Achieving VfM From A Railway Systems Authority: Final Report

A report for the McNulty Rail VfM Study

February 2011

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Executive Summary

The Rail Value for Money (RVfM) Team's Interim Submission to the Secretary of State for Transport (September 2010) identified potential annual savings of £600m to £1,000m by 2018/19. The team concluded that *"such improvements are likely to come principally from getting all parts of the rail system to work together more effectively within a whole-system perspective".*

In a subsequent report for the RVfM study, AD Little picked up this theme and recommended the creation of a systems and standards body to "*facilitate the development of a more uniform, consistent and less complex national rail standards regime, as well as overcoming key barriers towards innovation"*. Based on some high-level analysis, it was estimated the body could deliver savings in the range of £200m-£230m per year (plus £10m-£300m per major investment scheme).

Risk Solutions and Steer Davies Gleave were appointed to develop the concept of creating a railway Systems Authority (SA) and quantify the savings it would deliver. This report presents our findings.

Is there a need for a Systems Authority?

It is widely recognised that the current industry structure and contractual regime discourages taking a systems approach to problems and opportunities in GB rail. A systems approach is one in which decisions are taken that are optimal for the entire rail sector (including funders and customers) in the long term and not just immediately beneficial for the parties with the power to take the decision.

The industry's standards and approvals processes are often identified as barriers to change and sources of additional cost, but we found that these are symptomatic of more fundamental problems in how the industry makes decisions and deals with systems issues. Although some changes would be beneficial, particularly to Network Rail's company standards, it is widely accepted that changing the standards process in the absence of other, more fundamental, changes will make little difference. During the course of our consultations, we have identified a wide variety of systems problems and observed mixed success in dealing with them. Appendix 1 identifies some 'successes' and these often relate to problems where the systems solution was imposed on the industry or there was broad agreement within the industry on how to address the problem. We also identified a number of solutions which were delayed due to people referring decisions, instead of making them, or not having the power to make decisions that would result in some organisations being disadvantaged by the change. These issues arise from the fragmented industry structure and commercial pressure that encourage an adversarial, rather than cooperative, approach to problems. There is recognition that the industry is changing, moving towards greater cooperation, but commercial interests continue to hinder progress.

There is considerable support in the GB rail industry and amongst its stakeholders for changing the way in which systems issues are dealt with, and the need to implement European directives on safety and interoperability has made the need to act even more compelling. However, there is considerable debate over the best way to address these needs. The spectrum of options being debated in the industry range from short-term solutions needed to implement the Interoperability Directive but with no power to resolve more intractable systems problems, to the creation of a new body with a clear remit for addressing system issues. Some believe that such a body could deliver significant changes, using existing powers and structures and a consensus-based approach, provided the government was able to set a clear industry strategy. Others believe that such a body must have the ability to negotiate deals and impose decisions if agreement cannot be reached.

Systems Authority Activities

Before considering the powers that are needed, it is useful to consider the activities that the SA would need to perform in order to provide leadership in this important area. We have identified a wide range of such activities and general agreement that they should form part of the SA's remit. The activities have been grouped, in the report, under headings corresponding to a standard four-stage management cycle (see Figure 1).

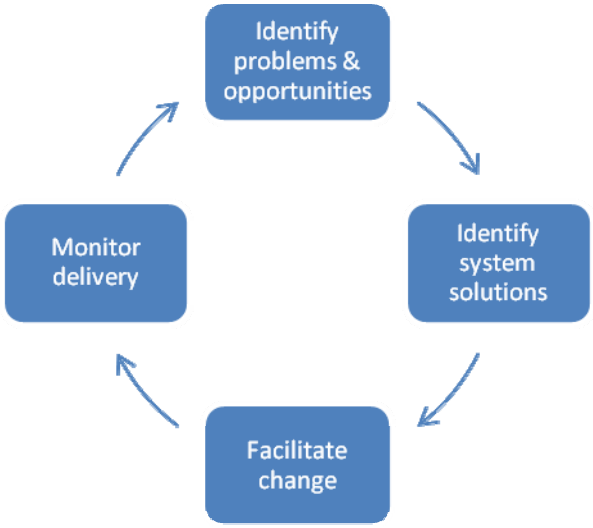

Figure 1: Main Systems Authority Functions

In summary, we have concluded that the SA would need to take on most of the Rail Safety and Standards Board's current roles but some roles would sit more naturally elsewhere within the industry. The SA would, however, need to perform a number of additional activities, some of which are currently performed by other bodies and some are new. The additional activities are:

- Taking responsibility for any of Network Rail's company standards that relate to key interfaces and including them in a new framework of National Interface Standards.
- Taking greater interest in, and responsibility for, product and systems approvals, including acting as the Designated Body (DeBo) for GB rail.
- In support of this role, maintaining the National Vehicle Register and Infrastructure Register by linking to databases held by all of the Infrastructure Managers and owners of rolling stock.
- Establishing an electronic Systems Archive containing key drawings, specifications, standards and research studies.
- Collating financial and other information supplied by railway operators, and using this to develop economic models used to evaluate systems options and calculate compensation to organisations whose interests are harmed by a systems solution.
- Advising on franchise specifications and contract incentives to maximise opportunities to improve system performance (and value for money) at minimal cost.
- Playing a more active role in developing and costing strategic industry plans.

Enabling the Systems Authority

Having considered all of the arguments and examined a number of project examples we conclude that there are significant opportunities to improve RVfM but much of this will remain untapped unless the Systems Authority has the powers it needs to ensure that, for example:

- Organisations respond quickly to questions and requests for information
- Organisations are required to cooperate with trials
- Where organisations are disadvantaged by a change, the compensation paid reflects the cost and risk to them rather than the amount they are able to negotiate from parties wanting to implement the change (which simply adds costs to projects and makes change less attractive).

Some people in the industry are concerned that moving away from a consensus-based approach to decision making would undermine support for initiatives and could expose the SA to significant liabilities. We do not share these concerns. The fact that the SA has the ability to impose solutions does not mean that it would do so on a regular basis – indeed, this would quickly lose valuable goodwill in the industry and impede its ability to perform its role effectively. Nevertheless, it is important that, when negotiating deals to enable changes to be implemented, the parties concerned know that if they become too intransigent they may end up having to accept a poorer deal than the one currently being offered.

When considering the SA's powers, it is necessary to consider:

- The source of the SA's authority
- Its scope, remit and objectives
- Governance and funding arrangements
- Its legal form and how it deals with liability and risk.

The source of the SA's authority

To avoid the need for primary legislation, we recommend that the SA's powers would, in effect, come from the Office for Rail Regulation (ORR) which would create a new licence condition on rail operators to cooperate with the Systems Authority and comply with its decisions. Similar conditions already exist, requiring railway operators to be members of the Rail Safety and Standards Board (RSSB) and comply with Railway Group Standards. If an operator failed to comply with the licence condition, ORR would have the power to impose a substantial fine or even remove its licence to operate.

Scope, remit and objectives

The areas in which the Systems Authority is able to exercise its power would be defined by its remit. Our initial proposal for the remit is as follows:

> *"The Railway Systems Authority's role is to work with the industry to improve rail value for money for the industry's users and funders. It will do so in accordance with European and national legislation, government policy and its own powers. The RSA's interest in value for money will be in terms of optimising the performance of the whole railway system, both now and in the future. Internal decisions made by organisations and with their supply chain are, unless they affect key interfaces, outside the RSA's scope."*

The 'railway system' would extend to all mainline railways in Great Britain and any routes subject to the Technical Specifications for Interoperability (TSIs), such as High Speed 1 and Crossrail.

The remit would be fleshed out in the form of objectives agreed by Department for Transport (DfT), as the SA's funder, and ORR, as economic regulator. Possible objectives could include:

- Helping to develop industry strategies needed to make better systems decisions that are deliverable within the available funds
- Supporting the implementation of industry strategies by resolving systems problems quickly and effectively
- Identifying and addressing areas where sub-optimal decisions are increasing industry costs unnecessarily
- Improving decision-making processes in the industry (e.g. standards and approvals processes) to encourage innovation and improve RVfM.

The Systems Authority would be charged with developing a 5 year Strategic Plan with supplementary plans produced each year setting out the priorities for the next year. The Strategic Plan would be developed in consultation with the industry, thereby promoting a

debate about what needs to change and giving industry players an opportunity to influence the SA's priorities.

Governance and funding of the Systems Authority

To ensure that the SA delivered its remit/objectives and did not abuse its powers, there would need to be robust governance arrangements and appropriate funding arrangements.

Measuring performance

Regardless of where it sits in the industry or its legal form, we recommend that the SA is overseen by a Board of Directors comprising Executive and Non Executive Directors (NEDs). The Board would be responsible for developing the System Authority's strategy and the NEDs would hold the Executive Directors to account for delivery of the organisation's remit and objectives. We recommend that the organisation's performance is measured in a variety of ways including:

- Performance indicators relating to key processes (e.g. standards change, product acceptance)
- Assessing the benefits of initiatives using formative and summative evaluations
- Meeting key milestones in its Strategic Plan.

Board appointments

The NEDs would need to include people with broad rail industry experience as well as experience from other sectors used to managing complex systems, such as telecoms and the military. To avoid the Board being unduly influenced by parts of the GB rail industry, the NEDs would be appointed from outside the industry and could include railway engineers and operators working in other countries or who have recently retired.

Appeals

The ORR already hears appeals under the Network Code and Railways Infrastructure (Access and Management) Regulations 2005. Since the Systems Authority's powers would be granted by the ORR, we recommend that it would also hear appeals against the SA's decisions. The appeal could be because a decision has not followed due process or is inequitable, or may be that the SA has failed to intervene to resolve a systems issue. Alternatively, an operator may claim that a decision would put them in breach of the law (e.g. the Health and Safety at Work Act 1974, the Disability Discrimination Act 1995 or the Equality Act 2010) or regulations stemming from primary legislation.

By consulting widely, following due process and using competent people it is expected that there would be few appeals. However, it is vital that the appeals mechanism is swift and efficient to ensure that important changes are not delayed unduly so, for example, a formal challenge against a decision should be lodged within perhaps 28 days and a decision within 28 days of the challenge.

Funding

We recommend that the SA should be funded by a direct grant from government. This is already the case with ORR, the Rail Accident Investigation Branch (RAIB) and, to a large extent, RSSB[1], and would emphasise that the SA's purpose is to deliver savings to rail industry funders.

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[1] RSSB's main funding sources are DfT's research budget and membership fees from Network Rail (which is largely funded by government grants or track access charges from subsidised train operators) and franchised train operators who include a provision for the RSSB levy in their franchise payments.

Legal form, risk and liabilities

Having considered a variety of legal forms that the SA could take, we recommend that it is a Company Limited by Guarantee (CLG); unlike other models, this has the attraction of not requiring legislation. Network Rail (NR) is a CLG and this form is often used for non-profit organisations which require a legal personality (i.e. has rights, protections, privileges, responsibilities, and liabilities under law). The organisation's guarantors are called members and they give an undertaking to contribute a nominal amount (e.g. £1) in the event of the company being wound up.

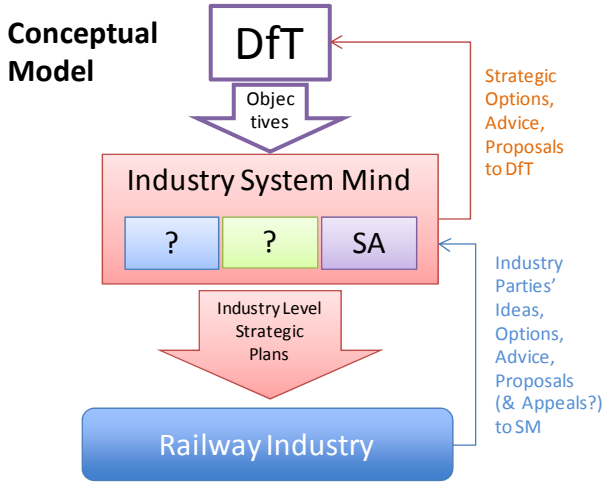
The SA would need to carefully consider the risks and liabilities associated with its decisions. Such liabilities should be managed by seeking warranties from suppliers that could be claimed against if products fail to perform as expected, but situations could arise where the Systems Authority itself was held liable for an incident or increased industry costs. This problem proved to be the stumbling block in previous attempts to establish system authorities, but a key difference is that the purpose of this Systems Authority would be to reduce costs to the Exchequer (rather than improve shareholder returns). Furthermore, much of the SA's work would benefit, or be implemented by, NR so there is a risk that the SA and NR would be paying twice for the same cover. In view of this we conclude that the risk should be covered by NR's third party insurance (which has cover up to £155m) with higher claims underwritten by the government, as is the case with NR.

Location in the industry

In its earlier report, AD Little identified four possible models for the proposed Systems Authority: extend RSSB's role, make it part of either Network Rail or ORR, or create a new, independent organisation. To help evaluate these options, we established a number of important principles and concepts including:

- The scope of the system issues being considered by the Systems Authority.
- The source of its authority, which has been discussed previously, and the fact that it will also derive authority from being competent, efficient, consultative and (most importantly of all) trusted.
- The need for it to operate within the framework of broad industry strategies and in close concert with bodies responsible for other systems issues beyond the remit of the Systems Authority (e.g. timetabling, ticketing and network regulation).

The last of these points helped identify the need for a 'System Mind' that provides an over-arching view of systems issues and is responsible for setting industry strategies that help deliver government policy within the available funds. The Systems Authority could play a key role in developing such strategies as well as being guided by them when making system decisions. As a result, the Systems Authority would need to be part of, or closely aligned with, the System Mind. The concept is illustrated in Figure 2. The RVfM Team is developing the idea of creating a System Mind to oversee development of the whole GB rail system.



Note that this figure is not showing industry STRUCTURE but high level process.
Source: Risk Solutions

Figure 2: System Mind Concept

Having established these principles and concepts we were able to consider alternative options for where the Systems Authority should sit in the industry. This process was complicated by the fact that the RVfM Team is, in parallel, considering major changes to the rail industry's structure. Nevertheless, we identified two viable models:

1. Making the Systems Authority a subsidiary of the National Network Operator (Network Rail)
2. Making the Systems Authority an independent organisation accountable to the DfT and ORR.

The second option would, in effect, be a strengthened RSSB, with additional powers, new responsibilities and different funding and governance arrangements. In either case, we have assumed that the SA would be an entity in its own right but it could also be part of a larger body which included the System Mind and other systems functions.

Creating the Organisation

Organisation size and structure

Data supplied by RSSB, NR, DfT and ORR indicates that 403 staff are currently employed on activities that we recommend should be taken on by the Systems Authority. More than 85% of these people are employed in professional or technical roles, with the remaining staff employed as managers, administrators and in various support functions (HR, finance, IT, etc.). By merging these activities and co-locating staff, significant efficiency savings should be possible. This is due to reduced 'man marking' and 'interface bureaucracy' between organisations, and the benefits of simply co-locating staff and sharing resources. Assuming a 25% reduction in people employed in professional or technical roles and their support staff, we calculate that the SA would need to employ 312 staff, meaning that 91 fewer staff would need to be employed in the industry performing these activities.

The organisation size assumes that much of the work in these areas will be performed in-house but several senior stakeholders have expressed the view that the organisation should be very 'lean' making extensive use of contractors to deliver specific activities. We agree and would recommend employing contractors, on a fixed price basis, to deliver defined packages of work but retaining a strong core of permanent staff employed as project managers and in specialist roles. This model will enable the SA to be 'fleet of foot' so that the pace of change is not constrained by the availability of in-house resources and will enable, by competitively tendering work, to ensure that work is good value for money (vfm).

It is, however, difficult to judge the proportion of the SA's workload that could be contracted out so, for the purposes of calculating the cost of the new organisation, we have assumed that the staff would be employed by the SA.

Getting the right people

Much of the SA's authority will come from the competence and independence of its staff. The SA will need to employ people with a broad range of skills including engineers, operators, economists, statisticians, risk analysts, mathematical modellers and project managers. Most importantly, it will need to employ staff who approach problems creatively and have the leadership qualities needed to drive through change.

To ensure that the SA is responsive and maintains the right balance of expert knowledge and creativity, we recommend that the SA should:

- Retain a body of staff to perform specialist functions (e.g. maintaining the industry's risk models), provide continuity on long term projects and develop key industry processes.
- Minimise its reliance on industry 'volunteers' because (a) it is then dependent on who the industry is willing to release (rather than who is most suitable) and (b) the

throughput of work (and hence pace of change) will be limited by how much time the people can afford to take out of their 'day job'.

- Seek to attract high calibre staff from the industry on secondments to give the SA's proposals authority by virtue of them being made by people who understand the issues and are respected in the industry.
- Make use of contractors, through framework agreements or call-off contracts, for well defined 'projects'. To ensure good vfm, the work should be competitively tendered and awarded on a fixed price basis.

Railway Innovation & Growth Team

In a parallel study for Area G of the RVfM Study, Atkins considered how the industry could improve value for money by being more innovative. A central recommendation is the creation of a Railway Innovation and Growth Team (RIGT) which would be responsible for helping the industry gain maximum advantage from emerging technologies. Atkins recommends that:

- The RIGT should subsume the existing R&D/innovation roles and functions of DfT, the Technology Strategy Advisory Group (TSAG) and RSSB
- The RIGT functions should be discharged under the remit and governance of the Systems Authority.

We agree that there would be significant benefits from placing the RIGT within the SA to share expertise/resources and ensure continuity of thinking between the two organisations.

Office location

In order to recruit a competent workforce, the SA needs to be located where there is access to a large pool of people with the necessary range of skills. Basing the SA in central London would involve minimal change and would assist in the retention of staff already based there, but may be more expensive in the long term (due to higher wages and office rents). Consideration should therefore be given to basing the SA outside London (possibly with a satellite office in London as a transition arrangement). The office should be located somewhere with good rail connections, a large pool of potential employees and with local representatives of key industry stakeholders.

Outline implementation plan

The report considers the steps that would need to be taken when creating the SA. Due to uncertainty over the future industry structure, we have been unable to recommend where the SA should sit in the industry so the plan assumes that the SA is a new, independent organisation, and that its powers derive from a new licence condition imposed on railway operators.

The implementation plan also assumes that certain key decisions have been made by DfT, following consultation, on the organisation's remit, powers, governance and funding arrangements and on where the organisation would be based. Changes to these assumptions would result in modifications to the plan and timescales, but the key steps and considerations are unlikely to change.

Importantly, we have been advised that staff whose roles would transfer into the SA would be subject to the Transfer of Undertakings (Protection of Employment) Regulations 2006, or TUPE. This applies to roles transferred from RSSB, NR, DfT or ORR and has significant implications for the change management process.

The outline plan indicates that it would take approximately three months to establish a Change Management Team and develop a detailed implementation plan. It would then take a further seven months of intensive work before the SA could be launched.

Creation of the SA would have important implications for other parts of the industry. In

particular:

- 'Donor organisations', such as RSSB, NR, DfT and ORR, would lose staff or, in the case of RSSB, cease to exist.
- ORR would become responsible for holding the SA to account, hearing appeals and supporting its activities through the activities of its inspectors.

Would the SA be Value for Money?

Our analysis shows that there are significant savings to be made from adopting a better systems approach to rail industry problems and opportunities. Many of these are likely to be realised by the rail industry in its current form, but these are likely to be slower and more costly to implement than they should be and, as a result, there is a risk that some improvements will not be achieved at all. Creation of a Systems Authority should increase the pace of change and reduce these risks; it should also help create a climate in which innovation is encouraged and barriers to change are quickly identified and addressed. This change in culture is likely to deliver far greater benefits than the high-profile cases that people tend to focus on, and which are far easier to quantify.

The report assesses whether the SA would be good value for money by comparing the net costs and net benefits. This suggests that creation of the SA would deliver efficiency savings amounting to approximately £10m per year and would deliver benefits to the industry which we conservatively estimate at £100m per year[2]. The latter figure has been derived from extrapolating the benefits that we calculate an SA would have delivered on six case study projects. Figure 15 shows the cumulative savings in each area.

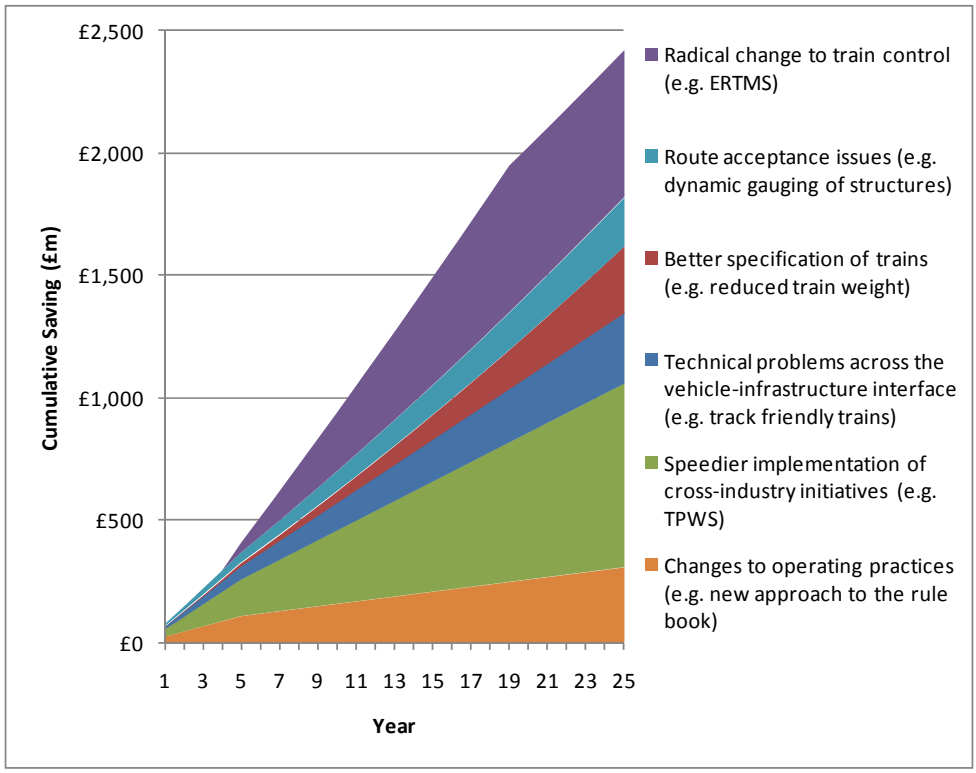


Figure 3: Cumulative savings from 'known' SA benefits

Based on the experiences of other industries (where system authorities are thought to have delivered savings of 10% to 20% on complex projects), the SA could deliver savings of £250m to £500m per year on NR's average expenditure of £2.5bn per year on enhancement projects.

[2] We have attributed a small fraction of the overall benefits to the SA in each of the case studies.

Summary

Our analysis has identified a number of systems solutions that would deliver substantial savings to the GB rail industry. Many of these will happen whether or not an SA is created, but experience suggests that these solutions will take longer to implement and are vulnerable to being 'held to ransom' by stakeholders whose interests could be harmed or who detect a commercial opportunity. We calculate that the benefits attributable to the SA would amount to approximately £2.5bn over 25 years. These are net savings which take into account any additional costs to the industry. Creation of the SA would therefore reduce industry costs by approximately £100m per year and this could increase to between £250m and £500m per year if savings achieved in other sectors could be made on NR's enhancement programme.

We believe that these savings would be achieved by creating a body that would cost £10m per year less to operate than current arrangements. The main downside being that there would be a period of change while the new organisation is created and 'finds its feet'.

Some industry players believe that the risks associated with creating the SA are too great and that the benefits could be achieved using existing powers and structures, provided that a clear industry strategy was created. Others focus on the need to transpose the Interoperability Directive and believe that, by creating a body that deals with these issues, there will be no need for a Systems Authority. In our view, such arguments fail to address the fundamental problem that individual industry players have strong commercial reasons to act in their own interests, rather than for the common good, and they are unlikely to become more altruistic in the current economic climate.

We conclude that there is a compelling case for creating the Systems Authority, but this needs to be an energetic organisation that quickly demonstrates its worth in order to win over the sceptics.

Table of Contents

1 INTRODUCTION

1.1 The Rail Value for Money (RVfM) Team's Interim Submission to the Secretary of State for Transport (September 2010) identified potential annual savings of £600-£1,000m by 2018/19. The team concluded that:

"…such improvements are likely to come principally from getting all parts of the rail system to work together more effectively within a whole-system perspective – with clear objectives from Government, more effective industry-led strategies, much stronger emphasis on partnership working, and with incentives which are aligned to encourage partnership and a focus on cost reduction. These initiatives need to be supported by franchising methods and regulation which are compatible with new approaches. The end result should be industry having greater freedom, and taking greater responsibility for delivering more efficient rail services, and Government involved less in the detail of rail operations."

1.2 The creation of a railway Systems Authority, charged with identifying and facilitating the implementation of systems solutions that improve value for money, is a central part of this vision. Risk Solutions and Steer Davies Gleave have been appointed to develop and test the concept of creating a railway Systems Authority and this report presents our findings. Over the nine week study we have consulted widely within the GB rail industry to identify how a Systems Authority (SA) could improve rail value for money. We have also drawn upon a number of related studies, including the work being done in parallel areas of the RVfM Study, and examined how other industries and railway administrations in other countries deal with similar issues. Using these sources and our project team's experience of working in the rail industry we have drawn conclusions on:

- The system problems that need to be addressed
- The extent to which a Systems Authority is needed to resolve these and other changes (e.g. cultural and contractual) that are needed
- The functions that the SA would perform and the capabilities that it would need to perform these
- Where the Systems Authority should sit in the industry, its remit and the basis of its 'authority'.

1.3 The report is structured as follows:

- Section 2 summarises the arguments for and against the creation of a Systems Authority, as presented to us and based upon our own observations. This describes how a Systems Authority focussed on particular types of systems issues would need to work closely with organisations setting the strategic direction for the industry and dealing with broader systems issues.
- Section 3 develops these ideas on the need for a Systems Authority by identifying specific functions it would need to perform.
- Having explored the role of the Systems Authority, Section 4 discusses the key principles that should underpin its creation, where it should sit in the industry, its relationship with other industry organisations, where it would get its authority and funding from and how it would be held to account.
- Section 5 considers the practical matters in creating the organisation, including size and structure, how it would recruit the right people, and the steps needed to create the organisation.
- Section 6 quantifies the benefits from creating the Systems Authority.
- Section 7 summarises our findings and sets out our recommendations for the creation of the Systems Authority.

2 THE NEED FOR A SYSTEMS AUTHORITY

2.1 In its report to the RVfM Study, AD Little (ADL) identified potential savings of £250m-£400m per year in the areas of safety, standards and innovation. A key recommendation was that:

> *"…the creation of an independent systems and standards body would facilitate the development of a more uniform, consistent and less complex national rail standards regime, as well as overcoming key barriers towards innovation."*

2.2 This body was predicted to deliver savings in the range of £200m-£230m per year (plus £10m-£300m per major investment scheme) which made it the biggest source of savings identified in the report by quite a margin. ADL also presented a number of options for where the organisation should sit in the industry and stated that the body's *"…role would be primarily technical rather than commercial or regulatory."*

2.3 In this section we summarise industry views on the creation of the Systems Authority and draw different conclusions on the nature of the problem and the scope and skill set it would need to deliver significant cost savings.

Terminology

2.4 Throughout this report we refer to system problems, opportunities and solutions. To help define these we need to introduce the concept of the 'rail sector' which we have taken to include rail users and funders as well as the rail industry itself.

- A **system problem** arises when a decision is taken that is locally optimum for the part of the rail sector taking the decision but which impose avoidable costs or constraints on other parts of the rail sector.
- A **system opportunity** exists where a sub-optimal decision can be changed to strike a better balance between the needs of the sector as a whole and local requirements.
- A **systems approach** is one in which decisions are taken that are optimal for the entire rail sector (including funders and customers) in the long term and not just immediately beneficial for the parties with the power to take the decision.
- A **system solution** is a decision that optimises the outcome for the rail sector as a whole[3].

2.5 Since any change takes time to deliver benefits, system problems can arise when the benefits would benefit future holders of a franchise (for example) rather than the incumbent, so system opportunities need to consider the interests of future generations as well as today's.

2.6 We have assumed that the SA's interests would be limited to the national rail network (including high speed lines and Crossrail) but it would also be mindful of other railways, such as London Underground, where there may be benefits from cooperation.

System roles & responsibilities

2.7 A number of organisations in the GB rail sector have system-wide roles and responsibilities.

Department for Transport[4]

2.8 The Department for Transport (DfT) is democratically accountable for the public funds that flow to GB railways. Its rail functions include:

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[3] Local parts of the system may adopt different systems solutions, the so-called 'differentiated railway', but these should not compromise overall system value for money.

[4] In the interests of brevity we have simply referred to DfT's role throughout the report but, where relevant, the observations and recommendations would also apply to Transport Scotland.

- Defining, every 5 years, the High Level Output Specification (and associated Statement of Funds Available) for the railway. The current (and first) HLOS includes a safety requirement that passenger and workforce risk will fall by 3% over the Control Period.
- Determining the balance between Track Access Charges and direct subsidy received by Network Rail, the two adding up to the value in ORR's Determination.
- Negotiating and enforcing passenger service franchises.
- Co-ordinating interoperability policy with the EU, making decisions on the need for derogations from Technical Specifications for Interoperability (TSIs) and informing the EU on Notified National Technical Rules (NNTRs)[5]; these are explained in further detail below.

Office of Rail Regulation

2.9 The Office of Rail Regulation (ORR) is the combined economic and safety regulator for GB railways. Its duties include:

- Economic regulation of Network Rail – licensing Network Rail, determining the level of funding that it is to receive for each Control Period, assessing its performance, and, if necessary, imposing penalties for breaches of its licence.
- Competition regulation of Network Rail and train operators.
- Licensing all operators, including passenger, freight, stations and depots.
- Safety regulation of all GB railways, including mainline, metro, London Underground and heritage railways.

2.10 In the context of safety regulation, ORR:

- Is the UK's National Safety Authority, as defined by Directive 2004/49 (the railway safety directive).
- Assesses the submission for and, if satisfied, issues the safety authorisation for infrastructure managers (including Network Rail) and the safety certificate for train operators (passenger, freight and specials such as engineering trains).
- Audits the Safety Management Systems of train operators and Network Rail, which they are required to maintain under the Railways and Other Guided Transport Systems (Safety) Regulations 2006 (ROGS).
- Includes the former HMRI (Her Majesty's Railway Inspectorate), so is responsible for investigating accidents and incidents, enforcing safety law and, if necessary, prosecuting alleged breaches.

Network Rail

2.11 In EU parlance, Network Rail (NR) is the GB's main Infrastructure Manager with responsibility for:

- Operating the national mainline infrastructure (signalling, routine maintenance)
- Ensuring the long term health of the national mainline infrastructure, including renewals and upgrades
- Ensuring that rolling stock can be accepted onto its network
- Establishing and applying company standards.

2.12 It has safety responsibility for its components of the railway and a duty, imposed by ROGS, to cooperate in matters of safety with any train companies with which it interacts.

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[5] Britain's NNTRs are published on the following web page: http://www.dft.gov.uk/pgr/rail/interoperabilityandstandards/interoperabilitystandards/nntrs/current-notified-rules/

Passenger and Freight Operators

2.13 Train Operating Companies (TOCs) provide passenger services. Most are franchised by DfT, delivering contractually-defined services, either receiving a subsidy or paying a premium. Some are so-called 'open access operators', operating a commercial service on NR's tracks. ORR is responsible for deciding if there are sufficient train paths to permit open access and its current test is to ensure that the open access operator's services are "not primarily abstractive" from the franchised operator to prevent 'cherry picking' the most profitable routes.

2.14 Freight Operating Companies (FOCs) are not franchised and pay a commercial rate for track access, albeit at marginal costs. TOCs and FOCs are referred to in European terminology as Railway Undertakings.

2.15 Under ROGS, TOCs and FOCs are responsible for the safety of their components of the railway and have a duty to cooperate with NR and other operators using the same routes on matters of safety.

Rail Safety and Standards Board

2.16 The Rail Safety and Standards Board (RSSB) is a not-for-profit company owned by the duty holders (NR, TOCs, FOCs, ROSCOs, infrastructure contractors and rail industry suppliers). It has extensive system responsibilities including:

- Analysing and reporting industry safety performance, and developing risk models.
- Managing Railway Group Standards (RGS).
- Supporting cross-industry groups (that act as Systems Authorities for specific issues) including the Technology Strategy Advisory Group (TSAG) and the five System Interface Committees (SICs).
- Managing and ensuring the relevance of the DfT funded railway research programme, including the strategic research programme[6] which is overseen by TSAG.
- Coordinating the industry's input to European legislation and standards.

2.17 RSSB is not a duty holder and has no role under ROGS. None of the other EU member states has an equivalent railway body although RSSB reports that visitors from other countries see much merit in the model.

