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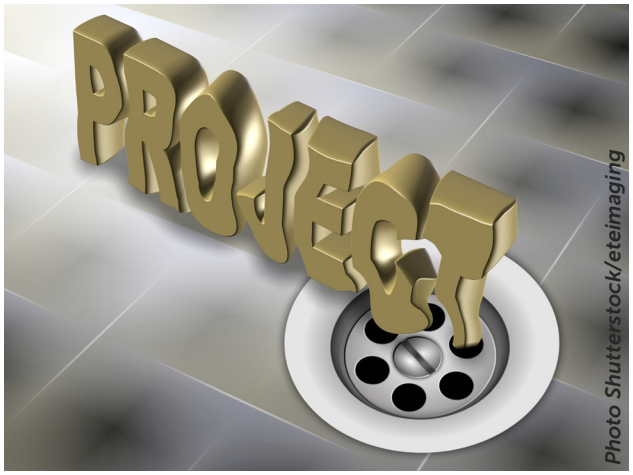
Why do signalling projects fail?



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Prepared on behalf of the International Technical Committee article by Alan Rumsey

Why do signalling projects fail? The reason for asking this question is that, in recent decades, the frequency at which projects fail appears to be increasing rather than decreasing.

There is a growing concern and frustration amongst some operators that signalling and telecommunications technology deployment is too slow, which leads to the unfortunate perception that the profession lacks innovation and is incapable of successfully delivering upgrades in a timely fashion. If this is indeed the case, then it is important to fully understand the root cause or causes of project failures.

For the purposes of this article, a project is considered to have 'failed' if it fails to deliver the anticipated business case benefits in the planned and contracted time frame i.e. the project is 'late'. In extreme cases, the contract may be cancelled, and the work never completed, or the contract may be re-bid resulting in additional delay. More typically, the actual project completion date is many months or years after the originally contracted completion date.

When a project is late, there are inevitably financial and reputational implications for the parties involved in implementing the project. In addition, to minimise schedule and budget impacts, it often becomes necessary to reduce the originally contracted scope, with potential consequential reductions in the anticipated business case benefits. In an attempt to maintain the schedule, there is an increased risk of 'cutting corners', leading to errors, omissions and rework that further delay project completion.

Clearly, not all projects do fail, and many are successfully delivered on schedule and within budget. 'Greenfield' projects on new rail lines, for example, are typically implemented more successfully than 'brownfield' projects on existing operating rail lines. Projects that simply involve the replacement of equipment 'in-kind' are typically more successful than projects that involve the introduction of new generations of technology. Project complexity is therefore seen as an important factor in influencing project success.

It could be argued that the principle reason for project failures is simply a lack of experience, expertise and competence within the parties responsible for implementing the project (on both the supplier-side and on the contracting agency-side). This could include technical, process-related, and project management-related competences.

With respect to technical competence, as systems increasingly become computer-based, communications-based, software-based and information technology (IT) based, and as these enabling technologies continue to evolve at an ever-increasing rate, some contracting agencies are now beginning to look more to their IT departments, rather than their traditional signalling and telecommunications departments, to take on the leadership role when delivering state-of-the-art control and communications projects.

It is certainly clear that for any project to be delivered successfully the project team on both the client-side and the supplier-side must be appropriately staffed with qualified personnel with the necessary expertise and experience in the technology being implemented. It is a sad reality that often there is a shortage (in numbers) of the specific talents needed to deliver all the complex system developments and projects that the profession is working on today.

As such, it is not unusual, particularly on the client-side, to increasingly rely on consultant organisations to provide the necessary expertise. There are also many railway professionals who have worked exclusively in either a client role or a supplier role. As such, those working in a client role may not fully appreciate all the implications of changes to software-based, real-time, safety systems, while those working in a supplier role may lack experience with the practical realities of operating and maintaining a rail transportation system.

There is also a tendency to suggest that a real or perceived lack of technical expertise and experience on the supplier-side can be mitigated through 'better' and more rigorous processes, and high levels of project oversight, on the client-side. While appropriate processes can certainly contribute to project success, unfortunately they cannot replace competent resources. At the end of the day it is people that deliver successful projects.

While a lack of sufficient competent resources can certainly be an important reason why projects fail, this article suggests that it is not the only factor, or even the dominant factor, in project failures.

