VISUALIZING THE END GOAL IN RAIL MEGAPROJECTS

This article explores the value of using visualizations to create a universal understanding for successful delivery.

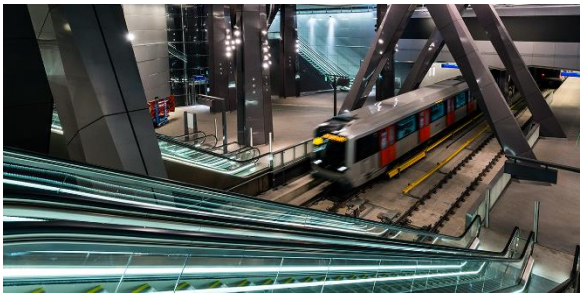
It is universally understood that “a picture is worth a thousand words”. Perhaps, though, 19th-century Russian writer Ivan Turgenev said it better: “The drawing shows me at one glance what might be spread over ten pages in a book.”

In managing the delivery of large-scale rail programs today, pictures, or rather diagrams, are extremely useful in conveying complex information in a simple-to-understand way.

One of the functions of systems integration (SI) is to provide program stakeholders with the information they need to make decisions at the right time. Visualizations help to create that clarity amid the complexity of rail programs.

Toward a Common Goal

In delivering SI, it is important that all participating groups are focused on a well-defined common goal—to deliver the outcomes required by the client and realize the benefits for the customers. Showing each participant’s stake in achieving this goal is essential.



Noord-Zuidlijn Centraal Station, The Netherlands

The WSP SI:D3 approach focuses on three guiding points for each program participant group. Associated bespoke visualizations clearly show involvement and contribution toward delivering targeted results:

- **How** to proceed – Specific requirements enable and guide progress.
- **What** to deliver – Physical assets are identified.
- **When** to render results – By-when dates are clearly stated.

How

Breaking down the program goals into project requirements is relatively easy for a systems engineer. Tools like DOORS[1] allow requirements to be linked into hierarchical arrangements so that traceability can be shown from project requirements back up to the program goals. But as participants will normally receive only their own particular set of requirements, they might not appreciate how their part contributes to the overall common goal. Through seeing graphical representations of either the specification structure, a schema (Figure 1, next page), or modified Goal Structuring Notation (Figure 2, next page), the relationship of the project requirements to the program goals can easily be understood.

[1] IBM DOORS ® - Dynamic Object-Oriented Requirements System

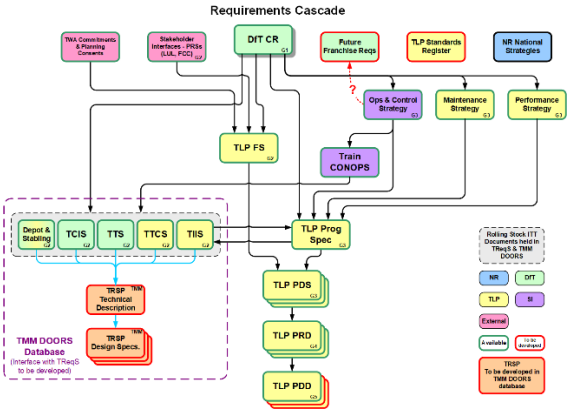


Figure 1 - Requirements Schema

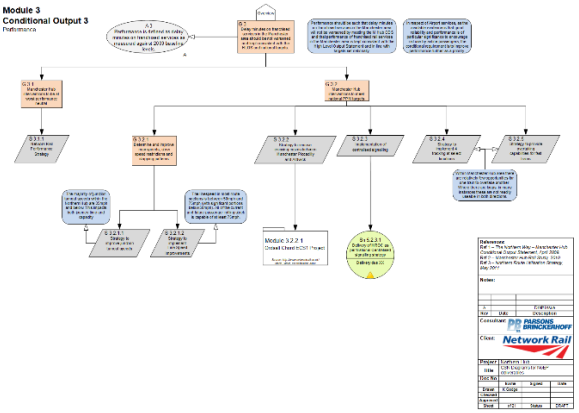


Figure 2 - Example Goal Structuring Notation

What

Describing “the what” in the context of the whole program can be challenging. Participants often well understand their part in the overall system but struggle to understand how their role works with the other elements of the wider program. This is where our system architecture views come into play.