Rail Accident Investigation Branch

2.18 The Rail Accident Investigation Branch is an independent part of DfT, analogous to its marine (MAIB) and air (AAIB) sisters. Its task is to investigate accidents or incidents in order to find cause, not blame. It makes recommendations that are submitted to the Secretary of State (in practice ORR) for consideration and, if appropriate, application in the rail sector.

Industry's views

2.19 We interviewed a wide range of rail industry stakeholders from the DfT, ORR, NR, RSSB, TOCs, Rolling Stock Leasing Companies (ROSCOs), rail industry suppliers and engineering contractors. The aims of the interviews were to identify the root causes of systems problems on GB rail, the extent to which a Systems Authority is needed to address these and the principles that should be applied when creating such an organisation.

The problem with standards and approvals

2.20 ADL's report identified standards as lying at the heart of many systems problems. We found a general consensus that Railway Group Standards (RGS) are mainly output-based and fit for

[6] RSSB is in the process of merging the two research programmes.

purpose[7], but gaining derogations against them or making changes was reported to be a slow and bureaucratic process (something that RSSB denies). Stakeholders were more critical of NR's company standards and were able to cite examples of where these were highly prescriptive and had resulted in more costly solutions. However, others suggested that the way in which standards are applied by NR staff is the main issue. This was supported by a number of anecdotes of when NR had over-specified solutions when contracting out work and had ruled out innovative solutions.

2.21 Organisations following a well established process (e.g. rolling stock approvals) had fewer complaints about standards and approvals – their concerns were about NR's limited knowledge of its own infrastructure and the burden this placed on suppliers[8]. However, approvals processes represent a significant risk to projects (especially where suppliers are unfamiliar with them) and can act as a significant barrier to entry to the GB rail market. Established suppliers may therefore benefit from complex product acceptance processes.

Root causes

2.22 Stakeholders identified a number of reasons why standards are applied conservatively (the industry's so called risk averse culture):

- There are limited incentives on the industry to reduce costs, especially on enhancement projects, since they eventually get passed back to government.
- Where standards are not mandatory (e.g. the requirement to *consider* fitting gates on platform ends when work is done) decision makers feel exposed if they do not implement them anyway. This is because if an incident did occur they could be accused of not following good practice by not doing everything practicable to reduce the risk. The legal requirement is to do what is *reasonably* practicable but no-one wants to find themselves defending decisions in court. RSSB's programme of work on safety decision making sought to assist the industry in this area but needs to be matched by a greater willingness by the industry to take (and for leaders to support) risk-based decisions.
- To help guard against this risk, decision makers often use industry processes to 'syndicate risk' – i.e. share responsibility for the decision. Unfortunately, this often makes the decision-making process long, costly and uncertain which discourages people from offering innovative solutions that might involve derogations or changes to standards.

2.23 This problem is compounded by the fact that decision makers usually choose to reach decisions that favour their company, for obvious commercial reasons, rather than taking a systems view. As a result we conclude that, while there are problems with some standards and the ways they are managed (particularly NR company standards), the fundamental problem lies in the fragmented industry structure which contractual incentives have, so far, been unable to address.

Benefits from a standards body

2.24 Standards play a crucial role in the rail industry and stakeholders identified a number of benefits from creating a standards body managing all national rail standards (including those currently owned by NR) and representing GB rail's interests in Europe. These included:

- Providing an informed industry view on TSIs

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7 This view was expressed by industry contractors as well as industry 'insiders' such as NR, TOCs and ROSCOs.

8 NR infrastructure is often non-compliant with TSIs (for either good technical reasons or historical reasons) so suppliers need details of where this is the case. However, NR does not always provide information about its infrastructure so rolling stock suppliers need to survey routes to identify problems with platform heights, gauging, track circuits, etc. Since the rolling stock is built to comply with standards, infrastructure that does not meet the standards may need modification and, if so, the supplier is required to bear the cost.

- Ensuring that national standards[9] fit into a clear hierarchy, are not unduly prescriptive and do not contradict each other
- Ensuring that the processes of gaining derogations and making changes to standards operate more efficiently.

2.25 If such a body were created, there was a strong feeling that industry ownership of standards is an important principle; a Systems Authority which imposed standards on the industry (without accountability to the industry) would be seen as a backward step. This view is not surprising but other stakeholders noted that the Systems Authority will not improve the situation unless it has the ability, following consultation, to impose a solution.

2.26 On the basis of our consultations we conclude that:

- the creation of a standards body would be beneficial to the industry but
- much of the potential benefits are already achieved by RSSB's role and
- merely moving that role to another body and extending its scope to NR company standards would fail to address the commercial and cultural factors that lie at the heart of the problem.

The need for better systems thinking

2.27 Consultees all recognised the importance of basing decisions on a systems view of the problem but held differing views on the extent to which the industry is currently dealing with these issues. Stakeholders identified a number of areas where the industry is working together to identify and address systems issues including:

- Planning Oversight Group (POG) which is developing industry strategies and the RUS process, which develops Route Utilisation Strategies (including the network RUS on electrification).
- Technical Strategy Advisory Group (TSAG) which is soon to be renamed the Technical Strategy Leadership Group and is responsible, amongst other things, for developing the Rail Technical Strategy and overseeing the industry's strategic research programme.
- The five System Interface Committees (SICs) such as VTSIC which has led research into a number of wheel/rail interface problems and championed solutions such as Track Friendly Trains.
- Various groups coordinated by RSSB, such as the Sustainable Development Steering Group, Operations Focus Group and Community Safety Steering Group.

2.28 However, these bodies and processes are consultative and have little 'authority' to drive through important changes or resist the 'project effect' where individual projects adopt solutions that best suit their needs but may not be best from a whole system perspective.

2.29 Appendix 1 lists a number of case study examples that were cited as evidence that the industry is getting better at developing systems solutions, although it was acknowledged that many of these had taken too long to implement. This was seen by some to be a 'price worth paying' if the industry retained ownership for developing and implementing solutions, but most people recognised that a Systems Authority is needed to ensure that systems solutions are implemented quickly and effectively.

2.30 Although stakeholders were able to identify examples where the industry has succeeded in applying a systems approach, there was general recognition that this happens best when the need for change has been mandated (e.g. the Train Protection and Warning System, TPWS) and there is strong leadership/political will behind the change. We found few examples of the industry working effectively to reduce costs, although there were examples of it working together to avoid unjustified and expensive fitment of new windows and modified horns on

[9] National standards would include RGS, which act as National Notified Technical Rules under the EU Interoperability Directive, and most of NR's company standards.

trains. In both cases RSSB worked with the industry to establish a robust evidence base for a decision that was optimised for the whole rail sector and not just one company or interest group. The outcome was a proper balance of safety and cost.

2.31 We were told that the work of TSAG, SICs, etc. is generally based on a "technical gap analysis" but there is a need for systems bodies to be working towards a strategic vision for the railway designed to meet government objectives. The need for such a vision has long been recognised. For example, the government White Paper "Delivering a Sustainable Railway" was produced in 2007 and notes that *"the architects of privatisation made no provision for any single body to define the railway's strategic priorities and the level of public expenditure required"*. The White Paper was intended to address this and identified the government's *"long-term ambition is for a railway that:*

- *"Can handle double today's level of freight and passenger traffic;*
- *"Is even safer, more reliable and more efficient than now;*
- *"Can cater for more diverse, affluent and demanding population; and*
- *"Has reduced its own carbon footprint and improved its broader environmental performance."*

2.32 More recently, TSAG has proposed the following 30 year challenges to improve the industry's competitiveness using the 'four Cs':

- Cost – Halve the cost of rail operations
- Capacity – Double network capacity (this matches the White Paper)
- Carbon – Halve the industry's carbon footprint
- Customer – increase customer satisfaction to 99%

2.33 For the Systems Authority to function effectively, it would need to operate within broad industry strategies developed to meet such objectives set by government.

Technical or Commercial Role?

2.34 As noted earlier, ADL saw the Systems Authority performing a primarily technical role but we disagree. The raison d'être of an SA is primarily to improve value for money – whether by technical innovation or simply changing industry processes. In order to perform this role the SA needs to have an independent perspective and have a clear understanding of both the economics and engineering of the railway, a combination that no single agency currently has in Britain. It will also need to challenge industry incentives as well as broker deals to align the objectives of organisations involved in making systems changes. Such deals will need to ensure that parties disadvantaged by a change are suitably compensated. The compensation could be between different parts of the industry or, where benefits will be realised beyond the end of a franchise, the government[10].

2.35 Of course, this happens now. NR and TOCs often enter into bi-partisan agreements and SICs occasionally broker deals on a cross-industry basis. Organisations affected by a change often use this as the basis for horse-trading but the level of 'compensation' paid is based on how much the beneficiary of the change is willing to pay rather than the costs and risks being imposed on the other party. This increases the project's costs and the protracted negotiations can also cause delays. Furthermore, bi-partisan deals are unlikely to deliver optimum solutions for the sector as a whole.

[10] Current franchises include the concept of 'franchise assets' which are intended to compensate franchise holders for investments they make that run beyond the franchise period. However, this mechanism has not (as far as we know) ever been used. This may, in part, be because the payment is received at the end of the franchise rather than when the investment is made – so has significant cash implications for TOCs.

2.36 NR stated that it may take the opportunity, when making changes, to go beyond what is strictly needed to allow the new train (for example) to run[11]. This looks like adding unnecessary cost but NR argues it is taking a systems view by making the infrastructure more compliant with standards or increasing capacity at marginal cost. In such cases it sees itself as taking a systems view despite the current regime and stated that it would welcome a framework that allowed it to make such decisions in a more transparent way. However, the organisation funding the original changes should not also be asked to pay for work of this nature.

Approaches used in other countries and industries

2.37 To inform our thinking on the best model for the Systems Authority we examined the practices employed by other railway administrations and in other industries.

Systems Authorities in other industries

2.38 The concept of system engineering first developed in the aerospace and defence sectors. By the mid 1950s it was recognised as a separate discipline, complementing the traditional mechanical, electrical and aeronautical roles. Arguably it has been around much longer – Brunel was a system engineer *par excellence*, but he just called himself an engineer.

Defence

2.39 The current model in the UK defence sector recognises three players: the armed forces, the defence industry and the Defence Equipment & Support. DE&S is responsible for procurement but it does much more. It carries out the system engineering function of reconciling the aspirations of the armed forces with the capabilities of the industry. It is responsible for devising innovative contractual arrangements, such as the recently redesigned Tornado maintenance contract that has halved operational costs and the incentivised contract that greatly cut the cost of the Astute submarines. DE&S also orchestrates the consultation needed when a new capability is being considered, to ensure that its effects on other systems are anticipated.

2.40 The System Authority in defence is designed to be hierarchical. This is inevitably a theoretical ideal solution and the extent to which it is carried out varies between projects and people. The overall architecture of a platform or capability is developed by a system architect in DE&S, responsible for thinking through how different pieces of equipment and elements of the capability could and should work together. Responsibility for delivering individual projects within that architecture lies with the Integrated Project Team (IPT).

2.41 The IPT brings together representatives of the different user communities, procurement specialists and DE&S' own experts to form the Systems Authority for a project. It will make the trade-offs between alternative technologies and designs, and should ensure that the formal requirements drive innovation but do not prescribe solutions. The IPT derives its authority from being the integrated customer, giving it a strong role in ensuring that decisions are optimised for the entire defence sector and not just in response to local demands.

2.42 The UK MoD underpins this with a set of standards that set out the duties of the different players. These recognise the importance of MoD and the armed services in bringing together the disparate elements that constitute a capability, with a clearly defined but bounded role for the supply industry.

[11] Stakeholders noted that this approach marks a significant change from the days when Network Rail decided not to base the West Coast Route Modernisation on TSIs even though trains using the route have (since 2003) been compliant with TSIs.

Civil aviation

2.43 The civil aviation sector is generally simpler than rail, in that most decisions lie within a single company. The aircraft manufacturers will employ sophisticated system thinking to optimise an aircraft design by trading parameters including payload, fuel consumption, range, noise and cost to meet market demands. Airlines will perform a similar analysis to optimise their fleet. Air Traffic Management, analogous to railway signalling, brings all of the main players in the industry together. The regulator (CAA) plays a key role as the Systems Authority for this and NATS is charged with the routine operations of the system.

2.44 The regulation and oversight of civil aviation is changing in the UK as a reflection of what is happening globally. The UN's global body (International Civil Aviation Organisation, or ICAO) is leading a move from prescriptive regulation, which specifies exactly what duty holders must do to comply, to goal setting regulation, which sets general objectives for the duty holders. This creates more opportunity for innovation, albeit within a strict interoperability and safety framework.

2.45 Some decisions have to be globally agreed. For example, the maximum wingspan of a civil airliner (equivalent to gauge) must be agreed by all international airports and aircraft makers. ICAO orchestrates the interplay of the technical, operational and commercial arguments to reach a consensus.

2.46 Both defence and civil aviation look to a strong central body to be the Systems Authority, bringing all of the relevant players together to find a consensus that balances innovation with effectiveness and safety. In each case the body has real authority, either as customer or regulator.

Methods used by other railways

2.47 Our assessment of practices in other European countries is that they have generally placed the responsibility for system thinking with the main Infrastructure Manager (IM), under Transport Ministry control and supervision:

- This is perhaps most obviously the role of ADIF in Spain; Infrabel in Belgium and RFI in Italy have a similar responsibility. This is similar to Option 1 described later in this report.
- In France, RFF formally owns the infrastructure but it contracts operations, maintenance and investment design and delivery to SNCF. This was at first a mechanism to achieve financial independence of track and trains, in order to satisfy EC Directive 91/440. However, RFF has since developed to be a more confident 'System Mind' for French railways, positioned between the Transport Ministry and the operating companies, but continuing to draw upon the system knowledge which lies in SNCF's infrastructure and engineering divisions. This is similar to Option 2 described later in this report
- In Germany there is a single dominant company (DB) that includes the System Mind and Infrastructure Manager, and also has several divisions that are Railway Undertakings (TOCs in UK parlance). There are also many other TOCs, generally smaller than those operated by DB. This does not match exactly with any of our Models, having elements of Option 1 and Option 2.
- The Netherlands has two IMs (Prorail for main line and Keyrail for one freight line) and all passenger services are provided by a single state-owned RU which is broken into several divisions for different types of service. There is however a more powerful economic regulator (Office of Transport Regulation) with powers similar to ORR in the UK. It does however appear to take a more hands-on role in defining the system and strategy so is closer to our Option 3.

2.48 Amongst continental European railways it is generally accepted that:

- The dominant IM negotiates a contract with the Transport Ministry for the service that is to be provided and then delivers against that contract – the concept of an independent economic regulator is not needed where the ministry acts as economic regulator

- The RUs (TOCs) accept that the dominant IM has a stewardship role, providing the capability for them to operate their services at market prices (with investment in the network being driven by the return that can be realised).

2.49 In Britain this would translate to the DfT specifying how the network needs to develop and negotiating the funding arrangements directly with NR, with no economic regulation role for ORR.

2.50 In the US the Government, through the Federal Railroad Authority, specifies minimum mandatory standards. Standards for rolling stock and infrastructure are regarded as industry best practice which it would be prudent to comply with. There is less of a focus on interoperability because standardisation was achieved some time ago.

2.51 The Association of American Railroads (AAR) is a trade association dominated by (non-subsidised) Class One freight railroads and acts as a lobby to government. These railroads have similar interests and are 'vertically integrated' with both a Railway Undertaking and Infrastructure Manager role. They also share a focus on freight operations – passenger services are somewhat peripheral. The AAR approves designs for rail equipment, especially rolling stock, and ensures interoperability of wagons; prescriptive standards for 'standard' cars are thus welcomed. Common IT systems (documentation /condition monitoring) are administered by AAR-owned organisations.

2.52 Another example suggested to us, by Bechtel, was that of the Hong Kong Government's 'AdsCom' (Advisory Committee) which operated as a systems authority for a £15 billion programme of major railway projects in the 1990s. AdsCom[12] comprised the chief executives of key stakeholders and met fortnightly, on Saturday mornings, to address systems issues that could not be resolved through the normal channels. Since AdsCom was populated by very senior people, there was considerable pressure to resolve problems before they were referred to it. The Cabinet Office's COBRA committee was cited as another example of this approach to resolving systems issues. In some ways this model is analogous to the IPT in the defence example, creating an organisation which derives its authority from being an integrated 'customer'.

Parallel activities

2.53 In parallel to developing the concept of a Systems Authority the RVfM Team has been exploring a number of ideas that impinge on this study including how to encourage greater innovation in the industry and how to address problems with industry culture. In particular, the work on innovation, performed by Atkins, has resulted in proposals to create a Railway Innovation and Growth Team (RIGT) which could form part of the Systems Authority. This is considered further in paras 5.19 to 5.21.

2.54 In the course of this project, the need for a System Mind which oversees all of the systems activities (including the Systems Authority) has been identified and this is being developed alongside the RVfM Team's thinking on the future structure of the GB rail industry.

2.55 In addition to these activities, DfT is in the process of transposing the EU Interoperability Directive in line with DV29[13] and is proposing that a single body should manage standards relating to system interfaces. DfT envisages that the body would develop and publish National Notified Technical Rules (based on RGSs but including some standards currently managed by NR), publish the methodology for assessing conformity, certify conformity and agree derogations against the NNTRs. In this model a new train would be assessed for conformity

12 See http://www.thb.gov.hk/eng/boards/transport/land/tac.htm for the terms of reference and other details of the current Transport Advisory Committee in Hong Kong.

13 DV29 Version EN03, dated 23/09/2010, "Working document on the authorisation for placing in service of structural subsystems and vehicles under Directive 2008/57/EC", produced by the European Commission.

to TSIs by a Notified Body (NoBo) and then be assessed against National Notified Technical Rules (NNTRs) by a Designated Body (DeBo). DfT is proposing that the body responsible for managing the industry's interface standards should also act as the DeBo for GB rail, and this could either be NR or an independent organisation.

In summary

2.56 Action on systems issues in the GB rail industry must address a number of areas including leadership, commercial relationships and industry culture. If they are addressed (and other Areas of the RVfM Study are considering how best to do so) the problem remains over how systems issues are identified and resolved. These solutions will often be needed to resolve problems that exist now but, when developing solutions, at least half an eye has to be on the railway of tomorrow. If not, the solutions will not be good value for money in whole life terms. There will also be a need to value and trade off cost savings against performance and safety benefits so clear criteria need to be set at the systems level.

2.57 For the Systems Authority to discharge its role efficiently it needs to work within a broad industry strategy addressing long term questions such as electrification, gauging, signalling and the concept of a 'differentiated railway'. Other strategies might relate to engineering work[14] and whether trains should be diverted onto other lines/routes to minimise service disruption. The SA also needs to understand when major investment is planned or franchises will be awarded, as these often represent opportunities to introduce better systems solutions at minimal cost.

Systems Authority role

2.58 From our consultations we conclude that there is a need for a body that:

- Is closely aligned with (or forms part of) an organisation setting key industry strategies.
- Identifies system problems and opportunities, whether they be methods that could reduce costs or improve system performance, or 'insertion points' when new methods could be most cost-effectively introduced.
- Has the capability to identify system solutions that meet immediate needs and are good value for money in whole life terms – this means that the organisation would need a strong understanding of railway engineering, operations and economics to assess options and the ability to conduct research/trials to develop and test solutions.
- Has the ability to address barriers to implementing the change, whether they are: changes to standards, industry systems or processes, or addressing economic issues by amending contract incentives and brokering deals to ensure that no-one is disadvantaged by the change.
- Has the power to impose solutions on the industry if, despite its best efforts, organisations continue to block important changes.
- Monitors the delivery of system solutions to identify and address unhelpful behaviour, and develop its understanding of how best to address system problems.

Systems Authority powers and governance

2.59 While there was general agreement on the need for a body capable of implementing systems solutions, views on its powers and governance varied markedly.

[14] The industry needs a clear strategy on when infrastructure can be maintained since this affects the equipment and systems it needs to invest in. For example, if work will be performed predominantly in weekday possessions then effort should be directed to taking and releasing possessions quickly with light road/rail equipment that can get quickly on and off the track. The New Approach to the Rule Book and Network Availability Programme (formerly known as the '7 Day Railway') are seeking to address this issue.

- People working in the industry had little appetite for creating a body that could impose its will on the industry. This was generally seen as a retrograde step in an industry that is starting to work more cooperatively – the need was to address disincentives to take a systems view (e.g. contractual arrangements and difficulty changing or getting derogations from standards). However, it was recognised that there would need to be mechanisms, such as appeals processes, that prevent an impasse stopping important developments.
- Others were more sceptical about an SA accountable to the industry having the necessary vigour and being able to deal with more challenging systems issues. In particular, there was concern that the industry, as it is currently configured, is dominated by NR and the SA needs to get its authority from outside the industry in order to be truly impartial.

2.60 Other European railways face similar problems but they are rarely addressed explicitly. It seems that system issues are the responsibility of the Infrastructure Manager, reflecting a different commercial culture from the UK. In most countries there is a duty on the principal (and usually the only) IM to take responsibility for the stewardship of the railway system, working with the Transport Ministry to agree the level of funding. The single integrated IM acts on behalf of the entire railway sector to determine the optimum solution to any problem. The TOCs' role is to operate their trains within the framework defined and operated by the principal IM. For such a model to work there needs to be a clear industry strategy that will survive changes of government – something that is less likely in our political system.

2.61 Regardless of the legal power it is given, the SA would also derive a measure of authority from being:

- Independent and willing to challenge anyone, including government, for not taking a systems view
- Respected for its competence to resolve systems issues equitably and effectively.

2.62 It would also need to operate with probity and be trusted to keep commercially sensitive information confidential.

2.63 To ensure that the Systems Authority is diligent in its efforts to improve the system, it would need to be overseen by the organisation setting industry strategies. How it spent its budget and the speed and quality of its decisions would also need to be reviewed by an independent organisation (the Office of Rail Regulation or National Audit Office being the obvious candidates).

3 SYSTEMS AUTHORITY FUNCTIONS

3.1 There are a large number of functions that a railway Systems Authority (SA) could perform. We have grouped these under four headings that reflect a standard four-stage management cycle.

3.2 Within each of these stages we have identified functions that the Systems Authority would need to perform and identified who performs these roles now.

3.3 It is important to note that the SA would need to take on many of RSSB's current roles but some peripheral roles may, in future, sit more naturally elsewhere within the industry (within NR, ATOC or RIA for example). These are identified in the text and have been excluded from our plans for the SA.

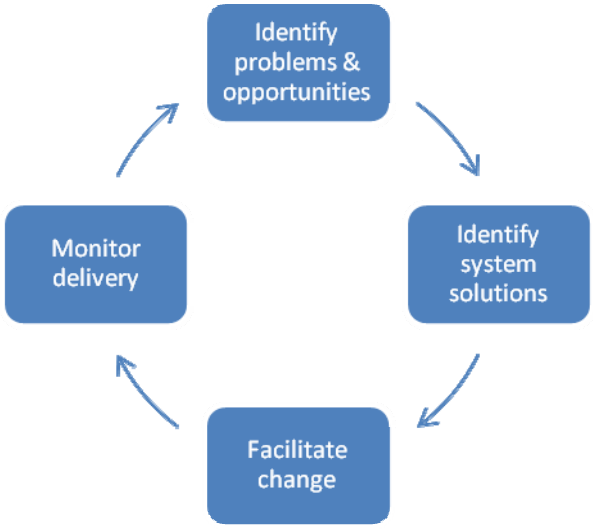

Figure 4: Main Systems Authority Functions

Identification of problems and opportunities

3.4 A number of systems problems may be referred to the SA by projects or stakeholders seeking to introduce a change, but the SA should also be proactive – anticipating systems problems and identifying cost-effective solutions. In order to do this, and support downstream activities, the SA will need good systems intelligence and knowledge management systems.

Identification of opportunities & challenges

3.5 The following activities are currently performed, to a limited extent and on a slightly *ad hoc* basis, by DfT and NR, and through RSSB's Technology Watch activity.

New methods

3.6 A key role for the SA is identifying new methods that could improve the value for money of GB rail. These could include operating practices or technologies employed by other rail administrations or in other industries, or could be innovative solutions developed for the domestic market.

3.7 To capture these ideas and ensure they are properly considered, the SA would need to operate a system of identifying possible solutions, prioritising them and recording whether they are transferable into GB rail. The findings of such investigations would feed into the SA's knowledge management system to avoid 'reinventing the wheel' on a regular basis.

Insertion points

3.8 Significant changes can often be made most cost-effectively if linked to major projects or franchise renewals. The SA would therefore monitor industry plans, identifying opportunities to introduce changes and build these into its plans to deliver systems solutions.

Horizon scanning

3.9 The scale and complexity of the GB rail network means that systems changes can take decades to implement. It is important, therefore, that the industry is anticipating systems problems and the SA will play an important role by 'horizon scanning' for opportunities and challenges that are likely to occur.

3.10 This activity could, for example, identify policy changes in related areas (e.g. linked to climate change) and changes to legislation emanating from Europe that would affect how decisions are made. Equally, it could be considering likely developments in communications, energy storage or materials that could benefit the rail industry. The latter role ties in with the concept of the Rail Innovation and Growth Team (RIGT) introduced in para 2.53 and discussed in further detail in paras 5.19 to 5.21.

Monitoring system health

3.11 To monitor the 'health' of the GB rail system and provide essential information for identifying systems solutions, facilitating changes and evaluating their effectiveness, the SA will need to acquire and analyse information from a wide range of sources. Much of this data is already collected by NR, RSSB and ORR.

Safety performance

3.12 RSSB takes the lead in analysing and reporting safety performance for the industry. It does this by supporting SMIS (the industry's Safety Management Information System), commissioning studies into risk issues and maintaining a number of industry risk models including the Safety Risk Model (SRM) and Precursor Indicator Model (PIM).

3.13 Other important sources of safety intelligence are the industry's Confidential Incident Reporting & Analysis System (CIRAS), which RSSB also operates, and recommendations from accident investigations performed by RAIB. There is great merit in these functions remaining co-located, because they support and enhance each other.

3.14 The SA should continue to manage SMIS and CIRAS on behalf of the industry, use these and other sources of safety intelligence to analyse safety performance and maintain key industry risk models.

Analysis of train delays

3.15 The industry publishes train performance using the Public Performance Measure (PPM) which reports on the proportion of trains arriving 'on time' (i.e. within 10 minutes for long distance services and within 5 minutes for other services). More detailed data is available in the form of train 'delay minutes' which are attributed to a range of cause codes and classified to show whether it is a primary or secondary delay. However, this rich source of data is not analysed and published in the same way as safety performance data. If the SA is analysing and reporting on safety performance, it would make sense to extend the role to cover operational performance too. This would ensure a more holistic view of system performance and, since the precursors to safety incidents are often linked to operating incidents, could offer new insights.

3.16 Responsibility for maintaining TRUST (the industry's system for recording and attributing train delays) would reside with the National Network Operator, as would responsibility for managing the delay attribution process. However, the SA should have unfettered access to TRUST data and should seek ways of linking incidents in SMIS to TRUST[15].

[15] RSSB has been seeking to integrate the systems fro some years and proposes that SMIS should become an integrated part of a system wide asset condition monitoring and reporting system – integrated with track and trains.

Industry costs & revenues

3.17 Industry cost data is regularly shared for specific purposes but it is commercially sensitive and using it for other purposes is often prohibited. This is inefficient, resulting in repeated requests for the same information, and introduces delays.

3.18 In order to identify the optimum system solution the SA must have a good understanding of industry costs and we recommend that the SA should be able to require NR, TOCs and FOCs to provide revenue and cost data. This could be on an 'as required' basis but there would be considerable merit in requiring operators to provide high level information in a standard format via an Annual Return. In order to understand how costs and revenues flow between organisations, and hence the extent to which parties are affected by a change, the SA would also need access to LENNON[16] and ORCATS revenue data as well as details of contractual obligations and incentives.

Performance of standards and industry processes

3.19 In addition to managing industry interface standards (see para 3.45), the SA would report the numbers of derogations against particular standards or groups of standards to identify areas where compliance was an issue. It would also report on the time taken to implement changes to standards and gain product acceptance to ensure that processes were operating efficiently. The Industry Standards Coordination Committee is currently performing a similar role but does not publish performance metrics in the area.

Responding to cross-industry safety recommendations

3.20 The ORR frequently makes recommendations on how to improve safety performance, in some cases in response to recommendations made to it by RAIB. Many of these are directed at individual duty holders but some are systems problems requiring a cross-industry response. The SA would identify any such recommendations and coordinate the industry's response.

Knowledge Management

Asset Registers

3.21 Asset management will play an increasingly important role in managing rail interoperability but registers are currently held by a variety of organisations. For example there is a European Register of Authorised Vehicle Types proposed in DV29[13], while individual vehicle registers are currently held by their owners (ROSCOs and train manufacturers), but are intended to be held in a National Vehicle Register (NR is currently designated as the Registration Entity for this). Network Rail is moving towards a comprehensive Infrastructure Register but this should be compatible with that of other Infrastructure Managers (e.g. High Speed 1) and should clearly identify infrastructure that is non-compliant with TSIs to assist other parts of the rail industry to plan their activities.

3.22 These asset registers are fundamentally important to the work of the SA, especially if it acts as the Designated Body (DeBo) for GB rail as discussed in para 3.52, so we recommend that the SA is made responsible for maintaining both national registers and identifying any additional information it needs to perform its role competently[17]. These systems would be 'fed' by databases held by IMs and vehicle owners so responsibility for maintaining the information in the database would continue to reside with them. The National Vehicle Register should also identify vehicle modifications that would affect interoperability (including within a fleet).

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16 LENNON (formerly CAPRI) is the rail industry's central ticketing system. It provides information on passenger kilometres, journey data, and ticket sales.

17 The National Vehicle Register, for example, assumes that vehicles are built to a standard loading gauge but this is not the case on GB railways. The SA system will, at least for the foreseeable future, need to contain the data needed to calculate the kinematic envelope of vehicles operating on the GB rail network.

Systems Archive

3.23 RSSB already operates the Rail Document and Drawing Service (a major archive of drawings and specifications inherited from BR's DM&EE department) on behalf of the industry and is in the process of establishing a Knowledge Management function to manage its catalogue of research studies.

3.24 In an industry where organisations and individuals change on a regular basis there is a need to create a central repository for long-term industry knowledge relating to network-wide system issues. The systems archive should include key research reports, specifications and technical drawings, as well as vehicle dynamics models and risk models. Responsibility for managing the industry archive could rest in a number of places but none of these organisations have the same breadth of interests as the SA and the information is likely to prove invaluable to it when discharging its other functions. We therefore recommend that the SA takes on the role of creating and operating, on behalf of the industry, an electronic systems archive.

Relationship to existing functions

3.25 It is apparent from this section that the SA should subsume all of RSSB's current monitoring functions.

Identification of solutions

3.26 The SA needs to identify the best solution from a systems perspective that meets immediate needs and is also good value for money in whole life terms; this means that the organisation would need a strong understanding of railway engineering, operations and economics. Current systems bodies (such as the SICs) tend to be dominated by one group or the other[18] and, where this is the case, are more likely to produce sub-optimal solutions to systems issues.

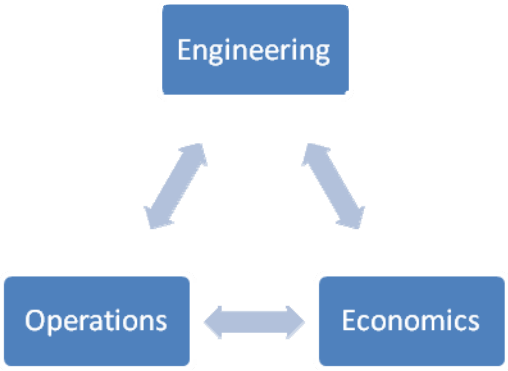

Figure 5: Key SA Skill Sets

3.27 The SA would need to develop systems solutions to problems that achieve the best balance between:

- The whole life cost of maintaining and operating the system
- The benefits (in terms of safety, performance and revenue from rail users) of changes
- The risk associated with key areas of uncertainty.

3.28 Aspects of this are currently performed by TSAG, the SICs, RSSB and Network Rail, but this is not applied consistently and in any structured way; addressing these issues would result in substantial cost savings to the industry.

Planning & appraisal

3.29 Choosing the optimum solution is often difficult since it depends on a wide range of factors including financial metrics (e.g. benefit:cost ratios and pay back periods), assumptions about future demand growth and technological change, and the extent to which the industry moves

[18] Two of the SIC chairmen stated that would like to have greater representation from the operating fraternity but there has been limited interest in providing this. When the VTSIC began looking at wheel-slide protection, the Adhesion Working Group, which is predominantly made up of operators, insisted that it was something they should lead on. A suggestion that the Adhesion Working Group should be a sub group reporting to the VTSIC has reportedly been resisted.

to a 'differentiated railway' model. In order to ensure a consistent and coherent approach to decisions it is crucial that they are made using clear criteria and in the context of a broad industry strategy.

