Achieving Value for Money in Safety, Standards and Innovation

Rail Value for Money Study – Theme G

DfT Contract number: PPCA10046

Final Report to
DfT and ORR

20 May 2011

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Reference P10001721/037rep

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Executive summary

A study of the Value For Money being provided by the GB railways is being conducted for the Department for Transport (DfT) and the Office of Rail Regulation (ORR). This report covers the results of one of 10 study themes: Theme G, which covers Safety, Standards and Innovation. The scope comprises:

- Reviewing GB rail's current approaches to safety and standards, including drivers of cost.
- Identifying options to improve cost-efficiency related to safety and standards, and to accelerate or enable innovation to achieve greater cost-efficiency.
- Assessing and, where possible, quantifying the potential benefits of these options in terms of cost-efficiency, including identifying any disadvantages and/or risks.

The scope includes the GB railways that operate on the Network Rail (NR) controlled infrastructure, excluding metro, light rail, heritage and Northern Ireland railways.

The study was conducted over a 12 week period, and included document review, over 40 stakeholder consultations, and collation of relevant comparator case examples on safety and standards approaches, including Pro Rail (Netherlands), other overseas railways, the GB aerospace sector and National Grid.

The study has sought to identify a range of credible options for improving cost-efficiency, illustrating costs, benefits, disadvantages, constraints and relevant evidence from comparators and stakeholders. The inclusion of an option in the report does not necessarily imply that there is full consensus amongst the various stakeholders about its desirability. Quantification of benefits has been provided wherever possible, however in many cases data is not available and rough estimate ranges have been prepared based on stated assumptions and approximations. These estimate ranges should be treated with a due degree of caution pending further definition.

Areas in which to seek cost efficiencies

The total annual expenditure of the GB rail industry is estimated as approximately £12.7bn, of which £6.7bn relates to NR, £5.1bn Train Operating Companies (TOCs), £0.7bn Freight and £0.2bn regulatory, governance and support organisations including the Office of Rail Regulation (ORR), Rail Safety & Standards Board (RSSB), Railway Accident Investigation Board (RAIB) and DfT. Sources of cost relating to safety and standards exist within all parts of the railway, reflecting the full integration of safety issues into most core activities of the railway. Against this backdrop, the study identified a number of key areas in which to seek cost efficiencies:

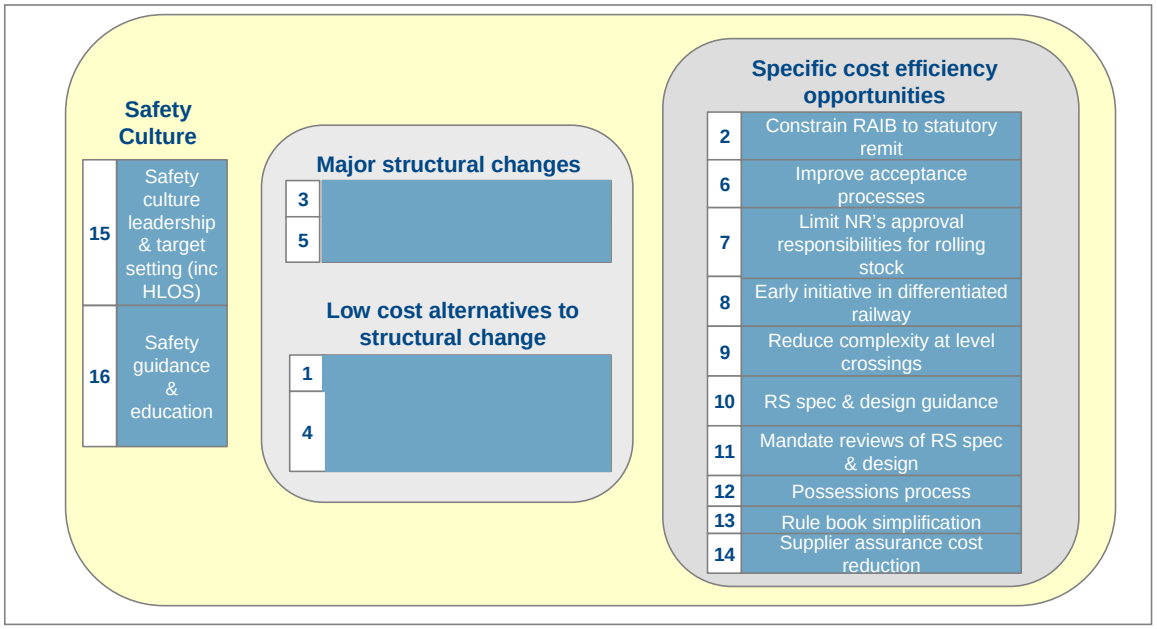
- Safety and standards aspects of GB **rail governance and regulation**: such as the costs of governance body staff, facilities and budgets, resources for the industry to respond to safety-related regulatory requirements.
- Safety or standards-related **asset requirements**: including extra costs in the assets themselves, such as the costs of enhanced signalling, automatic train protection, level crossings and rolling stock, as well as costs associated with the processes of bringing the assets into service, such as assurance, approvals, and compliance with local, national or European standards.
- Safety and standards-related aspects of **railway operations**: such as the costs of practices associated with track possessions, rule book, maintenance and safety/standards management.
- Safety and standards **culture**: the behaviours, perceptions, attitudes and structural factors which affect the way in which the industry makes safety and risk-related decisions.
- Barriers to **innovation**: referring to ways in which barriers can be reduced or removed to enable cost-saving innovations to be developed and implemented more quickly.

A simple model was developed to help analyse the causes of current barriers towards innovation and greater cost-efficiency in safety and standards. This model was also used to help validate conclusions regarding possible options.

Cost efficiency options

Overall, 16 options for further improvement of cost-efficiency have been identified which can be mapped into four categories: Major structural changes; Low cost alternatives to structural change; Specific cost efficiency opportunities; Safety culture

Figure 1: Map of options



Source: Arthur D. Little

It may be seen from Figure 1 that Options 3 and 5 both constitute major structural changes to safety, standards and innovation governance. Options 1 and 4 are low cost (and lower impact) alternatives to Option 3. The specific cost efficiency opportunities in the right hand box are options which could be carried out anyway, irrespective of whether the major structural change options are adopted. Finally, Options 15 and 16 refer to important enabling measures to change safety culture.

Each of the above options is summarised in the following table. Further details of each may be found in the sections of the report referenced in the right hand column.

Table 1: Summary of cost-efficiency options and potentials

Area	No	Title	Implement-ation risk [1](H/M/L)	Timescale to impact (S/M/L)	Range of cost to implement (£m)	Range of cost efficiency impact (£m/year)	Category	Ref report section
Safety, standards and innovation governance	1	Reallocate functions currently provided by RSSB	Medium	Short (within 18 months)	6-8 (one off)	10-15	Low cost alternative to structural change	3.1.3
	2	Constrain RAIB's work to its statutory remit and streamline its operation	Medium	Short (within 18 months)	1-1.2 (one off)	3-10	Specific cost efficiency opportunity	3.1.3
	3	Create a new independent systems and standards body and rationalise standards (Note: See Appendix 7 for sub options)	Medium	Medium/Long (within CP4 and during CP5)	30-45/year	200-230 +10-300 per major investment scheme	Major structural change	3.2.3
	4	Maintain current structure, adapt standards and provide guidance	High	Medium/Long (within CP4 and during CP5)	10-15/year	100-120	Low cost alternative to structural change	3.2.3
	5	Create more effective mechanisms to translate research into demonstrations of de-risked technology	Medium	Long (CP5 onwards)	2-3/year + research funding dependent upon project portfolio	Enabling: included in Option 3	Major structural change	3.2.3
	6	Make acceptance processes more accountable, more visible and faster through either regulator intervention or more radical restructuring	Medium	Medium (within CP4)	2-3/year	Enabling: included in Option 3	Specific cost efficiency opportunity	3.3.3
	7	Maintain status quo, but clarify and limit NR's approval responsibilities for rolling stock	Low	Short (within 18 months)	<1(one off)	1-5	Specific cost efficiency opportunity	3.3.3
	8	Take an early initiative in the crafting of the categorisation of the differentiated railway	Low	Long (CP5 onwards)	1-2/year	10-100	Specific cost efficiency opportunity	3.4.3

[1] "Implementation Risk": the likely difficulty of implementation, e.g. High means substantial barriers and/or major uncertainties, Low means few barriers

Area	No	Title	Implement-ation risk [1](H/M/L)	Timescale to impact (S/M/L)	Range of cost to implement (£m)	Range of cost efficiency impact (£m/year)	Category	Ref report section
Reducing costs through changing asset design standards	9	Reduce the technical complexity at level crossings[2]	Medium	Medium (within CP4)	1-2 (one off)	10	Specific cost efficiency opportunity	4.3.3.
	10	Provide best-practice guidance on specification, procurement and design of rolling stock in support of innovation and cost-effectiveness	High	Medium (within CP4)	1-2 (one off)	10-20	Specific cost efficiency opportunity	4.4.3
	11	Mandate reviews to drive best practice in specification, procurement and design of rolling stock in support of innovation and cost-effectiveness	Medium	Medium (within CP4)	2-3/year	10-20	Specific cost efficiency opportunity	4.4.3
Reducing costs through changing operating standards	12	Provide support in the cost efficient and speedy changing of possession standards to support the findings from the NR workstreams as appropriate	Medium	Short (within 18 months)	<1 (one off)	70-100	Specific cost efficiency opportunity	5.1.3
	13	Provide strong and overt support for the Rule Book New Approach including aligning stakeholders behind the activity	Low	Short (less than 18 months)	3-5/year	30-80	Specific cost efficiency opportunity	5.2.3
	14	Accelerate progress on supplier assurance cost reduction	Low	Short (less than 18 months)	0.5/year	30 -35	Specific cost efficiency opportunity	5.3.3
Changing safety culture	15	Promulgate a new leadership culture of effective and efficient safety, including removing HLOS safety improvement target, changes to Railway Strategic Safety Plan and ORR/RAIB goals	Low	Short/Medium (initial action immediate, impact will be longer term)	1/year	10-15 nominal, plus enabling impact for other cost efficiency improvements	Safety culture	6.3
	16	Rejuvenate efforts at cost-conscious safety guidance and education, including interpretation of HSAWA	Low	Short/Medium (initial action immediate, impact will be longer term)	1-2/year	Covered in Option 15. Enabling impact for other cost efficiency improvements	Safety culture	6.3

Source: Arthur D. Little analysis

[2] At the time of producing this report, a level crossing accident with a sewage lorry and a two car diesel train had just occurred at Little Cornard near Sudbury, which resulted in a train derailment and passenger injuries. The options for cost reduction presented in this study would have no impact on the likelihood of occurrence of this specific accident

Overall cost-efficiency potentials

We estimate an overall potential cost-efficiency saving of £250m-£400m/year at a cost of £45m-£70m/year, with an additional significant upside savings potential for future major national railway investment projects

Table 2: Cost efficiency potentials including major restructuring options

Options	Title	Implementation risk (H/M/L)	Earliest year of savings	Range of cost to implement (£m)	Range of cost efficiency impact (£m/year)	Category
3	Independent systems and standards body and rationalise standards	Medium	2012	30-45/year	200-230 +10-300 per major investment scheme	Major structural change
5	Translate research into demonstrations of de-risked technology	Medium	2012	2-3/year + research funding dependent upon project portfolio	Enabling: included in Option 3	
2	Constrain RAIB to statutory only	Medium	2011	1-1.2 (one off)	3-10	Specific cost efficiency opportunities
6,7	Improving acceptance and approval processes	Medium	2011	2-3/year	1-5	
8	Differentiated railway	Low	2015	1-2/year	10-100	
9	Reduced technical complexity at level crossings	Medium	2012	1-2/year	10	
10,11	Best practice in rolling stock spec/ procurement/design	Medium	2012	2-3/year	10-20	
12,13,14	Accelerating possessions, rule book and supplier accreditation improvements	Low	2011	3-6/year	130-215	
15,16	Safety culture improvements	Low	2011	2-3/year	10-15 Enabling for others	Safety Culture
			Totals (£m/year)	**45-70**	**370-600**	
				Excluding Options 12-14	**250-400**	

Source: Arthur D. Little analysis

It may be seen from the above table that the cost-efficiency improvement potential is some £370m-£600m including Options 12-14. If these options are excluded on the basis that they are pre-existing, then the potential becomes £250m- £400m. Broadly speaking, these numbers exclude items already in the NR Transformation Plan, although in reality there may be some overlaps.