There are three basic and highly interrelated elements of any project, namely scope, cost and schedule. These are the key elements of any project, and this article suggests that one of the

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principle reasons projects fail is when there is a failure to appropriately balance these three elements when viewed within the context of the delivery risks inherently associated with complex signalling and telecoms projects.

All too often, the full complexity of a project is not recognised (or acknowledged) until after contract award, when the project schedule and cost have already been fixed. If the project scope is the priority, then this clearly should drive the project schedule and cost. It is not unusual, however, for the project schedule i.e. the timeline for completing the project, to be constrained by external political factors unrelated to the realities of the project delivery.

In this case, if the project schedule is the priority, then often either the project cost must be increased, or the project scope reduced. The project cost, i.e. the total cost required to implement the project scope within the defined project schedule is, however, also typically constrained by available funding. A competitive procurement environment, where lowest cost is the primary selection criteria, can also lead to unrealistic project cost expectations.

To successfully deliver a project therefore, the primary challenge becomes one of optimising the project scope to be compatible with the project schedule and cost constraints, and with consideration and management of the inherent project delivery risks which follow. If this is not done it will inevitably result in project failure, regardless of the competency of the project participants.

Project delivery risks

In this section, some of the inherent risks associated with the delivery of any complex project are described. Each of these risks, if not mitigated, can lead to late project delivery and cost overruns.

Specification/scope risks

The risk here is that project scope is poorly or ambiguously defined by the contracting agency in the contract specifications, or the scope is not consistent with the key business case objectives. This risk includes both under-specifying and over-specifying the project requirements. Mitigating this risk rests with the contracting agency and their consultants, and is discussed in more detail later in this article.

Adaptation risks

The risk here is that the level of adaptation to service-proven products, or the level of new product development required to meet the requirements of the contract specification, is underestimated by the contracting agency and supplier, and thus inadequately reflected in the project schedule and project cost.

This risk is closely related to the above specification/scope risk, and realistically can only be mitigated through early interactions between the client and supplier organisations prior to contract award, and prior to finalising the project scope, schedule and cost.

Systems integration risks

The risk here is that there is inadequate interface definition and interface management with respect to the system's internal and external interfaces. While the supplier is responsible for the internal interfaces within their scope of supply, it is the external interfaces to the infrastructure, to the trains, and to other legacy systems that are typically more complex and of higher risk.

The contracting agency must play a critical role in risk mitigation both in the specification of, and the management of, these interfaces. This can be particularly challenging if the contracting agency does not have access to the relevant interface information (which can then require direct information exchange between two suppliers under two separate contracts), or if the necessary interface information simply is not available, is not up-to-date, or cannot be trusted.

Design risks

The risk here is of a failure to develop detailed designs that are consistent with contract requirements and the contracting agencies' expectations. While mitigating this risk rests primarily with the competence of the supplier, the contracting agency can also influence this risk, both positively and negatively, through the specification requirements and the method of working during project execution.

Migration, commissioning, and operational readiness risks

The risk here is two-fold. There is a risk that the migration plan and implementation schedule is unrealistic given track access constraints, level of effort required, or the dependencies on work to be performed by others. There is also a risk that the migration plan and implementation schedule result in unacceptable levels of impact to passenger service during implementation.

Given that control and communications projects are inherently tightly linked to rail operations, the client organisation, through its own in-house expertise and knowledgeable staff, is inevitably in the best position to mitigate this risk although all too often an attempt is made to contract-out this risk to the supplier.

Safety certification risks

The risk here is the level of effort required for safety certification is underestimated by the contracting agency or supplier and inadequately reflected in the project schedule and project cost. While mitigating this risk again rests primarily with the supplier, the contracting agency

can also influence this risk, both positively and negatively, through the specification requirements and the method of working during project execution. The contracting agency is also responsible for managing the safety certification of those elements of the project that are external to the supplier's scope, such as external interfaces and operating and maintenance readiness.

System availability risks

The risk here is a failure to achieve and sustain an acceptable level of signalling system reliability/availability when the system is cut-over into revenue service. This could be a result of inadequate or incomplete system test & commissioning (which is primarily a supplier responsibility), but could also be a result of insufficient attention to maintainability and maintenance training (which is typically a joint supplier/contracting agency responsibility).

Project management risks

The risk here is ineffective project management by the contracting agency and/or supplier, because of a lack of sufficient resources to complete the project on schedule, or a lack of competency as discussed earlier in this article.