Strategic planning

3.30 In Section 4 we introduce the concept of a System Mind which translates government policies and objectives into strategic industry plans, and we envisage that the SA would play a key role in helping to (a) develop the plans and (b) implement them. The industry does already produce such plans, albeit on an *ad hoc* basis. Recent examples include:

- DfT's Rail Technical Strategy produced in July 2007 to support the government's white paper on Delivering a Sustainable Railway. The strategy set out a 30 year timeline which identified, amongst other things, the need to optimise the track-train interface, introduce in-cab signalling, make better use of regenerative braking, increase standardisation of assets and move towards a differentiated railway.
- Development of high-level Technical Route Maps by TSAG setting out the timescales, over the next five Control Periods, in 16 areas including optimising engineering interfaces.
- NR's Network Route Utilisation Strategy on Electrification, published in October 2009, which includes an electrification 'gap analysis' and prioritises routes where electrification: may enable more efficient operation of passenger or freight services, could provide diversionary route capacity or could enable new services to operate.
- Route Utilisation Strategies, developed by NR with the TOCs using each route and other stakeholders.

3.31 The SA would help develop strategic plans addressing these sorts of issues but with more detail provided on when changes would be implemented. This would, of course, be likely to change – especially when planning decades ahead – but would provide the basis on which other industry plans could be built. Such plans could, for example, be developed for the national roll-out of GSM-R and ERTMS, platform heights and gauging, adhesion and WSP systems, selective door operation, remote condition monitoring and possession management.

3.32 The SA would pay particular attention to addressing systems issues which are adding cost or hindering the commercial development of the industry – especially where benefits may only be realised over the longer term, beyond individual franchises or regulatory review periods. The SA would therefore combine medium and long-term thinking with a commercial perspective about the future needs of the industry as a whole, and the most cost-effective ways of achieving these.

Performing options appraisals

3.33 The preferred solutions to systems problems identified by (or referred to) the SA would be identified by conducting options appraisals using established industry methods and then prioritising schemes in terms of value for money (for the whole system and in whole life terms), affordability and fit with broader industry strategies.

3.34 In order to perform this analysis the SA would need staff who understood the engineering and operational aspects of the problem and their likely effects on industry revenues and costs. To quantify the costs and benefits the SA would need access to decision support tools in areas such as timetabling and capacity planning, revenue forecasting, infrastructure and rolling stock maintenance costs and industry operating costs. In particular, DfT's Network Modelling Framework was created to assess investment options for the High Level Output Specification (HLOS) and would be a valuable tool – although more specialist models would also be needed.

Research & trials

3.35 Options analysis may well identify key areas of uncertainty when introducing new methods or systems to the GB rail system. If these are material the SA may opt to perform research on the proposed solution or conduct trials. Where these activities relate to innovative technical solutions, these would already be at high Technology Readiness Levels; research and development of solutions at low TRLs would be dealt with by the proposed RIGT (see paras 5.19 to 5.21).

Identifying strategic research needs

3.36 Longer term solutions, especially ones involving significant innovation, may need to be included in the industry's R&D programme. Because of the way the industry is structured and regulated, longer term solutions are often more difficult to justify and the SA would play a key role in identifying research priorities in areas that could play an important role in the industry's strategy. These could then be fed into strategic research programmes managed by the European Rail Research Advisory Council (ERRAC), Technology Strategy Board or the Engineering and Physical Sciences Research Council (EPSRC). This could enable the research to benefit from being part of a wider programme, as well as having access to additional funds, but can result in the work being less focussed on the GB rail industry's needs.

Conducting applied research

3.37 The SA would need to manage the industry's applied research into methods that are 'near to market' by:

- Consulting on research needs, setting priorities and producing project specifications
- Identifying funding opportunities, including EU frameworks, industry sponsors and suppliers wanting to introduce new products
- Managing the industry's R&D programme.

3.38 If the SA took on this role it would be able to keep the R&D focus on commercially-driven developments, but based on its long-term strategic thinking. Findings could be published without the need for consensus across all industry members.

Arranging trials

3.39 Where a systems solution is untried on the GB railway and there are key areas of uncertainty over its suitability or the benefits it would deliver, the SA would develop a test plan or pilot scheme with industry stakeholders. This could involve one duty holder performing the trial on behalf of the industry or it could involve a number of organisations.

3.40 Before commencing, the questions that the tests/trials need to answer and the criteria that would be used to assess whether they had provided sufficiently reliable (i.e. statistically significant) results would be agreed.

Relationship to existing functions

3.41 It is clear that the SA would, in its role of identifying system solutions, take over many of the functions that currently lie in RSSB, ORR, NR and DfT.

Facilitating change

3.42 The SA needs to have the ability to address barriers to implementing solutions by:

- Ensuring that interface standards exist within a clear structure, are well written and not unduly prescriptive

- Ensuring that industry processes for product acceptance, standards change and derogations operate efficiently and fairly
- Sharing expertise in how to improve system performance by communicating good practice and becoming directly involved in projects
- Ensuring that industry structures and incentives do not hinder systems thinking and, where they do, aligning incentives by brokering deals between stakeholders.

GB champion on TSIs

3.43 TSIs are developed by Working Groups created by the European Rail Agency (ERA) which include bodies representing European Infrastructure Managers, the Community of European Railways (representing train operators) and other stakeholders. Representatives from Network Rail, ATOC and RSSB sit on the various Working Groups and RSSB also represents ORR (the UK's National Safety Authority) when commenting on draft TSIs. DfT is responsible for the implementation of TSIs (which are legal instruments) in the UK and for notifying the ERA of any national rules that will apply when determining interoperability. DfT makes use of technical expertise within RSSB and the Standards Committees to perform these roles.

3.44 An important role of the SA would be to ensure that TSIs achieved good system-wide outcomes (for Britain and Europe) whilst avoiding unnecessary costs or operating restrictions being imposed on GB rail. It would provide early input on TSIs and ensure that (a) appropriate people sat on development committees and (b) the industry's view was clearly expressed during consultation. The SA would also ensure that appropriate Specific Cases are included for the GB railway where appropriate. Where changes are required, it would try to ensure that these were introduced in such a way as to minimise the cost burden on GB rail[19]. The SA's role would complement that of ORR, which would continue to be the NSA, and DfT, which would remain responsible for notifying ERA of the GB railway's NNTRs.

Development of National Interface Standards

3.45 TSIs will play an increasingly important role on GB rail but there will always be a need to complement these with NNTRs for areas where there are special cases, open points, derogations and for parts of the network not covered by TSIs. RGS perform this role in Britain and are supported by NR's company standards, a number of which affect system interfaces.

3.46 One of the SA's priorities will be to identify all interface standards employed in the GB rail industry and ensure that they are managed as part of a coherent system of National Interface Standards. NR has approximately 1,200 company standards, 800 of which are engineering standards and half of these are thought to relate to key interfaces. In principle, then, approximately 400 of NR's company standards may need to be rationalised and incorporated into the suite of National Interface Standards[20].

3.47 The SA should also consider how best to organise the National Interface Standards to ensure that they have a clear hierarchy and are easily navigable by the industry.

3.48 RSSB currently manages approximately 120 RGS (plus a number of Rail Industry Standards) and this role would become a core function of the SA, which would ensure that the process of developing standards and getting derogations against RGS was efficient and avoided placing unnecessary requirements on the industry. The processes would continue to give industry players opportunities to comment on standards but, having heard the arguments, the SA would be empowered to reach a decision on behalf of the industry. This power would only be

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19 This would be a continuation of a recent initiative by RSSB to create a 'GB Strategic Direction' for each TSI when it is about to be revised. This was done for the first time in 2010 with the Freight Wagon TSI, and is now being extended to other TSIs.

20 This process should also be applied to any standards relating to key interfaces developed by train operators and ATOC, and Railway Industry Standards developed on behalf of the industry by RSSB.

exercised where the process was becoming unduly protracted and was delaying important systems changes, and would be subject to appeal.

3.49 RSSB also produces Guidance Notes and Railway Approved Codes of Practice. These are complementary to RGS and are often treated as *de facto* standards; these would also need to be managed by the SA in the same way that it manages RGS.

Approvals processes

3.50 A recurring concern about the current arrangements in the GB rail industry was in the area of approvals processes. These can extend project timescales (thereby adding cost and delaying benefits), result in unnecessary changes (adding further cost) and act as 'barriers to entry' for new suppliers/products (reducing competition and resulting in slow take up of new methods).

3.51 The SA will play an important role in getting approvals processes to operate more efficiently by:

- Ensuring that approvals processes and decision-making criteria are clearly set out, and that they are proportionate to the levels of uncertainty and risk
- Providing independent technical advice in complex technical areas
- Ensuring that processes for seeking derogations against National Interface Standards operate fairly and efficiently
- Ensuring that Notified Bodies (NoBos) registered in Britain are competent and provide an efficient service to the industry.

3.52 We also recommend that the SA becomes the Designated Body (DeBo) responsible for ensuring that systems are compliant with GB rail's NNTRs. As custodian of the Infrastructure Register, National Vehicle Register and National Infrastructure Standards, the SA would be ideally placed to perform this role.

3.53 Similarly, we recommend that the SA could act as an Independent Safety Assessor to assess compliance with EU regulations on the adoption of common safety methods (a requirement under the Railway Safety Directive). This process needs to be applied to all significant changes, which are defined as changes that are safety-related or fail to meet other criteria (e.g. low consequence of failure, low novelty/complexity, easy to monitor or easily reversed).

Supplier approvals/accreditation

3.54 The GB rail industry operates a large number of supplier accreditation/assurance schemes and previous studies, including ADL's earlier report for the RVfM Team, identified significant savings to the industry from:

- Rationalising the schemes to avoid duplication
- Streamlining the process and adopting a risk-based approach to allow parts of the process to be skipped
- Reducing the overall number of suppliers and improving partnership working between suppliers
- Improving KPIs and IT systems.

3.55 Such schemes are designed to reduce the costs of industry players by simplifying procurement processes and reducing the need for checking suppliers' processes – particularly for safety critical systems. While they have a clear contribution to make in terms of reducing industry costs, there is a risk that such schemes place a disproportionate burden on the supply chain and effectively become 'barriers to entry'. As a result, we recommend that the SA should oversee industry schemes to ensure they:

- Are well integrated, avoiding the need for suppliers to register with multiple schemes
- Operate efficiently, with the level of detail required proportionate to the risks
- Are used appropriately by the industry.

3.56 The aim being to encourage the adoption of such schemes without discouraging new entrants (particularly SMEs which often have most to offer in terms of innovation). We do not recommend that the SA should play a role in running or accrediting specific schemes.

Aligning incentives and negotiating compensation

3.57 To encourage industry cooperation the SA would seek to ensure that incentives in track access agreement, franchises, etc. require parties to share information and cooperate when addressing systems issues.

3.58 However, such approaches will not guarantee the right behaviours so the SA would also seek to align the interests of stakeholders by brokering deals which ensure that parties who will be disadvantaged by the change are suitably compensated. Industry stakeholders already negotiate such deals on a bi-partisan basis and the SICs also attempt to do this on a cross-industry basis, but these negotiations are often based on what the party receiving the benefits is willing to pay rather than compensating the other parties for the costs and risks they are being asked to bear. This makes the sums of money involved considerably larger, adding cost and discouraging initiatives that cross contractual interfaces.

3.59 In order to perform these roles, the SA will need to understand where costs, benefits and risks fall and have the ability to establish mechanisms that provide appropriate incentives/ compensation.

3.60 Such negotiations can be greatly simplified by linking them to key stages in the regulatory and franchising cycles. For example, if solutions are planned at the time of franchise renewal, then the SA could recommend to DfT that franchise holders are required to make agreed changes (in which case the cost of these would be reflected in the franchise payments to/from DfT). In the same way, contingencies or incentive mechanisms could also be included in the franchise agreement.

Knowledge sharing

3.61 The SA's role is to facilitate better systems thinking in the industry – not to make every systems decision on its behalf. As a result, a key role will be providing tools and techniques that the industry can use when conducting appraisals (including demand forecasting and performance models as well as safety risk models). RSSB has done much valuable work in this area – particularly in terms of Taking Safe Decisions and developing decision-support tools for the industry. RSSB's technical experts also provide advice to the industry on a wide range of issues including risk assessment and compliance with standards. These activities enrich RSSB by keeping its staff in touch with day-to-day issues on the railway and allow the industry to benefit from an important body of knowledge.

3.62 We would recommend that the SA continues providing this role but, as we discuss later, conclude that it should charge for its services. This would:

- Discourage the industry from becoming dependent on the SA for advice and failing to develop in-house skills in key areas
- Avoid the SA cross-subsidising other parts of the industry (and hence making the SA appear expensive for what it delivers)
- Make it more attractive for the industry to use other sources of technical expertise, including consultants operating in niche areas and those with experience of other rail markets, which would enrich the industry.

3.63 RSSB also supports a number of operational activities including various working groups and websites addressing topics in the areas of 'community safety', SPADs, etc. These are system activities but not all such activities should fall within the remit of the SA (e.g. timetabling and network regulation are also systems activities). We conclude that these particular RSSB activities fall more naturally within the remit of ATOC or the National Network Operator and should lie outside the scope of the SA.

Relationship to existing functions

3.64 It is clear that the SA would, in its role of facilitating change, take over many of the functions that currently lie in DfT and NR.

Monitoring delivery

As a learning organisation, the SA would need to monitor the delivery of systems solutions to ensure they deliver the expected benefits and feed back important lessons. This could be structured using the well-established Programme Logic Model as illustrated in Figure 6.

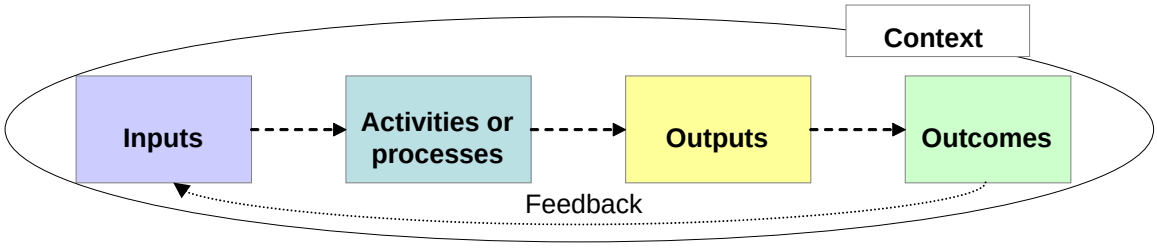


Figure 6: Overview of Programme Logic Model approach

3.65 In the diagram:

- **Inputs** include items such as financial inputs, staff time and data.
- **Activities** use inputs and result in outputs. Activities are of value only to the extent that they produce useful outputs.
- **Outputs** are of value to the extent they are necessary for outcomes to be achieved.
- **Outcomes** are the end products of the programme.

3.66 For key systems issues the SA would monitor activities and outputs against agreed implementation plans, identifying causes of delays and cost increases, and ways to mitigate these. It would also use safety and operational performance data gathered as part of its systems intelligence role to quantify the benefits and identify where these have been delayed or reduced.

3.67 It has been suggested that the SA would also need to have an audit function which would review how systems decisions are actually being made by the industry. This would include ensuring mandatory requirements are being met and investigating instances when additional costs have been incurred to ensure that they are fully justified. However, this activity would overlap significantly with that of ORR's inspectors and we do not recommend that the SA performs this role. If the SA undertook auditing the application of standards, we believe a perception would form of the organisation as a 'policeman' which would hinder the fundamental objective of incentivising the industry to deliver systems solutions itself through appropriate use of standards.

Relationship to existing functions

3.68 Even without the audit function, it is clear that the SA would, in its role of monitoring delivery, take over a number of functions that currently lie in ORR.

4 ENABLING THE SYSTEMS AUTHORITY

4.1 The ability of the Systems Authority to discharge the functions described in Section 3 will depend on a number of factors including where it sits in the industry, the powers it is granted, how it is funded and its governance arrangements. In this section we explore different options for where the Systems Authority should sit in the rail industry and then go on to describe how it should be managed and governed to ensure that it acts competently, impartially and with sufficient authority to achieve its objectives.

Key principles and concepts

4.2 AD Little identified four possible 'models' for the proposed Systems Authority:

3. Extend RSSB's role
4. Make it part of NR
5. Make it part of ORR
6. Create a new, independent organisation

4.3 Before considering the merits of these alternatives it is important to establish some important principles and concepts that should inform the decision.

Design principles

4.4 There are some basic requirements that the Systems Authority must satisfy, regardless of how it is constituted or where it is located in the railway sector. The two most fundamental are truisms – it must address the System and it must have Authority.

System

4.5 An essential quality of a system is that its components interact, so that a decision cannot be taken about one component without considering the impact on others. Ideally the interactions are through well-defined and tightly controlled interfaces, so as to restrict the scope of that interaction. However, interface definitions are almost never perfect – they are not complete and they do contain errors. A recent example of a system change failing, in part because of an inadequate interface, was the Integrated Train Planning System upgrade.

4.6 The key contribution of a Systems Authority is to be able to understand the impact of proposed changes on all of the parts of the system that might be affected. In this context the system is Britain's mainline railways, so encompasses all parts of the network and all of the stakeholders who use, operate, maintain, supply or regulate the system.

4.7 The other essential quality of an effective and progressive system, is its responsiveness to information and changes coming from its external environment, as well as its own impact back into that environment. If the system is the mainline railways, then the wider environment to be considered is the UK government, users and society, as well as other railways and transport modes.

4.8 The first Principle is therefore that the Systems Authority must be empowered to consider every aspect of the railway system[21] and relevant developments in its operating environment.

[21] This does not mean that the SA's remit will include every type of system problem. Operational matters such as timetabling, ticketing and network regulation, for example, would lie outside its scope. To avoid creating interfaces between bodies responsible for different systems issues we later introduce the concept of a System Mind to oversee all of these activities.

Authority

4.9 The second fundamental is that the Systems Authority has the power to effect change. Its role would be to ensure that the optimal solution for the railway system is implemented. In doing so it may have to over-ride the interests of parties affected by the decision. There are two ways in which the SA could derive authority: by having legal powers and by being authoritative.

4.10 **Legal powers** would need to be granted by Parliament, although possibly this could be achieved by secondary legislation. In theory the SA would be acting in the name of the Secretary of State. An alternative would be for its powers to be contractual, but this would require the SA to have a dominant position over the railway as a whole rather than just over decisions that have systemic consequences. In order to be able to discharge legal powers, the SA must be (and be seen to be):

- Independent – its decisions must not be perceived as partisan
- Transparent – not only must its behaviour be open to scrutiny but also it must make public the basis for its decisions[22].
- Fair – it must treat all parts of the rail sector fairly, including making appropriate financial arrangements to compensate those whose interests have suffered in the pursuit of a greater good.
- Bounded – the SA must be seen to have finite powers, subject to some form of regulation (by DfT or ORR) to keep it to its legitimate role.
- Accountable – for how it employs its resources and exercises its powers.
- Subject to appeal – there must be an accessible appeals mechanism for any party who feels wronged by an SA decision (including a decision to not address a systems issue), tempered with the need to take and implement timely decisions. A mechanism like the time limit on judicial review would be a good start, together with a swift and conciliatory decision process.

4.11 The SA would also achieve authority by being seen to be **authoritative**. This requires it to be:

- Competent – the SA must have the expertise to challenge and match that of the sector.
- Efficient – its decisions and actions must be timely, well-focussed and relevant.
- Consultative – it must seek and consider the opinions of the sector, but not be driven by them; its decisions should not be taken democratically.
- Trusted – this follows from all of the qualities in this paragraph and the previous one and goes beyond them; the entire sector has to accept that the SA is acting for the greater good.

4.12 Previous attempts to establish System Authorities, dealing with particular issues in the GB rail sector, foundered in part because there was an unwillingness to give the organisations sufficient authority. The questions of where the SA gets its authority, how it is funded, its governance arrangements and legal form are considered in greater depth later in this section.

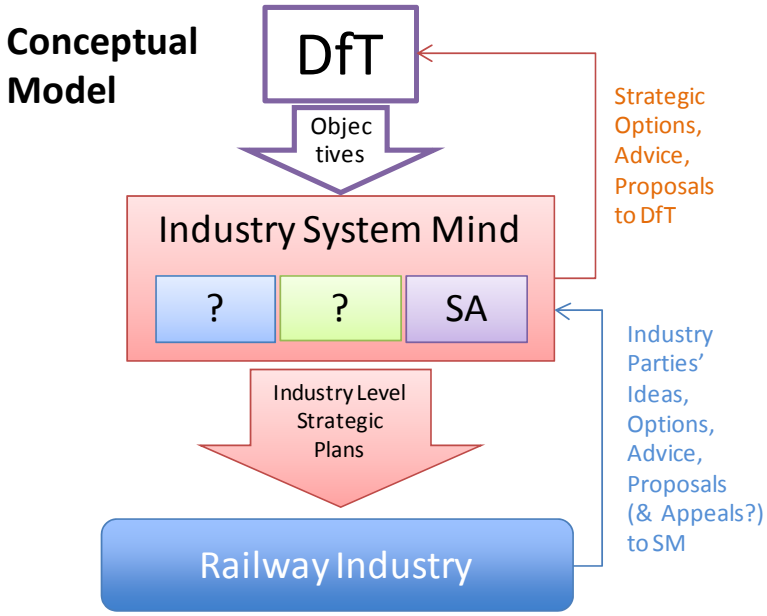
The System Mind

4.13 If the SA does not have authority over all systems issues (e.g. timetabling), it follows that the SA will need to work closely with the bodies responsible for systems issues outside its remit. For this to work effectively we reason that there would need to be an over-arching body which we have termed the ‘System Mind’. The term System Mind is being used here simply to refer

[22] One of the reasons why the industry has struggled to resolve systems issues has been due to a lack of transparency over industry revenues and costs. The SA will need to have the power to require infrastructure maintainers and train operators to provide this information but will need to decide the extent to which it can (or should) keep this information confidential. The Freedom of Information Act and requirement to publish the basis of its decisions will mean that the information will be made public unless a robust argument can be made for why this would not be in the public interest. The RAIB faced a similar issue regarding evidence that it receives during an investigation but which could later be used to prosecute organisations or individuals.

to the crucial role of applying a systems approach to the commercial and technological development of the railway resulting in industry strategies that the SA and others work to deliver. The strategy could simply be to reduce costs, or it could be to improve value for money (which could involve increasing capacity and revenue). The strategy would also decide which is of greater importance: long term systems solutions that should deliver step changes in value for money (ERTMS being an example of this) or short-term, low risk initiatives.

4.14 A clear message from our consultation with industry was that, in order to promote a systems approach to problems, there is a need for a System Mind that translates government objectives into industry strategies. The concept is illustrated in Figure 7.



Note that this figure is not showing industry STRUCTURE but high level process.
Source: Risk Solutions

Figure 7: System Mind Concept

4.15 It is beyond our scope to make recommendations concerning the System Mind but we believe it is important to recognise the need for it to exist for the Systems Authority to function effectively and to work alongside other bodies performing other systems roles. One option suggested to us for the System Mind would be a body of senior experienced and credible railway people (plus others as appropriate). The System Mind would have several roles:

- Leading the interpretation of DfT strategic objectives into broad industry strategies which would command industry support and create the framework for setting industry priorities.
- Providing input to and commenting on transport policies and supporting the development of the HLOS and SOFA.
- Addressing systems problems that can not be resolved by the SA and other systems bodies within the industry.

4.16 If a System Mind were identifiable in the industry structure, then we believe that a fundamental requirement for any Systems Authority would be that it would:

- Receive its direction and authority from the SM
- Provide input to the SM on SA issues
- *Ideally*, be organisationally located in the same industry body as the SM[23].

[23] To avoid the creation of more interfaces and the risk of systems organisations sending conflicting messages to industry.

Where should the SA be located in the industry?

4.17 Simple systems theory and management experience lead us to conclude that you would follow certain principles when deciding where to locate the SA:

- Adopt an industry structure, including placement of both the SM and the SA, which allows for a clear, common agreement of what the DfT objectives require (and their intent) and an agreed strategic plan of all industry level plans to meet those objectives.
- Place the SA where it could best draw on the resources, data and experience it needs to pursue RVfM in the context of that industry strategy.
- Place it alongside or as close to any other systems functions also needing to take a whole industry VfM view - all of which would relate to the SM.
- Place the SA where it can speak to both the industry and those with the power to adjust funding arrangements, so that it can 'broker deals' and influence franchising terms if it will serve the wider purpose of RVfM.
- Minimise the number of other bodies or parties with which it would have to interact across an organisational or contractual boundary to perform its work[24].

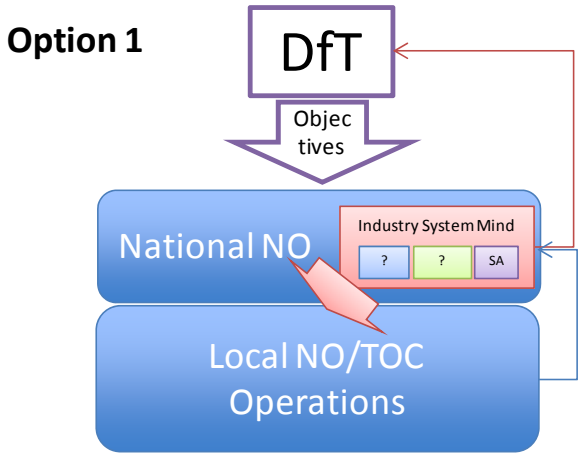
4.18 Looking at this question, the sorts of functions we have envisaged for an SA and the themes that have emerged in our consultation we have identified three fundamental options.

Option 1: SM and SA inside the NNO

Note we are using the term National Network Operator to refer to whatever form the national part of NR will take in the future, but also to provide a way of signalling that changes in culture, approach and internal structure have taken place. The point is that whilst it may still be the same registered company, the NNO would be distinct from the current or past NR in definable ways.

4.19 This is the simplest possible structure for the leadership of the industry and is illustrated in Figure 8. It brings all the elements requiring systems thinking together – especially eliminating the separation of NR and RSSB across which boundary much of the systems thinking currently take place. ORR (not shown on the diagram) would continue to regulate but with a remit amended to make whole system RVfM a priority.

4.20 Coupled with the move to encourage greater systems and VfM thinking at local level between the Local NO and TOCs, this would meet the principles governing where the SA should be located. However, it would also be necessary to address the question of trust and the ability of the SA to take decisions that did not favour other parts of the NNO.



Source: Risk Solutions

Figure 8: Option 1 Model for SA

[24] The point here is that this minimises the time and energy spent negotiating the boundaries of what can be discussed, checking back with different hierarchies for authority to 'speak' on a given matter etc – all the activity that is about how and whether we can work together, without adding to real productivity. We have termed this characteristic of a fragmented industry as "interface bureaucracy" in this report.

Recreating Railtrack S&SD?

4.21 If NR continued to be the NNO and Infrastructure Manager it could be argued that this would, in effect, be recreating Railtrack Safety & Standards Directorate (S&SD) or its successor Railway Safety.

4.22 The industry's safety and standards body began life as Railtrack S&SD because:

- It was recognised at privatisation that, as the national system operator, Railtrack needed to take systems decisions in a number of areas
- The Railway (Safety Case) Regulations 1994 gave Railtrack responsibility for ensuring system safety
- Having a body that monitored safety performance, conducted accident investigations and managed standards was a natural extension of that role; there was a reluctance to create another organisation to perform these activities.

4.23 Responding to concerns about Railtrack S&SD's independence, the organisation was separated out into Railway Safety, an 'arms-length' organisation within the Railtrack Group but independent of Railtrack plc. However, this did not satisfy the industry and, following Lord Cullen's enquiry into the Ladbroke Grove accident, Railway Safety was replaced by RSSB in 2003.

4.24 Moving RSSB into NR would not be recreating Railtrack S&SD or Railway Safety because:

- NR is a 'not-for-dividend' company; part of the concern with Railtrack was that being, a 'for-profit' company, its Directors' first responsibility was to its shareholders. NR is accountable to its members who are drawn from the public and across the rail industry, although the organisation naturally tends to behave in ways that favour its own interests over those of others.
- Under ROGS, NR has no responsibility for approving the safety management systems of TOCs.
- RAIB conducts (and reports on) independent accident investigations.
- The organisation's remit and governance arrangements would be very different, to address industry concerns.

4.25 It could be argued that this option would reverse the recommendations of Cullen, but this is not really the case; RSSB has never been able to fully adopt Cullen's envisaged role. ORR and the Strategic Rail Authority (SRA) would have found it difficult if another independent body was given a mandate to lead the industry so it was made into an industry-owned body (although it is worth noting that virtually all of its funding comes, indirectly, from the DfT[25]). Furthermore, RSSB's limited remit and governance arrangements mean that it is unable to provide leadership, although it makes frequent attempts to challenge how the industry thinks about safety management and other strategic issues.

4.26 It is possible that the RVfM Study will recommend changes to NR's role and this could involve separating the IM and NNO roles. If so, the SA should reside in the NNO rather than the IM so that it was closer to other primary systems functions (such as timetabling, network regulation, ticketing and revenue apportionment).

4.27 The other elements of the conceptual model (e.g. the interpretation of the DfT objectives, information flows between the SA and SM and from the industry up to the SA) would operate as in Figure 7. The SA, operating inside the SM, would be the gathering point for industry

[25] NR and TOCs collectively fund over 90% of RSSB but NR's contribution is included in its business plan and the TOCs' payments are effectively included in their franchise payments, so both elements effectively come from government. The franchise payments include an allowance for RSSB which is then held constant throughout the franchise – regardless of RSSB costs. Therefore the TOCs (and NR within control periods) have an incentive to manage RSSB costs down as they will keep any reduction themselves. An exception to this is the R&D Programme (representing about one third of RSSB's income), which is 95% funded by DfT directly. RSSB also receives funding from industry to operate its Confidential Incident Reporting and Analysis System (CIRAS) and support Network Rail's ERTMS and GSM-R programmes.

input and liaison on the issues that RSSB handles at present through Standards Committees, TSAG, SICs and general consultation, as outlined in Section 3 of this report.

Option 2: Separate SM

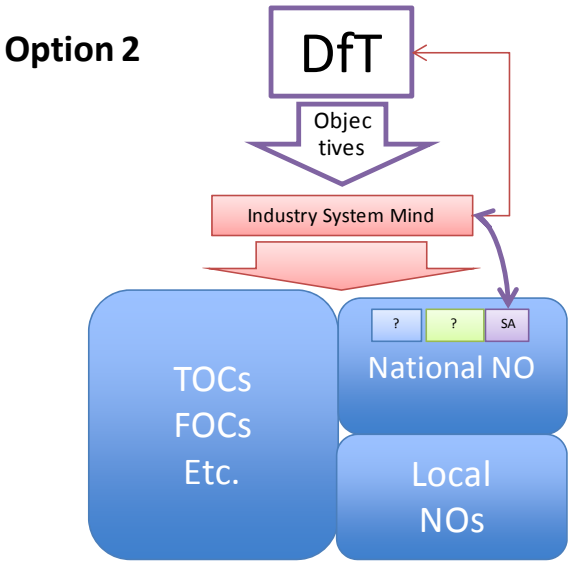
4.28 A variation on Option 1 would be to place the SA and other systems functions inside the NNO but place the System Mind outside the organisation. This would allow the SM greater independence of the NNO, while allowing the SA and other system functions to share resources and work closely together.

4.29 This model sacrifices the principle of keeping the SA in the same organisation as the SM, but the close links between the SM and the SA would be built in across the boundary of the two bodies.

4.30 By keeping the day-to-day traffic of contacts and relationships between the SA and the other system wide functions within the NNO, this option would still reduce the 'interface bureaucracy' compared with the alternative of having the SA outside the NNO.

4.31 The SA could still have a 'special relationship' with the SM through which it would derive its authority to act in the interest of system RVfM and also be a key actor in proposing ideas to the SM.

4.32 The big challenge of this model is that whilst it may resolve the issue of too much power being vested in the NNO, it requires the introduction of a new entity, albeit a small one – however, the concept here is of a slim SM which may not employ anybody (the secretariat could be provided by DfT for example).



Source: Risk Solutions

Figure 9: Option 2 Model for SA

4.33 The governance and terms of reference of the SM would need to be worked out carefully, but the key principles would be that it remain small – possibly just a board with a small secretariat. It would be formed of well regarded senior industry figures from each function of the railway who would act in close relationship with other industry leaders, the ORR and DfT. It would have the ability to directly influence the DfT industry funding processes, where it could show it was in the interests of RVfM and hence the taxpayer.

Option 3: Separate SM and SA outside the NNO

4.34 If having the system functions inside the NNO is unacceptable then the SA could be:

- Made part of ORR
- A new independent organisation.

Make part of ORR?