It should be noted that there is an additional anticipated potential benefit for major railway investment schemes of tens or hundreds of millions of pounds, depending on the scheme, arising from the contribution of the proposed standards rationalisation and system-based innovation.

Excluding the major structural change items, the savings potential is £150m-£300m at a cost of £25m-£40m

Table 3: Cost efficiency potentials excluding major restructuring options

Options	Title	Implementation risk (H/M/L)	Earliest year of savings	Range of cost to implement (£m)	Range of cost efficiency impact (£m/year)	Category
1	Reallocate/resize RSSB	Medium	2012	6-8 (one off)	10-15	Low cost alternative to structural change
4	Maintain current structure, adapt standards and provide guidance	High	2012	10-15/year	100-120	
2	Constrain RAIB to statutory only	Medium	2011	1-1.2 (one off)	3-10	Specific cost efficiency opportunities
6,7	Improving acceptance and approval processes	Medium	2011	2-3/year	1-5	
8	Differentiated railway	Low	2015	1-2/year	10-100	
9	Reduced technical complexity at level crossings	Medium	2012	1-2/year	10	
10,11	Best practice in rolling stock spec/ procurement/design	Medium	2012	2-3/year	10-20	
12,13,14	Accelerating possessions, rule book and supplier accreditation improvements	Low	2011	3-6/year	130-215	
15,16	Safety culture improvements	Low	2011	2-3/year	10-15 Enabling for others	Safety Culture
			Totals (£m/year)	**25-40**	**280-510**	
				Excluding Options 12-14	**150-300**	

Source: Arthur D. Little analysis

If the low cost alternatives to structural change are pursued, the savings potential goes down to some £150m-£300m. It should also be recognised that the risk of failure to achieve these benefits goes up considerably, due to barriers inherent in the current dispersed safety and standards ownership structures.

Conclusions

Our overall conclusions from the study are as follows:

1. ***There is potential to make cost-efficiency savings of perhaps some £250m-£400m/year at a cost of some £45m-£75in/year in safety, standards and innovation through a combination of major structural changes, specific opportunities and changes to safety culture***
   Notwithstanding the significant uncertainties inherent in the savings and cost estimates, we conclude that there is potential for significant savings. A balanced set of interventions including structural changes to the governance of standards and innovation, technical and operational changes and accelerations, and critical enabling measures on safety culture will have the greatest likelihood of achieving sustainable cost-efficiency improvement.

2. ***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***
   There is wide consensus that the current complex regime of standards under multiple ownership leads to delays, constrains innovation and adds unnecessary cost. Whilst rationalisation, simplification and clarification will be a major task, the unification of standards under a single body with system-wide purview provides the most effective means of making it happen. Such a body could be effectively combined with a second key role to explore and evaluate system-wide, through-life technological innovations which could have a profound impact on the future of the railway. Today these innovations are significantly hindered by interface barriers between different players in the rail system. There are several options for how an independent standards body could be achieved in practice. Key ownership and governance criteria include independence, sufficient authority and stakeholder credibility. The new body would be very different to the former unsuccessful Strategic Rail Authority, in that its role would be primarily technical rather than commercial or regulatory. Further consideration of the structure, size and powers of the new body is beyond the scope of this study.

3. ***The provision of a mechanism to bridge the R&D gap between product development and large-scale demonstration is a further important measure to enable cost-saving technologies to be deployed***
   The gap in the product development cycle between concept and de-risked large- scale demonstration is widely acknowledged. The need is to develop and maintain an industry strategy and to support research necessary to bring ideas to the point that their business case and future potential is proven. This will build naturally on the work of the Technology Strategy Advisory Group and of the DfT's strategic research to date. Examples such as the Energy Technologies Institute provide a pointer to how this could be achieved.

4. ***There are many technological innovation projects already in the pipeline which have significant cost-efficiency potential. Some minor additional opportunities have been identified relating to level crossings and rolling stock. The concept of the "differentiated railway" also provides potential but on a longer timescale***
   There are many technological innovation projects in the pipeline with collective potential savings opportunities in the £billions. In this study we have only counted the one-off benefit of *acceleration* of these projects in our cost-efficiency potentials in order to avoid "double-counting". Other opportunities have been identified in this study including simplifying level crossing designs and best-practice guidance in rolling stock specification. The concept of the "differentiated railway" which is still in early stage of development could lead to the possibility of simpler technology (e.g. low cost off-the-shelf signalling systems) for low-density lines. However this is considered too speculative and long term to be included as an option in this study. In the meantime we do not see new opportunities for cost-efficiencies in train protection systems, including ERTMS or TPWS, within the CP4 period.

5. ***There are opportunities for accelerating existing projects to reduce safety-related operating costs***
   The study identified the potential to accelerate current projects relating to possessions, rule book simplification and supplier accreditation, all of which face barriers associated with the need to align objectives and interests, and secure consensus among multiple stakeholders in order to proceed. Acceleration opportunities will require additional high-profile leadership and support, as well as changes to standards.

6. ***Changing safety culture is a key enabling measure to underpin cost-efficiency improvement, and important options have been identified to support culture change***
   Whilst GB Rail safety culture has many positive attributes which have supported significant safety performance improvement over many years, there is a widely held view that attributes such as personal risk aversion, lack of individual accountability and excessive "double-checking" are barriers to greater efficiency and innovation. In addition to some of the other "hard" measures suggested in this report, it will be important to promulgate a leadership drive towards efficient and cost-effective safety. Options are suggested for changing goal-setting philosophy, (e.g. removing the HLOS safety target) and for education and guidance on cost-conscious safety.

7. ***Options for changing safety governance bodies generally provide only limited cost-efficiency benefit***
   In themselves, the costs of running the safety parts of ORR, RAIB and RSSB are relatively limited compared to the overall costs of the GB railway. Whilst there will always be opportunities to continue to improve efficiency and reduce budgets, the degrees of freedom for significant change are limited, for example:
   - ORR acts as the National Safety Authority, and the safety regulatory function will always be required.
   - RAIB, as the independent accident investigation body, is also required by law. However there are some opportunities to reduce its scale and scope, also supported by comparisons with other European railways.
   - RSSB, which was set up in response to Cullen, is not required by law. However its functions would, for the most part, still need to be carried out somewhere in the industry even if RSSB did not exist. These functions include: a research programme, safety information reporting, education and training, the Safety Risk Model, and Group Standards. Options for RSSB are closely connected with other major restructuring options.

8. ***Based on the evidence we judge that with due care it is possible to make significant improvements in cost-efficiency whilst at least maintaining, and possibly enhancing control of safety risks***

   As part of this study we have examined selected relevant comparators and benchmarks including, amongst others: safety and standards governance regimes in four European and two non-European countries; one European railway (Pro Rail); the US Railways; the Aerospace sector; and the National Grid. These comparators and benchmarks have been used to help assess the feasibility of individual options.

   In addition we have conducted over 40 interviews covering GB railways including NR, TOCs, FOCs, ROSCOs, suppliers and regulatory/governance bodies. We have also examined and assessed GB rail safety trend data. Finally we have drawn on our broader experience in consulting and advising on safety, risk management and innovation across the rail and other sectors internationally. Based on this evidence we can conclude that:

   - There is a shared consensus that current GB rail safety and standards arrangements are not optimal from the point of view of duplication, efficiency and effectiveness. There is also evidence from across private sector industry that the best performing businesses commercially also tend to have high safety performance, so there does not have to be a trade-off.
   - There are many examples from comparators which would tend to support the feasibility of proposed cost-efficiency options.
   - Based on trend analysis, the spend on safety that would be "justified" to meet future safety performance requirements is less than what has been spent up to now. This is because of the effect of "diminishing returns", given the very significant improvements in safety performance that have already been made since privatisation. This is the case even taking into account increased risk levels due to additional future traffic.

9. ***Overall, any argument for reducing spend on safety-related activities needs to take account of societal and commercial factors, including possible sudden changes in societal preference in the event of a major accident or incident***

   The justification for spend on safety depends not only on legal duty (including the principle of reducing risks SFAIRP), but also on commercial and policy issues. In commercial terms, a duty-holder may decide in certain circumstances that more money should be spent than would be required to meet legal requirements – for example if the risk is perceived to be something that could have a detrimental effect on company reputation, or if powerful stakeholder groups have a particular interest in the issue. In policy terms, the industry may decide to implement safety measures which significantly exceed legal obligations for reasonable practicability (i.e. costs are grossly disproportionate to safety benefits), purely because of the expressed or inferred preference of society, often as interpreted by political leadership.

Follow up and implementation

We envisage that the following initial steps would be needed for implementation:

- Integration of study findings with those of the other themes, including rationalisation of data and clarifications where needed.
- Review of overall structural and policy options by government.
- Articulation and agreement of an overall strategy for GB rail.
- Further feasibility studies to provide a better definition of objectives, scope, risks, costs and benefits.
- More in-depth examination of particular restructuring options.
- Fleshing out of key scope items.
- Consultation on critical items.

Clearly a communications and stakeholder engagement plan would also have to be a key early priority in further work.

The authors would like to express their sincere gratitude for the cooperation of the numerous stakeholders consulted in the study, and for the valuable insights they have provided.

1 Introduction

1.1 Context

The costs of the rail network in Great Britain (GB) are rising faster than revenues, resulting in increasing subsidy from government. At the same time the costs of the GB railway are reported to be high relative to other European railways and other regulated sectors where comparable activities take place (ref Rail Value For Money (VFM) Scoping Study report, March 2010). The Secretary of State for Transport announced a study into the VFM of the GB railways in December 2009. The recent plans announced by the new GB government to make major cuts in public expenditure have added further urgency and impetus to the need for identifying significant cost savings in the railways.

