Industry Integration on The Greater West Programme: A Case Study.

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Keywords: System Integration; Programme Management; Infrastructure; Rolling Stock

Abstract

In 2015 the GB Government Public Accounts Committee (PAC) [1] reviewed Network Rail's 2014-19 investment programme, and in particular the programme of enhancements on the Western Route (The Greater West (TGW) programme), and concluded that cost increases on the programme were "staggering and unacceptable"; the programme had not integrated all the elements needed to deliver benefits for passengers; and the infrastructure enhancements and new trains procurement were seen as two linked projects, rather than "one programme which needed to be managed as a whole". By January 2018, the TGW programme had successfully brought into passenger service the first of the new class of Intercity Express Trains and over 40 Class 387 Electric Multiple Units on the Western Route boosting seat capacity in the London Thames Valley Area and further west as Class 16x stock was cascaded to Bristol and beyond. This paper presents a case study on how, since the 2015 PAC, the TGW Programme has been managed at a cross-industry, 'whole-system' level and how system engineering and project/programme management processes were combined into an innovative approach by the Industry Systems Integration team to deliver the whole system outcomes.

1 Background to 'The Greater West' Programme

The Western route covers the railway from Paddington to Penzance, Bristol, and on to Cardiff, Oxford, Gloucester, and Worcester. Originally designed by Brunel in the 19th century, the last major upgrade to the route came in the 1970s, which saw the introduction of 125mph diesel intercity trains. With these trains being 40 years old and life expired, the decision was taken to electrify the main line to allow the introduction of replacement rolling stock. As well as new high speed intercity trains, delivered through the Intercity Express Programme (IEP), a new fleet of electric suburban trains (Class 387) are being introduced, allowing the "turbo" diesel trains (Classes 165 and 166) to be cascaded west. The introduction of these new train fleets, combined with works to increase track capacity, is providing many more seats for passengers, improved journey times and better service reliability.

The core rail infrastructure works to enable the change in service include electrifying the lines from London Paddington to Swansea, and a number of branches on the route, capacity projects at Reading, Oxford, Bristol Parkway and Bristol Temple Meads, and associated works to introduce new and cascaded fleets of electric trains and the cascade of diesel rolling stock. Until mid-2014, the various elements were managed as separate but related projects, rather than as one integrated programme, even though improving services for passengers required all the elements to be completed on time.

By November 2015, the GB Government Public Accounts Committee [1] in reviewing Network Rail's 2014-19 investment programme, and in particular the programme of enhancements works on the Western Route, concluded that:

- cost increases were "staggering and unacceptable";
- the programme had not integrated all the elements needed to deliver benefits for passengers at the planning stage, and was not being managed in a joined-up way;
- the infrastructure enhancements and new trains procurement were seen as two linked projects, rather than "one programme which needed to be managed as a whole."; and
- the programme had not produced an integrated critical path combining the electrification, the trains and franchising elements.

In November 2015, the new incoming Network Rail Chairman, Sir Peter Hendy, undertook a review of the affordability of the national enhancement portfolio [2]. This resulted in the resetting of the cost and schedule baseline across the national portfolio of enhancement programmes and projects. Notably for the TGW Programme, the Hendy Review pushed back the anticipated completion dates for electrification of the GWML. As a result of the electrification delays, the decision was made to alter the make-up of the IEP fleet being procured and opt instead for a fully diesel/electric bi-mode fleet to mitigate the consequential effects of the electrification delay, safeguarding as many of the expected programme benefits as possible.

2 Scope of the Industry System Integrator

The model of a system integrator to manage the integration risk between the four main industry parties - the Department for Transport (DfT), the train manufacturer, Network Rail, and the affected Train Operating Companies (TOCS) - was first applied on the Thameslink Programme. In May 2011, Sir Roy McNulty published his findings and recommendations for improved efficiency and value for money in the GB rail market [3]. The report identified a number of barriers to efficiency including the fragmentation of industry structures and interfaces, and the relationships and culture within the industry. The report also recognised that the industry partners needed to work more closely together to implement a 'whole-system' approach to planning of timetables, infrastructure, and rolling stock improvements, so as to improve the efficiency of the rail system as a whole. However, McNulty identified the Thameslink ISI approach as being best practice at the time, having "*delivered significant benefits to date*" and "*designed out non-value adding requirements and mitigated many problems*".