4.35 In other countries, such as Germany, the industry regulator is responsible for setting industry strategy and promoting systems solutions. This has the attraction of being demonstrably independent[26] of both the industry players (reducing concerns about decisions being overly

[26] It is also an EU requirement that the industry regulator is independent.

influenced by NR for example) and of government (ensuring greater consistency of approach over time). However, it has some major disadvantages:

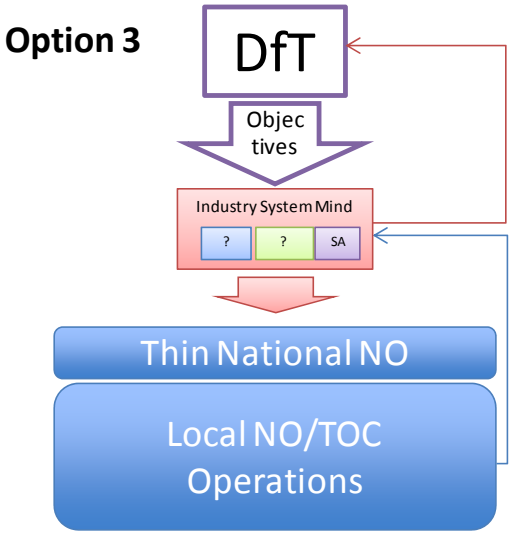
- It would only be looking at some systems issues; others would remain with the NNO.
- The decisions would not be owned by the industry and there would be a danger of it producing solutions that did not recognise the realities of operating a complex railway. This is a common complaint about ORR's safety regulating function – though one that ORR vigorously denies.
- If it performed this role who would ensure that it was developing value for money solutions? The NAO may be able to perform this role but it would not have the specialist industry knowledge needed so ORR is better placed to perform this role, which would not be possible if ORR were also the SA.

4.36 We see these as compelling reasons for not making the SA part of ORR and conclude that it would be better for it to play a complementary role holding the SA and industry to account, and hearing appeals against decisions made by the SA. Paras 5.17 and 5.18 set out this complementary role in further detail.

A new independent organisation?

4.37 An independent Systems Authority would, in effect, be a strengthened RSSB with additional powers and responsibilities, and with new governance and funding arrangements. This is a viable solution and is, in fact, the model that we use as the basis of the outline implementation plan in Section 5. However, it would mean that the SA was separated from other NNO based system-wide functions.

4.38 A more comprehensive approach, illustrated in Figure 10, would be to move all of the systems functions into the new organisation. This would involve co-locating the SA with the source of its authority to act in the interests of RVfM and avoid having different organisations dealing with systems issues (something that the GB rail industry has suffered from in the past[27]). Possible problems with this approach are:



Source: Risk Solutions

Figure 10: Option 3 Model for SA

- It would require the creation of a new organisation with powers extending beyond those being considered for the SA and could be thought of as a throwback to the SRA.
- As a separate organisation, its staff may become isolated from the day-to-day experience of the industry and, however good it was at consensus building, it would be hard for it to develop a credible leadership role from this position.

4.39 For all of the options, the SA would draw heavily on expertise currently residing in RSSB, NR and DfT. As discussed in para 5.11, ensuring that the SA's staff remain up to date with the operating railway and new techniques will be a challenge for all of the options being considered.

Recreating the SRA?

4.40 The SRA was responsible for the commercial development of the rail network and operated on the philosophy that train operators were closest to the customer so best placed to determine how the industry should develop. This 'bottom up' approach was not strategic and the SRA,

[27] When the SRA, ORR and HMRI were sending conflicting messages to the industry.

despite its name, had very limited authority. As a result, the SRA did not take a systems view or provide the necessary leadership. The SRA was a child of its time and it is now understood that:

- The System Mind would need to be responsible for translating government policies and objectives into clear industry strategies.
- During the course of developing these strategies, the System Mind would need to cost the options (as is done now for the HLOS) and then be given the powers to deliver the strategy within the available funding.
- The ORR (or NAO) would ensure that the System Mind and Systems Authority were delivering VfM.

4.41 An important principle would be that government sets the transport policies and leaves the SM to develop strategies that deliver those policies within the available funds. This approach is consistent with the Secretary of State's view that the DfT should be dealing with the rail industry at a more strategic level.

Fundamental questions

4.42 The location of the SA in the industry depends on:

- The future shape of the industry
- Whether stakeholder concerns, about the level of independence that could be achieved by an SA situated within NR, can be met
- Whether the safeguards applied to address stakeholder concerns would effectively 'draw the teeth' of the SA and make it ineffective in dealing with more challenging system issues.

4.43 The success of the SA will depend on a significant change in culture within the industry (especially in NR, given its power within the industry), its funders and regulators.

Is there evidence that NR could perform the role of SA?

4.44 In our consultation we certainly heard a good deal of criticism of NR from past events where other industry players felt that the organisation had taken advantage of its powerful role and had not been open to appeals to wider VfM or industry interests. We noted in Section 2 that many of the concerns over prescriptive standards and problems with derogations related to NR company standards rather than RGS.

4.45 However, many of these poor examples were from the past and a number of stakeholders stated that they had detected changes in NR in recent times.

- Where problems occur it is often due to the way individual NR staff were interpreting standards, rather than the standards themselves. This is not to suggest that the standards are perfect – NR admitted that the standards are difficult to navigate and overly prescriptive in some instances. It could suggest, however that the issue is predominantly one of changing the culture in NR.
- Interviewees also noted a greater openness by NR to discussion, doing 'deals' locally to benefit both parties, and we found cases where NR had adopted systems thinking beyond their own boundaries. We also heard stakeholders saying that, whilst the NR processes for standards, derogations and approvals were challenging, once you "got the hang of them" you could work with them and make progress.

4.46 Interviews with senior NR staff appeared to tell a similar story: acknowledging the need for major cultural and behavioural change in NR and projecting a future organisation markedly different to the present one. The NR Transformation Programme (NRTP) was cited by NR as

evidence of this change[28].

4.47 However, it takes years to change organisational culture in an organisation as large and well established as NR and, whilst there are encouraging signs, there is not yet clear evidence that NR in its current form would be trusted to take on the SA role.

What else would need to change?

4.48 For systems VfM to become a major determinant of decision making in the industry will require a significant change in the industry's prevailing mindset and culture. The value of 'whole system thinking' is recognised in parts of the industry but it is not the dominant mindset and is often forced upon the industry by a crisis. This cultural change needs to reach into DfT (which will acknowledge and reward TOCs who take the systems view), ORR (when it is performing its economic and safety regulatory functions), NR, train operators and their supply chains. The challenges involved in establishing a new culture in and around the SA are discussed in para 5.46 onwards.

Powers, governance & funding of the SA

4.49 This section considers:

- The remit and powers that the Systems Authority would need in order to perform the activities described in Section 3 and deliver the benefits presented in Section 6
- How to manage any associated risks, including dealing with liabilities it could incur
- The governance and funding arrangements needed to keep the SA accountable whilst maintaining its independence
- The legal form that the organisation should take.

Remit & Powers

4.50 Draft 1 of the Final Report identified a wide range of areas where a properly constituted SA could deliver benefits. The majority of these were associated with identifying solutions to systems problems and enabling change (i.e. train weights, track brakes, wheel-slide prevention systems, track friendly trains, regenerative braking, changing ICMU thresholds, acoustic monitoring of bearings, TPWS, GSM-R, ERTMS, and rule book changes). This requires the SA to be able to impose a technical or operational change on the industry, albeit after consultation and ensuring that organisations are compensated for any additional costs or risks they incur. Other examples related to:

- Developing clear industry strategies (Thameslink/Crossrail)
- Acquiring data needed by others to improve RVfM (NR needing train data for dynamic gauging)
- Producing cross-industry business cases (e.g. containment, train horns, NOS)
- Addressing problems with approvals and standards (maintenance depot, re-signalling schemes, etc.)

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28 The NRTP is not solely focused on costs management in CP4, nor solely on engineering and operations. There are strong supporting programme threads designed to bring about change in organisational effectiveness (including productivity and headcount), business processes, systems and data and people - with success criteria on customer service and other external facing characteristics of the company.

In addition, the NRTP lead team had brought together a mix of long term NR/railway managers with others from outside the railway. Those from 'outside' seemed to have been chosen to have sufficient engineering or other relevant experience for them to have credibility, but were encouraged to challenge and question the thinking and approaches of those who were 'insiders'.

The NRTP is just reaching the stage where the initial benefits are starting to be realised – mainly in the asset management area. The people/cultural change elements are just beginning to be rolled out, so it is not possible to comment on their effectiveness.

4.51 In order to perform such roles, the SA will need to have powers to make organisations provide data, implement technical and operational solutions, and address problems in their business processes.

Remit

4.52 Our proposed remit is less specific but would ensure this, provided that the SA also had the necessary powers:

> *"The Railway Systems Authority's role is to work with the industry to improve rail value for money for the industry's users and funders. It will do so in accordance with European and national legislation, government policy and its own powers. The RSA's interest in value for money will be in terms of optimising the performance of the whole railway system, both now and in the future. Internal decisions made by organisations and with their supply chain are, unless they affect key interfaces, outside the RSA's scope."*

4.53 The remit would be fleshed out in the form of objectives agreed by DfT (as the SA's funder) and ORR (as economic regulator). These are likely to include:

- Helping to develop industry strategies needed to make better systems decisions that are deliverable within the available funds
- Supporting the implementation of industry strategies by resolving systems problems quickly and effectively
- Identifying and addressing areas where sub-optimal decisions are increasing industry costs unnecessarily
- Improving decision-making processes in the industry (e.g. standards and approvals processes) in specific ways to encourage innovation and improve RVfM.

4.54 The objectives would be set out in a 5 year Strategic Plan with supplementary plans produced each year setting out the priorities for the next year. The Strategic Plan would be developed in consultation with the industry, thereby promoting a debate about what needs to change and giving it an opportunity to help set the SA's priorities.

Powers

4.55 It is widely recognised that, in order to drive through solutions quickly and cost-effectively, an SA would need powers to require industry players to comply with its decisions. There needs to be a legal basis for the powers so they need to be either established by commercial contracts (e.g. Franchise Agreements and Track Access Agreements) or legislation. In the latter case the powers need to be based on statutory powers and could be provided by:

- Legislation or regulations granting the necessary powers
- Licence conditions imposed by the ORR (under powers delegated to it by the Secretary of State for Transport).

4.56 Under the Railways Act 1993 operators of railway assets (which includes trains, networks, stations and light maintenance depots) are required to hold a licence to operate. The licences impose duties on the operator including, for passenger train operators, the need to comply with RGS, be a member of RSSB and be insured against third party liabilities[29]. ORR is able to amend licence conditions and, if RSSB were to be dissolved, the licences would need amending in any case.

4.57 The simplest way of granting the SA the powers it needs would be to add a licence condition requiring operators to cooperate with the SA and comply with its instructions[30]. This would be

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[29] Follow this link for an example of a passenger train licence: http://www.rail-reg.gov.uk/upload/pdf/lic-passlic.pdf

[30] Alternatively, the licence condition could require operators to cooperate with the SA and the SA could make its recommendations to the ORR which would then impose it. This is how RAIB's powers are applied but would mean that every decision by the SA would need to go across the ORR's desk which would add delays and make the SA less effective.

similar to the current conditions requiring operators to be members of RSSB and comply with RGS. In effect, the SA's authority would come from the ORR which would be able to fine an operator or even remove its licence if it failed to comply with the licence condition. This is our recommended approach.

4.58 Alternatively, primary legislation could be used to establish the SA and make other changes recommended by the RVfM Study. This would delay the process but allows the government to define exactly what is needed and sends a very clear signal that the change is substantive.

4.59 The concept of a Systems Authority does not conflict in principle with European law, but in carrying out its tasks the SA will have to take account of both general competition law and the specific railway Directives that, for example, restrict cross-subsidy between track and trains and also require acceptance of CE-marked compliant constituents.

Liability & Risk

4.60 The SA would need to carefully consider the risks and attendant liabilities associated with its decisions. Where possible, it should seek warranties from suppliers that could be claimed against if products failed to perform as expected. For example, Freudenberg Schwab provided a warranty for the HALL bush which is being fitted to Siemens' Desiro trains to reduce track damage. However, not all decisions could be covered in this way. For example, changing the ICMU threshold on DC EMUs to make them trip less frequently in icy weather could result in interference with signalling equipment and, in theory, increases the risk of a train collision which could result in significant liabilities to the SA.

4.61 The SA could purchase insurance to cover such liabilities but this is likely to be expensive and proved to be a key stumbling block for earlier incarnations of Systems Authorities. However, it is important to remember that earlier attempts were industry initiatives being implemented as a commercial arrangement between Railtrack and train operators. The companies were reluctant to accept the liabilities and DfT had no reason to do so on their behalf (the Systems Authorities should have improved safety and reduced *industry* costs so why would DfT under-write their decisions?).

4.62 Much has changed in the intervening years and DfT is already under-writing industry costs in various ways:

- Network Rail is a not-for-dividend company with no funds of its own to cover losses so, ultimately, its costs are recovered through track access agreements and direct grants from DfT.
- To a large extent the industry 'self insures' against its own costs but heavy losses could cause a TOC to fail in which case the franchise would return to DfT.
- Railway operators are required, as a licence condition, to carry third party liability insurance. This is typically £155m but some smaller operators have less cover. Where this is the case, NR's insurance covers liabilities up to £155m. Liabilities above this figure are underwritten by DfT.

4.63 We recommend that DfT and NR negotiate with insurers to include the risks associated with Systems Authority decisions to be included within NR's existing third party liability insurance. This seems appropriate since many of the initiatives will benefit NR directly and taking out an additional policy would probably result in the government paying twice for the same risks (via the policies held by NR and the SA).

4.64 Alternatively, the Department could simply decide to underwrite any SA liabilities that could not be transferred cost-effectively. This is likely to be the simplest and most cost-effective solution.

Funding & Governance

4.65 We recommend that the SA should be funded by a direct grant from government. This is

already the case with ORR, RAIB and, to a large extent, RSSB, and would emphasise that the SA's purpose is to deliver savings to rail industry funders.

4.66 Regardless of its legal form, we recommend that the SA is overseen by a Board of Directors comprising Executive and Non Executive Directors (NEDs). The purpose of the Board would be to hold the Executive Directors to account for delivery of the organisation's remit and objectives (see above). A key issue here will be how the organisation's performance is measured against its objective to improve rail value for money whilst operating efficiently itself. Assessing the contribution that the SA has made in reducing industry costs whilst improving outputs, such as safety and punctuality, will be difficult. Indeed, no such benchmarks are used to assess RSSB's performance now. However, we would advocate creating KPIs for key processes (e.g. standards change, product acceptance) and conducting evaluations of initiatives to assess the benefits actually delivered and, importantly, learning lessons for future initiatives. The SA's performance would also be assessed against the delivery of its Strategic Plan, as described in para 4.54.

4.67 The NEDs would include people with broad rail industry experience as well as experience from other sectors used to managing complex systems (e.g. telecoms, airport operators and the military). To ensure the NEDs were able to take an objective view of the SA's strategy and priorities, the Board would not include anyone currently holding a position within the GB rail industry. Rather, the rail industry experience would be provided by respected railway engineers and operators who are retired or working outside the GB rail industry and are therefore free from potential conflicts of interest.

4.68 Since the SA would have the power to impose decisions on the industry it is important that operators are properly consulted and have the ability to appeal against its decisions. However, unlike the present arrangement for RGS consultation, the entire process needs to be swift and efficient, with a tightly limited period for responses. This should be underpinned by good informal relationships so that formal consultations are no surprise. There must be a mechanism for any operator to appeal to the ORR, again with a mechanism to prevent this blocking innovation. This might follow the model used for judicial review, which imposes time limits of 6 or 12 weeks on any challenge in order to uphold the principles of efficient administration.

4.69 Another important safeguard is that operators would be able to reject any decision that they consider to be unsafe (i.e. result in risks that were not ALARP) or illegal for any other reason. Again, there should be a strict time limit on the period of delay and a swift and effective appeal mechanism that requires a formal challenge to be lodged within perhaps 28 days and a decision within 28 days of the challenge.

Legal Form

4.70 There are many legal forms that the SA could take. Examples include:

- An Executive Agency, such as the Highways Agency or DVLA
- A non-ministerial department, such as the independent regulators (including ORR), Crown Prosecution Service, Food Standards Agency and HMRC
- An Executive Non Departmental Public Body (or Quango) such as the Environment Agency or HSE
- A Company Limited by Guarantee (CLG), such as Network Rail and RSSB.

4.71 The first three all report to government, with varying degrees of independence, and are usually created using legislation; this is essential if the new body is to have powers delegated from the Secretary of State.

4.72 The alternative would be to create a CLG. These are often used for non-profit organisations which require a legal personality (i.e. has rights, protections, privileges, responsibilities, and liabilities under law). The organisation's guarantors are called members and they give an undertaking to contribute a nominal amount (e.g. £1) in the event of the winding up of the

company.

4.73 Creating an SA as a CLG would not require any legislation, primary or secondary. As stated previously, the duty to cooperate with it could be imposed by changes to licence conditions and operators would be required to obey decisions made by the SA, with a right to appeal to ORR.

5 CREATING THE SYSTEMS AUTHORITY

5.1 This section assesses how many staff the SA might need to employ, sets out a possible organisation structure and provides an outline implementation plan for the creation of the Systems Authority.

Organisation size and structure

5.2 There was a strong view from the industry that there is little duplication of staff performing SA-related activities and that, with a few exceptions, the organisations have complementary roles. Nevertheless, we have identified some activities performed by RSSB that would not need to be performed by the SA:

- Activities performed by the National Programmes Team, which would fall more naturally within the scope of a systems body responsible for network operation and ATOC.
- Staff developing and supporting RISAS, RSSB's supplier accreditation scheme, which is claimed to save suppliers significant sums and could therefore be funded by suppliers themselves. The SA would, however, retain a role overseeing such schemes.

5.3 Data supplied by NR, RSSB, DfT and ORR suggests that 403 staff are currently employed on activities that we recommend should be performed by the SA (described in Section 3). However, by bringing these into a single organisation and co-locating staff we estimate that 25% fewer staff would be needed and the SA would need to employ 312 staff[31] (including finance, IT and HR support functions). Appendix 3 shows how this figure was calculated.

5.4 The size of the organisation provides a useful starting point for the organisation design, but should be treated with caution because the SA would be taking on a number of roles that no-one in the industry is currently performing – at least not to the extent envisaged for the SA. Significant new activities include:

- Collating and analysing industry costs, performing options appraisal, aligning industry incentives and brokering deals
- Overseeing the systems, product and supplier approvals arrangements and acting as the Designated Body for GB rail
- Operating the National Vehicle Register and Infrastructure Register and establishing an industry Systems Archive.

Use of contractors

5.5 The organisation size assumes that much of the work in these areas will be performed in-house but several senior stakeholders have expressed the view that the organisation should be very 'lean' making extensive use of contractors to deliver specific activities. This would be a departure from the approach currently adopted by RSSB, NR, DfT and ORR who generally resource these activities using in-house resources supported, in the case of RSSB, by industry volunteers. However, in a recent report[32] to the Public Accounts Committee the National Audit Office noted that:

"Consultants, when used correctly, can provide great benefit to clients. Using consultants can provide access to skills that it is not necessary, sensible or economic for the organisation to build or maintain itself."

5.6 The NAO found that, to get the best value from consultants, organisations need to set clear

[31] The organisation size is in the middle of the range estimated by ADL (300-350 staff). However, the proposed organisation includes a number of functions that were not envisaged by ADL so actually represents further efficiency savings.

[32] "Central government's use of consultants and interims", NAO report HC 488, October 2010.

objectives and avoid using consultants on a time and materials basis. We recommend employing contractors, on a fixed price basis, to deliver defined packages of work but retaining a strong core of permanent staff employed as project managers and in specialist roles. This model will enable the SA to be 'fleet of foot' so that the pace of change is not constrained by the availability of in-house resources and will enable, by competitively tendering work, to ensure that work is good vfm.

5.7 By making greater use of contractors, the number of staff employed by the SA could be significantly less than the 312 employees calculated in Appendix 3. However, this figure is representative of the number of staff employed on SA activities (whether in-house or not) and can be used to assess the organisation's funding requirements.

Organisation structure

5.8 In the course of describing the SA's functions we have identified particular skills that would need to reside within (or at least be available to) the SA. Many of these skills would be needed across a range of SA activities and this section presents an outline organisation structure for the SA which creates teams responsible for core functions with staff needed to support a range of activities employed in a 'pool' of in-house experts.

5.9 Figure 11 presents a simple organogram for the Systems Authority broken down to Team level.

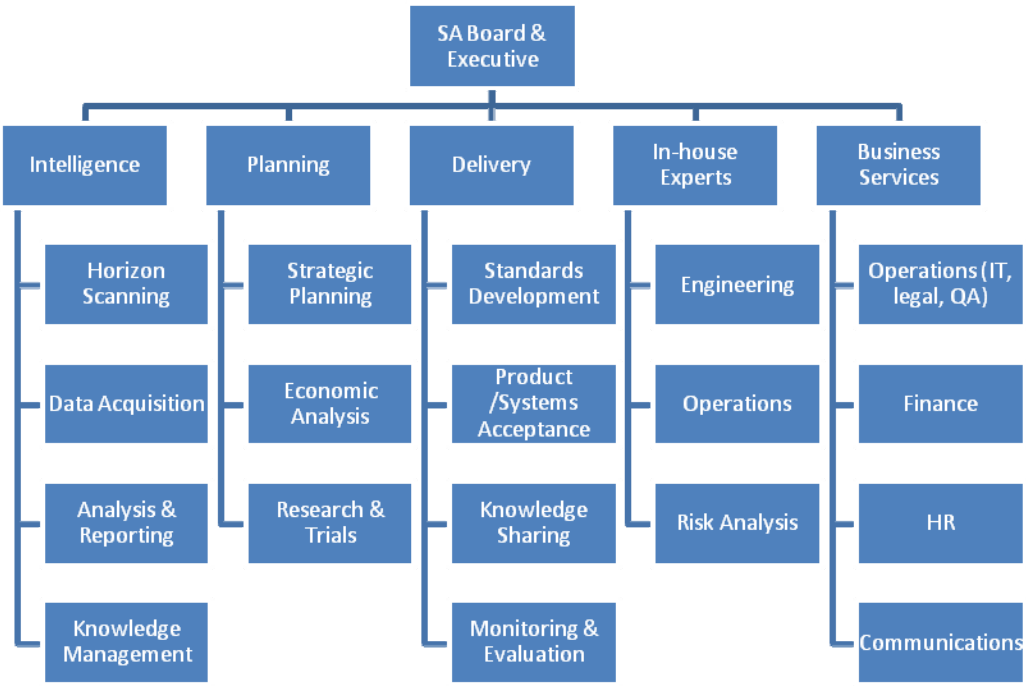

Figure 11: Systems Authority Organogram

Getting the right people

5.10 In Section 4 we consider where the SA would get its authority from and much of this is from the competence and independence of its staff. In Section 3 we identified that the SA needs to employ people with engineering, operational and economics skill sets. It will also need statisticians, mathematical modellers, technical writers and project managers. Most importantly, it will need to employ staff who approach problems creatively and have the leadership qualities needed to drive through change.

5.11 A key risk is that SA staff could lose touch with the day-to-day challenges of running the railway and this would undermine their credibility and competence. To address this we propose that the SA should:

- Retain a body of staff to perform specialist functions (e.g. maintaining the industry's risk models), provide continuity on long term projects and develop the organisation's processes and procedures.
- Minimise its reliance on industry 'volunteers' for key committees because (a) it is then dependent on who the industry is willing to release (rather than who is most suitable) and (b) the throughput of work (and hence pace of change) will be limited by how much time the people can afford to take out of their 'day job'.
- Seek to attract high calibre staff from the industry on secondments to give the SA's proposals authority by virtue of them being made by people who understand the issues and are respected in the industry.
- Make use of contractors, through framework agreements or call-off contracts, for well defined 'projects'. To ensure good vfm, the work should be competitively tendered and awarded on a fixed price basis.

5.12 The use of contractors will help keep the organisation 'lean' and focussed on the delivery of its objectives. Using consultants with experience of other sectors and countries will also bring in new ideas[33].

Office location

5.13 In order to recruit a competent workforce, the SA needs to be located where there is access to a large pool of people with the necessary range of skills. Basing the SA in central London would involve minimal change and would assist in the retention of staff already based there, but may be more expensive in the long term (due to higher wages and office rents).

5.14 Consideration should therefore be given to basing the SA outside London (possibly with a satellite office in London as a transition arrangement). The office should be located somewhere with good rail connections, a large pool of potential employees and close connections with key industry stakeholders. Obvious candidates would include established centres such as Derby. This was the former location of BR's Railway Technical Centre and is the home of a number of engineering consultancies that grew out of BR Research and the former Department of Mechanical and Electrical Engineering (DM&EE). A recent study by URS[34] reported "the East Midlands is the rail capital of the UK and is Europe's densest cluster of rail engineering companies". As a result of its central location and BR connection, a number of key industry players are also based there[35].

Impact on other organisations

'Donor organisations'

5.15 Creating the SA would result in a number of activities currently performed by RSSB, NR, DfT and ORR transferring into the new organisation. Some of RSSB's tasks would not transfer because we think that they would be better performed by the National Network Operator, ATOC or rail industry suppliers.

5.16 As a result of the change RSSB would cease to exist and a substantial part of NR's engineering department would also transfer across. We calculate (in Appendix 3) that NR would lose 185 staff (including 6 staff employed outside NR engineering and asset information) and that DfT and ORR would lose 15 staff and 3 staff respectively. Table 1

[33] There are also wider benefits to the UK economy since UK-based consultants working for the SA would be better able to compete in the global market which, in turn, increases their exposure to methods used by other railways (which can then be fed back to GB rail).

[34] "Planes, Trains and Automobiles Research", URS, December 2009.

[35] Network Rail, Balfour Beatty Rail, RAIB, East Midlands Trains, Bombardier, Porterbrook and Angel Trains all have offices in Derby.

identifies the SA activities that the staff concerned are currently engaged in.

Table 1: Staff transferred out of 'donor organisations'

SA Activities	NR	DfT	ORR
Horizon scanning/foresight to identify strategic systems requirements	3.0	4.5	
Identification of current systems problems & opportunities	4.0	1.0	
Safety analysis (incl risk modelling) and reporting	3.0	0.4	
Analysis of delay data	3.0		
Perform benchmarking studies on costs	7.0		
Monitor performance of standards and industry processes	13.0	0.3	
Custodian of infrastructure register and rolling stock database	3.0		
Repository for corporate memory	20.0		
Industry consultation on systems issues	3.0		
Performing options appraisals	7.0	0.8	
Identifying research requirements (incl gap analysis)	11.0	0.5	
Managing the research programme	5.0	1.0	
Arranging trials	7.0		
Input on TSIs	3.0	2.8	2.0
Managing/developing national standards, guidance & COP	34.0	3.2	0.5
Managing/supporting cross-industry initiatives/projects (incl ERTMS/GSMR)	2.0		
Communication of industry good practice	15.0		
Product & systems acceptance	29.0	0.3	
Systems verification	4.0		
Manage supplier accreditation schemes	1.0		
Monitor delivery of activities and outputs	8.0		
Totals	**185.0**	**14.8**	**2.5**

ORR

5.17 As discussed in 4.36, the ORR would also play an important complementary role to the SA by:

- Holding it to account for its decisions (in terms of meeting government objectives, delivering against its own plans, vfm of systems solutions etc.)
- Ensuring it is operating efficiently by, for example, monitoring KPIs including how SA staff spend their time
- Using its inspectorate to audit industry's compliance with the letter and spirit of standards (e.g. that decisions are justified economically as well as compliant with standards)
- Providing an appeals mechanism for parties unhappy with SA decisions (including decisions to not address a particular systems issue).

5.18 As economic regulator, ORR monitors NR's investment plans and sets challenging targets to deliver efficiency savings. There is a danger in doing that of encouraging NR to drive its own costs down at the expense of the system as a whole. We conclude that ORR should also be required to take a broader, RVfM, view of economic regulation.

Railway Innovation & Growth Team

5.19 In a parallel study for Area G of the RVfM Study, Atkins considered how the industry could improve value for money by being more innovative. A central recommendation is the creation of a Railway Innovation and Growth Team (RIGT) which would be responsible for helping the industry gain maximum advantage from emerging technologies in areas such as materials, communications and energy storage. Atkins' report recommends that:

- The RIGT should subsume the existing R&D/innovation roles and functions of DfT, TSAG and RSSB
- The RIGT functions should be discharged under the remit and governance of the Systems Authority.

5.20 The SA has a similar role to the RIGT in terms of horizon scanning and identifying new

methods that could be introduced to GB rail, but is focused on solutions at high Technology Readiness Levels which require minimal development. The RIGT's role is therefore complementary but there are clearly close parallels between the two organisations' activities:

- The SA already has a horizon scanning function and there seems little sense in duplicating this in the RIGT
- The SA would have the skills needed to manage the proposed GB Railway Innovation Investment Fund (GBRIIF) and resulting research
- The SA's more applied research would complement the 'blue skies' research promoted by the RIGT.

5.21 We therefore agree that the RIGT should form part of the Systems Authority.

Outline Implementation Plan

5.22 Despite the considerable level of uncertainty over where the SA would sit in the rail industry, and hence its legal form and governance arrangements, we have been asked to provide an outline implementation plan for establishing the SA. In order to do so we have agreed a number of assumptions with the RVfM Team:

- The SA is a new, independent organisation in the GB rail industry (simply because this is the 'cleanest' of the options on which to base an outline plan)
- Creation of the SA and granting it the necessary powers is achievable without legislation (e.g. it can get the necessary powers through changes to licence conditions).

5.23 The implementation plan also assumes that certain key decisions have been made by DfT, following consultation, on the organisation's remit, powers, governance and funding arrangements (as set out in Section 4) and on where the organisation would be based. For the purposes of this plan, we have assumed that the organisation would not be based in London (this is a conservative assumption, but it allows the more complex change process to be illustrated and it could result in longer-term benefits).

5.24 Changes to these assumptions would result in modifications to the plan and timescales, but the key steps and considerations are unlikely to change.

5.25 Importantly, we have been advised that staff whose roles would transfer into the SA would be subject to the Transfer of Undertakings (Protection of Employment) Regulations 2006, or TUPE. This applies to roles transferred from RSSB, NR, DfT or ORR and has significant implications for the change management process, as explained below.

5.26 The outline implementation plan comprises four phases:

1. Preparation & enabling
2. SA creation
3. SA launch
4. Embedding & monitoring

Phase 1: Preparation & Enabling

5.27 Phase 1 would be to develop detailed plans for creating the organisation and giving it the necessary powers to perform its role. The specific tasks would be as follows:

Creation of Change Management Team (CMT)

5.28 DfT would appoint a team of people to develop a detailed implementation plan, based on this outline, and manage the process of creating the SA. The CMT would need to include staff knowledgeable in finance, HR, facilities management and IT, as well as people who understand the industry and the government's aims in setting up the SA. As key roles are filled in the SA, the CMT would continue to work with them to ensure continuity throughout the process.

Organisational Design and Change Planning

5.29 The next stage would involve:

a. Agreeing the changes to be made to licence conditions by ORR and the timing of these
b. Developing the SA organisation structure, focusing especially on the integration of functions performed in existing organisations, and confirming the organisation size
c. Identifying key dependencies (e.g. space needed for new offices, proximity of break points in existing leases)
d. Preliminary investigation and assessment of potential locations/facilities.

Appointment Processes

5.30 The CMT should identify the:

a. Core competences, skills and experience required for key roles in the organisation, including desired cultural fit for top team members (e.g. attitude, character, commitment to key SA goals, openness to innovation)
b. Appointments process for senior posts
c. Appointment/migration process for staff into other roles.

Develop Detailed Implementation Plan

5.31 The CMT would then make detailed recommendations on the organisation's size and structure, appointment processes, where its office(s) should be located, including during any transition period, and how support services (e.g. Information Technology) would be provided. It would also review the timescales set out in this outline implementation plan and finalise the proposed budgets for creating and running the SA.

DfT Phase 1 Sign Off

5.32 Phase 1 would end with DfT signing off the plan and authorising the CMT to proceed with creating the SA. The authorisation would include instructions to 'donor organisations' to cooperate with the change process.

Phase 2: Systems Authority Creation

Initiation Activities

5.33 Phase 2 would begin by a set of initiation activities signalling the formal start of the process of creating the SA, including public announcements reinforcing the rationale for the change and the proposed launch date. A key message will be that ongoing work that will fall within the SA's remit should continue and not be held up until the new organisation is in place.

Legal Registration

5.34 The legal form that the SA will take would have been decided before Phase 1 began. For this plan we have assumed that it will be a Company Limited by Guarantee. If so, the SA would need to be registered in order that appointments could be made and actions taken in the name of the new organisation.