The VFM study is being conducted for the Department for Transport (DfT) and the Office of Rail Regulation (ORR). This report covers one of 10 themes within the VFM study, namely Theme G Safety, Standards and Innovation.

1.2 Terms of reference

The aim of the study is to identify and, where possible, quantify opportunities for improving the cost-efficiency of the GB railways. The scope of the Theme G study comprises:

- Reviewing GB rail's current approaches to safety and standards, including drivers of cost.
- Identifying options to improve cost-efficiency related to safety and standards, and to accelerate or enable innovation to achieve greater cost-efficiency.
- Assessing and, where possible, quantifying the potential benefits of these options in terms of cost-efficiency, including identifying any disadvantages and/or risks.

The scope includes the GB railways that operate on the NR controlled infrastructure, so excludes metro and light rail systems. There are a number of interfaces that this Theme G study has with other themes:

- Theme B Industry leadership, planning and decision-making: Our report covers certain options relating to industry leadership and decision-making for safety, standards and innovation.
- Theme C Structures, interfaces and incentives: Our report includes options relating to the structure of governance and management for aspects of safety, standards and innovation.
- Theme E Asset management: Our report includes options for reducing the capital cost of assets through accelerating innovation or making changes to standards. However we do not include extensive consideration of whole-life costs and/or asset management optimisation practices.
- Theme F Supply chain management: Our report includes options relating to acceptance and supplier assurance processes. We also refer to enabling measures to improve innovation that are pertinent to supply chain management approaches.

Arthur D. Little's role in this study has been to identify, and make an initial assessment of, a broad range of credible options for improving cost-efficiency, including some radical options that have potentially far-reaching implications. In many cases further detailed study would be needed fully to explore the feasibility and impact of such options.

It should be noted that the inclusion of an option in the report does not necessarily imply that there is shared consensus amongst the various stakeholders about its desirability – indeed such consensus has not been sought by us. Furthermore we have not sought to recommend any single preferred option or options. Our role has been rather to maintain independence and objectivity in identifying options and gathering available evidence for further consideration by the government and other key decision-makers. Evidence is provided on a best efforts basis depending on its availability.

In some cases there are wider political, societal and other strategic issues that would need to be considered in order to decide how to proceed and these are beyond the scope of the study.

Quantification has been provided wherever possible for potential improvements in cost-efficiency. However, in many cases only anecdotal cost data, in piecemeal form is available, and in one or two cases cost data is virtually unobtainable. In these cases estimate ranges have been prepared based on assumptions and approximations which have been clearly set out in the report. These estimates should be treated with a due degree of caution pending further definition.

In considering cost-efficiencies we have not made any distinction between different parts of the rail sector, nor have we assessed the flow of money between them. Cost savings are considered equally valid irrespective of whether they accrue to the government, regulators, train operators, infrastructure managers or the supply chain.

1.3 Methodology

The approach taken for the study comprised:

- Development of an issue analysis to identify a set of mutually-exclusive/collectively-exhaustive issues to be addressed in the study.
- Review of existing relevant information from DfT, from publicly available sources, and from in-house knowledge and information based on previous relevant work.
- Development of hypotheses for possible areas where cost-efficiency could be improved in relation to safety, standards and innovation. This included development of a simple system model of the key building blocks of safety and standards governance and their interrelations.
- Gathering the views and insights of a range of key stakeholders from across the industry, including collation of additional data and information.
- Comparative benchmarking including:
  - Rail safety and standards governance arrangements in 4 European and 2 non-European countries.
  - European railways, including one in detail (Pro Rail, Netherlands).
  - The US freight railroads through Transportation Technology Center Inc (TTCI), owned by the Association of American Railroads (focusing on governance, management and acceptance processes).
  - The GB aerospace sector (focusing on safety approvals).
  - National Grid (focusing on prioritisation of assets for safety-related expenditure).

Further details of the stepwise approach, issue analysis and consultees are given in Appendices 1 and 2.

1.4 This report

The report is structured as follows:

- **Section 2 The potential for cost-efficiencies**: provides an overview of rail costs, characterises the source of safety and standards costs, and assesses what might be an appropriate spend on safety based on historical trends. It goes on to diagnose the barriers that may be preventing better cost-efficiency, and summarises relevant efficiency improvements already planned by NR.
- **Section 3 Rationalising safety, standards and innovation governance**: covers key options for restructuring the governance of safety, standards and innovation.
- **Section 4 Reducing costs through changing asset design standards**: covers options for reducing the cost of certain railway assets through changing technical requirements for safety-orientated assets including level crossings and train protection.

- **Section 5 Reducing costs through changing operating standards**: covers options for improving the cost-efficiency of safety and standards-related aspects of rail operations, including possessions, rule book simplification and supplier assurance.
- **Section 6 Changing safety culture**: covers critical enabling factors for the industry to change the culture of the industry with regard to safety.
- **Section 7 Overall conclusions**: summarises the overall conclusions of the study, including a listing of options, and suggested short-term and longer-term schemes.

Appendices 1 to 3 cover respondents, methodology and references respectively. Appendix 4 provides a set of comparator case examples which are referenced at various points in the main body of the report. Appendix 5 provides a summary of the governance arrangements in place for safety and standards in four European countries and two non-European countries. Appendix 6 provides further details on the trend analysis we have conducted to review what might be an appropriate amount to spend on safety improvement. Appendix 7 identifies options for the creation of a systems and standards body. Appendix 8 focuses on Network Rail's technological innovation projects with cost saving potential. Appendix 9 is an RSSB document that indicates the costs and benefits of a new approach to the Rule Book. Appendix 10 details the logic behind our estimates of the costs and benefits of the Systems and Standards Body. Finally, Appendix 11 provides a glossary of abbreviations.

Certain items with commercially-sensitive information have been redacted at NR request. These are marked "REDACTED".

1.5 Explanation of options ratings

In sections 3 to 6 we have provided a series of options for cost-efficiency improvement. Each option starts with a summary which includes a simple rating system for two parameters: Implementation Risk and Timescale to Impact. These ratings should be interpreted as follows:

- *Implementation Risk*: the risk of the objectives not being achieved, representing the likely difficulty of implementation
  - High: substantial barriers and/or major uncertainties
  - Medium: significant barriers and/or some uncertainties
  - Low: few/no barriers, limited uncertainties
- *Timescale to Impact:* the approximate lead time before the option would lead to any significant cost-efficiency impact
  - Short: impact within 12-18 months (2011/12)
  - Medium: impact within CP4 (2014/15)
  - Long: impact after CP4 (after 2014/15)

It should be recognised that these ratings are approximate, in line with the limited level of definition of most of the options at this stage.

1.6 Acknowledgement

The authors would like to express their sincere gratitude for the cooperation of the numerous stakeholders consulted in the study, and for the valuable insights they have provided.

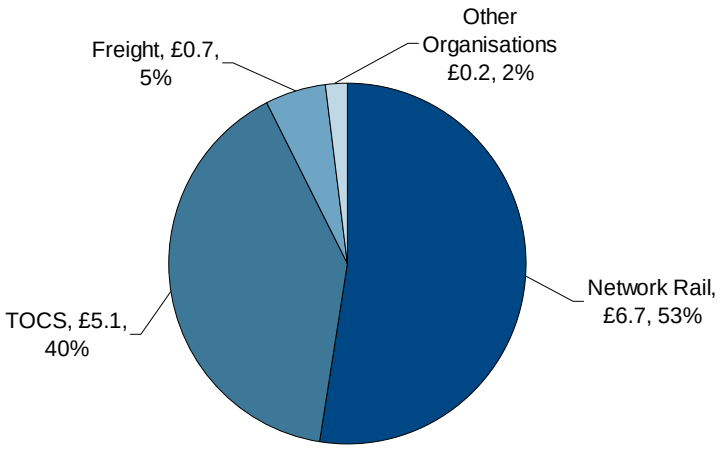
2 The potential for cost-efficiencies

In this section we briefly review the overall cost of GB rail, summarise sources of cost relating to safety and standards, and examine some key issues around achieving cost efficiencies in the safety domain. We go on to propose a simple system model for safety and standards, and use this to illustrate where there are key barriers preventing greater cost-efficiency.

The total annual expenditure of the GB rail industry is estimated as approximately £12.7 billion[3]
The starting point for improving cost efficiency in safety and standards is to understand where costs are being incurred in the rail industry, and what might be a suitable assumption for the proportion of costs that relate to safety and standards in particular. This provides a useful frame of reference for the "size of the prize". We have only sought to cover costs at a high level - it is understood that other Themes will be analysing and benchmarking costs in a range of areas in more detail.

The total annual expenditure of the GB rail industry is summarised in Figure 2 below:

Figure 2: Rail industry high level estimated annual expenditure



Source: DfT/ORR Rail VfM Scoping Study, NR Annual Return 2009, ORR Business Plan 2010, RSSB Strategic Business Plan 2009-2014, ORR Business Plan 2010, DfT Annual Report 2008/2009. "Other Organisations" category includes expenditure of ORR, RAIB, and RSSB expenditure as well as DfT rail related resource expenditure (i.e. excluding capital and grant related expenditure)

This breakdown is based on publicly available expenditure data primarily for 2008/2009[4]. The figures refer to real expenditures including investments but excluding internal money flows (such as track access charges from TOCs to NR). The figures do not include any other expenditures or investments by the GB rail supply chain (including ROSCOs) which are not funded through NR, TOC or FOC expenditure. The accounting methods used have not been investigated in detail.

Further breakdown of the NR total of £6.7bn shows the following split:

- Opex: £0.9bn (14%)
- Maintenance: £1.1bn (16%)
- Renewals: £3.2bn (47%)
- Enhancements: £1.5bn (23%)

[3] This total is different to that provided in the scoping document as new categories have been added which were previously omitted

[4] Data sets were used to ensure the maximum comparability

The NR Renewals total of £3.2bn includes approximately £1bn of track renewal.

Of the TOC expenditures of £5.1bn, £900m (18%) refers to payments to ROSCOs.

2.1 Identifying safety & standards cost efficiencies

2.1.1 Sources of cost relating to safety, standards and innovation

There are four main aspects of safety and standards we are considering as sources of cost

In the following table we have provided an initial characterisation of the generic sources of cost relating to safety and standards in the GB rail sector, based on an issue analysis which is provided in Appendix 2.

