Thought Leadership

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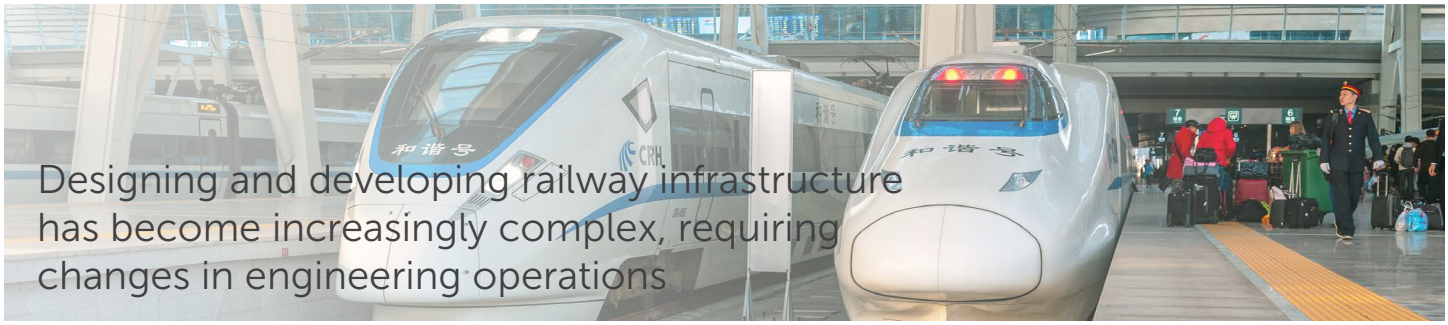
Inspire the Next

Creating the Next Generation of Railway Infrastructure

Engineering Productivity

Transportation



Designing and developing railway infrastructure has become increasingly complex, requiring changes in engineering operations

Mastering the Five Levers of Engineering Productivity

Global freight and passenger transport is expected to double over the next four decades[1]. This transportation boom requires major investments to expand and modernize railway infrastructure – tracks, bridges, signalling, crossings, platforms, etc. The worldwide investment in railway infrastructure is estimated to be $4 trillion over the next 15 years, according to a study published by the Organization for Economic Co-Operation and Development (OECD)2.

While most of the new tracks are being laid in China, India, and Latin America, the massive legacy railway systems of Europe and North America are also undergoing considerable renewal and expansion. Increased inter-modality – the seamless integration of airway, railway, underground, roadway, and maritime infrastructures – is driving additional investment. This investment, which, coupled with new competition due to market liberalization, is placing higher demands on railway infrastructure providers. Their engineering operations, in particular, are being challenged like never before. With shrinking time-to-market requirements, increasing price pressures, and growing technical sophistication, infrastructure engineering organizations are required to make a step change in productivity.

The design and development of railway infrastructure is an increasingly complex undertaking, from both a technological and organizational perspective. Infrastructure companies which were once regional or national, now face globalization. This brings new challenges of managing multi-cultural teams, managing new kinds of customer relationships, working to a wider range of standards and regulations and partnering with an international supplier base. Coping with these new challenges and levels of complexity requires nothing short of re-thinking engineering operations.

This includes processes, organization, management systems, communications, and staff competencies.

In summary, a lot of change. Over recent years, Hitachi Consulting has been working closely with the engineering departments of several major railway infrastructure companies. Through this experience we have identified five key levers of engineering productivity which need to be mastered:

1. Customer Requirements Management
2. Contract Management
3. Effective Workflow Interfaces
4. Common Practices
5. Resource Balancing

Engineering organizations need to take a close look at their maturity in these five areas, and the overall impact on performance in terms of time, cost and quality. A strong operational performance focus on all five elements will provide the means to build a more competitive end-to-end engineering capability.

Customer Requirements Management

Engineering productivity starts with the customer — specifically how customer requirements are defined, captured and managed. Failure to fully understand, document and work with the true customer requirements creates costly engineering change orders (ECOs), re-engineering, in-field downtime, as well as over-engineering.