Office Accommodation & Systems

5.35 The CMT would negotiate office leases and identify the extent to which new IT, telecoms systems etc. would be required, and the extent to which these would be migrated en-bloc from donor organisations. In practice, an obvious option for CMT to consider is that RSSB's systems (which now are operated in-house) would be taken over by the SA, but that little equipment would transfer from other 'donor organisations'.

Appointments Processes

5.36 Under TUPE, staff employed in jobs that are to be transferred, either "wholly or substantially"

to the SA must have an opportunity to consult about the transfer of their position and be informed whether there are any measures being taken that might be detrimental to them. The consultation will either be with Union Representatives, Staff Representatives or with the affected individuals themselves. DfT/CMT will of course need to engage professional HR advice on the TUPE requirements and any potential redundancy process that may arise from this. For the purposes of this outline plan we have simply indicated the following broad steps that will be taken once the required employee liability information has been supplied.

a. Identify the posts which will transfer to the SA under TUPE and identify any differences between the terms and conditions (including location) of the Transferor and Transferee to establish whether there are any detrimental measures that need to be consulted over

b. Establish who is accepting the transfer or not , and give consideration to the representations made and seek agreement to any intended measures[36]

c. Identify any remaining posts left by those not wishing to transfer, including any newly created ones, advertise them more widely and appoint new staff.

5.37 This process applies regardless of grade. To meet the timescales posts will need to be filled in parallel, rather than working from the top down.

Review Management Processes

5.38 The CMT will need to develop management processes for the new SA, including finance and HR functions. Basing these on established processes in RSSB would be beneficial (since they are 'ready made' and many of the staff would be familiar with them) but this would also present an opportunity to introduce new processes, such as time recording[37]. The CMT will review RSSB's existing management processes and identify any that may no longer be suitable or may be missing, and then ensure the critical ones are in place for 'Day One'.

Phase 3: Systems Authority Launch

5.39 The actual launch of the SA could be a single point event ('big bang') or it might be possible to manage a phased migration, allowing the new organisation to gradually absorb and establish its functions over a series of well orchestrated moves. Clearly, in either case there would be a fixed date on which the formal transfer of powers and responsibilities took place.

5.40 On the outline Gantt chart presented here, these options are illustrated by the launch activity being a milestone with pre and post launch organisational formation and building activity, measured in months (rather than years) to emphasise that it should not go on too long.

5.41 When deciding whether to adopt a big bang or phased migration, the CMT would consider:

a. The constraints of having to transfer powers / responsibilities at a clearly defined date so as not to cause confusion or uncertainty in the industry

b. The possible benefits of phasing to dovetail the changes with dependencies on enabling changes in the donor organisations

c. Logistical factors such as building leases or other contractual commitments which could lead to delays or perhaps poor VfM decisions in the creation process itself.

5.42 Although the scale of change for the SA is not huge by industrial standards, the implications for the industry are out of proportion to the numbers of people who will actually be 'changing seats'. The CMT will need to plan targeted activities to enable them to monitor (and perhaps adjust) the early progress of the change including the understanding and level of engagement with the culture / behaviour change amongst staff inside the SA, as well as in relevant teams

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[36] Redundancy situations may arise from the TUPE process and DfT/CMT will need to determine where any potential redundancy costs will lie, given that some costs will fall inside the donating (transferor) organisation, whereas others may fall on the new SA. Aside from the actual redundancy payments, there may be associated transferor costs of managing the process and perhaps of downsizing.

[37] RSSB does not use time recording now and, as a result, finds it difficult to explain how much of staff time is spent on different activities. This is something the CMT may wish to review.

in NR and ORR.

5.43 At launch, CMT would formally hand over its responsibilities to the SA board.

Phase 4: Embedding & Monitoring

5.44 The primary rationale for creating an SA for GB rail is that it would help deliver improved value for money from the GB rail industry. The changes in attitude and behaviour required to deliver such changes will not be achieved automatically by virtue of creating the SA. There will need to be a continued focus on embedding the new thinking into the SA itself (in its decision processes, ways of thinking, what it rewards and celebrates in staff behaviour etc.), the ORR and the rest of industry. Culture change takes time and it will take years before attitudes and behaviours are transformed and become the norm. There will therefore need to be an ongoing monitoring role to assess progress, reinforce the SA operational and cultural change objectives and challenge recidivism.

5.45 The Gantt chart in Figure 12 indicates main activities and timescales for the first three phases; Phase 4 would be ongoing.

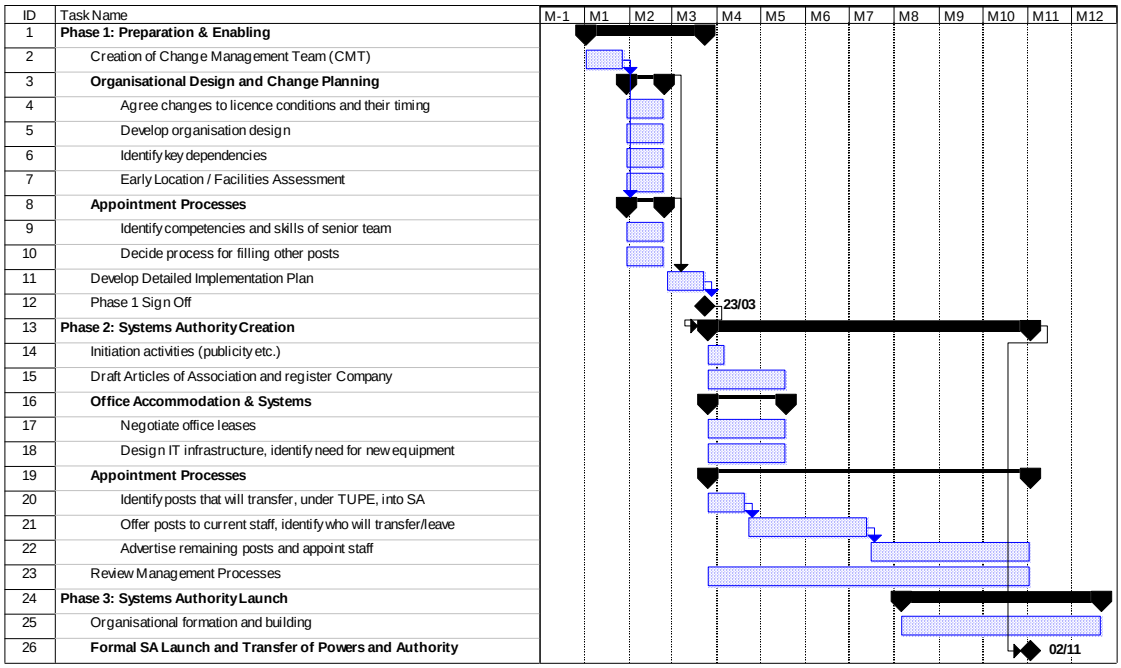

Figure 12: Outline Gantt Chart for SA Implementation Plan

Achieving effective change

5.46 We have examined the issues identified earlier in this section using an established Organisation Development (OD) model[38] and good OD principles. This section summarises the evolution of the SA in terms of that model.

5.47 In doing this, we recognise that creating an effective Systems Authority in GB rail will have inherent challenges – even with industry agreement to the principle – because it would signal:

- A move away from decision making solely by consensus (or there is no 'authority')
- The requirement to share data that is considered commercially sensitive
- A shift in the industry's commercial and regulatory priorities and incentives.

[38] Though not used in its full form for this simple assessment, the underlying OD framework is the Burke-Litwin model of individual and organisational performance (1992).

5.48 There are then a series of key change issues, the management of which will have a significant impact on the transition and the effectiveness of the resulting SA.

Enabling Steps and Environment Factors

1. **Clarity on the 'end state'.** Many reasons have been cited for the creation of an SA. Clarity on its role, especially in regard to delivering RVfM, will be vital.
2. **Positive industry engagement.** Previous GB rail industry changes have often been driven by commercial pressures, external (political) directives or major incidents. The creation of a Systems Authority marks a decisive shift away from an industry based on short term markets and will require a new mindset. This change will be required throughout the industry and implies a fundamental change in leadership at the whole industry level and beyond.
3. **New commercial / economic mechanisms.** The introduction of an authority with RVfM as one of its objectives will require new mechanisms to manage commercial and economic imbalances and may also mean individual organisations need to review internal incentive schemes.
4. **Stable political and policy environment.** For RVfM to become a real driver of industry action without regular interventions by the DfT in decision making processes, sustained governmental support and a clear remit for key industry bodies will be important.
5. **Legal enabling.** If the SA, or the System Mind body in which it resides, is a new organisation it will either require primary legislation if it takes on delegated responsibilities from the Secretary of State or a duty on railway companies to work with the SA imposed by a licence condition (this is already the case for the duty to belong to and pay for RSSB). There remains a risk that licence holders could refuse to accept the new condition.
6. **Legal liability.** Work will be needed to clarify the legal duties and/or liabilities taken on by the SA either intentionally or by virtue of a decision it makes which is later challenged or becomes the focus of an incident investigation. The relationship to the duty retained by industry parties needs examining[39]. Without this, directors and staff in the SA may be reluctant to use the 'authority' they have been given.
7. **Integration / alignment with other ongoing change processes.** Care will need to be taken in understanding how changes arising from the RVfM review affect ongoing programmes (such as the NR Transformation Programme) or are affected by them. Where possible, a merging of the change objectives and plans should be sought for two reasons. Firstly, not to do so would itself demonstrate a lack of systems thinking. Secondly, putting existing programmes on hold or making revolutionary changes to them without well communicated reasons, would add to change fatigue and disillusionment in the industry, instead of enthusiasm to make the changes work.

Transformational Change Factors

8. **Clarity on political objectives.** Government level objectives have been noted above as an environment factor, but political objectives within the industry will also need to be considered. For example there will be changes in real or perceived influence and power within the industry and these should be considered when creating the SA.
9. **Clarity on driving and shaping factors of the proposed change**. The rationale for creating an SA will need to be honed until capable of fairly simple expression; this is vital both for those leading and planning the change and the rest of the industry.
10. **Leadership.** There are a number of leadership change issues we would note:

[39] This might reopen the whole issue of whether railway companies should be regulated as employers or transport providers, in relation to the HSWA - a long running debate.

a. In order to plan for successful and sustainable change not only in structure, but in culture and mindset, the change management team should balance emerging leaders in the industry with visionary existing senior figures.

b. This change will take place with recent changes still fresh in the minds of a large proportion of those affected. The change team will need to show that it has learnt from these experiences to minimise damaging change fatigue.

c. To signal its determination to achieve a major change in industry culture and behaviours, the choice of leaders and their characteristics is crucial. In particular, the introduction of new blood from outside GB rail may be valuable but such people need to be seen to have relevant skills and experience (e.g. specifying and delivering changes to complex technical systems) in order to be credible.

11. **System Mind.** For the SA concept to be effective, it requires the establishment of a System Mind that is able to translate government policies and objectives into industry strategies. It is crucial that this organisation is made up of people with the necessary intellect, vision, charisma and industry experience to make a success of the role.

12. **Industry culture**. The change in culture required for effective operation of an SA in GB Rail has been referred to throughout this work. The challenge will be to articulate the nature of that change and work through its practical expression in the SA and throughout the industry. This may require a programme of leadership coaching supported by an ongoing programme of interaction at many levels of the industry. The success of the cultural adjustment will have a far greater influence on the long term success of the SA concept than any minor (and correctable) error in organisational arrangements.

13. **Clarity on Expected Outcomes and Benefits**. It is important to measure the benefits of the change but this will be difficult over a short timescale. One solution to this is to monitor the achievement of key outcomes and measure attitudinal change using surveys. The key is that such metrics should be against clear objectives and not simply be a means of self-justification.

14. **Communication.** Creation of the SA will affect some staff more than others so the communication plan will need to be heavily differentiated to different groups. For example, if the changes will have only limited effect on, say, track workers, the change should not be communicated as a radical shift (another ‘new dawn’). However, another outcome of the RVfM study may affect track workers more and so the communication there would be targeted to them and less to others. Communicating only the relevant changes to each group and not ‘over blowing’ what is being done is one way in which unnecessary and wasteful change fatigue can be avoided.

15. **Alignment of contracts.** Depending on the decision on the governance of any new organisation in which the SA is placed, there may be work to do on contractual change for staff, decisions on whether TUPE will be applied etc.

5.49 This review of key change issues is intended to give some idea of the areas for discussion and starting points that the RVfM team need to consider as they seek to integrate the issues in establishing an SA with their other thoughts on industry change.

5.50 The concern here is to support a change management design process likely to result in a Systems Authority for GB Rail which is capable of being effective and sustainable.

6 BENEFITS OF A SYSTEMS AUTHORITY

6.1 It is clear from our consultations that the industry could realise significant savings from a better integrated and systems-based approach to making decisions. These will range from high-profile decisions on major projects to resolving day-to-day problems efficiently and in the interests of improving rail value for money. It is in the nature of things that people tend to focus on the opportunities from getting big decisions right but these are infrequent and the benefits are likely to be far less than could be gained by ensuring that everyday decisions represent good vfm.

6.2 In this section we consider the savings that a Systems Authority could deliver by:

- More efficient management of systems issues by combining roles and co-locating staff
- Applying a systems approach to routine decisions made by the industry
- Championing initiatives that require close co-operation between industry stakeholders.

More efficient management of systems issues

6.3 The proposed SA would take on a number of roles currently performed by different organisations and, by bringing these under 'one roof', it will require fewer staff to manage systems issues. In Appendix 3 we calculate that the SA will need to employ 312 staff, which is 91 fewer than are currently employed by RSSB, NR, DfT and ORR in the same roles. The reduction is as a result of reduced 'man marking' and 'interface bureaucracy' between organisations as well as benefits from co-locating staff.

6.4 The Systems Authority will perform similar functions to RSSB so it is appropriate to estimate the cost of running the SA by comparing the two organisations. RSSB has an annual budget of £30m, £10m of which is used to fund R&D. Approximately £4m of the R&D budget is spent on external consultants/universities etc. so RSSB receives approximately £26m per year to fund its own activities. This averages £115k for each of RSSB's 225 employees, which is relatively high and we think it reasonable to assume that the SA could make savings here – especially if it moved away from central London[40].

6.5 Assuming that the cost per employee were reduced by 10%, to £104k, and that the SA employed the equivalent to 312 staff, then the organisation's budget would be £32m per annum plus £4m in external R&D costs. However, by employing 91 fewer staff the industry's costs would be reduced by £10m.

6.6 It is important to note that this figure is indicative and does not include the one-off costs associated with creating the new organisation. More detailed analysis of these costs will be possible once the location of the SA in the industry and where it will be located geographically, have been decided. However, the analysis suggests that the creation of the SA should deliver valuable cost savings with a short payback period.

6.7 It is important to note that the saving achieved by combining roles is, whilst valuable, at least an order of magnitude lower than the savings expected from the SA resolving system problems quickly and effectively. Whilst it is important to ensure that the SA is a lean organisation, it is important that it is provided with the resources it needs to deliver the bigger prize.

Savings from improved decision-making

6.8 High profile projects may attract more attention but greater savings are likely to be made from

[40] Salary costs are typically £4k per annum higher in London, and this will increase when pensions and national insurance contributions are included. Office accommodation is also more expensive.

the SA enabling and encouraging the industry to apply a systems approach to routine decisions. Consultees provided us with a number of examples where savings could be made but many of the examples were associated with NR producing prescriptive specifications for work which prohibited design consultants and contractors from developing and delivering cheaper, innovative solutions. There were also some innovative methods[41] which would improve RVfM but are not associated with interfaces – they come down to NR being slow to adopt new methods and, since they do not relate to industry interfaces, are beyond the scope of an SA. They are, however, areas that NR should be addressing internally to meet ORR's targets to improve efficiency (e.g. as part of the Network Rail Transformation Programme).

6.9 Challenging prescriptive requirements in interface standards is a legitimate SA role but seems to be more of a problem for NR company standards than RGSs. It is clear that an SA would deliver benefits by removing unduly prescriptive NR company standards and streamlining the processes for gaining approvals (including gaining derogations) and making changes to standards. Quantifying the benefits is, however, difficult since:

- We were given few examples of such problems (re-siting a signal, the track layout in a new depot, the need for platform gates and approval of re-signalling schemes)
- The cost of the problems had not been quantified and the organisations concerned were unwilling to provide specific examples that could be seen as a criticism of their main customer (Network Rail)
- It is difficult to judge how frequently such problems occur even if we were able to quantify them.

6.10 Nevertheless, it is possible to estimate the scale of such benefits by making assumptions about the efficiency savings that could be made. Other sectors in which System Authorities are employed, such as aerospace and defence, would expect to see a direct saving on a complex project of 10% to 20% of the overall cost as a result of the optimisation that an SA brings. This is inevitably an estimate because each project only happens once - it is never possible to compare the same project with and without the benefits of an SA.

6.11 The indirect benefits arise from the better and more efficient conduct of a project. The Royal Academy of Engineering's guidance on system engineering, "Creating systems that work", quotes a leading US system engineer: *"the expensive mistakes are made on the first day"*. The guidance includes a simple graph of money committed and money spent, as a function of time (see Figure 13). The message is clear: work done in the early stages of a project determines the future cost. This is where an SA delivers value, by ensuring that the early stages define a more optimum future.

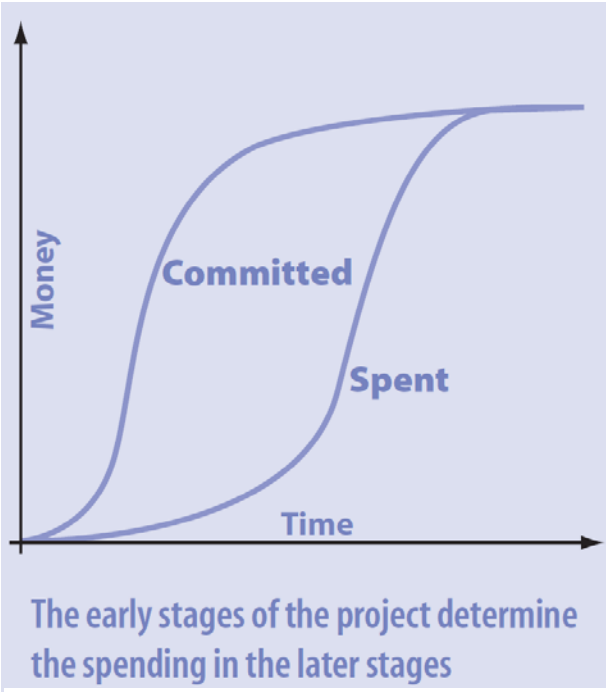

Figure 13: When money is committed and actually spent on projects

6.12 Network Rail's CP4 Delivery Plan (2010 update) includes the following table which indicates enhancement expenditure totalling £12.7bn (i.e. £7.7bn of enhancements plus £5bn of "Non PR08 funded enhancements") and a further £12.9bn on maintenance and

[41] Examples provided included modular switch & crossing, plug & play signalling, video recording of track condition, weld repairs to S&C, flash-butt welding, intelligent infrastructure, and 'golden assets' philosophy.

renewals expenditure.

Appendix 6 Expenditure (network)

£m (2010/11 prices)	2009/10	2010/11	2011/12	2012/13	2013/14	Total
Operating expenditure						
Controllable opex	1,028	971	945	885	853	4,682
Non-controllable opex	443	421	413	450	484	2,210
Total	1,471	1,392	1,358	1,335	1,337	6,892
Maintenance	1,124	1,058	991	938	889	5,001
Renewals	2,336	2,751	2,620	2,265	1,980	11,952
Enhancements	1,039	1,555	1,933	1,760	1,455	7,741
Total PR08 funded expenditure	5,971	6,756	6,902	6,297	5,660	31,587
Expenditure deferred from 2008/09	233	131	–	–	–	363
Non PR08 funded enhancements	595	995	1,372	1,056	986	5,004
Total expenditure	6,799	7,883	8,274	7,353	6,646	36,955

Figure 14: Network Rail's expenditure projections for CP4

6.13 Assuming an average enhancement spend of £2.5bn per year, a saving of 10% to 20% would deliver savings of £250m to £500m per year. Similar savings could be achieved in the areas of maintenance and renewal but these areas are less likely to involve interfaces and the ORR is already pushing hard for efficiency savings. Such savings would make a substantial contribution to the RVfM Team's target of reducing industry costs by over £600m per year by 2018/19 but are highly speculative.

Case study analysis

6.14 To produce a more robust figure for the potential benefits from creating a railway Systems Authority[42] we have considered a variety of projects and problems. Appendix 1 provides a number of examples of where a systems approach has delivered, or could deliver, cost savings to the industry, and Appendix 2 examines six of these in detail. These examples range from how the railway is operated (by considering the New Approach to the Rule Book) to addressing system problems at key interfaces (such as Track Friendly Trains and Dynamic Gauging of Structures) and the delivery of cross-industry schemes (such as TPWS and ERTMS). We have also examined more insidious system problems (such as achieving Reductions in Train Weights).

6.15 Table 2 summarises the benefits that our analysis suggests would have been delivered for each of the case studies, had a Systems Authority already been in place.

[42] A number of the examples are taken from previous or ongoing projects which will not benefit from the creation of a Systems Authority (indeed, there is a concern that its creation could disrupt ongoing projects and be harmful in the short term – care will need to be taken to ensure that this does not happen). These examples have been used to demonstrate the benefits that would occur if a similar project were to occur in the future.

Table 2: Benefits from Creation of a Systems Authority

Type of Systems Problem	Benefits from Case Study	Subsequent Similar Opportunities
Technical problems across the vehicle-infrastructure interface (e.g. track friendly trains)	Commercially sensitive*	£12m per year
Better specification of trains (e.g. reduced train weight)	£531m over 35 years	None
Speedier implementation of cross-industry initiatives (e.g. TPWS)	£300m over 10 years	£30m per year
Radical change to train control (e.g. ERTMS)	£450m-£750m over 15 years**	None
Route acceptance issues (e.g. dynamic gauging of structures)	£100m over 25 years	£4m per year
Changes to operating practices (e.g. new approach to the rule book)	£106m over 5 years	£50m every 5 years

* This information is commercially sensitive and has been omitted at NR's request

** Starting in Year 5

6.16 The following paragraphs explain how the benefits have been calculated.

Track friendly trains

6.17 The VT SIC identified a novel and cost-effective solution to the increased track damage caused by SWT's Desiro EMUs but implementation of the HALL bush was delayed due to concerns over how SWT would be compensated for fitting the new bushes. As a result, the potential savings have not been achieved as early as possible and the opportunity was missed to fit them as part of the recent major overhaul of SWT's Class 444s, (which would have reduced the cost of fitment significantly). It is also likely that a Systems Authority with a better understanding of TOC costs and the ability to negotiate with the manufacturer and challenge the cost of fitment, would have been able to reduce costs significantly. The benefits are based on fitting the HALL bush more quickly and at a reduced cost to all the Desiros and potentially the Electrostar fleet. The estimated benefits (which are commercially sensitive, so we have agreed not to publish them) ignore the potential opportunity of reducing track and train maintenance costs by fitting the HALL bush to other fleets.

6.18 This problem is not unique: we have identified a number of similar technical issues where a Systems Authority might achieve a quicker and better resolution of a problem occurring across the vehicle/infrastructure interface. These include the calibration of Interference Current Monitoring Units for DC EMUs operating in icy conditions, the use of (emergency) track brakes and the activation of regenerative braking. There is likely to be a steady flow of such issues which the SA would be able to help resolve and we conclude it is likely to be faced by a similar technical issue every three years.

Reduction in train weight

6.19 Our investigations suggest that the weight of DMUs and EMUs procured post privatisation has increased by ~10% and that much of this weight increase is unnecessary. The added weight increases track damage and energy consumption and a study by RSSB[43] sought to quantify

[43] "Research into trains with lower mass in Britain Quantification of benefit of train mass reduction", RSSB, August 2010.

the effects of reducing vehicle weights for future procurements. This calculated an annual saving (per tonne per vehicle) of:

- £2,194 for Inter City vehicles
- £1,833 for Inter Urban vehicles
- £630 for Outer Suburban vehicles
- £568 for Inner Suburban vehicles
- £645 for Metro-style services.

6.20 The utilisation of suburban and metro-style vehicles is relatively low (due to lower average train speeds and the 'peakiness' of the service); this explains the relatively low savings associated with these vehicles. Using these figures, we calculate that a reduction of 3 tonnes per vehicle would deliver annual savings of £30m – but these would only be realised as rolling stock is replaced and we have assumed that this would occur over a 35 year period. The total saving over this timescale would be £516m and we have attributed all of this to the creation of a Systems Authority which would play a key role by:

- Helping to develop train specifications
- Issuing mandatory train design standards
- Advising on contract incentives in track access agreements.

TPWS

6.21 Development of TPWS, as an alternative to Automatic Train Protection, took place over several years but was then implemented very quickly. Had a Systems Authority been in place it would have progressed the concept more quickly but then implemented it in a way that was less disruptive than the Big Bang approach that the railway actually applied. TPWS took over ten years to implement and we believe that a Systems Authority could have reduced this timescale by three years. Based on the projected safety benefits from TPWS, this would have prevented one major train accident at a cost of £100m to the industry (in lost revenue, damage to the infrastructure/ rolling stock, legal costs and fines, and responding to enquiry recommendations).

6.22 However, the main benefit of an SA would have been in avoiding the damaging impact of the TPWS implementation on other signalling schemes and industry costs generally. This 'collateral damage' has been calculated to be £192m over the period from 2003/04 to 2009/10.

6.23 TPWS was implemented in 2002 and was the successor to BR's Automatic Warning System (introduced in 1956). This suggests that opportunities for an SA to deliver comparable benefits are rare – but similar issues are involved in other systems, such as train data communications and remote condition monitoring. As a result, we estimate that a project delivering these types of benefits might arise every 10 years.

ERTMS

6.24 ERTMS has had a long and difficult gestation in Britain. In 2001, the joint Uff/Cullen public inquiry into train protection systems[44] recommended that regulations should require ERTMS installation on UK high speed lines by 2010 and to all main lines by 2015. This was seen to be unrealistic but Britain has only just implemented its first trial scheme (217 km of track and 24 vehicles operating on the Cambrian line in north Wales).

6.25 ERTMS has the potential to reduce capex costs, if implemented instead of conventional re-signalling schemes, and deliver significant operational savings resulting from reduced maintenance costs and increased reliability and capacity. Assuming that the project runs for 20 years and that an SA could accelerate the programme by two years, it is estimated to deliver the following savings to the industry:

[44] "The Southall and Ladbroke Grove Joint Inquiry into Train Protection Systems", Prof Uff & Lord Cullen, 2001.

- Reduced cost of train fitment to TOCs (or the project), £145m
- Capex savings to NR from earlier implementation, £200m to £400m
- Opex savings to NR, £unknown
- Opex savings to TOCs from earlier implementation, £100m to £200m.

6.26 The total identified saving from creating a Systems Authority is therefore (before discounting) between £450m and £750m. However, ERTMS is an exceptional project marking a quantum shift in how railways are run. As such, it is probably a 'once in 50 years' type of project.

Dynamic gauging of structures

6.27 Structure gauge is probably the most costly interface problem facing the GB railway, which was built to a much smaller loading gauge than its European counterparts. Our smaller loading gauge means that the gauge either needs to be increased to allow the passage of standard designs or that the vehicles need to be customised to fit – either of which adds considerable cost. The issue also restricts the movement of vehicles already operating on parts of the GB rail network and options for cascading of old rolling stock between areas.

6.28 However, traditional gauging techniques are highly conservative and are based on a structure gauge whose dimensions relate to the size and height of a working pantograph, adjusted for maximum train sway, wind, track positional tolerances and a suitable electrical clearance. The allowances for vehicle sway and wind relate to historic measurements of maximum values. In practice, such values are related to local factors such as train type and speed, track curvature and wind exposure. Further, tolerances and allowances are added to accommodate factors such as track movement. These values are applied cumulatively which results in a worst case scenario – but one that is extremely unlikely to actually occur. Dynamic gauging analyses the swept envelope required to achieve necessary clearances in relation to local conditions and analyses tolerances using modern 'uncertainty theory' methods to provide a realistic assessment of the space required. This is generally smaller than traditional techniques would suggest and, as a result, unnecessary modifications to structures can be avoided.

6.29 One application of the methodology is in assessing clearances for overhead electrification of lines. Our case study assesses the benefits from using the technique for electrification of the Great Western Main Line and then applies these savings to 1,500 route miles of electrification (estimated to be half of that set out in NR's recent electrification RUS) over a 25 year period. The potential benefits are enormous and even if we only credit the SA with 10% of them, this would deliver £100m in savings over 25 years. Applying the technique to other gauging-related issues could double this saving.

New Approach to the Rule Book

6.30 One of RSSB's most ambitious projects is to restructure and update the Rule Book over a five year period. This is projected to deliver benefits of £1bn to the industry over 25 years from:

- Increasing capacity
- Optimising the use of the railway
- Championing performance improvements
- Training efficiency benefits
- Improving safety.

6.31 The 'New Approach' will deliver rule changes needed to implement new methods of working which will deliver a wide range of benefits and is crucial to the delivery of the 'Network Availability Programme'. Other benefits come from a better means of incorporating future changes to operational practices and technologies and reduced training costs due simplification of the rules.

6.32 Whilst there are expected to be significant downstream benefits for TOCs and FOCs, the most immediate benefits will fall to Network Rail. As a result, the New Approach could be seen as a

distraction by TOCs who will need to commit additional resources to staff training. We understand that some TOCs were initially slow to embrace the project and that the programme was re-ordered as a result, but this has not delayed the overall project. However, any further delays would start to impact on the programme.

6.33 Had there been an SA in place, the New Approach could have begun earlier and (in our view) could have been progressed more quickly without jeopardising the project. RSSB agrees with the first of these points, but not with the latter. Our analysis assumes that the project would have begun a year earlier and been completed in 4 years (instead of 5 years) – thereby bringing forward the benefits by 2 years. The resultant benefit to the industry would be £106m and there would also be a small reduction in development costs (£2.5m out of a total budget of £42m) due to the reduced timescales.

Overall benefits from creating an SA

6.34 Table 2 shows the benefits that an SA could achieve by extending the benefits estimated for the six case studies to similar opportunities. Based on these assumptions, Table 3 shows the projected annual savings attributed to the Systems Authority over the next 25 years; Figure 15 shows the cumulative savings.

6.35 The table shows that the Systems Authority could deliver savings which we conservatively value at £70m per year over the first few years, and the rate increases to over £110m per year as ERTMS starts to be rolled out and savings from train weight reductions build up.

6.36 Since the savings are based on the incremental benefits achieved by applying a systems approach to projects, there would be no additional costs other than those associated with running the Systems Authority (which we have already shown will cost less than current arrangements).