Table 4: Sources of cost relating to safety and standards

Aspect	Illustrative examples	Type of cost impact	Comment
Safety and standards aspects of GB rail governance and regulation	■ RSSB ■ RAIB ■ ORR (part) ■ DfT Rail (part) ■ NR ■ TOCS/FOCS	■ Governance body operating costs and budgets. ■ Resources for the rail industry to respond to safety-related regulatory requirements. ■ Costs for ownership and management of company standards and safety arrangements.	Budgets of governance bodies relatively small versus total rail expenditure, approx. 3% of total.
Safety or standardisation-related asset requirements	■ Embedded in the asset: – Provision of special safety-related equipment and design features (e.g. related to signalling, automatic train protection, level crossings etc.). – Design features to comply or harmonise with local, national or European standards. ■ Part of asset procurement and approval: – Assurance, approvals and demonstration of standards compliance for new or modified assets.	■ Capital cost of new or modified assets to incorporate safety or other technical requirements to comply with the range of applicable standards. ■ Cost of time and resource needed for assurance, approval and demonstration of compliance with standards for new or enhanced assets.	Asset renewals and enhancements account for most of rail expenditure, e.g. 70% of NR expenditure – even a modest increase in cost-efficiency has a large potential cost impact.
Safety and standards aspects of railway operations	■ Track possessions procedures. ■ Safety-related aspects of many operating procedures such as train driving, signalling, maintenance etc. ■ Safety and standards management processes and procedures.	■ Operating costs to cover time and resources to conduct safety-related activities. ■ Costs of downtime relating to safety-related activities. ■ Safety and standards functional staff costs and budgets.	Safety aspects necessarily permeate most parts of rail operations.
Underlying culture related to safety, standards and innovation	■ Perceptions of reality affecting behaviour, e.g.: – "It's not worth trying to get a derogation for this equipment". – "We may be held liable if we don't implement this safety feature".	■ Indirect impact on safety and standards related decision-making. ■ Direct impact impossible to quantify, but culture and behaviour affects the achievability of other improvements.	Alignment of culture and behaviour is known to be a critical enabler in order to bring about change.

Source: Arthur D. Little issue analysis

These four categories of safety and standard cost are addressed in Chapters 3 to 6. It should be noted that Culture is best considered as a critical enabling factor for other direct improvements to be realised, as further discussed in Section 6.

For reasons of practicality and to minimise overlaps we have limited our scope in the areas of operations and asset requirements

Safety and standards issues are closely integrated into nearly all aspects of railway engineering and operations. In order to maintain reasonable scope boundaries and to avoid excessive overlap with other themes, we have taken the following approach in terms of asset engineering and operations:

- For assets, whilst we have considered a broad range of technological innovations that could save costs, we have focused most on assets which have a strong safety-related functionality, such as level crossings, signalling and train protection. We have not included any extensive consideration of whole life costings or, more generally, cost efficiencies in asset management.
- For operations, we have focused only on those operations with a strong safety focus, namely possessions, rule book and supplier assurance. Wider operational issues have not been covered.

Innovation is considered primarily in terms of removal of barriers

Innovation has tremendous potential to enable greater cost-efficiency. In this study we have focused on means by which barriers and gaps preventing or hindering innovation could be reduced or eliminated.

2.1.2 How much should we spend on safety?

Determining how much money should be spent on safety, and on what to spend it, is an issue which has been extensively explored within the GB railways over many years. The most recent guidance "Taking safe decisions" issued by RSSB provides a set of principles, a framework and worked examples for how to approach this for individual decisions within the current regulatory regime. At an overall industry level it is possible to use the same principles to gauge whether the overall safety benefit gained justifies the expenditure made (a VFM-based argument). However, as recognised in the RSSB guidance, policy and commercial issues are also a key part of the decision-making process.

In this section we examine historical trends on GB mainline rail safety performance and spend on safety improvement in the post-privatisation period, in order to establish whether or not VFM has been provided up to now and what might be appropriate for the future. This review has been developed from previous work by Professor Andrew Evans 'Rail safety and rail privatisation'. The main findings of the review are provided here, with full details and supporting explanation provided in Appendix 6.

At the end of the section we provide some observations about the policy and commercial aspects of reducing spend on safety.

Based on trend analysis we judge that the "additional" expenditure on safety improvement beyond the pre-privatisation (1994) baseline level has provided reasonable VFM to date in terms of total safety benefit

Our review shows that the actual annual accident rate on the GB railways since privatisation is lower than would have been predicted by extrapolating forward the pre-privatisation trend, with a total of 150 fewer fatalities in the period 1994 to 2008. We have estimated that the "additional" safety expenditure during this period, i.e. the expenditure over and above the typical safety expenditure prior to privatisation, was in the region of £1.5bn, or £100m per year on average. At the 2009 Value of Preventing a Fatality (VPF) level of £1.661m, this equates to a direct safety benefit of some £250m. GB Health and Safety Executive guidance recommends that indirect costs also need to be taken into account when valuing the cost of safety, and suggests that these are typically between 5 and 10 times direct costs. Allowing for this would bring the total benefit to some £1.25bn-£2.5bn, which compares reasonably with the estimated "additional" safety expenditure of £1.5bn. However clearly this is a very approximate assessment.

Looking ahead, it may be predicted that the spend which is justified to maintain today's safety risk levels and meet current safety improvement targets is significantly less than the equivalent average "additional" safety expenditure in the post-privatisation years, due to the diminishing achievable rate of further improvement

We can reasonably expect that the expenditure from 1993 to the current time will provide further safety benefits going forward, at least as far as, say, 2020 since it has provided systems that have a life to at least this point in time. Extrapolation of the accident rate trends to 2020 suggests that some 8 fewer fatalities per year may be expected relative to the predicted rate from the pre-privatisation period 1967 to 1993, giving 96 in total from 2008 to 2020. Looking ahead, in theory additional expenditure above "baseline" is required to both (1) maintain risks at their current level (in the light of increased traffic volumes) and (2) to meet the current HLOS safety improvement target which specifies a 3% reduction in risk (passenger and staff) by 2014 (Refer also section 6.2 for HLOS target discussion). Using similar trend analysis we have assessed that an amount of some £20m -£40m per year would be justified to meet these objectives, based solely on safety benefits achieved. This is substantially less that the equivalent "additional" expenditure in the post-privatisation years which is roughly estimated at £100m per year (see above). It should be stressed that these numbers do not represent the *total* safety-related cost of the industry – such a number is virtually impossible to estimate since safety is so closely integrated into many aspects of the railway. The primary significance of this analysis is that it provides some theoretical support to the view that the spend necessary to maintain and improve safety levels going forward could reasonably be expected to be less than the spend which has been made since privatisation, reflecting the significant levels of safety improvement already achieved and the diminishing achievable rate of further improvement. This, of course, assumes that initiatives such as Lord Young's review of the health and safety agenda marks a turning point towards a reasoned societal debate about the cost of safety, reflected in legislation.

2.1.3 Levels of discretion on safety expenditure

There are differing levels of discretion available to policy makers and duty holders to change safety and standards-related requirements for cost-efficiency reasons. A realistic perspective needs to be maintained

It is also helpful to be aware of the available levels of discretion for policy makers and duty holders to make changes in safety and standards-related requirements. In order of increasing discretion, these requirements can be characterised as follows:

- European or International legal requirements or standards.
- GB legal requirements or national/industry standards.
- Local or company requirements (based on accepted industry practice or specific needs).

In addition, there is a category of requirement which responds to *societal preference* – this may become especially strong in the aftermath of a major accident. It is difficult to place this in a hierarchy, as the requirement itself is often inferred or assumed, rather than explicit. Players in the GB rail industry from time to time cite societal preference as one of the key underlying drivers for their safety-related actions.

In this study we have aimed to consider all types of change, on the basis that even, say, international law is not immutable. However it is important to maintain a realistic outlook on what could be achieved in practice.

2.1.4 Conclusions

Overall, any argument for reducing spend on safety improvement needs to take account of societal and commercial factors, including possible sudden changes in societal preference in the event of a major accident or incident

The justification for spend on safety depends not only on legal duty (including the principle of reducing risks SFAIRP), but also on commercial and policy issues[5]. In commercial terms, a duty-holder may decide in certain circumstances that more money should be spent than would be required to meet legal requirements – for example if the risk is perceived to be something that could have a detrimental effect on company reputation, or if powerful stakeholder groups have a particular interest in the issue. In policy terms, the industry may decide to implement safety measures which significantly exceed legal obligations for reasonable practicability (i.e. costs are grossly disproportionate to safety benefits), purely because of the expressed or inferred preference of society, often as interpreted by political leadership. The implementation of TPWS is a good example of this.

Clearly great care needs to be taken in reducing costs related to safety – there is a risk that some changes could become a hostage to fortune. How to approach this is a matter of policy

An obvious way to increase safety cost-effectiveness is to spend only the amount that is required to comply with legislation, consistent with accepted moral and ethical principles around "duty of care". However, in so doing the policy and commercial parts of the decision cannot be ignored. Reducing spend on safety is a highly-emotive issue for society, and some cost-efficiency options which make sense from a VFM, legal (duty-holder) and "good practice" perspective, may still be seen as unacceptable. Perhaps even more apparent is that spending less money on safety could become a hostage to fortune – if a serious accident were to occur whilst safety-related cost reductions are still in the public consciousness, it is likely that a causal link will be presumed by media and society, irrespective of whether or not this really exists. We leave it to policy makers to decide how to approach this issue – our role is to set out the possibilities and options, backed up by whatever evidence is available.

2.2 Diagnosis of current barriers towards greater cost efficiency

An "ideal" rail safety and standards system is dynamic and delivers a safe, reliable and cost-efficient railway through continuous innovation

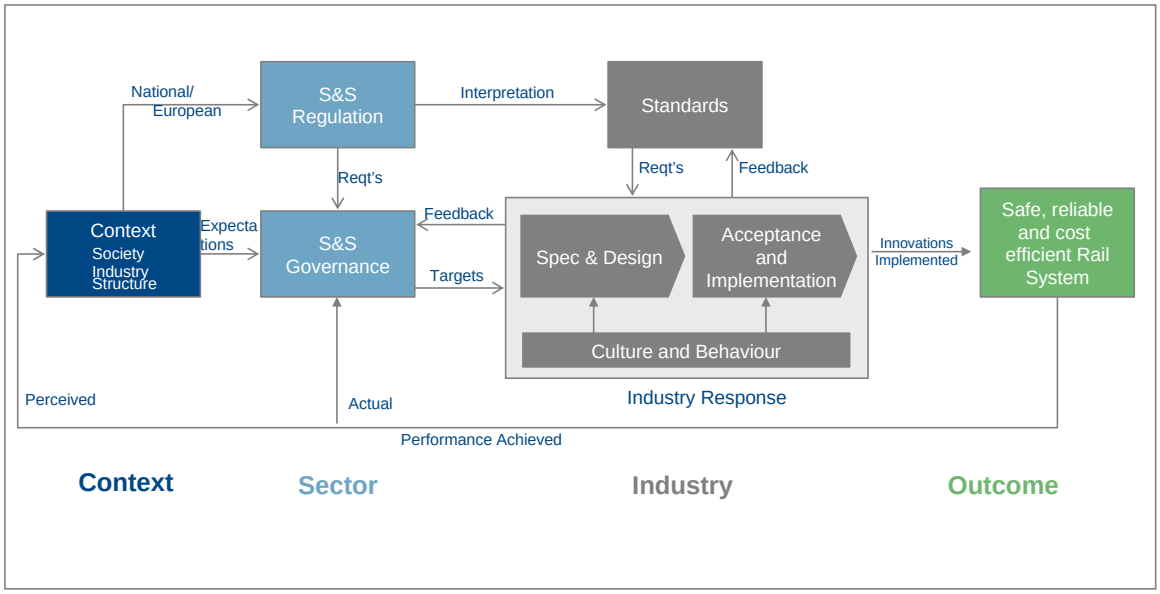
In order to be able to identify options for change, it is helpful to develop a view on the nature of the current situation and the barriers which may be preventing better cost-efficiency from being achieved. Based on the results of the consultation, and building on previous work (RSSB study T934 Enabling technical innovation in the GB rail industries – barriers and solutions[6]), we have developed a simple model in order to illustrate the way in which the key elements in the safety and standards "system"[7] interact to deliver the objective of a safe, reliable and cost-efficient railway (see Figure 3).