Following the successes of the ISI approach on Thameslink and other UK rail programmes, Network Rail was appointed by the DfT to perform the role of Industry-Level (Railway) System Integrator on its behalf for the TGW Programme. Network Rail appointed WSP to the ISI Team to provide specialist system engineering and programme management support on the 1st April 2014. The combined NR and WSP team is the focal point for integrating engineering, operation and franchise solutions to meet the DfT and Office of Rail and Road (ORR) requirements for the TGW programme and assure its successful delivery.

The multi-discipline, multi-stakeholder ISI team (figure 1) is responsible for ensuring that the system design reliably delivers the transport benefits that the DfT Client expects. The role requires the provision of support across programme governance, requirements specification & management, system architectures, operational readiness, integrated scheduling, programme risk & change management and interface management.

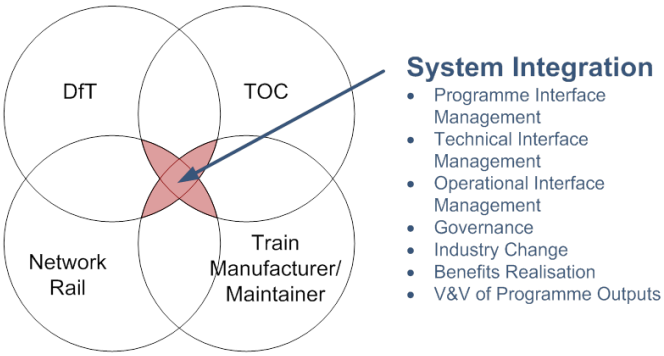

Figure 1 – position of the TGW ISI function within rail industry stakeholders.

During the existence of the ISI function the role has adapted to suit the shifting focus and needs of the TGW programme. Initially, the ISI team support provided was weighted towards systems engineering and the priorities were setting the scope boundary of the newly brought together TGW 'programme', identifying and controlling interfaces to external projects and dependencies, and agreeing the phasing approach to the delivery of passenger benefits across all industry parties. The ISI role transitioned to programme management in the later stages. This approach involved developing an integrated industry schedule, identifying and managing service change risk, controlling change and providing confidence that the outputs would be achieved through an operational readiness process.

3 Addressing the Integration Issues

The main challenges facing the ISI team on its appointment to the TGW programme were:

- defining the scope of the newly formed TGW programme;
- agreeing the incremental approach to delivering the client's outputs across the industry partners;
- creating an Integrated Industry Schedule as a single point of truth;
- establishing a technical and operational assurance regime to build confidence across the industry partners in the deliverability of the service changes; and
- development of stakeholder relationships through the transition period of collation in to a programme, and subsequent on-going management of these diverse relationships

3.1 Defining the Programme Scope and Boundary

As the TGW programme was never conceived as a single programme entity it was necessary to retrospectively define the system of interest boundary by identifying all of the infrastructure, operational and rolling stock projects occurring as part of the route's modernisation. Due to the many projects planned on the Western Route, the TGW programme contained many project-to-project interfaces, both within the scope of the TGW programme boundary and with external projects. Adding to the complexity, many component projects were already significantly progressed through their lifecycle with physical works underway, and others were at a very early stage of concept definition and design development.

Once the full portfolio of enhancement, renewal and business transformation projects on the Western Route had been identified it was possible to set the TGW programme boundary based on which projects were required for achieving the service change outputs and client benefits. The programme boundary, internal/external interfaces and delivery responsibility were communicated to the industry partners via a document called a Programme Wide Interactions diagram (PWI). The PWI diagram (figure 2) is a rich-picture diagram used to simplify the programme scope

and aid communication of the whole-system architecture [4] to the industry partners. The ISI took the decision to use a rich-picture approach, rather than a more rigorous system modelling language (SysML) format, to ensure clarity among the audience of senior programme management, route and TOC directors and DfT civil servants. Previous experience had indicated this highly visual method was better at conveying complexity.

and business change activities that were also necessary for the successful introduction of the train service changes that deliver the client's benefits and passenger outcomes. Additionally the TGW programme had fixed itself around three 'big-bang' operational changes which, given the complexity of the rolling stock programme and magnitude of the timetable changes, imported considerable risk to the programme.