Table 3: Annual savings (£millions) from 'known' SA benefits

Year	Type of Systems Problem						Total Annual Saving (£m)
	Technical problems across the vehicle-infrastructure interface (e.g. track friendly trains)	Better specification of trains (e.g. reduced train weight)	Speedier implementation of cross-industry initiatives (e.g. TPWS)	Radical change to train control (e.g. ERTMS)	Route acceptance issues (e.g. dynamic gauging of structures)	Changes to operating practices (e.g. new approach to the rule book)	
1	£11.5	£0.8	£30.0		£8.0	£21.2	£71.5
2	£11.5	£1.7	£30.0		£8.0	£21.2	£72.4
3	£11.5	£2.5	£30.0		£8.0	£21.2	£73.2
4	£11.7	£3.4	£30.0		£8.0	£21.2	£74.2
5	£11.7	£4.2	£30.0	£40.0	£8.0	£21.2	£115.1
6	£11.7	£5.1	£30.0	£40.0	£8.0	£10.0	£104.7
7	£11.7	£5.9	£30.0	£40.0	£8.0	£10.0	£105.6
8	£11.7	£6.7	£30.0	£40.0	£8.0	£10.0	£106.4
9	£11.7	£7.6	£30.0	£40.0	£8.0	£10.0	£107.3
10	£11.7	£8.4	£30.0	£40.0	£8.0	£10.0	£108.1
11	£11.7	£9.3	£30.0	£40.0	£8.0	£10.0	£108.9
12	£11.7	£10.1	£30.0	£40.0	£8.0	£10.0	£109.8
13	£11.7	£11.0	£30.0	£40.0	£8.0	£10.0	£110.6
14	£11.7	£11.8	£30.0	£40.0	£8.0	£10.0	£111.5
15	£11.7	£12.6	£30.0	£40.0	£8.0	£10.0	£112.3
16	£11.7	£13.5	£30.0	£40.0	£8.0	£10.0	£113.2
17	£11.7	£14.3	£30.0	£40.0	£8.0	£10.0	£114.0
18	£11.7	£15.2	£30.0	£40.0	£8.0	£10.0	£114.8
19	£11.7	£16.0	£30.0	£40.0	£8.0	£10.0	£115.7
20	£11.7	£16.9	£30.0		£8.0	£10.0	£76.5
21	£11.7	£17.7	£30.0		£8.0	£10.0	£77.4
22	£11.7	£18.5	£30.0		£8.0	£10.0	£78.2
23	£11.7	£19.4	£30.0		£8.0	£10.0	£79.1
24	£11.7	£20.2	£30.0		£8.0	£10.0	£79.9
25	£11.7	£21.1	£30.0		£8.0	£10.0	£80.7
Totals	**£291**	**£274**	**£750**	**£600**	**£200**	**£306**	**£2,421**

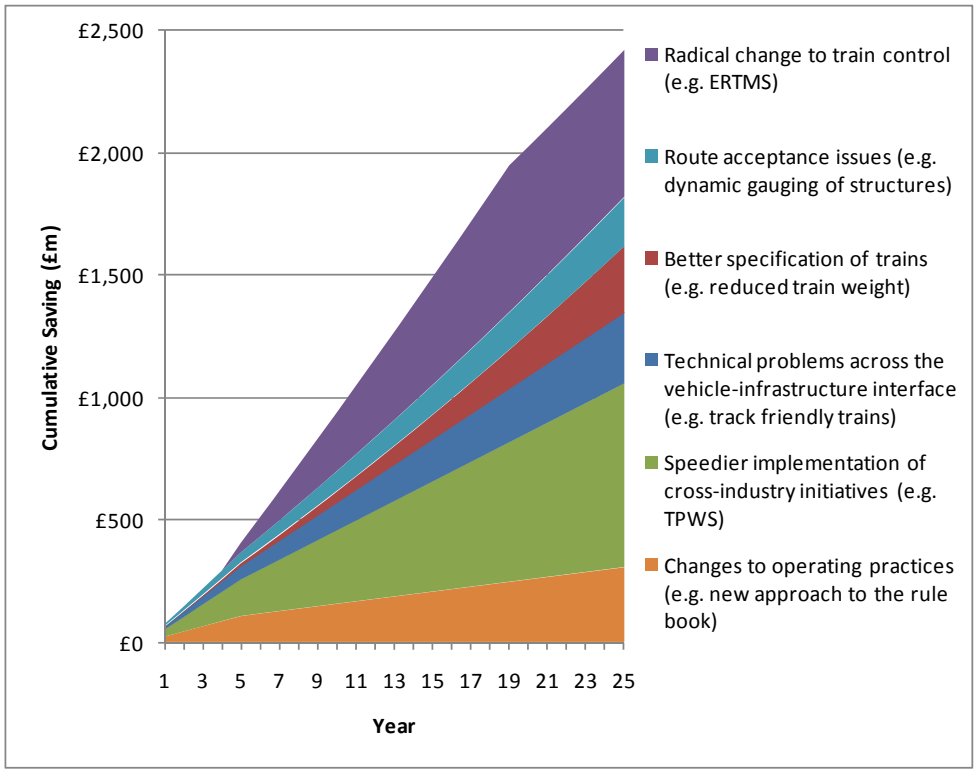

Figure 15: Cumulative savings from 'known' SA benefits

Where will the benefits fall?

6.37 To assess where the benefits from the Systems Authority are likely to fall, we analysed the Case Studies in more detail. Since some case studies were much larger than others, we began by converting the benefits into average annual savings over 25 years, based on the size and duration of the savings. Where the savings had been expressed as a range, we simply took the average. We then apportioned the benefits according to the information provided and, where this was not available, we used our own judgement. The results are shown in Table 4. It is important to note that this table is based on the six case studies whereas Table 3 and Figure 15 are extrapolated from these figures so produce different annual totals.

Table 4: Distribution of Average Annual Savings from Case Studies

Type of Systems Problem	Infrastructure Maintainer	Train Operators	'The Project'
Track friendly trains	Commercially sensitive		
Reduction in train weight		£11m	
TPWS	£26m	£4m	
ERTMS	£20m	£20m	
Dynamic gauging of structures	£4m		
New approach to the rule book	£15m*	£6m*	£0.5m
Totals	£65m	£41m	£0.5m
Distribution	**61%**	**38.5%**	**0.5%**

* Estimated split between NR and TOCs

6.38 The table shows that, for these particular projects, the bulk of the benefits are shared between the Infrastructure Maintainer (61%) and the TOCs (38%). In the case of track friendly trains and the rule book project, part of the savings would be a reduction in project costs and would fall to whoever was funding the work (NR and RSSB in these examples).

Key areas of uncertainty

6.39 This analysis is based on actual systems problems and a realistic assessment of the benefits that a Systems Authority could make. However, a number of significant assumptions have had to be made regarding:

- The ability of the Systems Authority to deal with systems problems more effectively than the industry has in the past and, to a lesser extent, is doing now.
- The frequency with which such system problems occur and appropriate solutions are found.

6.40 By projecting forward the benefits we expect the SA to deliver, we have assumed that there will be a steady flow of such problems for the foreseeable future. This might over-state the long term benefits, however, since the industry has a significant backlog of systems issues resulting from:

- A long period of under-investment in BR leading up to privatisation, which resulted in a lot of short-term thinking and sub-optimal solutions
- The privatised railway operating in a fragmented way for 15 years without a System Mind charged with developing a clear strategy or the ability to make the industry cooperate
- A series of 'shocks' caused by the break up of the Strategic Rail Authority and Railtrack, infrastructure maintenance being brought back in-house by Network Rail, and moving Her Majesty's Railway Inspectorate into the ORR.

6.41 It could be argued, therefore, that there are more opportunities for the Systems Authority now and that the law of ‘diminishing returns’ is likely to apply to its work. However, the experiences of other sectors suggest that an annual saving of £70m-£110m per year is actually a conservative figure and is likely to increase substantially from applying a systems approach on day-to-day decisions on projects.

7 CONCLUSIONS & RECOMMENDATIONS

Is there a need for a Systems Authority?

7.1 The industry's standards and approvals processes are often identified as barriers to change and sources of additional cost, but we found that these are symptomatic of more fundamental problems in how the industry makes decisions and deals with systems issues. We conclude that changing standards and approvals processes in the absence of other, more fundamental, changes will make little difference.

7.2 Looking at specific problems we found that, where there is broad agreement within the industry on how to address a systems issue (or the solution was imposed as a mandatory change) the industry is able to resolve systems problems reasonably effectively. However, we found many examples where systems solutions had been delayed due to people referring decisions, instead of making them, or not having the power to make decisions that would result in some organisations being disadvantaged by a change. Such problems arise from the fragmented industry structure and commercial pressure that encourage an adversarial, rather than cooperative, approach to problems. We found evidence that the industry is changing, moving towards greater cooperation, but commercial interests continue to hinder progress.

7.3 There is considerable support in the GB rail industry and amongst its stakeholders for changing the way in which systems issues are dealt with, and the need to implement European directives on safety and interoperability has made the need to act even more compelling. However, there is considerable debate over how best to address the problem. Solutions range from changes needed to implement the Interoperability Directive but with no power to resolve more intractable systems problems, to the creation of a new body with a clear remit for addressing system issues. Some believe that significant improvements could be delivered using existing powers and structures and a consensus-based approach, but others believe that such a body must have the ability to impose decisions if agreement cannot be reached.

7.4 Having considered the arguments and examined a number of project examples we conclude that there are significant opportunities to improve RVfM but much of this will remain untapped unless the Systems Authority has the powers it needs to ensure that, for example:

- Organisations respond quickly to questions and requests for information
- Organisations are required to cooperate with trials
- Where organisations are disadvantaged by a change, the compensation paid reflects the cost and risk to them rather than the amount they are able to negotiate from parties wanting to implement the change (which simply adds costs to projects and makes change less attractive).

7.5 Furthermore, for the SA to be effective it needs to operate within a clear and agreed industry strategy. This needs to encompass systems issues that go beyond the remit of the SA, as currently conceived. There is, therefore, a need for a 'System Mind' that takes a national view of the railway system and is responsible for developing industry strategies that help deliver government policy within the available level of funding. The functions of a Systems Authority need to be part of, or closely aligned with, the System Mind.

Systems Authority's Activities

7.6 Section 3 sets out, in detail, the activities that need to be performed by the Systems Authority. These include most of the activities currently performed by RSSB and a number of new activities:

- Taking responsibility for any of NR's company standards that relate to key interfaces and including them in a hierarchy of National Interface Standards.
- Leading product and systems approvals, including acting as the Designated Body (DeBo)

for GB rail.

- As part of this role, maintaining the National Vehicle Register and Infrastructure Register by linking to databases held by all of the Infrastructure Managers and owners of rolling stock.
- Establishing an electronic Systems Archive containing key drawings, specifications, standards and research studies.
- Collating financial information supplied by Network Rail and the TOCs, and using this to develop economic models used to evaluate systems options and calculate compensation to organisations whose interests are harmed by a systems solution.
- Advising on franchise specifications and contract incentives to maximise opportunities to improve system performance (and value for money) at minimal cost.
- Developing and costing strategic industry plans, in support of the System Mind.

Enabling the Systems Authority

7.7 We conclude that, for the SA to drive through important changes and improve RVfM, it will need to be enabled to do so by giving it appropriate powers. When granting such powers we make a number of recommendations:

- **The source of the SA's authority** – To avoid the need for primary legislation, we recommend that the SA's powers would come from the ORR which would create a new licence condition on rail operators to cooperate with the Systems Authority and comply with its decisions.
- **Its scope, remit and objectives** – The SA's remit would enable it to improve RVfM by optimising the performance of the whole railway system (both now and in the future); the railway system would include all main line railways including Crossrail and high speed routes. The SA's objectives would be set out in a 5 year Strategic Plan produced by the SA in consultation with the industry, with an annual 'supplement' setting out short term priorities.
- **Governance and funding arrangements** – The SA should be funded by a direct grant from the DfT and be accountable to a Board which includes Non Executive Directors who, between them, have an in-depth understanding of railway engineering and operations, and of dealing with systems issues in other sectors. To avoid conflicts of interest, the NEDs would be appointed from outside the GB rail industry. The Board would monitor the SA's performance against delivery of the Strategic Plan and against KPIs for key industry processes, as well as independent evaluations of major initiatives. Appeals against the SA's decisions would be heard by the ORR, with strict controls to ensure that the process was not allowed to delay important changes unduly. We recommend that the SA is a Company Limited by Guarantee (like NR and RSSB) and that it arranges to be covered by NR's existing third party liability insurance.

Location in the industry

7.8 There are strong arguments in favour of placing the SA within Network Rail, with other systems-wide functions, since the company already plays an important system integration role and has the resources needed to support major initiatives. However, changes to the way in which NR is structured that are being considered by the RVfM Team means that this may be less attractive and, in any case, some parts of the industry are distrustful of NR believing that it already has too much power and that the organisation's culture would limit what the SA could achieve. Alternatively, the SA could be a new, independent organisation – similar to RSSB but with additional powers, new responsibilities and different funding and governance arrangements. In either case, we have assumed that the Systems Authority would be an entity in its own right but it could be part of a larger body which included the System Mind and other systems functions.

Creating the Organisation

Organisation size

7.9 We estimate that just over 400 staff are currently employed by RSSB, NR, DfT and ORR on activities that we recommend are taken on by the Systems Authority. By merging these activities and co-locating staff, significant efficiency savings should be possible. This is due to reduced 'man marking' and 'interface bureaucracy' between organisations, and the benefits of simply co-locating staff and sharing resources. Assuming a 25% reduction in people employed in professional or technical roles and their support staff, we calculate that the SA would need to employ 312 staff, meaning that 91 fewer staff would need to be employed in the industry performing these activities.

7.10 The organisation size assumes that much of the work in these areas will be performed in-house but several senior stakeholders have expressed the view that the organisation should be very 'lean' making extensive use of contractors to deliver specific activities. We agree and would recommend employing contractors, on a fixed price basis, to deliver defined packages of work but retaining a strong core of permanent staff employed as project managers and in specialist roles. This model will enable the SA to be 'fleet of foot' so that the pace of change is not constrained by the availability of in-house resources and will enable, by competitively tendering work, to ensure that work is good vfm.

Getting the right people

7.11 Much of the SA's authority will come from the competence and independence of its staff. The SA will need to employ people with a broad range of skills including engineers, operators, economists, statisticians, risk analysts, mathematical modellers and project managers. Most importantly, it will need to employ staff who approach problems creatively and have the leadership qualities needed to drive through change.

7.12 To ensure that the SA is responsive and maintains the right balance of expert knowledge and creativity, we recommend that the SA should:

- Retain a body of staff to perform specialist functions
- Minimise its reliance on industry 'volunteers'
- Seek to attract high calibre staff from the industry on secondments
- Make use of contractors, through framework agreements or call-off contracts, for well defined 'projects'.

Office location

7.13 In order to recruit a competent workforce, the SA needs to be located where there is access to a large pool of people with the necessary range of skills. Basing the SA in central London would involve minimal change and would assist in the retention of staff already based there, but may be more expensive in the long term (due to higher wages and office rents). Consideration should therefore be given to basing the SA outside London (possibly with a satellite office in London as a transition arrangement). The office should be located somewhere with good rail connections, a large pool of potential employees and close connections with key industry stakeholders.

Would the SA be Value for Money?

7.14 We have identified a number of case study examples which demonstrate how a systems approach would deliver substantial savings to the GB rail industry. Many of these will happen whether or not an SA is created, but experience suggests that these solutions will take longer to implement and are vulnerable to being 'held to ransom' by stakeholders whose interests could be harmed or who detect a commercial opportunity. Creation of an SA would minimise these risks and we calculate that the benefits attributable to the SA would amount to approximately £2.5bn over 25 years. These are net savings which take into account any

additional costs to the project. Creation of the SA would therefore reduce industry costs by approximately £100m per year and this could increase to between £250m and £500m per year if savings achieved in other sectors could be made on NR's enhancement programme.

7.15 We believe that these savings would be achieved by creating a body that would cost £10m per year **less** to operate than current arrangements. The main downside being that there would be a period of change while the new organisation is created and 'finds its feet'.

7.16 Some industry players believe that the risks associated with creating the SA are too great and that the benefits could be achieved using existing powers and structures, provided that a clear industry strategy was created. Others focus on the need to transpose the Interoperability Directive and believe that, by creating a body that deals with these issues, there will be no need for a Systems Authority. In our view, such arguments fail to address the fundamental problem that individual industry players have strong commercial reasons to act in their own interests, rather than for the common good, and they are unlikely to become more altruistic in the current economic climate.

7.17 We conclude that there is a compelling case for creating the Systems Authority, but this needs to be an energetic organisation that quickly demonstrates its worth in order to win over the sceptics.

APPENDIX 1: PROJECT EXAMPLES

During the course of our consultations with the GB rail industry we have identified a number of examples showing the benefits that have been achieved from taking a systems approach to problems and the difficulties that are sometimes encountered. We have classified the projects into:

- 'Successes' – examples where the industry has dealt with a systems issue effectively; these are not necessarily evidence that there is no need for a Systems Authority but they do demonstrate the tangible benefits that could be achieved if a systems approach was applied more consistently and effectively.
- 'Delays' – examples where a systems solution was achieved but much more slowly than should have been the case; the creation of a Systems Authority would be expected to speed up the delivery of such solutions.
- 'Failures' – examples where the industry has not succeeded in addressing a known systems issue (although the process may be ongoing); these are indicative of the 'prize' that could be achieved if an effective Systems Authority was created.
- 'Opportunities' – examples of recent innovations or programmes that would benefit from the creation of a Systems Authority.

It is important to note that we have been unable to research all of the examples provided and some may represent a biased view of the problems. The reason for including them in this report is to illustrate the range of systems issues people have identified to us. This provided us with a 'long list' from which we selected the case studies that we have investigated in detail, and which are presented in Appendix 2.

Successes

The three examples below show where the rail industry has taken a systems approach to resolving a particular issue. However, consideration should be given to whether there is a systematic process or incentive for this to happen. Each of these examples is a reaction to an external event, rather than 'business as usual' where VfM is being examined throughout the decision making process.

Containment

Description of systems problem

It has become clear that the fitting of toughened glass in train windows, whilst driven by safety, was in fact not the optimum approach and laminated glass actually saves more lives.

Whilst changing the policy for future builds was a simple matter, addressing the issue of replacing existing windows required a systems view.

In this instance RSSB acted as the Systems Authority and commissioned research to assess the difference in safety risk between a fleet fully fitted with laminated glass and one with a mix of glass where the toughened glass is replaced gradually over time.

The analysis demonstrated that a costly campaign replacement of glass would deliver a small reduction in safety risk and was not VfM.

Potential benefits of having a Systems Authority

This case study demonstrates the value of a competent body coordinating the research and analysis on behalf of the industry and thereby enabling the industry and its stakeholders to reach a consensus on a sensitive issue. In this case the evidence demonstrated that the additional cost of fitting laminated windows early was not justified by the safety benefit and the

industry was fully supportive of the solution. Had the analysis shown that the safety benefits did justify fitting the windows it is likely that RSSB would have found it much harder to reach an industry consensus and would have relied upon the safety regulator to enforce the change. In relatively straightforward safety issues such as this, the current arrangements should be sufficient to ensure that safety measures are implemented but the same is not true of other systems issues. Claims that such examples demonstrate there is no need for a SA should, therefore, be treated with great caution.

Train horns

Description of systems problem

Around the year 2000 complaints received from neighbours to the railway regarding noise generated by train horns started to increase. Information was shared between all elements of the rail industry so that problem areas and how these had changed over time could be identified. A review of existing rules also noted that train horns were required to be sounded in circumstances where they were potentially no longer needed, as the risk was now managed through other means, for example on entering and exiting tunnels.

The increase in complaints was attributed to a combination of new whistle boards at level crossings and louder horns on new rolling stock. Modelling was used to assess the balance between risk to track workers, users of footpath crossings and the discomfort and harm to lineside neighbours.

Potential benefits of having a Systems Authority

- In this instance RSSB acted as the Systems Authority and co-ordinated all the elements of the rail industry to arrive at a solution which was safe and represented VfM. The industry reached a consensus position that it would be appropriate to reduce the level of sound and the times at which horns are routinely sounded – with the support of the safety regulator.
- This is a good example of how the industry can work together to resolve systems issues when there are no commercial barriers to address and everyone benefits from the change. Having realised, in 2005, that an initial solution to the problem had not been effective a steering group was put together, research was undertaken in 2006 and the Rule Book and other industry standards were changed early in 2007.
- As such it provides a benchmark for what could be achieved in other, more problematic, areas by a Systems Authority if it had the skills and powers to quickly resolve commercial problems.

Train Protection and Warning System (TPWS)

Description of systems problem

The Railway Safety Regulations 1999 came into force on 30 January 2000. They required that train stops be fitted at a number of types of location. These included stop signals, the passing of which could cause a train to collide with another train. The regulations also required that associated ‘speed traps’ (i.e. over-speed sensors) be provided to prevent signals being approached at an excessive speed. Railtrack commenced the wide-scale installation of TPWS track side equipment, and train operators commenced modifications of train mounted systems, in the early part of 2000. Infrastructure fitment of TPWS was completed to an accelerated programme in December 2002.

As introduction of TPWS was a mandated requirement, the ROSCOs were contractually obliged to fit train mounted equipment at their cost. This provided the incentive to ensure a standard, inexpensive and fit for purpose design. ATOC co-ordinated the TOCs in releasing vehicles to permit the fitment of in-cab equipment and to train staff in its safe operation and maintenance.

Potential benefits of having a Systems Authority

Delivery of the TPWS programme was managed by Railtrack (Network Rail) and ATOC and is probably the best recent example of the rail industry 'pulling together' to quickly and effectively deliver an appropriate solution for a specified problem. It is unlikely that a Systems Authority would have made any significant improvement on the process as in this example all parties were appropriately incentivised to deliver the scheme.

The need to meet a legislative requirement within challenging timescales meant that deliverability was a key factor in the design development stage giving: a focus on standardisation rather than bespoke solutions; a clear objective to minimise the 'tailoring' of the standard design to fit each individual location throughout the UK through a consistent interpretation of standards; and where derogations from standards were required, they were considered in a pragmatic and constructive manner.

This example is presented in more detail in Appendix 2.

Delays

We were provided with examples where systems solutions have been delivered but there had been unnecessary delays because of the lack of a systems approach. A recurring theme in these examples is the inconsistent interpretation of standards and the approvals process which leads to delay and increased cost. A key point to note is that no consultees have identified the standards and approvals process themselves as being poor – it is the subjectivity of their interpretation that is perceived to be the problem.

Construction of maintenance depot

Description of systems problem

East Midlands Trains built a maintenance depot and wished to provide for future expansion, even though it would not benefit from this under the terms of its current franchise.

Achieving this objective proved to be extremely time-consuming and expensive, in part due to having to comply with Network Rail standards as the depot was to be added to the Regulated Asset Base (RAB).

Potential benefits of having a Systems Authority

- Network Rail did not interpret its company standards in a manner which was fit for the purpose used. For example, main line track standards were being applied in a depot environment. Within Network Rail, there was differing views as to how the standards should be applied. Network Rail was also unwilling to 'champion' the case for obtaining a derogation from standards once the need for one had been agreed in principal. This resulted in delays and additional consultancy costs to prepare the safety arguments for the derogation.
- The standards in question were fit for purpose but their interpretation by individuals did not consider the context in which they were being applied. Furthermore the process for obtaining a derogation to the standard was not understood and the wrong approach followed in the first instance.
- A Systems Authority would need to encourage appropriate interpretation of standards and provide quick and clear guidance as to the route by which derogations should be sought. The key is to be the enabler of such a flexible approach, whilst still leaving business decisions with those that are responsible for the business. The Systems Authority would not, in this example, 'approve' the design instead of Network Rail.

New Approach to the Rule Book

Description of systems problem

The New Approach has a solid business case and will contribute to reducing industry costs directly and by enabling other changes.

There has been criticism in some quarters that the introduction of the New Approach has not been sufficiently rapid, thus not allowing cost reductions as early as they might be.

Potential benefits of having a Systems Authority

- A Systems Authority might have identified the need to address problems with the rule book at an earlier stage, but this is speculation.
- The project is proceeding in accordance with its five year programme although certain tranches, involving TOC staff, have been moved later in the project. RSSB denies that the project could be accelerated due to the ability of frontline staff to assimilate the rule changes more quickly. However, the changes are planned to be introduced over four years and there may be scope to progress some of the changes (e.g. ones relating to different groups of staff) in parallel.

This example is presented in more detail in Appendix 2.

Track friendly trains

Description of systems problem

The Class 450s operated by South West Trains (SWT) have stiff yaw suspension and create increased rolling contact fatigue (RCF). Network Rail complained but had no mechanism to charge SWT more for track access, so SWT had no incentive to deal with the problem.

The Hall bush solves the problem by being stiff at high speeds and soft at low speeds but SWT had no incentive to fit them. A deal was almost agreed but got stuck when SWT wanted assurances that any reductions in track access charges it agreed would apply for all time.

Network Rail is currently paying Siemens to fit the bushes on a trial basis but the problem has been running for years.

Potential benefits of having a Systems Authority

The technical solution came about as a result of research and modelling work commissioned by the VTSIC. This demonstrates the value of a Systems Authority helping to identify a good systems solution and the problem that then occurs if no-one has the ability to overcome barriers to implementing the solution. Creating a Systems Authority with the ability to broker deals and push change through would have resulted in this solution being implemented much earlier, resulting in reduced track and train maintenance costs.

This example is presented in more detail in Appendix 2.

Re-signalling schemes

Description of systems problem

Railtrack (and then Network Rail) tried to encourage new suppliers with tried and tested products to enter the GB signalling market. Unit costs would be reduced through the increased competition and innovation presented.

As part of the WCML route modernisation, Ansaldo were contracted to introduce a new Computer Based Interlocking (CBI) system on the Sandbach to Wilmslow route. At a similar time, Siemens were contracted to install their CBI system as part of the Dorset Coast re-signalling.

Both systems are now operational and working as required. However, both experienced large cost overruns and significant delay as a result of the approvals process.

Potential benefits of having a Systems Authority

- Arguably, Railtrack took a systems view when awarding the contracts but gave insufficient thought to (a) how approvals would be managed and (b) the views of the end users – the asset heads and maintainers. This resulted in a large number of people being empowered to say 'no' and have the schemes delayed until their requirements were incorporated. Scope creep was a significant factor on both projects.
- At one level this is an example of inefficient procurement from Railtrack / Network Rail. However the consultees felt that a Systems Authority could have provided a more consistent interpretation of standards (in an arbitration role in this case) and also encouraged a longer term VfM view, including consideration of operating and maintenance issues during the development phase rather than the implementation phase of the project.

Product acceptance

Description of systems problem

We heard of many examples where the introduction of new products and equipment was delayed significantly due to the approvals process. Examples included the use of standard tactile paving on platforms, stoneblowers, the 'slinger train' and 'mole'. NR accepted that the process had been difficult in the past but explained that it had recently made significant changes to address the problems. This included cutting out approval requests for products that it has no intention of buying and delegating authority so that low risk things can be accepted with minimal effort. These changes have resulted, according to figures provided by NR, in a reduced cycle time of 172 days (instead of 190 days in the previous year) and 227 applications in progress (down from 350 in the previous year).

Potential benefits of having a Systems Authority

These examples demonstrate the important part that product acceptance plays in the introduction of innovative approaches. NR believes that it has addressed the problems suffered on earlier projects to ensure that innovative solutions are implemented as quickly as possible. Time will tell how successful the changes are in addressing the problems and suppliers' perceptions of the process (and hence their willingness to embark on the process).

A Systems Authority would play an important role in ensuring that the industry's product acceptance processes are transparent, fit for purpose and ensure a consistent interpretation of standards. The creation of a Systems Authority is likely to give suppliers greater confidence in the process and encourage suppliers to be more ambitious in the products they offer to the industry.

Regenerative braking

Description of systems problem

Modern AC and DC rolling stock can regenerate electricity when braking. On AC lines, this can be exported beyond the rail network and in DC lines, whilst captive to the railway, the energy can be used to power trains in the same electrical section.

This clearly reduces energy cost for TOCs and also reduces the use of friction brakes with resulting labour and material savings on the change of pads and discs.

Following the Southern Power Supply Upgrade works modern EMU's replaced Mk1 slam door stock but Network Rail would not allow them to use regenerative braking due to concerns about fault currents being masked from protection switchgear.

It took a further two years for Network Rail to permit DC rolling stock to operate with regenerative braking engaged.

Potential benefits of having a Systems Authority

The TOCs (and through them the DfT) were the only parties incentivised to rapidly introduce regenerative braking. Network Rail wasn't despite the huge infrastructure investment to accommodate the modern rolling stock.

A Systems Authority would have the incentive to encourage joined up thinking such as was required here – note in this example the Systems Authority influence would have impacted the project considerably earlier as the TOCs had procured the modern EMUs without the need to consider their power requirements in the specifications. A Systems Authority would have provided the integrated long term vision which should have been incorporated in the TOC and Network Rail remits.

ERTMS

Description of systems problem

Introduction of ERTMS is mandated by the Control Command & Signalling TSI, and the DfT notified the European Commission of the GB National Implementation Plan in September 2007. The target dates in the plan are now binding on the UK. The UK plan focuses on implementation of the Global System for Mobile communications - Railway (GSM-R) and European Train Control System in support of the introduction of ERTMS Level 2 without lineside signals. The plan aligns with expected re-signalling dates and rolling stock replacement dates wherever possible to produce the most cost-effective outcome.

The ERTMS pilot was conceived by the SRA in 2005 with the aim of being operational by end of 2008 at a cost of ~£60m. Network Rail took over leadership of the project in 2006. The first operational trials were undertaken for a short period in early 2010 over part of the route. Issues with in-cab equipment have prevented a full service from operation.

The reasons for the delay and the forecast cost increase are still being compiled; RGS are felt to be sufficiently flexible to incorporate ERTMS without need for update.

Potential benefits of having a Systems Authority

The GB National Implementation Plan was based on a systems view and seeks to utilise planned infrastructure and rolling stock upgrades to facilitate introduction of ERTMS. The use of a pilot scheme to learn lessons before full roll out commences also fits with a systems approach. However the parties involved in delivery of the pilot project do not have the necessary incentives to ensure its success as the benefits are beyond the planning horizons for Network Rail and the TOC. A Systems Authority would have a key role to play in ensuring timely delivery of the pilot scheme which is an important enabler to a programme which will deliverer long term VfM, safety and performance benefits for GB rail.

A fuller investigation of the ERTMS example is presented in Appendix 2.

Supplier Accreditation Scheme

Description of systems problems

The supply chains within the rail industry are complex, and suppliers are subject to seven separate industry-wide assurance and accreditation schemes. Customers also impose external audits onto suppliers to provide themselves with assurance that appropriate systems are being followed, while suppliers must maintain in-house assurance systems for their own purposes. Suppliers are thus subject to a large number of internal and external interventions, often asking for the same information, at an enormous cost in terms of staff time. There are overlaps and inefficiencies across these schemes, and this causes frustration to suppliers who must comply with them all, as well as providing poor VfM.

Potential benefits of having a Systems Authority

Some of the barriers to change have been identified as:

- Risk aversion within the industry, with no incentive to ensure that such schemes have a 'light touch'
- Lack of a commonly agreed risk framework, and failure to agree common assurance and accreditation processes which can be used across the industry
- Dependence on consultation and consensus to achieve change, with little common understanding or alignment of objectives among stakeholders preventing this from being achieved.

RSSB has been leading efforts to improve the situation and has established the Supplier Assurance Framework Project (www.rssb-safp.com) with the aim of designing a single set of integrated supplier assurance arrangements which are effective, efficient and easy to understand. A study performed for the project estimated the potential benefits to the industry at around £35m, primarily from reduced staff effort within the supply chain, releasing time to focus on improving quality and innovation.

Failures

In these examples the rail industry has fundamentally got it wrong with no systems approach leading to significant waste. Interestingly in a number of examples, something tangible will have been delivered at the end of the process, however it either does not deliver the functionality originally identified or is no longer required.

Train weights

Description of systems problem

Since privatisation, new trains have become much heavier even on a like-for-like functional specification.

This would appear to be an example where there are no reasons for anyone to avoid weight increase because of the lack of applicable incentives (e.g. through track access charges).

Potential benefits of having a Systems Authority

- Ideally a Systems Authority would play a role in ensuring that incentives exist within the industry to procure lighter trains, which would improve train performance and reduce energy costs.
- A Systems Authority could bring a 'System Mind' to the issue and might encourage some standardisation of equipment. (Note that the work of the AAR in this regard is worthy of study.)
- Where DfT or Transport Scotland have been actively involved in procurement, contracts have included incentives to reduce weight – could this role be systematised by a Systems Authority?

This example is presented in more detail in Appendix 2.

Track brakes

Description of systems problem

Track brakes exist on UK tram systems and also on many European mainline railways but they are not permitted in Britain by Network Rail because of concerns about causing track damage.

The absence of track brakes can be argued to lead to the over-specification of pneumatic brakes and to the adoption of defensive driving techniques that are sub-optimal for capacity utilisation and performance.

Potential benefits of having a Systems Authority

This is an interesting case study because attempts have been made to have the ban on track brakes re-visited but without success, despite them being a TSI-compliant and 'off the shelf' solution. This appears to be a case where a Systems Authority needs to intervene to determine whether they can be safely fitted and assess whether Network Rail should be compensated for the risk of track damage.

GSM-R

Description of systems problem

As a case study, there are interesting parallels between the roll out of GSM-R and that of TPWS – both are standard programmes affecting GB wide rail infrastructure and all rolling stock. However the key difference is that TPWS was mandated whereas GSM-R is not. This has a significant implication as ROSCOs and TOCs have no contractual incentive to ensure that GSM-R is fitted. Indeed the Network Change process, through which the programme is being delivered, gives these parties the power to reject Network Rail proposals unless their requirements (including compensation) are met. Unlike the TPWS example, Network Rail is not dealing with a unified and incentivised body with a single interface (ATOC) but instead each TOC individually. In this instance the incentive for each TOC will be different depending upon their remaining franchise term and commercial performance to date.

There is evidence that some organisations are charging much more to fit the in-cab equipment than other organisations allegedly because the TOCs/ROSCOs have no choice.

The programme has been significantly delayed, is over budget and has resulted in a bespoke GB solution that is different from that fitted elsewhere in Europe (with obvious cost and interoperability implications).

Potential benefits of having a Systems Authority

- This study is a good example of Network Rail struggling to implement an important and high profile systems solution due to badly aligned incentives in the industry and Network Rail's failure to recognise and address these at an early stage.
- A Systems Authority would almost certainly have a key role in this type of project as it provides significant long term safety and performance benefits for all elements of the rail industry.

The industry's experience of GSM-R is included in the ERTMS case study in Appendix 2.

WSP enhancement

Description of systems problem

This concerns an attempt to introduce an improved Wheel Slide Protection (WSP) system involving a software enhancement to existing train mounted equipment.

This software allows brakes along a train to be applied with greater severity as the rail has been 'conditioned' by the leading coaches. This would also capture adhesion data that could be provided to following trains, thereby allowing trains to make maximum use of the available adhesion. In the longer term this sort of technology could help facilitate Automatic Train Operation.