The diagram shown in Figure 3 is a physical systems architecture view where each of the elements has been colour coded to show which program participant is responsible for delivery. The view not only shows what each participant must deliver, it also indicates where roles interface and how every element fits into the big picture.

We develop this kind of view by working closely with the participants and other stakeholders in the program to ensure universal buy-in to the approach and agreement that each participant’s scope has been accurately captured in the diagram.

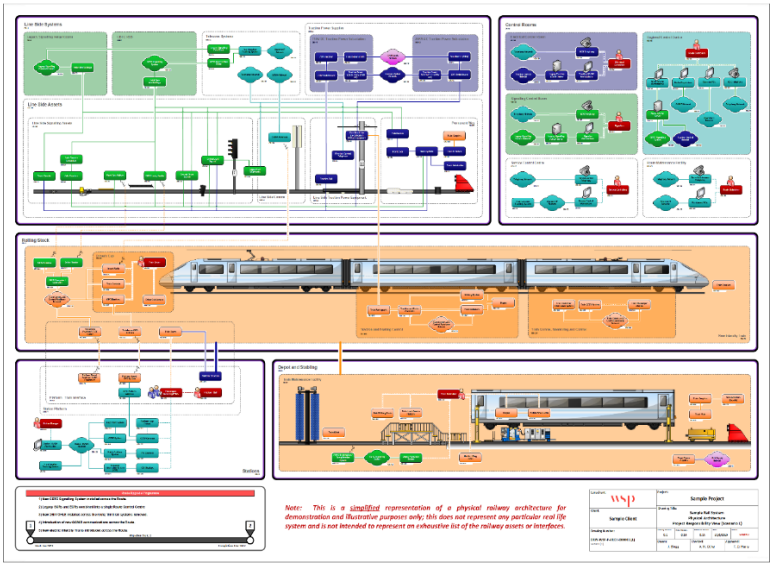


Figure 3 - Delivery Responsibility

When

In the project manager view, “the when” is typically represented by a complicated Gantt chart showing hundreds of activities, but without clearly presenting the interrelationship between the program elements.

Here is where our migration plan diagram proves helpful. A migration plan (Figure 4) takes the key milestones from each participant’s project schedule, plots them on timelines and shows the relationships between them. In this way, the migration plan demonstrates how the elements come together to deliver the program objective.

Figure 5 (next page) shows how a migration plan can be developed from a set of key program milestones that have been identified in the participants’ schedules (Gantt charts). A key program milestone exists at a point in time where two (or more) participants’ roles interrelate to achieve a required output. Once the key program milestones and interrelationships between the participants’ schedules are well understood, the points at which program benefits are realized can be determined and the migration states identified (Figure 4). A migration state exists at a point in time where the program achieves a key milestone that delivers a benefit.

Once the migration states have been established, we can utilize physical systems architecture views to show the differences in the physical state of the systems at each migration state (Figures 6, 7 and 8, next pages). In Figures 6 and 7, those assets that exist at each configuration state are shown in blue. In Figure 8, the status of each asset is represented by a unique color:

- Blue represents assets that are unchanged.
- Orange represents assets that are altered.
- Red represents assets that are removed.
- Green represents assets that are new.

Using diagrams like these makes it relatively easy for everyone involved in the program to understand what they must deliver, and by when.