[5] Ref "Taking Safe Decisions" RSSB publication

[6] www.rssb.co.uk/RESEARCH/Lists/DispForm.aspx?ID=910

[7] In this context "System" refers to the totality of the various key elements of safety and standards across the industry including their interrelations

Figure 3: System model for safety and standards



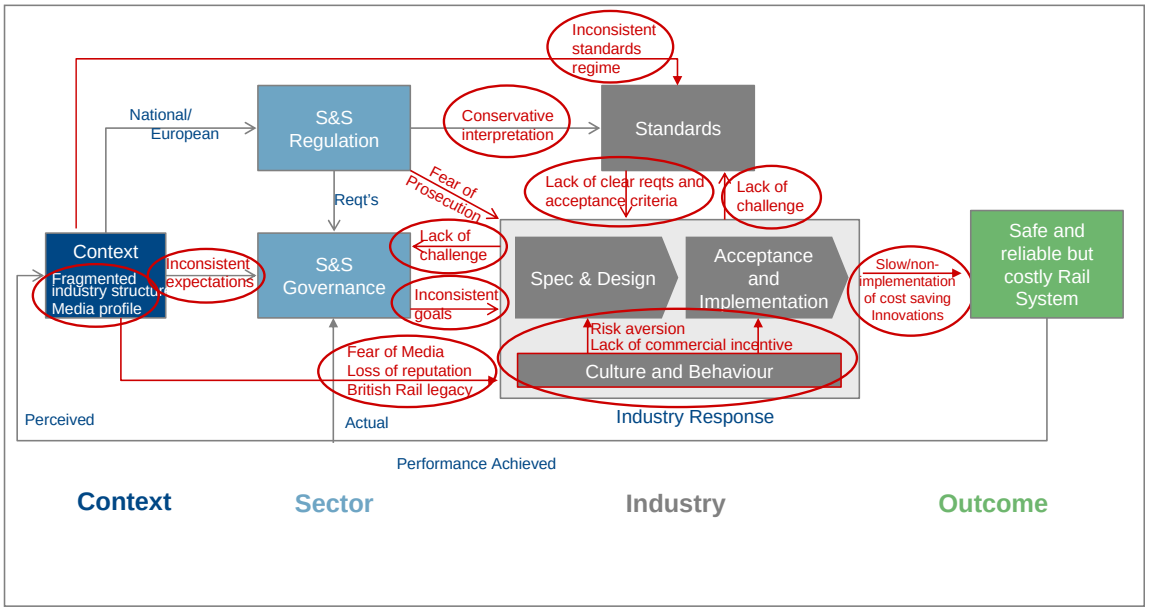
Source: Arthur D. Little analysis

In the idealised model above, the Industry delivers continuous innovation to ensure that safety, reliability and cost-efficiency are maintained and improved as the rail system grows and develops. Processes for specification and design of new technology or operating procedures, and acceptance of changes are key to delivery of innovation – though culture and behaviour is also a critical enabler for effectiveness. Standards are set in response both to Regulation and in response to the business needs of the Industry. Regulation and Governance ensures that national and international needs and requirements are met within the context of society's expectations and the current industry structure. The system has a number of feedback loops to ensure that there is dynamic change and continuous improvement.

There is widespread consensus that the current GB safety and standards system is failing to deliver these objectives in a balanced way

As part of this study we have solicited the opinion of a wide range of stakeholders about the current safety, standards and innovation effort. There is almost unanimous agreement that whilst the current system has delivered high safety performance levels and improved reliability, there are number of deep-seated barriers which affect cost-efficiency (refer Figure 4).

Figure 4: System model for safety and standards – illustrating barriers



Source: Arthur D. Little analysis

The diagram attempts to illustrate some of the key barriers which adversely affect cost-efficiency, in particular:

- Fragmentation and complex governance ***lead to*** inconsistent target-setting and incentivisation, an inconsistent standards regime, and a lack of trust between key players (for example issues related to short franchises, contractual boundaries between different players, lack of natural commercial and market pressures).
- Regulatory emphasis on duty-holder risk and demonstration of ALARP, grey areas in terms of acceptance criteria (e.g. how safe is safe enough), corporate memory of previous accidents, fear of commercial loss through damaged reputation, fear of prosecution and a volatile media environment, ***lead to*** conservatism and risk aversion amongst duty holders in application of safety and standards, and reluctance to challenge the status quo.
- Lack of cross-boundary systems leadership, lack of commercial incentives to innovate due to contract/franchise structures, slow and difficult approvals processes ***lead to*** poor implementation of innovations which hinder better performance and cost efficiency.

Many of these barriers have already been identified in previous work (e.g. RSSB study T934 Enabling technical innovation in the GB rail industries, RIA consultations and papers). It is also noteworthy that almost all players in the system see the cause of the problems residing with 'others'. This is symptomatic of "system-level" problems.

Measures to improve cost-efficiency need to address these system barriers

It is important to recognise that whilst there are a number of specific options for change which can directly improve cost-efficiency in the short term, in order to achieve lasting and major improvements it is necessary to address these critical system-based issues, many of which interact with each other. For this reason, in the study we have not only focused on specific targeted measures with direct cost-efficiency impact (such as changing level crossing standards), but also "enabling factors" to address system failures (such as removing barriers to innovation). These enabling factors cannot be realistically assigned a specific cost-efficiency impact, but are nevertheless critical to realising other gains and to achieving the necessary culture change.

2.3 Cost efficiencies already committed

There are already substantial savings committed to by the industry under CP4 – generally this study has sought to identify further options in addition to these, although some options focus on acceleration of existing projects

The industry is already in the process of responding to cost-efficiency targets. Most significantly, under CP4 NR are required to deliver efficiencies of 21% (on top of the 27% made since 2003). NR have advised that their current Transformation Programme has committed to savings of £3.3bn, covering categories of Asset Management, Effective Infrastructure Delivery, Access Management, Network Operations and Organisational Effectiveness. In this study we have sought to identify options *in addition to* these already committed efficiencies, although in some cases the option relates to acceleration or enabling of an existing committed project (such as possessions management or rule book simplification).

3 Rationalising safety, standards and innovation governance

In this section we cover costs resulting from the governance of safety, standards and innovation. After initial consideration of the costs of current safety governance bodies (Section 3.1), we focus in Section 3.2 on alternative governance arrangement for standards, innovation and research to enable significant cost savings to be achieved. In sections 3.3 and 3.4 we cover approvals, acceptance and the issue of a "differentiated railway".

3.1 Safety governance regime

3.1.1 Current situation

The safety governance regime accounts for some £60m of annual cost (including Railway Group Standards)

The current safety governance regime in GB comprises four main parts, the Office of Rail Regulation (ORR), the Railway Safety & Standards Board (RSSB), the Railway Accident Investigation Board (RAIB) and the Department for Transport (DfT) rail team. Further details on the nature and respective roles of these bodies are provided in Appendix 5.

The costs and number of staff (in Full-time equivalents, FTE) of these bodies to GB are summarised in Table 5:

Table 5: Railway governance bodies

Organisation	Annual cost (£m)[1]	Of which, S&S-related annual cost (£m)	Total FTE	Of which S&S FTE (Percentage in brackets)
ORR	32	18	298	126 (41%)
RSSB	32	32	250	250 (100%)*
RAIB	6	6	52	52 (100%)
DfT (Rail)	180	1	340	12 (3.5%)
Totals	**250**	**57**	**940**	**440**

*Note: It is estimated that some75-80 FTEs are derived from RSSB's research work

Source: ORR Business Plan 2010; RSSB Strategic Business Plan 2009-2014; DfT Annual Report 2008/2009; http://data.gov.uk/dataset/central-government-workforce-initial-release; Arthur D. Little Interviews with relevant Organisation

From the table it may be seen that annual cost related to safety and standards is some £57m.

Legislative constraints mean the overall safety governance framework in GB is largely similar to that of other European countries. How the framework is implemented differs across European countries

The European Railway Safety Directive requires all member states to establish a National Safety Authority (NSA) which is independent from railway undertakings, infrastructure managers, applicants for certificates and procurement entities. Legislated responsibilities of the National Safety Authorities include a duty to authorise, and in the case of rolling stock keep a register of new and changed components of the railway and ensuring relevant technical specifications for interoperability (TSIs) are met. The NSA is also required to develop a safety regulatory framework, including a system of national safety rules, and to produce an annual safety report to the European Railway Agency (ERA).

The Directive also requires member states to establish independent rail accident investigation bodies and sets out the principles of mandatory investigations of serious accidents and incidents. These requirements are thus reflected in all European governance regimes and the overall framework cannot be changed without a change in European legislation (refer Appendix 5).

There are however, some differences in how this framework is implemented including the use of additional bodies for particular roles, the integration of the safety and economic regulator, and size of the relevant bodies. For example, only GB has an additional body with responsibility for the national safety rules (RSSB), with other European countries generally choosing to set national rules through their National Safety Authority. Many European countries, such as the Netherlands and Germany and recently France, have a separate national safety authority (safety regulator) and economic regulator, whereas GB has a combined the economic regulator with the safety regulator (ORR). Differences also exist in how independence is implemented where required, such as with Accident Investigation Bodies. For example, Germany delivers independence of the accident investigation body from the NSA by using different functional entities within the same organisation. Other differences include the size (and therefore effort and cost) of equivalent bodies. For example, Belgium and France both have smaller Accident Investigation bodies than in GB. The following table provides some comparative FTE numbers for bodies across Europe.

Table 6: Comparison of FTEs in European safety bodies

Country	Body	Type	No of FTEs	Comment
France	EPSF	National Safety Authority	96	Includes authorizations, audits, inspections, database
	BEA-TT	Accident Investigation	13 (+12 non-permanent)	Covers all land transport
Germany	EBA	National Safety Authority	1250	Covers planning, inspection, audit, licensing, enforcement, funding
	EUB	Accident Investigation	20	Railway accident investigations
Netherlands	Railway Inspectorate	National Safety Authority	63 of which 14 FTE for Accident Investigation	Maintaining safety rules, admission of railway undertakings; also investigates incidents
	Directorate Rail	National Safety Authority	NA	Developing safety rules and legislation
	Dutch Safety Board	Accident Investigation	5 (board members only)	Serious accidents and incidents, multi-sector including transport

Direct comparison with the UK FTEs (some 440 as per Table 5 above) is difficult in view the different allocation of roles and tasks across the various bodies in each country, and without more detailed analysis it would be unwise to draw direct conclusions. However, it is apparent that accident investigation bodies in other European countries generally have considerably less full time resource than is the case for RAIB.