The technology is expected to reduce track and train maintenance costs (due to reduced numbers of wheel burns/flat and associated damage to track and train), and could reduce the risk of collisions marginally. However, RGS do not allow variable braking rates along trains and the system developer has found it hard to get someone to champion the idea and organise trials. VTSIC was interested in taking it forward but the Adhesion Working Group has now taken responsibility for it.

Potential benefits of having a Systems Authority

A Systems Authority would have quickly recognised the VfM opportunity presented by the technology and have convened a group to assess the risks and benefits, before proceeding with trials. The systems bodies currently looking at the idea are starting to see the short term benefits but may implement it in such a way that it does not seize the long term opportunities or integrate well with other strategies such as data communication.

Croydon turnback facility

Description of systems problem

As part of the East London Line (ELL) scheme, two stations were required to provide turnback facilities on the south London network. Three sites were developed in order to ensure that the facility would be delivered in the project timescales. Two sites have been delivered and the new rail timetable is working properly. However, at South Croydon (the 'contingency' site), designers were faced with the issue of integrating the new operation into a mechanical signalling interlocking. Issues with design approvals mean this project is now around 2 years late.

The turnback is no longer required as the other sites are fulfilling the ELL timetable requirements. However it is still being progressed because of 'value' it provides to other TOCs.

Potential benefits of having a Systems Authority

Staff turnover in Network Rail has resulted in a variety of interpretations of the design compliance with standards, generating significant rework. A Systems Authority would provide a more consistent oversight for such matters.

At Crystal Palace, one of the other turnback sites delivered, the turnback was introduced into a 1980s signalling interlocking which is prevalent throughout the UK but not strictly compliant with modern standards. The designers considered requesting if the design could be undertaken to the original standards in order to provide a consistent layout but decided this would be too much trouble with little chance of success. The resulting design as installed is approximately 60:40 split between compliance with modern and the 1980s standards. It is no safer in terms of train operation and the mix of standards makes it more complicated to renew or recover in future.

A Systems Authority could have provided a valuable sounding board for these ideas and provided support in progressing them. However the key value a Systems Authority could bring in this example is in asking why this project is still being delivered if it is no longer required by its funder. There are clearly benefits to other TOCs but these are not being captured through, for example, a subsidy reduction to TfL/DfT. It is also not clear whether the value to other TOCs is commensurate with the cost of the facility (and represents good value for money). In the present arrangement, no party is incentivised to investigate these and intervene before it becomes impracticable to escape from contractual commitments.

DC train operation in freezing conditions

Description of systems problem

EMUs drawing current from iced third rails can potentially generate currents which interfere with signalling equipment. Modern rolling stock is fitted with interference current monitoring units (ICMU) to prevent current being drawn above a threshold level – if tripped, this initially prevents the driver from taking power and after repeated trips shuts the train control systems down. Due the level at which the ICMU is set, a high level of train failure is being experienced during severe freezing conditions.

At present Network Rail determines the setting of these devices. The TOC claims that Network Rail is incentivised to specify a low threshold in order to reduce both the risk of damage to its equipment and the potential safety risk of a wrong side signalling failure. The TOC also

believes that much higher levels of current than the threshold level are generated by fleets which pre-date installation of ICMUs with no evidence of accidents or equipment damage resulting.

Potential benefits of having a Systems Authority

A Systems Authority would not intervene and increase the ICMU threshold level. However it would seek evidence from Network Rail to assess the safety risk and likelihood of equipment damage, and from the TOC on the benefits of changing the level[45]. The Systems Authority could also commission tests to compare the impact of new and older rolling stock. In short, the Systems Authority would act to quickly identify whether the current threshold is overly conservative and, if so, facilitate a solution that improved the performance of the railway system.

Crossrail and Thameslink trains

Description of systems problem

Crossrail trains are being designed to the same platform height as the Heathrow Express trains (1100mm) which is different from the rest of the rail network (983mm). The reason is to allow step-free access to the train but it does introduce another interoperability problem for a railway already bedevilled with such problems. Furthermore, the Thameslink trains, which will run on large sections of the current rail network, are being designed for a standard platform height.

Apart from interoperability problems, the decision to have different platform heights means that the Crossrail trains order will need to be for a new train rather than an extension to the Thameslink order. This means that the two orders will be more expensive and both trains will, of course, need to go through the rolling stock approvals process.

Crossrail raises another even more challenging systems question, that of gauge. In a letter to the DfT in June 2010 it was suggested that the tunnel diameter should be sufficient to allow the operation of double-deck trains through the tunnel if required to meet demand in the future. The DfT's response in July stated that:

> *"…the Department has evaluated the opportunities for passing double deck trains through the tunnel as designed and has concluded that the continental "GB" gauge trains would physically fit in through the tunnels as designed, albeit with the need for alterations to the overhead power supply and platforms. The areas around the tunnel wall that could affect the introduction of double deck trains would also need to be kept clear of significant cables and signals so as to facilitate future conversion. This "GB" gauge is similar to the profile of the double deck trains used on the RER in Paris. The platforms and overhead power supplies will need to be designed for the normal main line trains initially and then if capacity becomes an issue in the future, there would need to be a project for remaining conversion works to accept higher capacity trains. Accordingly you can see that we have taken a pragmatic approach to ensuring that the tunnel is future proofed for the potential introduction of double deck trains without unduly adding cost or complication at this stage.*
>
> *"Alongside this, the Department for Transport and Transport for London periodically update the Crossrail business case. This includes modelling of expected passenger demand to ensure Crossrail will meet potential increases in demand on the London Transport network. We expect that Crossrail will not reach capacity for some 30 years since we are building a railway for the future."*

[N.B. DfT based its decision that the tunnels could accommodate GB gauge trains on analysis performed using the used the PhX Dynamic software described in a later example.]

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[45] Anecdotally the benefits are improved performance and fewer trains being cancelled at a time when mobility is critical to the economy.

Others expressed concerns to us that special wagons (ballast, rail etc.) will need to be built if they need to run through the tunnel.

Potential benefits of having a Systems Authority

These systems questions need to be addressed as part of an industry strategy. As such, they may fall within the purview of the System Mind rather than the Systems Authority which would be charged with resolving systems issues generated by such decisions. However, a Systems Authority would examine bespoke solutions to meet project specific requirements very carefully to ensure that they do not reduce value for money overall or could impact on interoperability of rolling stock in the future.

Acoustic monitoring of bearings

Description of systems problem

ATOC has promoted acoustic monitoring of bearings (as used in Australia, India and US) instead of Hot Axle Box Detectors (HABD). They provide earlier warning so far fewer are needed (20-30 nationally instead of 200 HABDs) and enable TOCs to monitor problems and plan repairs which minimises disruption to services. ATOC produced a compelling business case although it recognised there are challenges locating devices (they need to be on straight track where vehicles are not braking and travelling at an appropriate speed). In addition, vehicles not following regular routes (particularly freight) are more difficult to ensure they are inspected sufficiently frequently.

NR has resisted fitting the equipment, arguing that there is a risk that an axle box failure could occur between inspections – so there is a safety and performance risk. However there is a suspicion that another reason may be that NR recently replaced all the HABDs and it would be embarrassing to remove them all now.

Potential benefits of having a Systems Authority

The acoustic system was identified after the HABD replacement programme had started but the HABDs were replaced in three batches and the last two batches should have been stopped while the new system was trialled. If successful, this would have resulted in a much better system being introduced at reduced cost.

VVSIC is currently looking at the business case and says that it is not as strong as ATOC first thought. ATOC takes the view that, had a Systems Authority taken the initiative, the acoustic system could have been introduced by now (at least two years earlier than is now possible).

Opportunities

Network Operating Strategy (NOS)

Description of systems problem

The Network Operating Strategy (NOS) is an initiative by Network Rail to answer the question:

"How can we operate and control the rail network differently to give greater business benefit?"

Currently signalling management is dispersed, uses a range of different systems and varies hugely in the efficiency with which it is controlled. It is not usually co-located with TOC related traffic and train management. Network Rail has developed a series of options in its NOS:

- Centralisation of all signal and traffic management into a small number of centres, co-locating signalling and relevant TOC teams.
- A full traffic management system with universal automatic route setting
- Bringing all rural routes into central control.

To date the business case has been developed purely on the capex and opex benefits to

Network Rail. NR is now working with the rest of the industry to examine the wider benefits (without basing the business case on them) which could include delay reduction (up to 50%), new peak paths, operating savings and reduced energy use. It might also mean better use of crew/rolling stock, integrated operating decisions and even the 'seven day railway'.

Potential benefits of having a Systems Authority

The current business case is entirely internal to Network Rail, because Network Rail does not have the data or the expertise to quantify the benefits to TOCs (who are reluctant to share commercially sensitive data). The team in Network Rail wants to progress the plan with the minimum of delay, so whilst they are consulting more widely across the industry, they are not basing the business case on wider benefits at this stage.

The benefits of a Systems Authority to the initiative, and to overall RVfM would include:

- Developing the business case on the full benefits to the industry
- Optimising the planned NOS scope based on full industry VfM information
- Where appropriate, changing other industry investment decisions related to the NOS scope
- Less piecemeal consultation on whether to re-control individual signals to the centres

If ERTMS implementation was accelerated by the Systems Authority, this would result in additional savings under the NOS project by making faster progress possible.

Dynamic Gauging of Structures

Description of systems problem

Route electrification requires sufficient headroom through structures (bridges and tunnels) to provide a safe path for 25kV cabling, support structures and for the passage of trains equipped with current collecting pantographs. Traditionally, the availability of this space is assessed using a structure gauge, whose dimensions relate to the size and height of a working pantograph, adjusted for maximum train sway, wind, track positional tolerances and a suitable electrical clearance.

The allowances for vehicle sway and wind relate to historic measurements of maximum values. In practice, such values are related to local factors such as train type and speed, track curvature and wind exposure. Further tolerances and allowances are added to accommodate factors such as track movement. These values have been applied cumulatively – a notional worst case scenario – despite acknowledgment that statistically such stacking is very unlikely to occur.

A small business has addressed the above issues by developing a software system (PhX Dynamic) that applies a risk-based approach. However implementing such an approach depends on:

- Co-operation across Network Rail, TOC and ROSCO interfaces
- The sharing of information that may be considered commercially sensitive
- The ability of the industry to embrace a risk-based approach.

Potential benefits of having a Systems Authority

The rail industry is very conservative, and constrained by commercial interests. New analytical methods, such as PhX Dynamic, can achieve cost savings by better understanding risk rather than simply layering conservative assumptions to ensure safety. Some of the information required to achieve greater harmony between train and infrastructure is considered proprietary by some train manufacturers. Whilst the SICs can achieve some impact by identifying system opportunities, they cannot do more than challenge Network Rail's conservative approach or express concern that useful information is being withheld – a Systems Authority would have the power to take an industry-wide VfM decision, and should have access to all relevant

information. It would also be able to champion innovative approaches to decision making. More detail on this example is presented in Appendix 2.

APPENDIX 2: CASE STUDIES

This appendix uses a series of case studies to illustrate the scale of cost savings and other benefits that could be realised by creating a Systems Authority with appropriate powers. The case studies are:

- Track friendly trains
- Reduction in train weight
- Train Protection and Warning System
- ERTMS (drawing on the experiences with GSM-R)
- Dynamic gauging of structures
- New Approach to the Rule Book

Each case study draws upon published information, complemented by information provided to the study team by Network Rail and RSSB, to estimate the project benefits and the impact that creation of a SA would make (or could have made).

The resulting figures have been used, in Section 6 to estimate the annual cost savings to the GB rail industry from the creation of a SA, and where these savings are expected to fall.

Case Study 1: Track Friendly Trains

Project Overview

Siemens Desiro multiple units, including the Class 450s and Class 444s operated by South West Trains (SWT), in addition to being very heavy, have stiff yaw suspension and create increased rolling contact fatigue (RCF). This leads to increased inspection and maintenance costs, including rail grinding and the replacement of rails using premium steels. Mitigation has also included work to improve alignments and to reduce cant deficiency (the 'camber') on curves.

In principle, the higher track maintenance costs are recoverable through higher Variable Track Access Charges (VTAC), which are relatively high for these units. However, Network Rail has long expressed discontent that they are not high enough to properly reflect this issue.

A train-based technical solution was identified – the HALL primary yaw stiffness bush[46]. This is stiff at high frequencies to provide stability but offers soft curving behaviour. Initially SWT had no incentive to fit them; a deal based upon reduced VTAC charges was almost agreed but got stuck when SWT wanted assurances that any reductions to these charges would apply in perpetuity (the future transition from CP4 to CP5 being a cause of uncertainty). In order to overcome this hurdle, Network Rail wrote to SWT giving comfort that the TOC will not suffer financially in the transition to CP5. ORR has also given assurance that the issue will be taken into account when VTAC rates are calculated for CP5.

Network Rail provided initial project funding and contracted with Siemens to fit the bushes on a trial basis. SWT and the ROSCO (Angel Trains) have now taken a leading role in the project. The role of Siemens is also pivotal as it assumes the majority of technical and implementation risk under its current contracts with TOCs, as well as owning and managing the majority of depots.

For the Class 450 fleet, advantage will be taken of an overhaul window between mid 2011 and mid 2013 to fit the bushes. For the Class 444 fleet this has not been possible as a major overhaul is just ending. However, a 'gun' is being developed by Siemens that will permit bushes to be changed without a bogie drop and fitment is expected to start soon.

It is intended to use the VTAC mechanism to incentivise all TOCs to fit the HALL bushes on their Desiro fleets. The VTAC reduction will vary between vehicle types and will be calculated using tools developed by the VT SIC.

Whilst the Desiro multiple-units are considered to be particular culprits for causing this damage, problems are caused also by other fleets and train builders – indeed bogie yaw stiffness has been an increasing problem since the 1970s. Similar problems have been encountered by other fleets operating on the East and West Coast Main Lines, East Anglia and the Trans-Pennine routes.

Whilst not as damaging as Desiros, Electrostars are also very heavy and it would be desirable to fit the HALL bush to these fleets as well. Unfortunately the Electrostar bush is smaller and Freudenberg Schwab (the HALL bush manufacturer) is investigating the development of a suitable version.

Systems Issues

The technical solution came about as a result of research and modelling work commissioned by the VT SIC. Delivery of the solution required cross-industry cooperation, including SWT, Siemens, Freudenberg Schwab, Angel Trains, Network Rail, DfT and ORR. It was particularly beneficial to the project that Siemens owns and manages the majority of Desiro depots and

[46] HALL is proprietary name for a product developed by Freudenberg Schwab. It is possible that competition in the supply market could allow the entry of similar products from other suppliers. However at present the only product available is from Freudenberg Schwab.

thus has an active involvement in the maintenance of these trains.

Benefits of a Systems Authority

The VT SIC played a key role in identifying the technical solution but was not in a position to drive it through. Further benefits would be gained from having a Systems Authority that is empowered to move beyond the identification of a technical solution to getting the solution implemented. It is probable that a Systems Authority with the ability to broker deals and push change through would have achieved an earlier implementation of this solution, resulting in reduced track and train maintenance costs.

Whilst the fitment of HALL bushes to the Desiros is proving to be a relatively successful project, it might have moved more rapidly had the difficulties in taking a long term view on VTAC rates not proved to be an issue.

Investigation of this subject has revealed a potential project that at best must be classified as a 'serious delay'. The HALL bush is ideally suited to the Mark 4 coaching stock fleet used on the ECML. It was in fact designed for use on SBB coaching stock with very similar bogies.

Network Rail has made known to East Coast Trains its wish to initiate a programme of fitment of HALL bushes. To-date, progress has not been possible because the East Coast franchise is temporarily being managed by East Coast Trains on behalf of DfT, a situation that, we are advised, makes it difficult to commit to such a programme.

This situation is one where a Systems Authority might be able to drive through a programme on the basis of a whole-life view, ensuring that the necessary trade-offs, including through franchise agreements, were handled in the best interests of the system.

Quantification of Benefits

The VT SIC has been very effective at finding a novel and cost-effective solution to the problem but has not had the necessary power to get the modification implemented quickly. The HALL bush is a direct replacement for the existing bush on the Desiros, requiring no modifications, and could have been swapped during the 6-yearly major overhaul. Had a Systems Authority been championing the change it is likely that trials with the HALL bush would have started one year earlier and negotiations over VTAC charges would have been shortened by a similar amount.

If the timescales had been reduced by two years, the modification could have been included in the major overhaul of the Class 444s (which has just ended) which would have reduced the cost of fitment significantly. By swapping the bushes during the overhaul (which involves changing the bushes in any case) the only additional cost should have been the difference in the cost of the two bushes. Earlier fitment would also, of course, have allowed SWT and NR to start benefiting from reduced maintenance costs earlier.

Fitting the HALL bush to the remaining 800 Desiros currently on the GB rail network (or in the process of being delivered) and the 1,600 Electrostar EMUs would deliver further benefits. Based on figures provided by NR we estimate that, had it existed, a Systems Authority would, have delivered substantial savings but, for commercial reasons, we are unable to publish them.

Scalability

This case study is of interest in its own right but is meant to be merely illustrative of the systemic benefits that might be achieved through the introduction of a Systems Authority.

Other cases have been brought to our attention where it is believed that a Systems Authority might have brought about a more appropriate or earlier solution to a technical problem, avoiding unnecessary time spent in disputes. Examples include the calibration of Interference Current Monitoring Units for DC EMUs operating in icy conditions, the use of (emergency) track brakes and the activation of regenerative braking. In addition, we believe that there are likely to be potentially beneficial technical developments that have not materialised in the

absence of a Systems Authority.

There may be many such issues but putting a value on the benefits that might accrue from the Systems Authority's involvement is a matter of judgement because 'unknown unknowns' form a part of the equation.

We would argue that a Systems Authority would be faced by a similar technical issue fairly regularly[47] and if each scheme were to deliver comparable savings to the track friendly trains example, this would result in an annual saving of £12m from such projects.

[47] We have omitted the assumed frequency of such schemes to prevent back-calculating the benefits from track friendly trains.

Case Study 2: Reduction in Train Weight

Project Overview

Since privatisation, new trains have become much heavier which increases track damage and energy consumption. This case study explores the potential savings that an SA could achieve by reversing the trend of increasing train weight.

The last pre-privatisation DMU was the Class 166 which weighed 39.6 tonnes per powered vehicle. The Class 168, the first post-privatisation procurement, weighed 43.7 tonnes per powered vehicle. In parallel, the Class 17X series, successors of the pre-privatisation Class 158, also saw increases with the Class 171 weighing 46.5 tonnes per powered vehicle.

All of these classes reflect a very similar functional specification (vehicle length, speed, traffic type) and the cause of the weight increase is not immediately obvious. For example, the Class 166 and Class 158 already had air conditioning, so that is not the cause. In fact, weight appears to have increased for a number of non-functional reasons. For example, for the Class 170/171, Bombardier:

- Used a 'raft' which all the power train components were bolted onto before the whole unit was bolted to the train. It is understood that this structure, which weighs about one tonne[48], was simply left in place for ease of assembly.
- Bolted together the final assembly as a clean cold process (previously welding had been used); the additional bolts weigh about a tonne.
- Used modularised body sections, not dependent upon internal fittings for structural integrity, to permit more flexibility of internal layouts.
- Installed bigger engines to propel the extra weight.

It was suggested to us that the problem may lie in TOCs who are procuring rolling stock having little incentive to avoid weight 'bloat'. In principle, TOCs are exposed to the additional costs of higher weights through:

- Variable Track Access Charges (VTAC) levied by Network Rail that reflect the damage done to the track
- Electric Current For Traction (EC4T) consumption rates levied by Network Rail for electric trains
- Diesel fuel costs for diesel trains.

Examination of VTAC charges for the DMUs mentioned above shows that the rates (in 2009/10) have very little spread:

- Class 166, 6.44 pence per vehicle mile
- Class 168, 6.65 pence per vehicle mile
- Class 171, 6.74 pence per vehicle mile.

This suggests that the VTAC provides little incentive to control train weight but it should be noted that the extremely heavy Class 185 has a much higher VTAC charge of 12.53 pence per vehicle per mile.

For DMUs, TOCs are exposed directly to the costs of additional fuel consumption by heavier trains. However, the relationships between train weight and fuel consumption is complex due to factors such as route characteristics, installed power, maximum permissible train speed and aerodynamic drag.

Typical energy costs for diesel vehicles at 2009 prices are 47p per vehicle mile for diesel

[48] Additional mass, particularly of bogies, causes increased damage to track with consequent increased maintenance costs. The subject is treated in more detail in the 'Track Friendly Trains' case study.

vehicles and 26p for electric vehicles[49]. Assuming a VTAC of 6.5 pence per vehicle mile for a typical DMU, the annual cost in VTAC and fuel for a vehicle operating 150,000 miles per year would be £80k per vehicle which is broadly equivalent to the annual leasing charge. If vehicle weight could be reduced from 44 tonnes per vehicle to 40 tonnes per vehicle this might result in a 5%[50] reduction in energy consumption which would equate to approximately £3.5k per vehicle per year.

The issue of train weight was addressed in the procurement of 200 DMUs by the DfT for which a weight limit of 40 tonnes and a bonus for 38 tonnes were specified. In response, tenderers offered trains weighing between 39 and 39.5 tonnes. This was a relatively small order to short timescales, suggesting that an off the shelf / low cost approach would have been taken. It is quite possible that a bigger procurement with new engineering design could see a return to nearer 36 tonnes[51].

The issue of weight is also causing concern for EMUs and it is noteable that the Class 380 currently being delivered in Scotland (procured by Transport Scotland) is lighter than other Siemens Desiro EMUs – almost entirely due to the reduction in on-board cabling brought about by the use of 'fly by wire' technology. The delivered units were approximately 4 tonnes per vehicle lighter than the contracted maximum, incentivised by a performance bonus for the supplier. It is estimated that the TOC will save £200k per annum from reduced VTAC alone – savings from EC4T are not yet quantified but are estimated to be at least comparable with the £200k VTAC reduction..

Systems Issues

There will normally be a preference by TOCs and ROSCOs for 'off the shelf' products and manufacturers will generally be keen to supply these – the TOC will also be heavily influenced by available funding packages. Furthermore, for many recent procurements use has been made of options for run-on orders – in some cases an option held by TOC A has been used to procure rolling stock for TOC B. Therefore, in practice, a competitive procurement is not being undertaken.

It is suggested by some consultees that bidders for franchises are making competitive offers for fleet utilisation where the market acts to incentivise the procurement of trains with reduced running costs. An example might be where the successful bidder for the London Midland franchise proposed to replace Class 321 EMUs with newly-procured Class 350s. However, this move was accompanied by a change to Siemens' maintenance arrangements for these and existing Class 350s at a new depot at Northampton, enabling the existing Bletchley depot to be closed. It can reasonably be concluded that the issue of vehicle weight would have played little part in the decision-making process or of the attractiveness of the franchise bid.

For most franchise bids, bidders are competing to employ similar fleets in different service patterns and the most important consideration is likely to be the relative revenue generation capabilities of the offers.

Benefits of a Systems Authority

This analysis suggests that a public sector funder taking a wider system view is more likely to see the benefit of making weight savings than a TOC. Transport Scotland, in procuring the Class 380, was able to assess costs and benefits over a 16 year lease life rather than the 4

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49 Network Route Utilisation Study: Electrification, October 2009.

50 A 10% reduction in weight is calculated to deliver a reduction in fuel consumption of between 6.6% (Büttner and Heyn 1999) and 8.6% (Ehinger et al. 2000) for metros and suburban services, and 3.2% (Büttner and Heyn 1999) for intercity services.

51 The Class 172 DMU, the most recent in the 17X family is a lighter weight solution. We have heard conflicting explanations for why Bombardier decided to produce this lighter DMU. One factor was certainly the opportunity to replace the heavy bogies with the much lighter bogies used on its 22X fleet (both fleets by this time being within the same company portfolio).

years which the current ScotRail franchisee could commit too

We consider that a 'system mind' is necessary to ensure that the industry acts collectively to ensure that vehicle weights are kept under control. However, consideration must be given to the degree of intervention associated with this role. Potential roles for a Systems Authority might include:

- Helping to develop train specifications
- Issuing mandatory train design standards
- Advising on contract incentives in track access agreements.

Quantification of Benefits

An RSSB report[52] sought to quantify the effects of reducing vehicle weights for future procurements. This calculated an annual saving (per tonne per vehicle) of:

- £2,194 for Inter City vehicles
- £1,833 for Inter Urban vehicles
- £630 for Outer Suburban vehicles
- £568 for Inner Suburban vehicles
- £645 for Metro-style services.

The utilisation of suburban and metro-style vehicles is relatively low (due to lower average train speeds and the 'peakiness' of the service); this explains the relatively low savings associated with these vehicles.

In order to assess the benefits of reducing train weights, the DMU and EMU fleet[53] has been assigned to the five service types as follows (in many cases, particularly the last two categories, this is a notional attribution):

- 1,013 Inter City vehicles
- 1,127 Inter Urban vehicles
- 5,304 Outer Suburban vehicles
- 1,813 for Inner Suburban vehicles
- 1,813 for Metro-style services.

Applying the potential savings per vehicle listed above, the total annual saving per annum for a 3 tonne reduction per vehicle would be £29.5m. However, this would only be achieved when all of the current fleet has been replaced. If the fleet is replaced over 35 years then the first year saving would be £843k, with the saving incrementing by that amount each year. Over 35 years the total saving would be £516m, with an average annual saving of £15m.

Scalability

The issue of weight is but one of the problems that have reduced the efficiency of passenger rolling stock. To some extent the Super Express Train project has attempted to apply the type of long term system thinking that takes whole life requirements (including later cascades) into account in specifying rolling stock, though it can be argued that it also exposed the shortcomings of trying to do this in the face of changing background assumptions (e.g. electrification strategy). Were a Systems Authority able to lead not only the development of whole-life rolling stock strategies but also the strategies for other system components then a better outcome than that for the Super Express Train might reasonably be expected.

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52 "Research into trains with lower mass in Britain Quantification of benefit of train mass reduction", RSSB, August 2010.

53 HST and locomotive-hauled coaching stock has been excluded as this is expected to be replaced under the Super Express Train programme and will not require replacement within the timeframe under consideration.

Case Study 3: Train Protection & Warning System

Project Overview

The report of the official inquiry into the 1988 Clapham rail accident (conducted by Sir Anthony Hidden QC – hence 'the Hidden Report') included a recommendation to introduce an Automatic Train Protection (ATP) system within five years of the selection of an appropriate system. Two trial systems were introduced but neither was adopted for national implementation. A cost-effective alternative, the Train Protection and Warning System (TPWS), was designed by BR Research to intervene in the highest-risk situations. This was developed to a reasonable technology readiness level before being put into production use.

The 1990s were characterised by inertia caused by arguments about what signals should be protected. Finally the HSE decided that only legislation would bring a national scheme into being. The resultant Railway Safety Regulations 1999, came into force on 30 January 2000 to mandate installation. They required that train stops be fitted at a number of types of location including stop signals, the passing of which could cause a train to collide with another train, some permanent speed restrictions and all station buffer stops. It was also a requirement that associated 'over-speed sensors' be provided to prevent signals being approached at an excessive speed.

Railtrack commenced the wide-scale installation of TPWS track side equipment, and train operators commenced modifications of train mounted systems, in the early part of 2000. Infrastructure fitment of TPWS was completed to an accelerated programme in December 2002.

Train leasing contracts at the time included a provision for ROSCOs to fund mandatory changes. As introduction of TPWS was a mandated requirement, the ROSCOs were contractually obliged to fit train mounted equipment at their own cost. This provided the incentive to ensure a standard, inexpensive and fit for purpose design. The terms of the rolling stock leases also required TOCs to release trains to ROSCOs as required to enable this to be done and there is no doubt that the contractual arrangements played a major part in ensuring that the project was delivered to tight timescales.

The ROSCOs jointly appointed a project director to ensure the smooth delivery of on train equipment design, supply and installation. At the same time, ATOC created the TPWS Executive, to coordinate the TOCs in liaising with the overall Programme Delivery Team. Fitment of on-train equipment to over 5,400 driving cabs was completed on time for a cost in the region of £60m[54]. The ROSCOs fitted the majority but not all of these. Others included on-track plant, fitted by Network Rail, and freight locomotives by freight operators.

Systems Issues

The need to meet a legal requirement within challenging timescales meant that deliverability was a key factor in the design development. A positive description of this scenario is that it was based upon:

- a focus on standardisation rather than bespoke solutions;
- a clear objective to minimise the 'tailoring' of the standard design to fit each individual location throughout the UK through a consistent interpretation of standards; and
- where derogations from standards were required, they were considered in a pragmatic and constructive manner.

A less positive account is that this pragmatism had many negative impacts upon other schemes. Railtrack Zone Directors' bonuses were made dependent upon on-time delivery of

[54] "The strategy for the Train Protection and Warning System (TPWS)", November 2009, TPWS Strategy Group on behalf of the Vehicle/Train Control & Communications System Interface Committee.

TPWS, leading them to put pressure on Asset Heads to take a pragmatic view on compliance with Company Standards and to prioritise work on TPWS. This was manifest in the TPWS project having total priority in obtaining controlled copies of site drawings and being free to be slow in returning them, meaning that large numbers of other projects were delayed or incurred additional cost in having to proceed on the basis of 'parallel design', where an additional layer of independent checks are applied to permit two projects to work from the same source records.

TPWS installations were generally 'dropped in' rather than integrated to existing signalling systems, records took a very long time to update (meaning other project teams couldn't work in the area) and sometimes not updated at all. Little thought was given to future maintenance or renewal of the revised system – the TPWS equipment itself is simple to maintain and renew but it integrates into a much larger system at each location. This can cause inefficiency for maintenance staff until the signalling equipment in the whole area is renewed.

The workload peak generated by TPWS contributed to a shortage in signalling design, installation and testing staff which resulted in salaries increasing significantly. The staff element drove up the cost of development and delivery of future signalling renewals work. The perception also took hold that when planning a renewal in an area where TPWS had been installed, contingency should be added to bring records up to date by properly recording the works already delivered and then increase the renewal workscope to integrate the TPWS equipment more efficiently with the rest of the signalling system in the area to ease maintenance.

In short, the TPWS project was implemented quickly and efficiently but with little regard to its impact on other projects or whole-system costs. As such, it demonstrates what can be achieved if commercial interests can be swept to one side and the risks to rail vfm of doing so without careful planning.

Benefits of a Systems Authority

It can certainly be argued that the HSE was unable to get a coordinated industry view prior to the passage of the Railway Safety Regulations 1999. Not only did this mean that TPWS was a seriously-delayed response to the Hidden Report recommendations, but it can be argued the requirements were more demanding than they would have been had they emerged from an empowered system mind.

Eventually the TPWS project did have a (dedicated) system authority but this did not come into being until January 2001 - roughly half way through the programme. It provided a forum in which trades-off and optimisation could be carried out and dealt with important but second order issues such as that of the overhang of freight locomotives.

Although initiated by legislation, the TPWS programme provides useful lessons as it is probably the best recent example of the rail industry 'pulling together' to quickly and effectively deliver an appropriate solution for a specified problem. Delivery of the TPWS programme was managed by Railtrack (later Network Rail) and all parties were heavily incentivised to deliver the scheme.

The less positive aspect of this system authority was that the industry's energies were focussed on the TPWS project. A system authority with a genuine system-wide view would have addressed the impact of TPWS upon other projects and ensure that implementation was not to the detriment of whole-system vfm. Had an SA grasped the nettle earlier the scope of fitment could have been better optimised and work could have been better integrated into other schemes.

Both the ROSCOs and ATOC established coordinating bodies to support the TPWS on-train fitment – indeed, ATOC was the overall winner of the 2004 Railway Innovation Award for its success in delivering the scheme on time and to budget. However, the ROSCOs and NR reported to us that ATOC's focus on minimising the impact on passengers and managing the staff training requirement created tensions with their priorities. An independent body able to strike the right balance may have eased some of these tensions.

Quantification of Benefits

If TPWS were being introduced under the current industry structure and incentives it would take many years to reach fruition. It is unlikely that creation of an SA could improve on the timescales achieved by the TPWS programme but, had it existed, implementation would have started earlier which would have enabled the industry to ensure that equipment was only fitted where the risks justified it and minimise the project's detrimental effect on other projects. As a result, the SA would have achieved TPWS implementation quickly whilst avoiding collateral damage to other projects and whole-life costs.

The benefits can, therefore, be expressed in terms of:

- Safety benefits (these are based on willingness to pay rather than direct costs to the industry so have been excluded from our analysis)
- Reduced costs associated with major rail accidents
- Less costly fitment of TPWS (this is difficult to quantify so has also been excluded)
- Reduced impact on other signalling projects.