A wide range of engineering problems can be traced back to a poor understanding of customer specifications, and in particular, a failure in capturing the critical-to-quality (CTQ) requirements. A robust requirements management process will ensure that the organization documents, verifies and meets the needs of its customers and key stakeholders.

This begins with the analysis of the infrastructure performance criteria and engineering constraints, and includes well-defined specifications, use cases and related information to ensure that delivered design fully meets the customer needs. Traceability is critical in managing requirements and reporting compliance, completeness, coverage and consistency. Good requirements management also supports effective change management, which considers the downstream impact of changes on related elements. Overall, this relies on effective communication among the project team members, suppliers, partners, and other stakeholders, based on well-defined terms of reference.

Contract Management

The second major lever of engineering productivity is effective contract (and risk) management. Contract management aims to improve the project's financial results and customer satisfaction in parallel. Effective contract management is based on mutual trust rather than conflict. In this context, risk analysis and management — whether the risks are technical, financial, contractual, or time related — is essential and must be done as openly as possible to achieve a win-win situation with the customer. The customer thus obtains the fair value for the service provided.

1. Global Land Transport Infrastructure Requirements, John Dulac, International Energy Agency (IEA), 2013
2. Strategic Transport Infrastructure Needs to 2030, International Futures Program, Organization for Economic Co-Operation and Development (OECD), 2011

Each party must also be accountable for mutually agreed responsibilities (e.g. the customer's promise to deliver clear and definite data, accountability for the potential impact of every late performance, etc.). This is why contract and risk management are integral to the offering process and must remain a major activity throughout the life of the project.

Good contract management requires common, well defined processes to manage amendments, changes and non-conformity. Critical is the tracking and the documentation of potential or actual deviations during the project and an estimation of their impact. This impact assessment helps to avoid awkward discussions, with decisions based on clear facts and assumptions. While the project leader remains in charge of customer satisfaction and risk management, the growing importance of contract management may require creating a new dedicated role of Contract Manager. This role can make a huge difference, when designed with the right role definition, metrics, skills profile, and reporting structure.

Effective Workflow Interfaces

Another critical enabler of lean and efficient engineering is the management of internal interfaces between technical disciplines, or more broadly between functions such as sales and marketing, the various phases of design, procurement and construction.

Every interface is a source of waste. Experience shows that workflow often crosses silos, where adjacent groups know little about the pressures each other are facing, and particularly in terms of what information they need and when they need it.

To reduce silo effects and optimize interfaces, roles and responsibilities must be clarified and understood, and well-communicated in an increasingly digitized workflow.

Creating effective workflow interfaces also requires understanding and assessing the risks related to advancing a project without inputs from all the functions. This is not always easy. It requires in-depth analysis of the work and a re-distribution of tasks to optimize the overall performance. This re-distribution effort requires engaged commitment and decisions making at the highest level of the organization. Requirements in terms of deliverables, quality and lead times need to be clearly defined, with standard terms of reference.

Performance must be regularly reviewed, every three to six months. It is often valuable to create a position responsible for coordinating studies between the engineering specialities, which requires sufficient knowledge of each specific field and their respective requirements and constraints. Management must be highly engaged, helping to break down silos and facilitating change, since destructive turf wars can easily erupt.

Lastly, improving workflow between interfaces can be aided by introducing common documents between specialities and a consistent management system, such as the MCRS® approach developed by Hitachi Consulting. It must ensure the right information is available to the right people, at each organizational level, in the right time, so they can make the best decisions in a timely manner.

