Systems Engineering Case Study #15: Thameslink Programme

Keywords: Integration, Transition, Project Planning, Risk and Opportunity Management

Background to the Project

The Thameslink line is a UK mainline railway that runs north-south through the center of London. It serves a large number of commuters, links two London airports and allows passengers to travel across London without changing trains. It is currently uncomfortably congested at peak periods. The Thameslink program will transform journeys for passengers by increasing capacity and introducing new through routes. A fleet of new trains is being delivered. Automated Train Operation (ATO) and the European Train Control System (ETCS) is being introduced to allow 24 trains per hour to be run through the core section in the center of London – essentially a metro service. Other works include strengthening electricity supplies, building flyovers and dive-unders to untangle the flow of traffic and radically renovating three major London stations.

The overall sponsor for the program is the UK Department for Transport (DfT). The infrastructure changes are being delivered by Network Rail, the UK's national rail infrastructure manager. The trains are being bought from Siemens by Cross London Trains, a train leasing company which leases them to the operator. Govia Thameslink Railway (GTR) has been granted the franchise to operate the service.

Work started on the program in 2006. Delivery is being phased. At the time of writing (November 2016), most of the major station and civil engineering works had been completed and train delivery had started. The 24 train per hour timetable is due to be introduced in December 2018.

Description of the Challenges Faced

Network Rail, Siemens and GTR have set up separate programs to deliver their parts of the overall program, which have been procured under separate contracts. There is, therefore, a need for the DfT to co-ordinate these sub-programs.

There are many other stakeholders in the program, including Cross London Trains and other train operators who will share tracks with Thameslink trains outside central London.

While metros routinely run 24 trains per hour, this frequency is outside the experience of most mainline railways and delivering it requires fundamental changes in the way in which the railway is operated.

There is limited experience within the UK of using the ETCS/ATO train control technology.

Technological and operational changes are being introduced in a number of phases to mitigate some of the risks associated with the challenges above. For example, a 6-month period of operating at 20 trains per hour is being introduced before introducing the 24 trains per hour timetable.

However, this phased approach exacerbates another challenge, which is to introduce fundamental changes into an extremely busy railway for which only short interruptions in service are tolerable. Typically, changes that affect the service have to be made overnight or on weekends and the railway has to be returned to service after a few hours of work. The need to break the 'migration' path from the original railway state to the final state into many small changes makes the path complex.

Description of the SE Performed

The DfT set up a Programme and System Integration (PSI) team to support the co-ordination of the sub-programs. SE approaches have been adopted in several areas and later versions of this case study may look at all of these areas but this version of this case study focusses on one area, where the benefits are particularly clear: migration planning.

For an upgrade to an existing railway which remains in use, it is not enough to design the final system, it is also necessary to design the ‘migration’ path: the sequence of interim states and the transitions between them. A migration plan documents this sequence and can be considered as part of an overall program plan but it can also be considered as the time dimension of the system design process. When, as in this case, a railway upgrade program is being delivered by multiple parties, the migration plan choreographs the intricate dance that the parties need to enter into to deliver the upgrade without undue disruption.

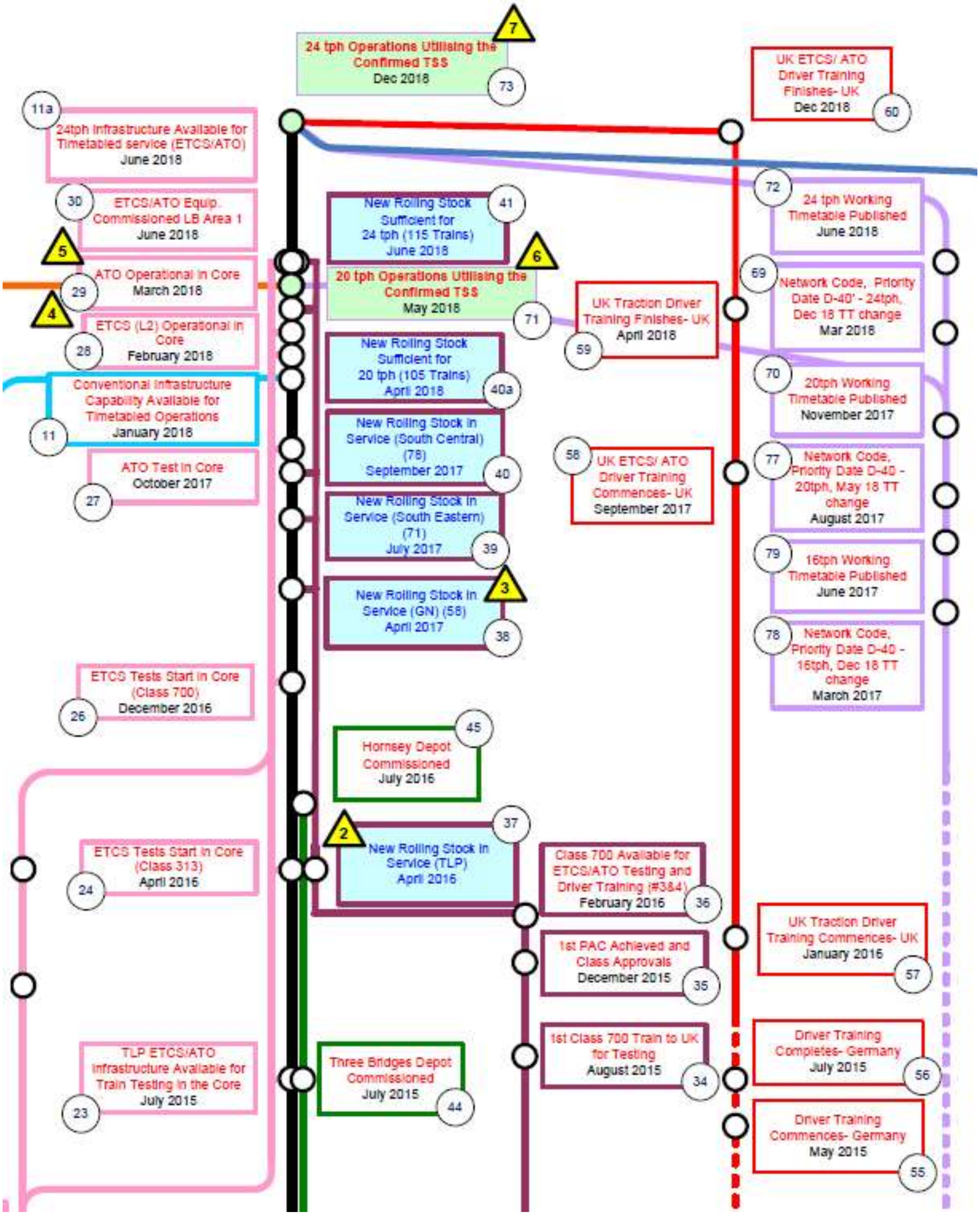
The PSI team adapted and developed an approach that had previously been used on the upgrade to the London Underground Victoria Line. A series of ‘configuration states’[9] were defined which were the changes to the railway which were associated with greatest risk. These were established as the primary milestones in the migration plan and additional preparatory and interim milestones were then established.