Cost of TPWS

A factsheet from the Commission for Integrated Transport in 2004 set out the costs and benefits for the then recently completed TPWS. CfIT estimated the final cost of TPWS installation to be £585m, composed of £525m for the track, £50m for passenger rolling stock, and a further £10m for freight rolling stock.

The potential lifespan of TPWS was estimated at 25 years, although it was recognised that it was likely to become obsolete sooner, as a result of the implementation of ERTMS. However, it has now been in place for 8 years and national roll-out of ERTMS is currently still many years away.

Major rail accidents prevented

The introduction of TPWS was expected to reduce total rail passenger fatalities per year from 4.28 to 2.76 which corresponds to 38 lives saved over the 25 year appraisal period. Assuming that these fatalities would have resulted from major train accidents averaging 5 fatalities each, this is equivalent to over 7 major train accidents in the 25 year period. This seems plausible; indeed it is believed that the system averted a head-on collision involving a Heathrow Express train within the first year of TPWS operation.

TPWS took over ten years to be implemented and it is not unreasonable to assume that a SA would have developed a viable solution and begun to implement it more quickly, but may then have longer during the implementation phase (to minimise the disruption to other schemes). Assuming that, overall, an SA would have implemented TPWS three years quicker than the current industry structures and incentives would do (a conservative assumption based on the experiences of GSM-R) then we estimate that would have prevented one major rail accident.

Assuming that a major train accident costs the industry £100m[55] (in lost revenue, damage to the infrastructure/ rolling stock, legal costs and fines, and responding to enquiry recommendations) then this saving would be attributable to the SA.

Reduced collateral damage

The additional cost burden placed on the rail industry in the medium term (through increased signalling engineering staff costs, increased maintenance costs and the impact of delay and scope creep to other renewal projects) is harder to quantify.

To give an indication of the cost impact on signalling renewals and enhancements we can review the reductions achieved in Network Rail's published data on Signalling Equivalent Units

[55] It should be noted that this figure is approximate and includes costs that are sometimes omitted when assessing the cost of train accidents, such as the cost of any enquiry and implementing its recommendations.

(SEUs). An SEU is a single input or output to the signalling system, for example a lineside signal or a single point end. Monitoring of SEU costs was introduced in 2003/04 with a base rate of £267k per SEU, equivalent to £331k in 2010 prices[56], with the current rate being £209k per SEU[57]. Assuming that half of the £122k per SEU reduction is attributable to inflationary costs caused by the TPWS programme, then the base cost per SEU would have been £61k lower (at 2010 prices).

Between 2003/04 and 2009/10 Network Rail replaced (according to its Annual Returns) 6,286 SEUs. Assuming that the cost inflation caused by TPWS has reduced at a constant rate over this period then the additional cost to NR is £192m (i.e. 6,286 SEUs x £61,000 per SEU / 2).

Overall costs & benefits

TPWS cost £585m in direct costs but resulted in additional costs to the industry which we have estimated to be £192m. Furthermore, had an SA been championing the project from the beginning, we believe that the overall project timescales could have been brought forward – thereby avoiding the risk of one major train accident and associated costs to the industry of £100m. Had a Systems Authority managed the project from the beginning, we estimate that it would have reduced industry costs by £300m. The bulk of these savings would fall to NR, but TOCs would benefit by avoiding a major train accident and we have assumed that 40% (£40m) of these costs would fall on the TOCs.

Scalability

TPWS was implemented in 2002 and was the successor to BR's Automatic Warning System (introduced in 1956). This suggests that a Systems Authority might rarely deliver benefits in these areas but similar issues are involved in other systems, such as train data communications and remote condition monitoring. As a result, we estimate that a project delivering these types of benefits might arise every 10 years.

[56] Uprated from 2004 to 2010 prices using RPI.

[57] Based upon average SEU derived from Network Rail CP4 delivery plan 2010 update.

Case Study 4: ERTMS

Project Overview

ERTMS (the European Railway Traffic Management System) is an on-board train control system that comprises two main components: ETCS, the European Train Control System which replaces older automatic train protection systems, and GSM-R, a radio system that provides voice and data communication between the infrastructure and the train. Together these components can replace existing signalling systems to provide a system that is both safer and can allow for more efficient use of the track, allowing greater capacity and potentially higher speed operations.

ERTMS has been developed on a Europe-wide basis and is available in 3 Levels; GB rail deployment is planned around Levels 2 and 3. Level 2 uses passive trackside balises to communicate the train position to the on-board train control system, which calculates and manages train speed. Movement authority is provided to the train via the GSM-R communication system, but is still dependent on existing signalling blocks, although lineside signals are no longer needed. Level 3 is similar to Level 2, but now the train integrity is checked on-board, so the train can operate within a moving block rather than the track-based fixed blocks. Track capacity is significantly increased.

To date ERTMS has been implemented at Levels 1 and 2 in various European countries, but Level 3 is still in the development stage. In the UK a pilot has been implemented at Level 2 on the Cambrian line, but the version used has no clear upgrade path to Level 3.

Chronology

GB rail has been developing plans to implement ERTMS for several years. In 2001, the joint Uff/Cullen public inquiry into train protection systems[58] recommended that regulations should require ERTMS installation on UK high speed lines by 2010 and to all main lines by 2015. A pan industry ERTMS Programme Board (EPB) was then created to provide an industry response. The Board was initially co-chaired by the SRA and Railway Safety, with representation from Railtrack, ATOC, FOCs, ROSCOs and RIA. The ERTMS Project Team (EPT) was formed to investigate implementation strategies for the system with staff seconded from across the industry. The final report of EPT was completed in May of 2002.

In 2003 the Chairman of the Health & Safety Commission wrote to the Secretary of State for Transport urging the government to commit to implementation of ERTMS and noting that *"the political and financial dimensions of such strategic decisions mean that they cannot be left to the industry alone"*. Later that year the SRA announced future testing and development of ERTMS Level 2 would include more extensive multi-supplier use of the Old Dalby test track under a Single National ERTMS Programme (SNEP) led by the SRA.

Following the abolition of the SRA in 2005, management of the programme passed to Network Rail, heading up a cross-industry team under the sponsorship of DfT Rail. In October 2006 Network Rail announced that it would pilot ERTMS on the Cambrian line and the scheme is currently being tested between Pwllheli and Harlech. It is planned to go live over the rest of the line in Spring 2011.

ERTMS benefits

In 2007 Network Rail, in conjunction with cross-industry bodies, created a business case demonstrating the positive benefits of ERTMS Level 2 deployment within the UK. The DfT notified the European Commission of this in September 2007. In the longer term the plan is to implement ERTMS Level 3, once a stable version exists, and to ensure that any implementation in the UK is upgradable to this with a minimum of additional investment.

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[58] "The Southall and Ladbroke Grove Joint Inquiry into Train Protection Systems", Prof Uff & Lord Cullen, 2001.

Most recently, Network Rail has calculated that implementation of ERTMS across a limited part of the network (not every piece of track or every vehicle) is expected to deliver approximately £2bn of benefits in terms of capital savings under the signalling renewals programme by 2020, out of a total cost around £12bn (which includes an allowance for train fitment). However, signalling is renewed on a rolling basis every year, and a comparable level of investment would need to be spent renewing the conventional signalling over this period anyway – in fact the £2bn benefits are based on ERTMS costing less than the planned conventional signalling renewal. This ignores the benefits available through updating the signalling operations that would also be made possible and any potential benefits to train operations, which again are considerable, estimated as running into £billions.

Systems Issues

The ERA acts as a Systems Authority for the TSI that sets out the key parts of a European-wide ERTMS system. However this TSI has significant gaps and opportunities for different versions that will all meet the overall specification. At present there are a plethora of cross-industry working groups, strategy groups, Boards, roll-out groups etc. in the UK working on ERTMS and the related GSM-R programme. Many of these groups, with senior industry representatives, are meeting monthly, in some cases for a whole day each month. However, despite the existence of these groups, we identified the following issues that indicate the lack of a system view and system thinking in relation to ERTMS implementation:

- There is no single body responsible for carrying out an economic evaluation of the costs and benefits of ERTMS to the UK railway industry as a whole, so significant areas of benefit are currently not quantified or included in any business case. NR is not in a position to understand benefits to TOCs, and is also loath to include its own operational benefits in its evaluation of ERTMS. Benefits are therefore seriously underestimated, and there is little pressure or urgency to see them realised. A Systems Authority would be able to evaluate all the costs and benefits across the network, and make decisions about the best way to implement the system to realise benefits for the industry as a whole.
- There is no clear mechanism for ensuring TOCs co-operate with the development of a cost-effective on-board train system and its fitment to rolling stock. Each TOC has an independent veto on any 'Network Change' implemented process. The GSM-R example indicates that it took 5 years for this process to generate an agreed in-cab radio that all TOCs were happy with[59]. We note that the GSM-R cab radio is a significantly simpler system that the on-board system needed for ERTMS. A Systems Authority would be able to select the most appropriate technology on the basis of economic evaluation of its benefits, and should have the authority to push through adoption, re-balancing costs and benefits to individual industry members if necessary.
- Even within Network Rail, there is no single view of the technology to be adopted. NR's Deployment Directors are planning to implement the system in different ways which may not be compatible with each other, although NR has identified the problem and is now working to resolve it. A Systems Authority would provide a systems overview for implementation, ensuring that even if different technical solutions are needed in different areas, they are compatible across the network.
- There is no leadership pushing the plan forward nationally to realise the benefits as soon as possible, leading to delays and no clear endpoint in sight. Despite the agreement in principle to go ahead with ERTMS taken in 2007, little progress has been made on implementation, apart from the Cambrian pilot scheme[60]. This scheme has been subject

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59 The resulting GSM-R design is non-standard compared with other European railways, and costs of fitment have been negotiated by NR on a TOC-by-TOC basis, leading to significant differences in costs charged.

60 The ERTMS Strategy Group, chaired by DfT, agreed that the decision on further roll out would be made once the Cambrian line is commissioned.

to delay[61] and the value of the scheme as a pilot has also been questioned[62].

- In parallel to planning for ERTMS, Network Rail is also developing its 'Network Operating Strategy' (NOS), which sets out how it will upgrade and rationalise its existing, conventional signalling system to realise efficiency and operational benefits. Speeding up implementation of ERTMS would enable some of the benefits of this strategy to be realised earlier, thus increasing its overall benefits.

Benefits of a Systems Authority

The key benefits a Systems Authority would bring to ERTMS would be to:

- Conduct a full economic evaluation of ERTMS across the rail industry, showing where benefits will fall, ensuring that costs and benefits are distributed fairly, and providing a stronger economic incentive to pursue the technology.
- Decide on an appropriate technology, and ensure the technology is adopted across the network as appropriate without the need for a consensus between all industry members. This would release people currently involved in committees etc. to get on with other activities.
- Create an effective implementation plan and ensure that implementation is carried out systematically across the network in a timely fashion to realise benefits as quickly as possible.
- Work at a European level with the ERA and other railways to ensure TSI changes are made that fit with GB railway requirements and to obtain, as far as possible, economies of scale in technology by using 'off the shelf' hardware or buying together with other European railways if possible.

Quantification of Benefits

The key benefits that can be quantified are those associated with ensuring the project is implemented in a timely fashion – delays will push benefits back and will also mean that extra capital is spent by NR in renewing conventional signalling that will eventually be made obsolete by ERTMS. For example, NR estimates that an SA pushing forward ERTMS could potentially save it between £200m and £400m in the cost of signalling renewals by 2020.

Benefits could also accrue from an SA agreeing a standard cab fitment and driving the cost per cab down to levels closer to those achieved in Europe. It is estimated that a saving of £69k per cab could be achieved and, based on fitting 2,100 train cabs, this equates to a one-off saving of £145m.

Once implemented, ERTMS is expected to deliver a range of operational benefits including the creation of additional train paths at key bottlenecks. These operational benefits are unlikely to be fully realised without a Systems Authority ensuring that the implementation of ERTMS is focussed on improving the efficiency of operations as well as capex savings to Network Rail. In the absence of detailed figures from TOCs, the overall operational benefits have been estimated at between £2bn and £4bn over 35 years. If the project timescales were reduced by 2 years, TOC operating costs would reduce by between £100m and £200m, in round terms.

As TOCs' franchises are negotiated in such a way that DfT would retain any significant benefits, particularly if identified and built in at the franchising stage, these benefits would be felt directly by the public purse.

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[61] The Cambrian scheme has been delayed by over a year. Network Rail announced the scheme in October 2006 and it was supposed to be up and running by December 2008. However, limited testing began in February 2010 and full commissioning has yet to be completed.

[62] The Cambrian line is a simple (single track) route and, as such, has a completely different operating environment from most of the GB railway. In particular, the ERTMS system is commonly designed to restrict trains to travelling at 40kph in the event of a failure, but because the distance between signals is greater than normal on the Cambrian, this would result in unacceptable delays if implemented, so the system has had to be modified for the trial.

Overall costs & benefits

National roll-out of ERTMS is predicted to cost £12bn, including train fitment (compared with £13.2bn for renewals with conventional signalling over the same period). If an SA, with suitable powers, was championing the project we estimate that it would deliver the following additional benefits:

- Reduced cost of train fitment, £145m
- Capex savings to NR from earlier implementation, £200m to £400m
- Opex savings to NR, £unknown
- Opex savings to TOCs from earlier implementation, £100m to £200m.

The total identified saving from creating a Systems Authority is therefore, before discounting, between £450m and £750m. However, if ERTMS implementation took 15 years to implement (starting in 5 years time) the annual saving over that period would be between £30m and £50m.

Scalability of benefits

The implementation of ERTMS is the largest railway project planned over the next few decades. As such it is difficult to compare potential benefits with other possible future projects.

Case Study 5: Dynamic Gauging of Structures

This case study considers the role of an SA in promoting new and perhaps simple innovations in the methods used to assess compliance with design standards, in this case in gauging for route electrification where current methods may be embedding conservatism in the calculations, leading to unnecessary replacement of structures.

Project Overview

Route electrification requires sufficient headroom through structures (bridges and tunnels) to provide a safe path for 25kV cabling, support structures and for the passage of trains equipped with current collecting pantographs. The availability of this space is assessed using a structure gauge, whose dimensions relate to the size and height of a working pantograph, adjusted for maximum train sway, wind, track positional tolerances and a suitable electrical clearance.

The allowances for vehicle sway and wind relate to historic measurements of maximum values. In practice, such values are related to local factors such as train type and speed, track curvature and wind exposure. Further, tolerances and allowances are added to accommodate factors such as track movement. These values have been applied cumulatively – a notional worst case scenario – despite acknowledgment that statistically such stacking is unlikely to occur.

The above issues have been addressed in an innovative software system: PhX Dynamic[63]. The software analyses the swept envelope required to achieve satisfactory electrification clearances in relation to local conditions and analyses tolerances using modern 'uncertainty theory' methods to provide a realistic assessment of the space required, which is generally somewhat smaller than traditional techniques would suggest. Accordingly, many structures marked for rebuilding may be retained if analysed effectively.

An exercise considering the proposed route from Airport Junction to Oxford on the GWML suggests that 6% of structures could be saved, with a resultant cost saving of £13.5m - £36m.

A further exercise was performed to consider the possibility of London's Crossrail tunnels being suitable for European interoperable trains (see Appendix 1). An exercise performed by traditional means suggested that an increase in tunnel diameter of at least 200mm would be required, at a project cost of around £1bn and a programme cost of 11 months. Using PhX Dynamic, it was found that the originally proposed diameter could accommodate this traffic.

Systems Issues

The innovative approach used by this software relies on 'fitting' infrastructure to train, and vice versa, rather than using generic interface parameters which provide a large factor of safety but which rely on little information about train or infrastructure. The approach is, of course, relevant to all gauging issues and has the potential to allow existing trains to operate over more of the network and ease the introduction of new rolling stock. Whilst the V/S SIC takes an active role in developing these interfaces, it does not possess sufficient authority to mandate a system approach and, as such, cannot always bring necessary parties together. In the electrification example cited above, Network Rail is likely to champion the approach, but input from train operators will also be essential.

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63 PhX Dynamic has been developed by a small private company with significant experience in the area of gauging and dynamic analysis. The company is in communication with the V/S SIC and has supported the use of its software name and data from past applications to be used in this case study. The company has also had discussions with relevant parties in NR, which has provided data on the GW projects used in the analysis.

Benefits of a Systems Authority

The rail industry is very conservative, and constrained by commercial interests. New analytical methods, such as PhX Dynamic, can achieve cost savings by better understanding risk rather than simply layering conservative assumptions to ensure safety. Some of the information required to achieve greater harmony between train and infrastructure is considered proprietary by some train manufacturers. Whilst the SICs can achieve some impact by identifying system opportunities, they cannot do more than challenge Network Rail's conservative approach or express concern that useful information is being withheld. In the former case, this may provide engineers with greater freedom to apply engineering judgement supported by analytical tools, such as PhX Dynamic. In the latter case, building a picture of where displaced rolling stock may be deployed (thus optimising rolling stock life) has been thwarted for some years through an inability to obtain the technical information needed to undertake the analysis. It is believed that an effective Systems Authority could unlock such a scenario.

It is also worth noting that this case study is an unusual example of innovation coming from a small specialist supplier. Such suppliers find it very challenging to be heard and get their ideas accepted in the current industry structure and it is often only possible if you have relevant contacts within the industry. When looking for opportunities to improve system performance, the Systems Authority would need to maintain a dialogue with small suppliers as well as more substantial companies.

Quantification of Benefits

Electrification of the Great Western route from Airport Junction to Oxford has recently been approved and hence provides up to date estimates for the cost of replacing structures which have been assessed using established techniques. It is also directly relevant since the project has started looking at the potential benefits from applying dynamic gauging. Analysis performed for this project shows that £170m has been budgeted for the modification and replacement of structures on the route. Of the 130 over-bridges on the route, it is estimated that 50% will need to be replaced and 50% of the remainder can be resolved without modification to the structure (e.g. by track lowering). Of the 33 remaining structures it is conservatively estimated that dynamic gauging would result in 10 bridges being retained that would otherwise need to be replaced. The cost of replacing a bridge is typically in the range of £1.5m to £4m but modifications would still be needed to the structures and we also need to deduct the cost of performing the analysis. After making these adjustments, the net saving is predicted to be between £13m and £36m on the route (i.e. between 8% and 21% of the overall structures budget).

Scalability

The Airport Junction to Oxford route is 50 miles long. If the same savings per route mile electrified applied to all GW routes (adding in Didcot-Bristol, Reading-Newbury, Bristol-Swansea, Newbury-Exeter) then the net saving would be between £81m and £217m.

Over the next 20-30 years it is likely that other routes will be electrified. NR's Network Route Utilisation Strategy on Electrification, published in October 2009, includes an electrification 'gap analysis' and prioritises routes where electrification:

- May enable more efficient operation of passenger or freight services
- Could provide diversionary route capacity
- Could enable new services to operate.

If all of these routes were electrified it would double the amount of electrified track, adding approximately 3,000 route miles. If only half this amount was actually electrified, the net saving would be between £0.4bn and £1.1bn over 25 years.

It is difficult to judge how much more quickly the dynamic gauging technique would be adopted and could be applied if an SA was created. NR is confident that the technique will gain

widespread support but it will rely on the cooperation of the manufacturers of all rolling stock using affected routes to achieve its full potential; an SA may make a valuable contribution here. If we assume that just 10% of the potential savings are attributable to the SA, it could be credited with savings of up to £100m on electrification projects over the next 25 years. All of the savings would fall to NR.

However, the savings are potentially much greater than estimated here, since the same approach to gauging assessment can be applied to many areas other than electrification. The technique could allow standardisation of gauge and greater cascading of rolling stock in Britain at reduced cost, and allow the operation of European type rolling stock on key routes. We have assumed that smarter techniques associated with electrification and route acceptance of vehicles could double these benefits.

Case Study 6: New Approach to the Rule Book

Project Overview

The Rule Book is a suite of modules that have wide-ranging application to the running of the railway. It defines how a wide variety of Network Rail, TOC, FOC and contractor staff of differing grades and roles undertake duties affecting the operational railway. Over the years the Rule Book has increased in size to meet the competing demands of comprehensiveness and 'personalisation' to different roles.

The extent of the Rule Book's application makes the process of making significant change difficult. Staff are required to know relevant sections of the rulebook by heart and those rules are fundamental to the way that they interact with or directly operate the railway.

The New Approach has been established to address these issues. Key themes are:

- The core objective of operating the railway has been articulated as "the safe and timely delivery of people and goods to their destinations".
- A set of nine operational principles have been developed and agreed at the highest levels in the industry, with the clear intention of using the principles to scope the operational rules. Anything which is not necessary to support the delivery of the principles should not be a rule.
- The content and structure of the Rule Book is being revised so that it is clearly aligned with the operational principles, and more accurately targeted at the skill sets of end users.
- An operational concept is being developed, which will describe the model for operating the railway embodied in the rules.

The New Approach is expected to have significant benefits for the rail industry which are estimated as £1bn over 25 years. The project is expected to deliver some benefits directly whilst enabling others; the benefits are derived from:

- Increasing capacity
- Optimising the use of the railway
- Championing performance improvements
- Training efficiency benefits
- Improving safety.

The greatest part of these benefits come from increasing capacity, principally through enabling the 'Network Availability Programme' (formerly known as the '7 day Railway'). The New Approach will deliver the rules changes needed to implement new methods of working for engineering works that enable the network to be available consistently to deliver the timetable. Another claimed benefit is a better means of incorporating future changes to operational practices and technologies to improve service performance.

In addition to the benefits delivered by the rules themselves and their development, it is claimed that training costs will be reduced due to each member of staff having less rules to learn and have their competence assessed against. This reduced knowledge requirement is in itself expected to deliver safety benefits (with consequent cost savings).

It should be noted that, whilst a completely new Rule Book will emerge from the process, there is no single date on which the railway switches from the old to the new rulebook. Twelve tranches of changes are being adopted:

1. Basic competency for going on the railway
2. Safe Systems of Work
3. Possessions
4. Electrified Lines
5. Level Crossings

6. Emergency Train Working
7. Signalling Regulations
8. One Train Working
9. Train Working General
10. Train Defects
11. Signals and Indicators
12. Signalling Failures.

At the time of writing, we have not been provided with the implementation plan, although we are advised that the programme to date has been delivered to schedule. The first tranche was implemented in June 2010 with the second in December 2010.

RSSB identifies the main risk to the New Approach as a lack of consensus at TOM (Train Operation and Management) Standards Committee, which is doing the detailed development work for the New Approach. A member with specific concerns around any particular tranche could seek to 'veto' the remaining elements of the programme in order to make sure their issues were addressed before the programme can continue. If there were a lack of consensus, the RGS Code makes provision for the RSSB Board to intervene and resolve the situation but there would inevitably be a delay. To help mitigate the risk of such problems, an Industry Leaders Group, with director level participants, has been established to provide guidance and constructive challenge to the work being produced.

RSSB is confident that the project can be delivered on schedule using the current, consensus-based approach and takes the view that this would not be achieved if a Systems Authority sought to override such concerns.

Systems Issues

The New Approach to the Rule Book project has taken a long time to develop. Acceleration of the programme was rejected by RSSB because of the industry's capacity to absorb changes in the Rule Book. (RSSB emphasises that the Rule Book, unlike many other standards, is used directly by front-line employees – of whom there are a large number.)

It was considered also that accelerating the project would run a risk of confusion, as a result of which the achievement of the benefits could be delayed for some years while the confusion is resolved – instead of being accelerated as intended. In its input to the RVfM Study, RSSB highlighted the value to be gained from passenger TOCs getting fully behind the New Approach.

Whilst acceleration of delivery was ruled out, there were delays in getting agreement in the early part of the programme that might have been avoided.

Benefits of a Systems Authority

RSSB has acknowledged that a Systems Authority with a wider scope than RSSB – encompassing the development of 'whole industry' strategy – might have made an earlier start on the New Approach and thus would have led to earlier implementation. However, it takes the view that a Systems Authority with similar scope to RSSB but more remote from the industry would have been less likely to initiate the project.

Whilst there are expected to be significant downstream benefits for TOCs and FOCs, the most immediate benefits come from improving access to the operational railway, which will primarily benefit Network Rail's maintenance and renewals work programmes. As a result, the New Approach could be seen as an unwanted distraction by TOCs who will be required to commit additional resources to training staff in changes relating to multiple tranches of the project. RSSB has acknowledged that the TOCs were initially slow to embrace the project and that the programme has been re-ordered as a result, with tranches affecting their staff moved to later in the programme.

Potentially, a Systems Authority could have addressed these concerns by arranging for

Network Rail, which will see immediate benefits from the changes, to compensate other stakeholders.

Quantification of Benefits

This case is considered under the 'delays' category; it is assumed that, with a Systems Authority in place, the decision to proceed with the New Approach would have occurred a year earlier and that the five year programme would have also been shortened by a year (by either combining tranches or progressing tranches affecting different groups of staff in parallel). Thus, overall, the programme would have been two years shorter[64].

The New Approach to the Rule Book project has developed its own business case which includes costs and benefits over 10 and 25 years. The types of benefits were set out in the Project Overview earlier and the costs include:

- RSSB's development costs
- Printing costs
- Training costs for implementation
- Costs of changes to company competence management systems.

The business case includes three scenarios, including a 'most likely' case which is the basis of the following analysis.

Costs

Development and implementation costs are £42m with the bulk incurred in the implementation phase. These costs are driven by the scale of the programme and would not vary had implementation been phased differently. However the smaller development element of £2.5m could have been reduced by a shorter development timescale.

Benefits

There is some 'front-loading' of the benefits. For this reason the additional benefits of early implementation should be derived from the figures for the benefits in the later years (because the number of 'steady state' years is increased). The 10-year benefits are quantified at £620m and the 25-year benefits as £1,424m. Deriving a single year figure for the 15 years between these two milestones gives an annual benefit from reduced programme length of £53 million, or £106m for the assumed two-year reduction.

It should be noted that the overwhelming majority of the benefits are associated with increased capacity created by rules changes that minimise the disruption to the timetable for engineering work (resulting in higher revenues). As such the project is an enabler and it is important to ensure that there is no double-counting of this revenue which may also form part of the business case for the implementation of new working practices by the Infrastructure Manager.

Scalability

The Rule Book plays a pivotal role in the industry and no other 'standard' is capable of having the same impact on industry costs. However, there is a large number of standards governing industry behaviours and careful examination of these, coupled with new technologies perhaps, is likely to find a number of opportunities.

Given the reduction in network maintenance costs that the ORR believes is possible on the network there will be continuing pressure to find smarter ways of working. A Systems Authority taking a cross-industry perspective might be expected to leverage greater savings than would be made by Network Rail concentrating unilaterally on its company procedures.

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64 RSSB is sceptical that an SA could have achieved this and notes that some people in the industry have claimed that the project is already going too fast. As with all of the case studies, the benefits claimed for the SA are speculative but are indicative of the 'size of the prize' that an effective SA could deliver.

However, given that the annual savings accruing to the New Approach are ~£20 million per year over 5 years, it is probable that future, more targeted savings will deliver more modest benefits. It seems reasonable to expect that the SA would be able to realise annual savings of at least £10m from championing changes to industry working practices.

APPENDIX 3: SYSTEMS AUTHORITY STAFF NUMBERS

The proposed SA would be performing roles currently undertaken by RSSB, NR, DfT, ORR and, to some extent, ATOC. Pooling the activities in this way reduces the risk of 'man marking' and 'interface bureaucracy' between organisations, as well as delivering benefits by co-locating staff. Experience within NR suggests that savings from combining roles and co-locating staff may be up to 20-30%. Informal opinions were sought from outside the rail sector (from experts in HR and from people working in mergers and acquisitions) where it was thought that such figures were higher than average, but could be justified if supported by local knowledge. Since NR has a good understanding of the interface 'traffic' between organisations, we have assumed that a 25% saving (the mid-point of NR's range) would be achievable.

Current staff employed on SA activities

Data provided by DfT, ORR, RSSB and NR identified the number of people employed in the industry on systems related activities. However, unlike the other areas, RSSB's figures included the Directors, Heads of Department and admin support as well as professional and technical (P&T) staff. Other organisational data provided by RSSB showed that 179 P&T staff will be employed by RSSB after the current reorganisation is completed (which will reduce RSSB from 250 to 225 staff). However, 25 P&T staff are employed in Business Services and 11 on National Programmes (which we argued should not be taken on by the SA).

The table below shows the total number of P&T staff currently employed on activities that would be taken over by the SA.

RSSB	143
NR[65]	185
ORR[66]	3
DfT	15
Total	346

RSSB also employs 30 non-administrative staff in Business Services, 12 of whom work in the Information Management team which runs 18 websites for the industry (another 4 people are employed in the Safety Knowledge and Planning department maintaining SMIS). A number of these websites are linked to the activities of National Programmes so, if this area is not taken on by the SA, we think it reasonable to halve the size of Information Management team. As a result, the work performed by 24 non admin staff in Business Services would transfer across to the SA.

To these figures we need to add:

- 4 Directors (RSSB employs 5 but the Director of National Programmes would not transfer)
- 9 Heads of Department (excluding 2 employed in National Programmes)
- 20 Admin staff needed to support an organisation employing 392 staff (assuming one Admin support to every 20 staff[67])

On this basis, we calculate that the industry currently employs 403 staff on roles that would transfer into the SA.

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65 The figures provided by NR also included 20 staff analysing delay data and 145 staff employed on activities "relating to network/system" in Train Planning & Performance, Finance, etc. It also included 33 staff employed auditing compliance in NR Engineering. These roles would remain in the National Network Operator and Infrastructure Manager respectively.

66 NR believes that the ORR figure is a significant underestimate.

67 Based on the ratio in Network Rail Engineering.

Staff needed by the SA

As explained earlier, by combining roles and co-locating staff we would expect to achieve a significant reduction in staff numbers. **Assuming a 25% reduction in P&T staff and their admin support the SA would need to employ 312 staff**, i.e. 91 fewer staff would need to be employed in the industry on these activities.

The table below shows the reduction in headcount in each organisation.

RSSB[68]	-200
NR	-185
ORR	-3
DfT	-15
Total	-403
SA	+312
Net reduction	91

Figure 11 in the main report shows an organogram of the new organisation. The table overleaf shows how the 260 P&T staff employed by the SA (i.e. 346 staff less 25%) would be deployed across the organisation and the time that would be spent performing the Systems Authority activities described in Section 3.

It is important to note that the SA would be working in partnership with other industry players and will continue to rely on them to support its activities by responding to consultation, sitting on steering groups, etc. In addition, the SA could play a complementary role to other bodies being considered by the RVfM Team such as a 'pan-industry' programme delivery organisation.

[68] 225 staff less 16 staff in National Programmes, 6 in Business Services and 3 further admin posts.

Table 5: Number of Professional, Technical and Administrative Staff Employed by the Systems Authority

Systems Authority Activities	Professional & Technical Staff Employed on Activity by the System Authority (by Team)														P&T Staff Employed by SA
	Intelligence				Planning			Delivery				In-house Experts			
	Horizon Scanning	Data Acquisition	Analysis & Reporting	Knowledge Management	Strategic Planning	Economic Analysis	Research & Trials	Standards Development	Product Acceptance	Knowledge Sharing	Monitoring & Evaluation	Engineers	Operators	Risk Analysis	
Identification of problems & opportunities															
Horizon scanning, i/d of new methods & insertion points	5.0														5
Monitoring system health															
Safety performance		15.0	3.0											2.0	20
Analysis of train delays			2.0									1.0	1.0	1.0	5
Industry costs & revenues		3.0	2.0			2.0						1.0	1.0	1.0	10
Performance of standards and industry processes		1.0	1.0												2
Responding to cross-industry safety recommendations			1.0												1
Knowledge Management															
Asset Registers				3.0											3
Systems Archive				5.0											5
Identification of solutions															
Planning & appraisal															
Strategic planning					5.0	2.0						2.0	1.0	1.0	11
Performing options appraisals						3.0						2.0	1.0	2.0	8
Research & trials															
Identifying strategic research needs					5.0										5
Supporting research projects							10.0					2.0	1.0	1.0	14
Supporting trials							10.0					2.0	1.0		13
Facilitating change															
Supporting systems															
Coordination of input on TSIs, ROGS, etc.								3.0				5.0	5.0	2.0	15
Development of National Interface Standards								20.0				25.0	10.0	2.0	57
Approvals/verification processes (incl DeBo role)									20.0			10.0	5.0	2.0	37
Supplier approvals/accreditation									1.0						1
Project delivery															
Aligning incentives and negotiating compensation						2.0						2.0	1.0	1.0	6
Supporting cross-industry projects							10.0					5.0	3.0	2.0	20
Knowledge sharing										5.0					5
Monitoring delivery															
Project activities & outputs			2.0			2.0					10.0	1.0	1.0	1.0	17
Total FTE Staff Employed in Team	**5.0**	**19.0**	**11.0**	**8.0**	**10.0**	**11.0**	**30.0**	**23.0**	**21.0**	**5.0**	**10.0**	**58.0**	**31.0**	**18.0**	**260**