3.1.2 Analysis

Safety governance roles and responsibilities are shared between a number of different bodies

Table 7: Safety Governance – Key roles and responsibilities

Task/role/responsibility	Responsible body (ies)	Comment
Conduct National Safety Authority tasks (authorise new and changed components of the railway, ensure TSI requirements are met, produce ERA report)	ORR	Combined safety and economic regulator
Issue safety certificates for safety management systems	ORR	None
Develop safety strategy	RSSB/ORR	RSSB has role in long-term strategy, though ORR has objective to improve H&S performance
Develop, maintain and manage the safety risk model	RSSB	None
Standards development	DfT/ORR/RSSB/Duty Holder	DfT and ORR have interoperability responsibilities, RSSB manages Group Standards, Duty Holders manage company standards
Manage approvals/acceptance/design authority processes	Duty Holder	Duty holder is responsible for initiating and managing approvals process, calling upon others for contributions
Contribute to approvals process by confirming compliance with requirements, rules and operational constraints	Nobos, Debos, affected parties (e.g. NR)	Technical approvals and comment on acceptability of proposed change
Conduct safety inspection and enforcement	ORR	None
Perform Accident investigations	RAIB	None
Conduct and manage safety, standards and technology related research	RSSB, some DfT, NR	RSSB manages cross-industry research
Develop technology strategy	TSAG[2]	Cross-industry group, managed by RSSB

1 Also Nobos, Debos, ISA

2 TSAG: Technology Strategy Advisory Group (cross-industry group)

Source: Arthur D. Little

The division of roles and responsibilities within the framework of safety governance is complex compared to other European railways with many areas of overlap

It can be seen from Table 7 above that there are several areas where responsibilities are shared in GB. The higher number of interfaces results in a more complex system compared to other railways. For example:

- More organisations are involved with the development of standards in GB compared to other European countries. It has been suggested that this additional interface adds complexity.
- GB has a separate body responsible for the co-ordination of research (RSSB) whereas other European countries rely on research conducted or co-ordinated by the Government.
- In most European countries, interoperability is ensured predominantly through the NSA (ORR in GB), whereas in GB both DfT and ORR are involved.

However, some aspects of the GB system simplify the governance structure, such as the combining of the economic and safety regulator reducing the need for a separate economic body (e.g. in contrast to the Netherlands, where they are separate).

There is some lack of clarity amongst industry players about the precise roles and interfaces of safety and standards governance bodies, and certain aspects of the value they provide are questioned by some

Although members of the DfT, ORR and RSSB understand clearly their roles and interfaces, others in the industry are unclear, some going so far as to attribute to this uncertainty a reluctance to seek derogations against standards when such derogation might be of value to the company, the project and the GB rail industry at large. Some express concerns about the ways in which economic and safety considerations are matched and some believe that there is inadequate consideration of the economic impact of new and changed standards or of the impact of changes made to pursue better safety.

DfT's role in Europe is not understood in detail, but generally the process is thought to work well. There is a shared view that changes in government strategy over many years have contributed to the current complexity in GB

The DfT's role with respect to Europe is not understood in detail by many, but people are aware of the way that it gathers inputs and represent GB's interests and believe that the process works reasonably well. With regard to operations in GB there is a range of opinions about the extent to which it should intervene, with some jaundiced views of the success of such interventions in the past. Most are of the view that the DfT should not have any significantly greater level of direct intervention in the running of the railway - this may have its roots in a perception that rapid changes in government strategy since privatisation have contributed to the current complexity of the industry and its lack of cohesion.

ORR's safety regulation role is clear, though the level of integration with economic concerns and interface with DfT on European regulation is not well understood

As the NSA, ORR's safety regulation role is clear. Whilst ORR has taken some steps to integrate safety and economic aspects of its role, some still point to instances of Railway Inspectors who failed to give adequate consideration to the economic consequences of their actions. Generally it is recognised that considerable progress has been made in achieving thoughtful and rational trade-offs. ORR's role with respect to TSI authorisations and its interface with DfT's broader European interoperability role is not well understood by many.

RSSB's role with respect to Group Standards and information management is well understood, but its safety leadership role and value of some of its research is questioned

RSSB was created in response to the recommendations of the Cullen Inquiry[8] and differs from the other bodies fundamentally in the sense that it is in industry body not a government body. RSSB stress their holistic role in providing the means for knowledge-based decision-making for the industry. In practice, RSSB's role in standards setting is well understood and the split between the Railway Group Standards and the standards managed by duty holders is recognised. The Safety Risk Model is generally valued, together with RSSB's stewardship. There are reservations within some parts of the industry about the value of parts of the research conducted and managed by RSSB, although they are recognised by many as a useful resource to investigate issues that no other single part of the industry is able to, or willing to, tackle. RSSB is owned by industry stakeholders and is therefore bound to operate on the basis of consensus. This means that it is in general not in a position to exercise leadership in any directive or coercive sense, although RSSB point out that interface standards (such as the RGSs) do, in any case, need to be based on consensus.

RAIB's role is well understood, but there are mixed views about the value of RAIB when operating outside its statutory remit

RAIB was created in response to the recommendations of the Cullen Inquiry[1]. The potential contribution of RAIB to safety in the industry is well understood, however there are mixed views about the value of RAIB when it is operating outside its statutory remit, in which it explores accidents and incidents on the basis of the likely importance of the safety lessons learned, rather than the strict legal criteria. Some believe that this leads to too many recommendations which can add undue cost, requiring time and money both to check cost benefit justification, to implement and to challenge. However others believe that these investigations can unearth potential precursors to more serious incidents. For reference, between Oct 2005 and Dec 2008, RAIB made just over 600 recommendations, approximately 190/year on average, with over 96% being accepted for implementation.

There is a perception held by many in the industry that the legislative framework and philosophy is such that liability is strongly issue-dependent and uncertain, which is a driver of risk aversion

Under the GB legislative framework, duty holders are responsible for managing the safety of their undertakings and having their systems and processes for doing so approved by the ORR in its role as NSA. However, the custom and practice associated with the use of safety management systems is what ultimately controls both safety and the expenditure on safety. Many duty holders regard the overall issue of governance and of responsibility to be strongly dependent upon the specific issue or situation and thus very uncertain. This tends to lead to conservative interpretations of the obligations of the HSAWA. As one duty holder described it, "what is important will be decided in court". This uncertainty is perhaps the primary driver of risk aversion that underpins much of safety management and innovation across the industry.

[8] The Ladbroke Grove Rail Inquiry – Part 2 Report (2001). Access August 2010 http://www.railwaysarchive.co.uk/documents/HSE_Lad_Cullen002.pdf

3.1.3 Options for change

Following on from the above analysis, in this section we consider two options which have short-term cost-efficiency impacts relating to, respectively, RSSB and RAIB. In the case of RSSB (Option 1 below) it is important to consider any change in the context of broader structural issues – hence this option is closely linked to other options reacting to standards and innovations governance (refer Option 3 below).

Option 1: Reallocate functions currently provided by RSSB

Ref	Title	Implementation risk (H/M/L)	Timescale to impact (S/M/L)	Range of cost to implement (£m)	Range of cost efficiency impact (£m/year)
1	Reallocate functions currently provided by RSSB	Medium	Short (within 18 months)	6-8 (one off)	10-15

Description

This option comprises reallocation of some or all RSSB functions including RGS management, research management, stewardship of the industry's Safety Risk Model (SRM), Safety Management Information System (SMIS) and diverse educational and leadership support functions. In the case of dismantling RSSB altogether, functions could in principle be reallocated as follows:

- SRM, SMIS, RGS management and education/leadership support functions could be covered by ORR.
- Research activities could be managed by DfT.

As variants on this option, some, rather than all, of RSSB's functions could be re-allocated or trimmed. These variants have not been considered in detail.

Key constraints

Reallocation of RSSB functions is closely linked to other options for standards governance. This option could perhaps be best seen as an alternative to more fundamental restructuring of safety and standards governance.

The implications of any changes with respect to the intent of the Cullen Inquiry (which led to the original setting up of RSSB) would need to be addressed.

Cost efficiency impact

The overall cost efficiency impact for the industry is estimated at a maximum of £5m to £10m, based on the constraints above. Savings are 30%-50% of current RSSB budget depending upon the degree to which functions are retained in any new structure. Savings would be achieved by sharing of overheads, net reduction of staff, and net reduction of programme budgets.

Cost to implement

We have not been able to conduct a fundamental review of RSSB. However, as a starting position we could assume that in the case of dismantling of RSSB a proportion of their 250 staff, say 40% to 60%, would be TUPE'd across to other organisations with others being made redundant. Based on an average redundancy cost of £50k, this would give a one-off cost of some £5m - £7m. There would be further costs associated with winding up the existing RSSB organisation and setting up new functions in ORR and DfT. These might be in the range £0.5m - £1m, giving £6m - £8m in total as a one-off cost.

Benefits

- Potential savings of £10m to £15m per year.
- Fewer governance bodies, simpler structure, more similar to European comparators.
- Could be lower cost and simpler that wholesale restructuring of Standards governance (see Option 3 below).
- Potential to achieve a more focused R&D programme (could also be done with the context of RSSB).

Disadvantages

- Trimming activities in the SRM, research, educational and leadership programmes could have some negative effect on engagement with the industry.
- Reallocating certain functions and leaving others would break up some of the synergies and co-dependencies in providing data, knowledge and analysis to support decision-making. For example, many of the skills used to support the development of standards are also used in delivering research.
- Could be perceived negatively by trade unions, public and media.

Comparators and benchmarks

The governance regimes of other European railways such as France, Germany and Spain do not have an equivalent stand-alone body with the same functions as RSSB. Indeed most countries do not operate these functions to the same extent as GB. Other European countries set the national safety rules through the National Safety Authorities only. Where countries do have an equivalent body, it is relatively small. For example, in the Netherlands, Rail Alert, which maintains the national safety rules, has a workforce of approximately 3.5 FTE.

Option 2: Constrain RAIB's work to its statutory remit and streamline its operation

Ref	Title	Implementation risk (H/M/L)	Timescale to impact (S/M/L)	Range of cost to implement (£m)	Range of cost efficiency impact (£m/year)
2	Constrain RAIB's work to its statutory remit and streamline its operation	Medium	Short (within 18 months)	1-1.2 (one off)	3-10

Description

RAIB's remit is to investigate accidents or dangerous occurrences that result in, or any similar incident that might have resulted in, the death of at least one person, serious injury to five or more people, or extensive damage to rolling stock, the infrastructure or the environment. In addition to these statutory duties, RAIB also investigates accidents and events that do not comply with this definition, but which are judged to be of particular value from the point of view of learning and improvement. The Secretary of State could choose to constrain RAIB to statutory investigations only, which would reduce both the direct costs of RAIB operations and the costs of the industry in responding to these additional recommendations. Alternatively, RAIB could choose to focus its attention only on the key issues raised by recent incidents, in other words adopting an 'issue focus' rather than an 'incident focus'. RAIB is more heavily resourced than other European railway comparators (see Comparators and benchmarks below).

