful for the systematic integration of different data sources
- Easy to be trapped in oversimplification
- Loosing track of which is which (WAI, WAP, WAD...), particularly because they tend to be recreated from WAP

Modelling, data systemisation and sense-making

FRAM modelling

Diagrams and process flows

- Useful for the representation of WADone but requires a level of granularity difficult to produce when considering large scale systems
- If sufficient granularity is not produced models tend to approach WADisclosed or WAP

3. The varieties of human work

From WAIImagined to WADone

Work As Perceived

Work As Imagined

Work As Prescribed

Work As Disclosed

Work As Done

Powerful sources of data but require in-depth understanding of context to identify to which variety of work should obtained information be attributed

Highly targeted at WADone but tend to consume substantial resources and often challenging to implement, particularly in highly distributed and intangible work scenarios

On-site evidence and ethnographic work	Observations of planning meetings and of work delivery
Interviews with planning and work delivery subject matter experts	
Questionnaire for the assessment of resilience related factors	

3. The varieties of human work

From WAIImagined to WADone