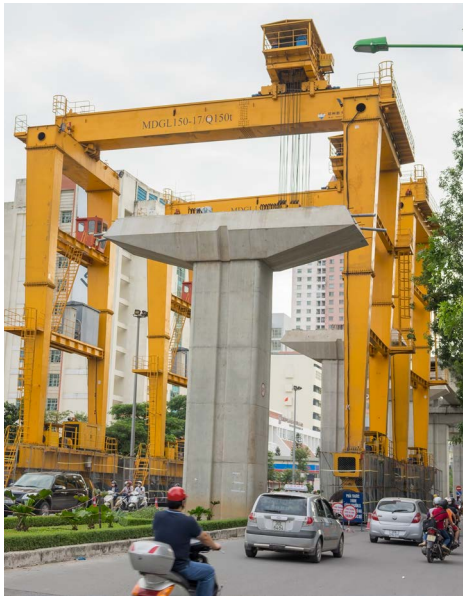
Common Practices

It has been over 100 years since the industrial revolution, yet the world is still far from having standardized practices in engineering and construction. This is especially true in the railway infrastructure business. The wide range of processes, procedures and standards is further compounded by the regional and national legacy of most companies. Different operating cultures have grown over the years on a site-by-site basis. As companies grow through mergers and acquisitions, heterogeneous working models continue to thrive years after the integration was declared complete.

Implementing a framework of common practices across the end-to-end value stream is a major driver of engineering productivity. This requires:

- Use of a common working language, lexicon, and terms of reference
- Standardized engineering methods and breakdown structures
- A common way of managing and measuring projects

Most companies have significant room for improvement in this area, but often



are not sure how to tackle it. The solution often lies in creating disciplined follow-up at close intervals, establishing the accountabilities of local managers. Implementation of gate reviews, both internally and with customers, is critical to reach that goal. If this is done well, and embedded into sustainable behaviour, it actually reduces the need for frequent top-down reviews. Implementing common practices, like quality, is a never-ending journey.

Resource Balancing

Maintaining the right balance between load and capacity in engineering is the fifth critical lever of productivity. Effective balance means work flows efficiently, with perfect and predictable resource utilization across end-to-end operations. It should be built upon a clearly defined engineering strategy and footprint. Usually three time horizons are required: two to three years for mid-term resource planning, 12 months for work planning and resource allocation and three to six months for work allocation at an individual and team level.

Sustainable resource balancing is achieved by engaging managers in clear methods of planning and adjusting resources to workflow. It is critical to understand the engineering workload in terms of unit cost, as well as the percentage of the project that remains. While there are some very effective software tools that can help in this area, IT cannot replace the role of humans

in interpreting the data and making judgements. Ownership of the process must be maintained by the operational managers, so that they can take on a full understanding of the forecast and live a daily commitment to maintain performance against it. It is sometimes even a good idea to simply bend the load balancing rules, and accept a 90 percent reliability. It is critical to build consensus around these decisions. This helps to eliminate rigid dogmas and ensure that human judgement remains an important part of the equation, empowered to make decisions to optimize the resource balance in the medium term, continuously.

Conclusions

Railway infrastructure engineering is a complex undertaking. It is getting even more complex with increasing customer demands in the areas of time, cost and quality. Unfortunately, there is no quick fix or silver bullet. Based on our experience, we have outlined five key areas which can produce significant results within several months. This requires close work, drilling down into the details of what actually happens in the engineering culture, how the work is really done and systematically improving it.

In focusing on these five levers, we have seen organizations achieve significant reductions in time-to-market, as well as multi-million dollar savings. However, the full transformation of the engineering value stream is a multi-year journey. It should be treated as such from the outset.

A critical success factor is to engage people from all levels of the organization in the effort and invest in their development. Those who perform the work on a daily basis have the best knowledge of what can be improved, and often come up with innovative ideas on how to make things work better. That is how sustainable culture change happens person by person. It is important to keep a good balance between top-down change programs, and bottom-up continuous improvement activities. Keeping this balance over the long-term is the key to success.

About the Authors

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Philippe has over 15 years of experience in operational consultancy across a variety of industries. He has worked extensively in the transportation industry, and has developed a deep understanding of the European railway industry. He has led several large transformation programs to improve the client organization's ways of working to deliver productivity improvements in engineering, operations and maintenance, at both railway infrastructure and rolling stock companies.

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Greg is the leader of the transportation industry practice in EMEA and has over 25 years of international experience in business transformation, as both internal change agent and management consultant. He was a pioneer in the TQM and Lean Six Sigma movement of the 1990s, and subsequently became a practitioner and thought leader in the fields of strategy execution, organizational change and business innovation.

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