Key constraints

The EU Railway Safety Directive requires that there is an independent investigation body for serious accidents. The Directive allows for discretionary investigations if they are likely to improve railway safety. It should be noted that RAIB scope also includes Metro, Light Rail, Heritage and Channel Tunnel railways. The implications of any changes with respect to the Cullen Inquiry need to be confirmed.

Cost efficiency impact

The annual expenditure of RAIB is approximately £6m, covering 33 inspecting staff and 19 support staff (48 FTE). There are 2 operational centres in Derby and Woking. Approximately 75% of RAIB activity is focused on the GB railway, the rest being on other railways (Metro, Light Rail, heritage etc.). Since its inauguration, RAIB has conducted 164 investigations. In accordance with the Railway Safety Directive, RAIB were obliged[9] to carry out 6 investigations (4%), with 110 (67%) being discretionary[10]. The remaining 48 (29%) were in alignment with the National Safety Rules[11].

Assuming that scope was restricted to only include investigations that RAIB must carry out, in accordance with the Railway Safety Directive and National Safety Rules this would reduce the number of inspections by around 70%. This could reduce the overall budget by some 40-50%. Further efficiencies through streamlining, including possibly an element of further outsourcing or subcontracting to provide a more flexible cost base (not explored in this study) might be able to achieve a further 5 - 10% reduction, giving a direct cost potential of perhaps some 40 to 50% (approximately £2m to £3.5m).

The potential savings of the broader industry in having fewer recommendations to respond to are hard to assess. Assuming an average of around 200 recommendations per year currently, this number may reduce by perhaps 100. We have tried to estimate the average cost of a recommendation, but this is very hard to model. We know that the average time for full closure of a recommendation is around 15 months, and that "engineering" recommendations are likely to be more costly to implement than those relating to simple management actions. Based on our experience we have assumed that the average cost to the industry of responding to each recommendation is conservatively £10K-£50K (on the basis that there are some 30 companies potentially affected, some recommendations will have minor/negligible impact and limited applicability to only one organisation, some will have greater impact). For example one Freight Operating Company advised us that responding to recommendations requires on average £30k each. On this basis, this could mean perhaps some £1m to £5m of further cost reduction. We recognise that a small number of specific cases could be substantially more expensive – for example if a new engineering solution is required across the network. This would give a total range of about £3m-£10m.

Cost to implement

There would be a one-off cost associated with restructuring. We have assumed that reductions of some 20 - 24 staff might be possible, though this has not been verified. This could give a one-off cost of perhaps £1m - £1.2m, assuming £50k per redundancy.

Benefits

- Potential savings of perhaps £3m-£10m, including indirect costs.
- This change would be in alignment with the option of changing safety-related targets and goals to reflect a greater cost-efficiency balance (see Option 20).

[9] These 6 investigations were initiated in accordance with Article 19, Part 1 of the Railway Safety Directive which states that "Member States shall ensure that an investigation is carried out by the investigating body referred to in Article 21 after serious accidents on the railway system, the objective of which is possible improvement of railway safety and the prevention of accidents.". Data obtained from http://pdb.era.europa.eu/safety_docs/naib

[10] Of these 110 discretionary investigations, 63 were initiated in accordance with Article 19 Part 2 of the Railway Safety Directive which states that "In addition to serious accidents, the investigating body referred to in Article 21 may investigate those accidents and incidents which under slightly different conditions might have led to serious accidents, including technical failures of the structural subsystems or of interoperability constituents of the trans-European high-speed or conventional rail systems. The investigating body shall, at its discretion, decide whether or not an investigation of such an accident or incident shall be undertaken". 47 investigations were initiated in accordance with article 21 of the Rail Safety Directive which states that "Member States may entrust the investigating body with the task of carrying out investigations of railway accidents and incidents other than those referred to in Article 19."

[11] These include the investigation of Channel Tunnel, Light Rail, Metro, Heritage which fall outside the Directive

Disadvantages

- Fewer safety improvement actions implemented by the industry. RAIB point out that the non-statutory investigations often provide greater learning than the statutory investigations.
- Reduced capacity of RAIB to respond as quickly to accidents and incidents as at present, in particular the ability to quickly respond to the larger incidents.
- Need to establish if change should also apply to Channel Tunnel, Light Rail, Metro, and Heritage.
- Likely to be perceived negatively by trade unions, public and media.

Comparators and benchmarks

RAIB conducts more investigations per year than the equivalent bodies in other European countries. In Belgium investigations are limited only to major events. The French Bureau d'Enquêtes sur les Accidents de Transport Terrestre (BEA-TT) started 18 investigations in 2008. The Dutch Safety Board investigates approximately one to two railway-related accidents per year (although an additional 22 accidents and investigations were investigated by the National Safety Authority). By contrast, RAIB initiated 31 investigations in 2008.

With a workforce of 48 FTEs, RAIB has a larger permanent workforce than equivalent bodies in other European countries. For example, in Belgium, the investigation board has a staff of 1 FTE, calling upon others as needed. In France, BEA-TT has an authorised workforce of 13 employees with 12 non-permanent investigators being used as needed. These result in lower operating costs, for example in 2008 BEA-TT had an operating cost of €374,000 compared to the approximately £6m of RAIB.

However, RAIB point out that RAIB is seen by the ERA as being the best in its field in Europe and is significantly more experienced than many.

3.1.4 Other options considered

- The possibility of **requiring RAIB to conduct formal Cost Benefit Analysis (CBA)** for all its recommendations was also considered but not considered feasible. Currently RAIB do not conduct formal CBA, but instead conduct a "scoping" process to define the scope for follow-up more explicitly, and focus on active dialogue with the recipients to gain their inputs to ensure practicality and feasibility of recommendations. We do not think that it is feasible to require RAIB to conduct their own CBA: firstly, RAIB are not the owners of the risk and need to maintain independence; and secondly, RAIB may not have easy access to the necessary cost data, especially as there may be indirect or other consequences that RAIB may not be aware of. It has been suggested that RAIB could conduct an appraisal prior to investigation to confirm the likelihood of valuable outcomes and insights before embarking on an investigation, however this also has inherent challenges as an approach.
- A further sub-option for RAIB is to **create a single Transport Investigation Board**, covering other transport modes as well as rail – this is a common model in other countries. This could provide some economies of scale and possibly could improve cross-learning of good practices from one sector to another. We have not assessed the feasibility of this, but in any case the cost-efficiency savings would be unlikely to be much more significant than for the main option considered above.

Section 3.2 considers a range of related options for standards and approvals governance.

3.1.5 Conclusions

The cost efficiency of governance of safety in the rail industry could be improved through consolidation and a degree of scope reduction and streamlining of RSSB and RAIB. However, the budgets concerned are limited and so the direct savings would be limited. There appears to be little scope to significantly reduce the budget of ORR, whose activities are largely driven by statutory requirements. All three bodies are very much aware of the need for cost reduction and greater operational efficiency.

3.2 Standards and innovation governance

3.2.1 Current situation

This section considers the standards and innovation governance regimes, including research. It is also closely linked to section 3.3 Approvals and acceptance.

The standards regime comprises three main parts

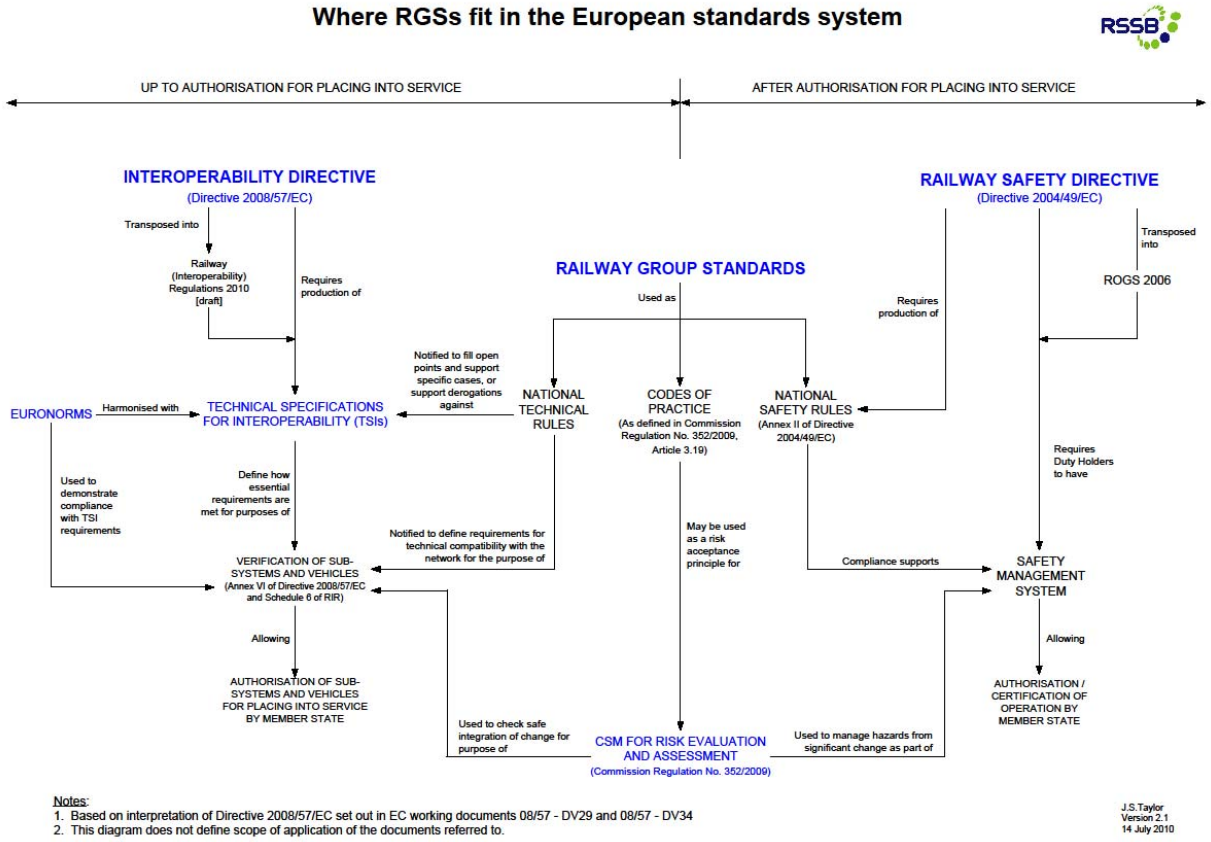
Broadly speaking the key elements of the standards regime are:

- Technical Specifications for Interoperability (TSIs)
- Railway Group Standards
- Company Standards

Today the legislation that embodies the EU Directives regarding the introduction of equipment onto the railway is reasonably clear. Furthermore, the ERA continues to issue guidance notes that seek to clarify further areas that could be subject to varying interpretation. European Technical Standards for Interoperability (TSIs) define essential requirements to be met for subsystems and components to be used on the railway. Although the TSIs could be better structured, and despite the fact that they incorporate a particular incarnation of the system architecture, they are now reasonably familiar to stakeholders in the industry. Where the TSIs are silent on an issue, where there are routes to which the TSIs do not apply or where there are local network characteristics that need to be covered to ensure network consistency, the Member States provide formal statements of the requisite standards, the National Notified Technical Rules (NNTRs). In GB these are included within the Railway Group Standards (RGSs). At the request of the industry, RSSB manages the RGSs. RSSB's governance and management processes are approved by the industry because RSSB is owned by the industry, and its board and delegated governance are determined by the industry. There are currently 171 RGSs, as well as Rail Industry Standards, guidance notes and codes of practice.