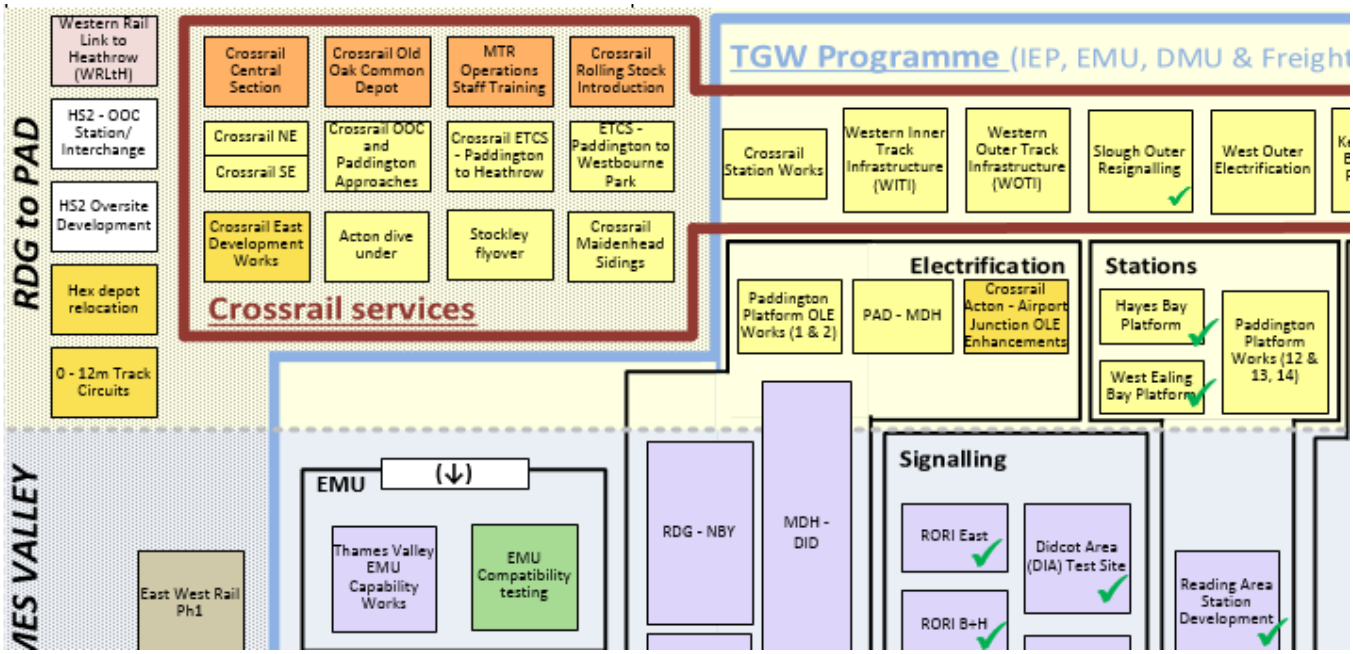

Figure 2 – extract of TGW Programme Wide Interactions diagram showing rich picture format

The PWI visualisation served as a communication tool, but it was underpinned by a data file where amendments, additions and deletions could be effectively controlled; so providing the formal control and configuration of other system architecture tools. This also allowed other 'views' of the information to be created, including a geographical representation as a schematic map upon which various aspects of the system can be overlaid. This was again beneficial for stakeholder understanding, but also aided the ISI team in identifying and defining interfacing projects on the programme.

In response to a concern raised by the rail regulator, the ORR, that there was no overarching programme specification, the ISI team developed a Route programme Requirements Document (RpRD). The RpRD summarised at a system level and in requirement form the infrastructure works necessary on the route to realise the benefits. These were largely collated from existing documentation, modified and uploaded to DOORS™ to allow traceability to project level requirements.