Stakeholder engagement risks

Finally, the risk here is insufficient, untimely, ineffective, and/or unconstructive stakeholder engagement that negatively influences project outcomes. Many major re-signalling projects are not stand-alone projects, but rather are just one component of a highly integrated transportation system upgrade programme, comprising multiple projects, collectively focused on satisfying specific long-term business needs.

For example, the system upgrade programme could include not only the re-signalling project, but also new train procurement, major control centre upgrades, trackwork upgrades, network electrification upgrades, maintenance and storage facility upgrades, etc. Successfully implementing such an upgrade programme has been described as akin to solving a huge logistical puzzle.

The number of internal and external stakeholders that can influence a project may be very large. Stakeholders include not only signalling and telecoms professionals, but engineering professionals from other disciplines responsible for enabling works and interfacing systems, operators, maintainers, procurement and contract managers, funding agencies, regulatory agencies, independent safety assessors, and various public advocacy groups.

Politicians, who may not fully appreciate the complexities of re-signalling an operating rail transportation system, can also apply pressure to deliver the benefits of the re-signalling project quicker and at a reduced cost. Stakeholder risks can be mitigated in part by the contracting agency through early stakeholder engagement and education, and by ensuring, where possible, that any stakeholder, who has the authority to make changes or veto decisions, is also accountable for the consequences of these actions with respect to schedule and cost impacts.

Optimising signalling project scope to mitigate project delivery risks

As noted earlier, one of the primary factors contributing to project failures is a failure to optimise the project scope to be compatible with the project schedule and cost constraints, when viewed in the context of the above inherent project delivery risks. The discussion on project delivery risks also clearly indicates that the responsibility for mitigating these risks is a shared responsibility between the supplier and the contracting agency, and it is particularly important that this reality be recognised by all parties when optimising the project scope.

The scope of any project can be summarised in terms of:

1) The geographic area and complexity of the project.
2) The performance/functionality to be provided.
3) The operating and regulatory environment in which the work is to be undertaken.
4) The procurement/ delivery model adopted.

Complexity of rail network

The complexity of the rail network to be signalled/re-signalled is typically a given, with little opportunity to reduce the complexity of the rail network as part of the signalling project. Indeed, there are often changes to the rail network being implemented in parallel with the project, with changes to track alignment, new tracks being added, changes within interlockings areas, etc.

The project may also be implemented in parallel with new train procurements and other system upgrades. The complexity of the rail network (including legacy equipment the project is required to interface to) is however a major factor in influencing the implementation strategy and migration plan for the project which in turn are major factors in influencing the project schedule and costs.

With a complex rail network, it is not unusual to implement the project in phases. While this is a perfectly appropriate migration strategy, care must be taken to ensure that the more complex and higher risk issues are not being pushed into the later project phases simply to maintain schedule in the earlier project phases.

Insufficient attention to migration planning early in the project lifecycle (i.e. prior to contract award) can be a significant factor in subsequent project schedule and cost overruns.

Performance/functionality to be provided

The project functionality, as well as the safety, availability, and operating performance levels to be provided, should be driven by the desired business objectives (such as enhanced safety, increased capacity, higher levels of automation, improved system availability, reduced maintenance requirements, etc.) and should be consistent with the anticipated concept of operations and maintenance after the implementation of the project.

Although the benefits of top-down requirements development and requirements management are well recognised, there are unfortunately too many examples where this approach is not followed. Rather than adopting a true business case-driven approach to requirements development, focused on the desired project outputs, all too often clients and their consultants will develop procurement specifications by building on specifications from prior similar projects (without consideration of any lessons-learned from those projects), supplemented by a wish-list of additional client-specific requirements drawn from various, and often numerous, project stakeholders.

With this approach, it is inevitable that specification requirements, and resulting system architectures, will become increasingly complex, with no improvement in specification quality. The volume (number of pages) of typical system procurement specifications is certainly increasing, not only in terms of technical requirements (what the project must deliver), but also in terms of process requirements (how the project must be delivered and contract-deliverable documentation).

The specification requirements must also be balanced against the capabilities of currently available, and service-proven, products such that the level of

product adaptation and new product development is clearly understood early in the project life cycle and appropriately reflected in the project schedule and cost.