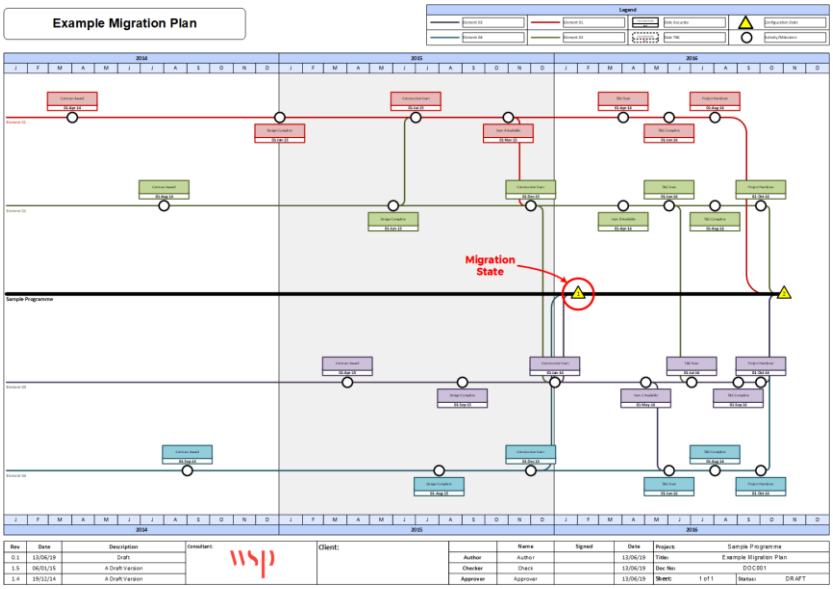


Figure 4 - Example Migration Plan

Figure 5 - Creating a Migration Plan

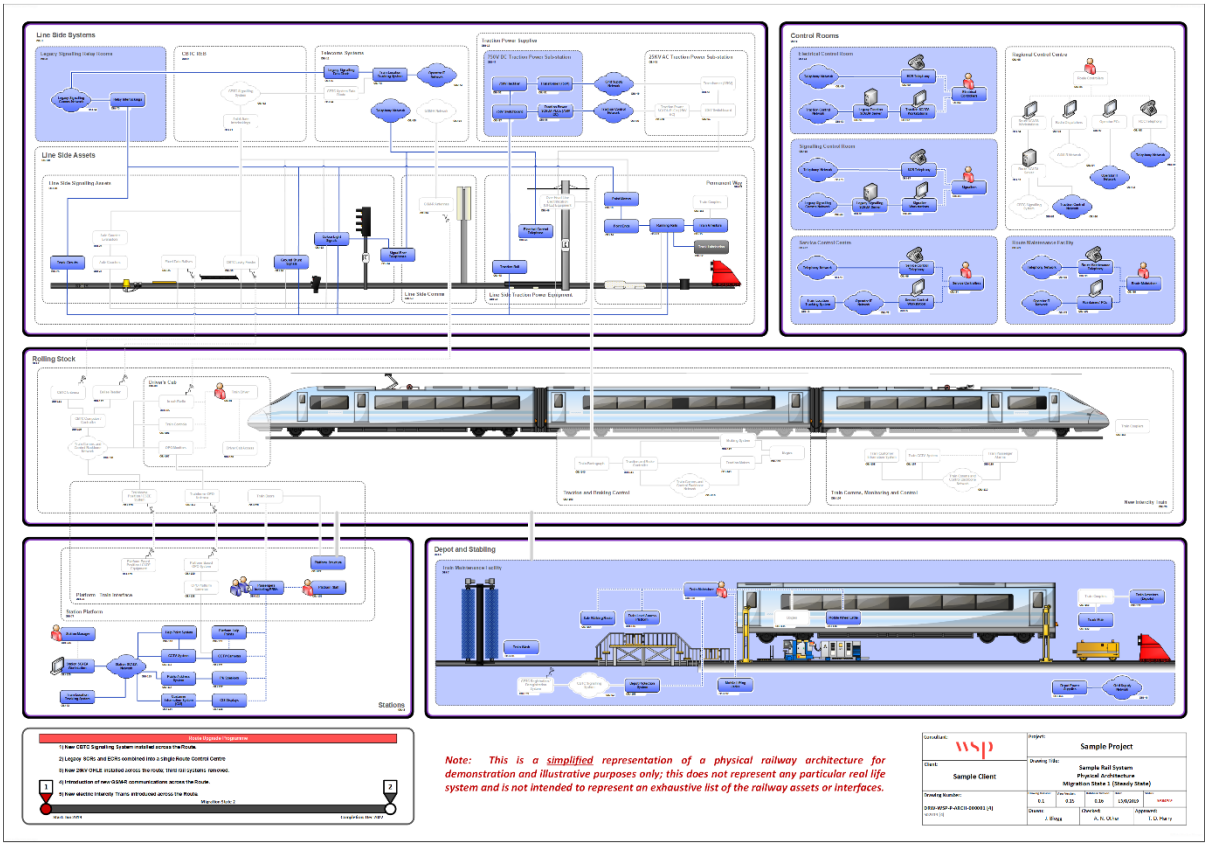


Figure 6 - Assets Existing at Migration State 1

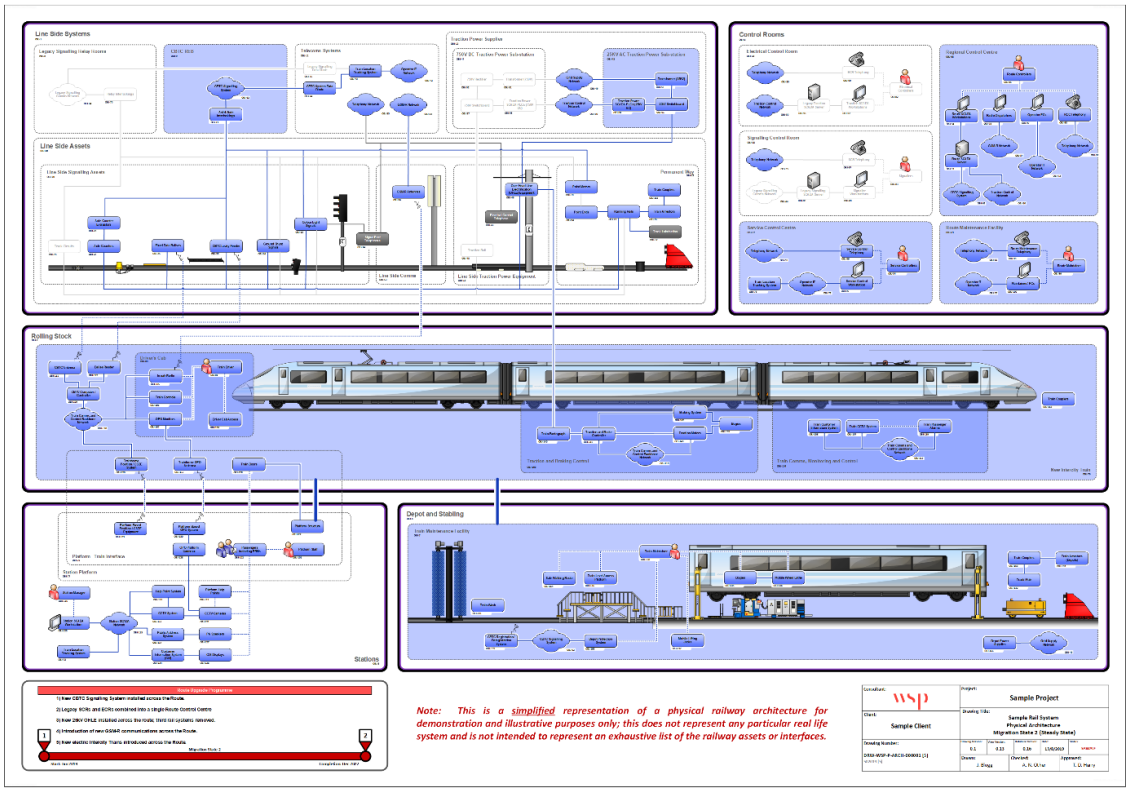


Figure 7 - Assets Existing at Migration State 2

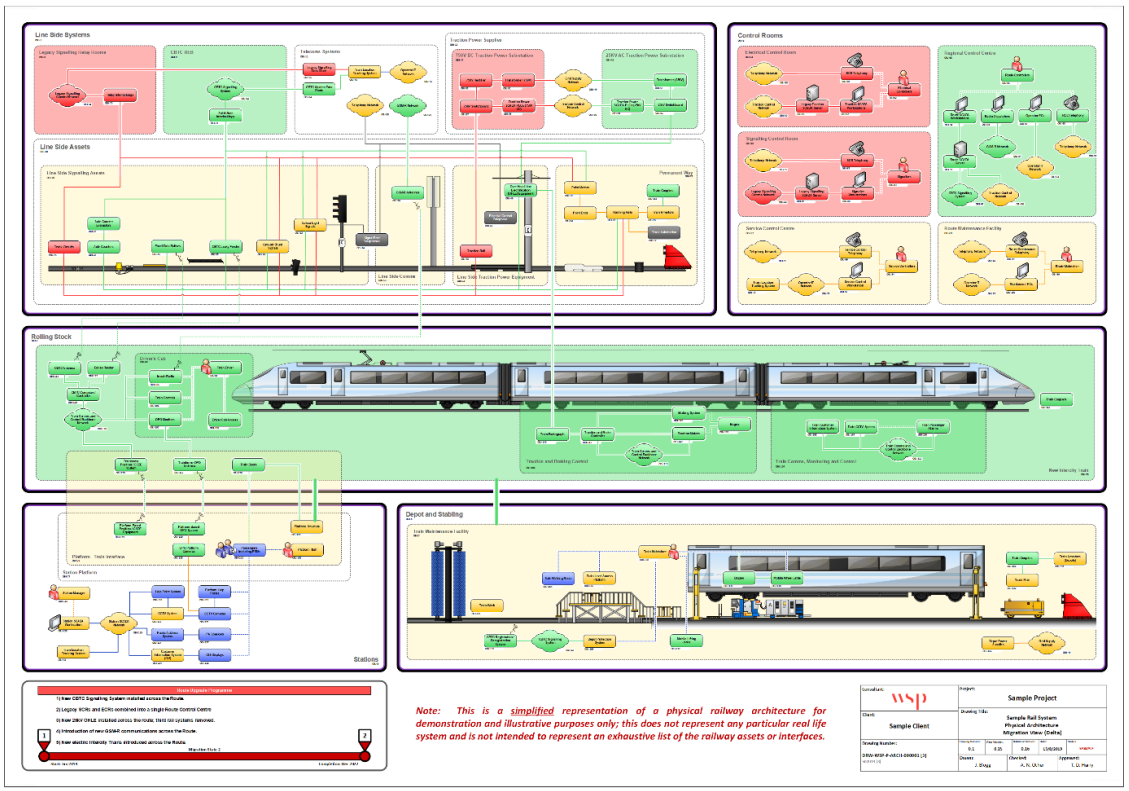


Figure 8 - Assets Changing Between Migration States

View and Perspective of the Program

Providing alignment relative to all the program participants and other stakeholders involved early in the program is critical to achieving a successful outcome. Therefore, enabling participants to see where they fit into the big picture and to understand their role in delivering the final result is fundamental in achieving that alignment.

When developed early in a program, a coordinated set of visualizations are key to providing a clear understanding of the program and guidance to the participants regarding their individual roles and contribution to the common end goal.

WSP's **SI:D^3** is based on using a common configured dataset—a single source of truth—to drive the production of the diagrams. In this way, the diagrams are based on controlled data that is attributable to a reliable source.

Author

Malcolm Thomas
Technical Director & Technical Discipline Lead, Systems Engineering, United Kingdom
Malcolm.Thomas@wsp.com

Contributors

John Welford, Technical Principal, Systems Engineering, New Zealand
John.Welford@wsp.com

Ian Jamson, Senior Engineer, Systems Engineering & Integration, UK
Ian.Jamson@wsp.com

About WSP

As one of the world's leading professional services firms, WSP provides engineering and design services to clients in the Transportation & Infrastructure, Property & Buildings, Environment, Power & Energy, Resources and Industry sectors, as well as offering strategic advisory services. Our experts include engineers, advisors, technicians, scientists, architects, planners, surveyors and environmental specialists, as well as other design, program and construction management professionals. With approximately 49,000 talented people globally, we are uniquely positioned to deliver successful and sustainable projects, wherever our clients need us. wsp.com