3.2 Programme Outputs and Benefits

Prior to the TGW programme becoming a single entity, the component enhancement projects were focussed on the delivery of the specified infrastructure works only. Very little consideration had been given to the operational, maintenance

The ISI team was central to shifting the focus of programme management from infrastructure delivery to an outputs focused approach to project planning and de-risking the schedule by defining a more incremental approach to the operational changes.

The benefits that underpin the TGW programme's business case are:

- increased passenger capacity;
- reduced journey times; and
- improved service reliability.

The programme also sought to reduce environmental impact and improve passenger experience.

The ISI team built on the earlier work of identifying the Western Route's projects and defining the TGW's programme boundary in the PWI diagram, by using Goal Structuring Notation (GSN) [5] to link work breakdown elements to the programme benefits from the Business Case. The GSN approach ensured a two-stage verification:

1. that the TGW programme scope was complete and that no enhancements works had been missed; and

2. that the programme benefits were all achievable.

Migration planning is a common approach used by the system engineering and project management disciplines to define and control the configurations of the main project phasing (figure 3). It helps defines how the programme's phases can incrementally achieve the required performance between goal definition and final operation. The TGW ISI team worked closely with the lead operator on the Western Route, GWR, to understand how the introduction of the new and cascaded rolling stock and the timetable service changes could be phased to align with the infrastructure delivery schedule. As far as possible the service change phases were decoupled from each other to reduce the risk of infrastructure or rolling stock introduction delays cascading across from one to another. Once identified, the service changes were agreed at the TGW Programme Board and then baselined.

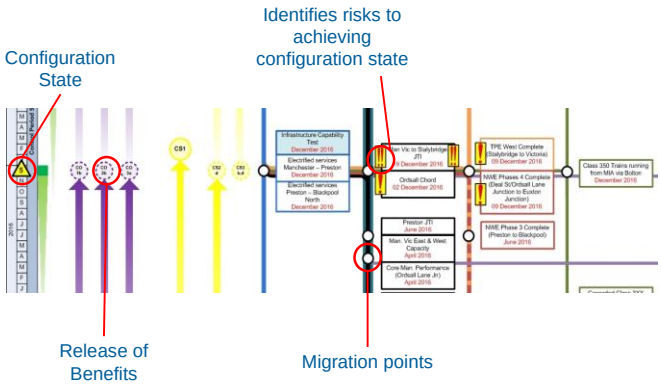

Figure 3 – annotated extract of a Migration Plan

3.3 An Output Focussed Approach to Industry Planning

One of the most critical findings of the PAC review in 2015 was that the TGW programme had not produced an integrated critical path combining the electrification, the trains and franchising elements. The migration planning approach had established a high-level phasing and secured cross-industry agreement on the service changes. However, a fully integrated schedule was still required to align the infrastructure, operations, rolling stock and business change schedules and establish confidence in the programme's ability to deliver.

The Industry Integrated Schedule (IIS) workstream took an industry wide approach to deliver the customer benefits relating to each service change. By focussing on each individual service change the schedule identified the critical activities required across the industry stakeholders, and the key inter-dependencies across the parties, to maximise the opportunity to deliver the benefits to the end-user at the scheduled time. The IIS includes the following evidence for every service change:

- a robust and integrated schedule (per service change), collating all industry stakeholders high level activities;
- a service change dashboard provided to TGW Programme Board every four weekly period that reported on risks, issues and overall confidence level of delivery;
- service change migration plan - outlining critical milestones, including decision points, for each industry stakeholder;
- service change checklist – clear schedule inputs with uncertainties surrounding deliverable dates visible to all industry stakeholders; and
- schedule assumptions and risks.

3.4 Operational Readiness Countdown

The IIS provided a strategic overview for the industry critical path in delivering each service change. It was recognised that as a service change approached the level of system assurance required would need to increase. Drawing on experience from Thameslink and other industries an Operational Readiness & Integration (ORI) process was developed.

The ORI process builds directly on the IIS and uses tools and techniques such as checklists, migration plans and risk registers to provide a more detailed tactical view on remaining activities to deliver a service change. As a service change approaches there is a greater need to coordinate stakeholder involvement with key dependencies between testing and commissioning, and operational handover. The level of review required is based on complexity, expected benefits and risks.