When developing specification requirements, the challenge is balancing long-term needs with short-term wants. The long-term needs relate to the business goals that justified the project in the first place i.e. they are something that must be delivered, and include not only functional requirements but also the overall system performance requirements (the project 'outputs'), including safety integrity requirements. If this requires product adaptation or new product development, then so be it, but this must be factored into the project schedule and cost.

The short-term wants on the other hand relate to preferences of the various stakeholders; things they would like to have but that don't necessarily relate directly to the business goals. This is where the problem of over-specification and unnecessary product adaptation can occur. There is an argument, however, that clients should not hold back on including such requirements, and should use such requirements to encourage innovation and attracting new players into the market; relying on the industry to push back if the requirements are unrealistic.

In a competitive procurement environment, however, there is a real danger that suppliers will promise more than they can realistically deliver, with the philosophy that at the end of the day it is better to have an unsatisfied client than no client at all. This risk can be mitigated, at least in part, though early contractor engagement, prior to contract award, to flush out unrealistic expectations.

When over-specifying the project requirements occurs, at the functional and detailed design levels as well as at the engineering process level, there is a resulting risk that demonstrating compliance with thousands of individual requirements during project execution (the 'paper project') can take on a higher priority than delivering the fundamental business objectives.

Major projects also often represent fundamental changes to operating and maintenance practices, specifically when there are major changes to signalling technology. A lack of attention by the client to organisational transition planning, and operating and maintenance readiness can also be a factor in project failures.

Operating and regulatory environment

The operating and regulatory environment can also be major schedule and cost drivers on complex signalling projects. On 'brownfield' re-signalling projects, for example, the operating environment and the need to maintain operations during project implementation inevitably results in constraints on track access and access to rail vehicles.

If these constraints are not fully understood early in the project life cycle, and balanced against project delivery needs, schedule and cost overruns become inevitable. It is particularly important that contracting agencies recognise their role in mitigating this risk.

Regulatory requirements, and other process-based requirements that impose constrains on 'how' the project is to be delivered can also result in schedule/cost overruns if not factored into the implementation schedule early in the project life cycle.

Procurement/delivery model

Delivering complex projects typically involves multiple entities (the client, suppliers, installers, consultants, etc.) all linked through multiple contracts, where each entity takes on specific responsibilities with respect to project delivery.

There is a danger in attempting to place all the project delivery risks with a single entity, especially if that entity is not in a position to manage all of those risks. This approach will inevitably lead to project failure.

A preferred approach is to fully understand all of the project delivery risks, and place each risk with the entity that is in the best position to manage it. A consequence of this approach, however, is that the method of working between the various entities becomes critical, which in turn requires a contracting strategy that encourages a collaborative and co-located 'one team' approach to project delivery, with shared milestones and processes, rather than a confrontational 'blame-based' approach.

A contracting strategy that recognises that successfully project completion should take precedence over total contract compliance i.e. the contract should support, not constrain, successful project delivery. Again, a prerequisite of such a collaborative delivery model is that the project schedule and cost is realistic given the project scope.

Conclusion

In summary, while there can be many reasons for signalling project failures, this article concludes that one of the primary factors is a lack of consistency between contracted project scope, project schedule and project cost, when all of the project delivery risks are considered.

One solution is to simply acknowledge up-front that complex projects will indeed cost more and take longer to implement than desired. The preferred solution is to remove, as much as possible, the unnecessary complexities in the project scope that contribute to project delivery risks, by:

1) Focusing more on project output requirements and business case objectives, and less on ever increasing detailed technical and process requirements.
2) Encouraging early engagement between the client and prospective suppliers to build confidence that there is a common understanding of both the technical requirements and the delivery process requirements (including migration planning), and to flush out unrealistic expectations, prior to contract award.
3) Minimising and simplifying, where possible, external interfaces to legacy equipment with the contracting agency acknowledging their role in mitigating system integration risks.
4) Minimising, where possible, product adaptation/new development and where this is required ensuring there is an allowance for the adaptation/development in the project schedule and cost.
5) Placing project delivery risks with the entities in the best position to manage the risks.
6) Adopting a co-located 'one team' method of working.
7) Simplifying 'process' requirements and ensuring that the process requirements contribute to, rather than constrain, project success.
8) Maximising access to track and trains (short-term pain for long-term gain); and
9) Showing a willingness to change legacy operating and maintenance practices, consistent with characteristics of the new system.