An overall plan was constructed for the entire program[10] and more detailed plans were then created for individual configuration states or groups of configuration states.

The plan is maintained using a standard project planning tool but the output of this tool is not presented in its raw form to program leadership. Instead effort is expended to produce a clear color-coded schematic. This looks a little like a London Underground ‘tube map’ and, like a tube map, is designed to suppress unnecessary detail and help the reader see clearly how to get to their destination. An extract of this map is reproduced on the next page.

[9] For historical reasons, some of the earlier configuration states were termed ‘key outputs’

[10] The title of this overall plan was changed to the ‘Industry Plan’ to reflect the increased number of preliminary milestones added to it over time, but for clarity we will still refer to it as the top-level of the migration plan.



7
24 tph Operations Utilising the Confirmed TSS Dec 2018
73
UK ETCS/ ATO Driver Training Finishes- UK Dec 2018
60
11a
24tph Infrastructure Available for Timetabled service (ETCS/ATO) June 2018
30
ETCS/ATO Equip. Commissioned LB Area 1 June 2018
New Rolling Stock Sufficient for 24 tph (115 Trains) June 2018
41
72
24 tph Working Timetable Published June 2018
5
6
ATO Operational in Core March 2018
29
4
20 tph Operations Utilising the Confirmed TSS May 2018
69
Network Code, Priority Date D-40' - 24tph, Dec 18 TT change Mar 2018
71
UK Traction Driver Training Finishes- UK April 2018
59
ETCS (L2) Operational in Core February 2018
28
New Rolling Stock Sufficient for 20 tph (105 Trains) April 2018
40a
70
20tph Working Timetable Published November 2017
Conventional Infrastructure Capability Available for Timetabled Operations January 2018
11
New Rolling Stock in Service (South Central) (78) September 2017
40
58
UK ETCS/ ATO Driver Training Commences- UK September 2017
77
Network Code, Priority Date D-40 - 20tph, May 18 TT change August 2017
ATO Test in Core October 2017
27
New Rolling Stock in Service (South Eastern) (71) July 2017
39
79
16tph Working Timetable Published June 2017
3
New Rolling Stock in Service (GN) (58) April 2017
38
78
Network Code, Priority Date D-40 - 16tph, Dec 18 TT change March 2017
ETCS Tests Start in Core (Class 700) December 2016
26
45
Hornsey Depot Commissioned July 2016
37
2
New Rolling Stock in Service (TLP) April 2016
ETCS Tests Start in Core (Class 313) April 2016
24
Class 700 Available for ETCS/ATO Testing and Driver Training (#3&4) February 2016
36
UK Traction Driver Training Commences- UK January 2016
57
1st PAC Achieved and Class Approvals December 2015
35
TLP ETCS/ATO Infrastructure Available for Train Testing in the Core July 2015
23
Three Bridges Depot Commissioned July 2015
44
1st Class 700 Train to UK for Testing August 2015
34
Driver Training Completes- Germany July 2015
56
Driver Training Commences- Germany May 2015
55

Outcome

The program does not have a complete, integrated program plan and, given that the parties to the program are delivering against separate contracts, it would be difficult to create and maintain such a thing. Nevertheless, by concentrating on the changes to the railway, which is where the interactions between the sub-programs are most critical, the Thameslink migration planning documents have delivered much of the value of a complete, integrated program plan at a fraction of the effort.

The migration planning documents are accepted as an essential support to decision-making on the program. All the parties to the program contribute to these planning documents and they are used routinely by the program leadership to support decisions. The configuration states are an accepted part of the vocabulary of program staff at all levels. Migration planning is now accepted as good practice on all complex railway updates within the UK.

The concept of a configuration state has helped the program to separate near-term, tactical planning from long-term, strategic planning and has helped program leadership to contain the effect of short-term slippage on the overall program timescales.

Conclusion

Whether you call it migration or transition, this stage in the system lifecycle is one where railway upgrade programs face greater challenges than are typically faced by programs in other sectors. Railway programs have developed good practice in the area of migration planning, which has been demonstrated to show benefits. Key to delivering these benefits has been the recognition that migration planning is a tool for supporting decisions taken by program leadership and presenting the information in a manner which is most helpful to its audience.