The process considers all pre-requisites from across all industry organisations and industry standard approvals, to focus on the delivery, operation & maintenance of infrastructure and rolling stock.

Countdown meetings provide progressive assurances to stakeholders of service change readiness in the form of RAG ratings. These are agreed by all stakeholders as part of the process to allow a common view to be presented to programme governance based on the agreed key risks and issues to aid effective and timely decision making.

This process has been successfully used to enable the on-time entry in to service of nine service changes covering new Class 387 EMU services, the cascade of Class 165/6 'Turbos' DMU and introduction of IEP Class 800 rolling stock.

4 The Importance of Effective Programme Governance

Programmes tend to be dynamic in nature with intense cross-discipline and cross-project integration [6], in which the actions of one functional project affects, supports and reinforces the other projects involved in the programme [7] [8]. On the other hand, programme management involves management of a group of projects [9] [10], while project management deals with the effective management of activities to deliver the project within the approved cost quality and time [11].

The TGW programme, by virtue of its value and complexity, is part of the Government's Major Projects Portfolio (GMPP) and by that nature is categorised as a Tier 1 programme. All Tier 1 programmes report into the Board Investment and Commercial Committee (BICC) chaired by the DfT's Permanent Secretary. The role of BICC is to approve business cases and commercial decisions for the DfT's portfolio of Tier 1 projects. It also monitors the progress, performance and impact of major programmes and projects. BICC asked that the Hendy Review [2] re-baselining be accompanied by a strengthening of the project and programme governance across NR and DfT. Similarly, Dame Colette Bowe's Review [12] called for improved governance and clearer roles and responsibilities.

At route level, a cross-industry Programme Board was established and charged with delivering an agreed set of outcomes for a given budget. The TGW Programme Board was created to work within defined parameters to decide how the programme would be conducted. The attendance of route leads and key industry partners for rolling stock and franchising enabled a holistic approach, integrating delivery to achieve the required rail user benefits. These key decision making forums were supported by working level meetings such as the Industry Planning Group (IPG), the Event Steering Group (ESG) and Maintenance and the Operational Readiness Working Group (MORWG).

Establishing a strengthened client role for DfT meant that the funder of the TGW programme, within the context of NR's accountability, was also key to establishing effective governance. The role of the DfT as Client through the governance forums is to robustly review the programme's incentives and risks for each organisation to ensure accountability and risks sit in the right place. The ISI Team drew on established models from elsewhere in the UK rail industry, such as Crossrail and Thameslink, to establish the right governance structure. When setting up the governance structure, it was important to set tolerances to avoid micro management of NR.

Strong and informed governance was an important early step in realigning the programmes. With the DfT client in the chair to oversee the different industry priorities, with attendance from the key stakeholders to ensure that all views were taken into account, and with an independent ISI to feed the information through governance, it was possible for decisions to be made that provided the best industry solution to issues raised whilst maintaining a focus on delivering the planned passenger benefits.

5 ISI Value Added and Benefits Realised

It is fair to say that an upgrade programme within an operational rail environment is a complex undertaking. In late 2013, the proposal to create an integrated delivery function within the TGW programme meant that critical success factors could be identified at a system level. The establishment of critical success factors for the programme by the ISI team, enabled the TGW Programme Board to track the value of programme outputs.

The ISI function was primarily created in order to mitigate the risk that the infrastructure, rolling stock and operations would not be integrated. It is very difficult to quantify the value of the risks mitigated and higher confidence levels achieved directly as a result of the ISI team. However, as of December 2017 the contract for ISI services has cost approximately £4m, less than 0.04% of total infrastructure and rolling stock cost. It is widely regarded by the senior programme management and industry partners that this represents good value for money.

The main benefits and value added by the TGW ISI approach include:

- Improved confidence in delivery as evidenced by the recent Infrastructure and Projects Authority (IPA) review;
- Increased industry confidence providing a better basis for planning commercial services;
- Decreased risk of delay between investment expenditure and benefit realisation through intermediate service changes and improved industry coordination; and
- Improved communication and trust between industry partners facilitating improved issue resolution and risk reduction or avoidance.

Acknowledgements

None.

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