Figure 5 shows the interplay between the Directives, the TSIs, the Railway Group Standards and the ways in which these provide coverage before and after authorisation for placing into service.

Figure 5: Where RGSs fit into the European standards system



Source: RSSB Analysis (Jon Taylor) July2010

Company standards (not shown on the above diagram) comprise a large body of standards which are maintained by companies to support their design and procurement processes. Many of these are to be found in NR as the Infrastructure Manager, whose company design standards current number approximately 1250 (plus 122 guidance notes). It is these standards that capture past practice, and set out parameters and preferred approaches and that are used by designers and suppliers. Using these standards, at best, streamlines design, prevents unnecessary reworking and avoids the waste of re-inventing well-understood principles. Other standards also come into play on the railways, for example Euronorms and British Standards, typically called up selectively by the design standards. The ORR conducted a review of the prevailing standards regime in 2009.[12]

Processes are in place to manage derogations

Instances may arise in which a candidate innovation is blocked by the way in which a standard is phrased. Under these circumstances derogation may be sought. A derogation is not so much an excusing from the imperatives of the standard as a proposed alternative that needs to be shown to achieve an equivalent outcome to that mandated by the standard. Derogations against the TSIs need to be managed through the DfT and against RGS to be managed through the relevant Standards Committee of RSSB. Both the DfT[13] and RSSB[14] suggest that an early step is a discussion to establish the feasibility of derogation and to discuss strategies for achieving the desired outcome. Both identify typical processes and timescales.

[12] http://www.rail-reg.gov.uk/upload/pdf/cons-rep_revstndrds_0808.pdf

[13] www.dft.gov.uk/pgr/rail/interoperabilityandstandards/interoperabilityfaqs/interoperabilityfaq1?page=1

[14] www.rssb.co.uk/RGS/Pages/DEVIATIONS.aspx

There is a shared consensus that the GB rail industry is conservative with respect to innovation, whilst there is an equally shared recognition that innovation is vital for the railway to deliver against its strategic goals

It is generally accepted that innovation is vital to the delivery of performance and cost improvements for the railway. Innovation covers incremental developments in the industry, the introduction of technologies and approaches from other railways but which are new to the GB railway, and also more radical innovation. Achieving a commercially sustainable railway depends upon continued and effective innovation. There are few stakeholders who would not agree that the GB railway is not as innovative as it could be. There are a number of studies that have sought to shed light on the reasons for lack of innovative capability. The issue of innovation within the industry currently falls within the remit of the industry's Technology Strategy Advisory Group, who recently commissioned a study from RSSB to identify barriers to innovation, building on previous would by the Railway Industry Association - "Enabling technical innovation in the GB rail industries – barriers and solutions" (T934).

3.2.2 Analysis

There is a widespread consensus that there are problems with the current standards regime

There is widespread consensus that the standards, especially NR's design standards, are complex, confusing, often contradictory and some would say, not fit for purpose. Some within NR would like to fundamentally revise the structure and content of the standards – 'tear them up and start again'. It is, however, recognised by all those who see the problems that to rebuild the standards regime represents a major task needing expensive and scarce resource.

Problems highlighted generally by respondents (though not all validated in detail as part of this study) include the following:

- The structure and content of the TSIs constrain architectures because of their description of sub-systems and interoperability constituents and the way in which they are parameterised.
- The need to define interfaces unambiguously requires the TSIs to be prescriptive, but this can too easily slide from parameterisation to embodying design solutions that constrain innovation.
- The Railway Group Standards, inevitably, embody past practice, some of which is changing and hence the standards need to be updated.
- Company-level design standards are sometimes complex and often contradictory.
- Company-level design standards often embody clauses inserted to cater for specific situations or because of specific events such as accidents, and these clauses then become constraints.
- Standards cross-reference each other, requiring specifiers and designers to pursue and assimilate these cross-references.
- Users, both specifiers and designers, sometimes fail to distinguish between the mandatory and the guidance, and so tend to over constrain.
- Standards sometimes provide a vehicle for the risk averse to constrain innovation.

To identify the implications of these issues it is useful to understand the availability of mechanisms by which standards can be modified:

TSIs: There are clear mechanisms by which the Member States can engage with the TSIs and by which the member states and industry participants can comment on the TSIs and their supporting guidance. Although such mechanisms are undoubtedly cumbersome, in large part this reflects the need for representation and agreement across the EU.

RGSs: There are, similarly, mechanisms by which RSSB governance processes manage the Railway Group Standards. Not only does the industry have means to influence the standards through those mechanisms but, also, because the industry owns and, through its board, governs RSSB the industry has a means to influence the mechanisms themselves. In other words the industry can influence both the RGS and the way they are managed. The principles of representation, and of agreement by full consensus, make these matters more involved and less rapid than many would wish.

Company standards: Companies have established processes to manage the design standards that are their property. Because the companies are not responsible to the industry as a whole, they may consult, but do not have to integrate the input from others. For example NR has standards management practices that are driven by cost benefit considerations and by its own business imperatives. That is not to say that NR is indifferent to the needs of the wider industry, but it is not formally responsible to the industry for its standards. This is also reflected in ATOC's response to the ORR's 2009 review of standards, commenting that NR has retreated in its consultation with stakeholders. There are also mechanisms for the industry to engage with the creation of Euronorms and British Standards, but in the latter case commercial considerations also come into play.

There is a widely held view that in principle, the industry would benefit from a more unified and coherent set of standards in order to reduce complexity and allow for greater and faster innovation – this would require significant restructuring as well as a major programme of work to adapt and align
One of the most common views from across the industry is that having a more unified set of standards would be effective in dealing with complexity, contradictions and risk aversion – thereby leading to greater innovation, providing the potential significantly to improve cost-efficiency in asset engineering and operations. However, creating a single integrated set of standards would require significant restructuring. The TSIs, the RGSs and company standards are 'owned' and managed by fundamentally different entities each with their own governance, constituencies and imperatives. A new structure would need to be created to manage a unified set of standards, and there are a number of options for how this could be done (see Options below). Moreover, irrespective of the governance structure, a major programme of work would still be required to adapt and align standards so as to form a coherent set, and this would have cost associated with it.

The current process and practice for derogations is seen by many to inhibit innovation
Derogations lead to two primary areas of concern:

- Perceiving that derogations are public, innovators choose not to seek derogations in order to avoid revealing aspects of commercial confidence.
- The added risk and uncertainty associated with derogations means that innovators do not pursue the derogation route, choosing instead to take the certainty of designing to comply with the standard and accepting the loss of functionality or performance.

There is acknowledged to be some uncertainty associated with seeking derogation. This uncertainty is magnified by the extent of the conflict with the established standard, by tight timescales, by large project values and, especially, by contracts with penalties for delay. There is considerable anecdotal evidence of design compromises being made to avoid having to engage in derogation processes, for example in Hitachi's choice of European braking system technology for the IEP. Inflexible contract conditions and adversarial contracting reduce the attractiveness of seeking derogation to allow innovation.

Recent work has suggested three primary sets of barriers to innovation in the industry

The above RSSB report for TSAG identified the primary barriers to innovation and proposed solutions. Many of the same issues identified in that study are valid also for improving the cost efficiency of safety and standards, albeit with different flavours and symptoms. That work highlighted three primary sets of blocks to innovation, two of which are summarised below:

- *Lack of motivation* – lack of motivation for individual players in the industry to innovate, typically as a result of structural issues leading to commercial benefits being diminished or obscured, or perceived high risks of failure. The absence of a single systems view, typified by the idea of there being a single design authority, makes it impossible to see the complete set of cost and safety benefit trade-offs and to manage these meaningfully. Short franchise periods mean that payback periods are tightly constrained. Hence any potential delay, for example arising from a delay in acceptance, has a disproportionate effect because it curtails the duration of payback and reward. The same phenomenon is driven by a strong focus on measurement within control periods. Often an innovation in one part of the system may benefit another party, and as there is usually no way to monetise the benefit in such a case, cross-system innovations are not pursued. Certainly there is no mechanism to share development risk prior to the introduction of innovation. Similarly, silo thinking between and within organisations means that safety benefits are not pursued if the beneficiary and the funder are different. Being the champion of an innovation that failed to deliver, irrespective of the quality of the thinking and undertaking, is seen as career-limiting and hence many choose the familiar rather than take the perceived career risk. So also do people avoid innovations because they do not wish to manage the complexity and uncontrollable delays of showing compliance with standards and appropriate levels of safety. Risk aversion affects both innovation and cost-effective standards and safety management.
- *Lack of strategic research and development capability* – disjointed and fragmented identification and development of innovations, especially large and risky undertakings involving several players. There are a number of channels of research pursued in the industry, strategic research under the DfT, RSSB's research, university work and activities within the duty holders. The industry's vision and the Rail Technical Strategy come together with the Technical Strategy Advisory Group. The industry needs a joined-up way of bringing research to demonstrator stage so that de-risked innovation can then be pursued confidently within commercial projects with tight budgets and schedules. In reviewing RSSB's research activities[15] the ORR concluded that there needs to be a stronger top-down focus on strategic research. This is indeed appropriate. The ORR goes on (Para 2.28) to advocate combining RSSB's core research budget and the strategic research budget on the grounds that this would simplify research management. However, to do so would lose the critical distinction of the nature of the work labelled 'research'. Some research work, which is in pursuit of the big strategic issues that face the railway, should be managed through a broader pipeline - this research should funded by the state to explore issues which are system-wide, which are likely to develop only over extended time frames, or which are so risky that there is no likelihood of such research being done by a commercial entity. On the other hand there is 'research' which is, or should be, of bounded duration and is directed at answering a specific question. Often such work is commissioned by the Standards Committees to support the development of a better standard or guidance. It is important to recognise that this work is very different in kind to strategic research and should be managed as such. Combining the budgets runs the risk of losing the distinction and further blurring the accurate targeting of work – which targeting will become more important as budgets are squeezed. A better alternative is to recognise that the industry's research should be regarded as a portfolio of projects, with different objectives, timeframes, risks and stakeholders. Budgets should be managed in this context.

The third primary block to innovation relates to bringing innovations into service. This is covered in Section 3.3 Approval and Acceptance.

[15] Report on ORR's review of RSSB, ORR, 2 August 2010, http://www.rail-reg.gov.uk/upload/pdf/rssb-review-report-020810.pdf (accessed 6 August 2010)

3.2.3 Options for change

Below we consider 2 options for addressing the issues of unification of standards and removal of barriers to innovation:

- Option 3: Create a new independent systems and standards body and rationalise standards.
- Option 4: Create more effective mechanisms to translate research into demonstrations of de-risked technology.

For Option 3, there are a number of suboptions for how a new body could be created from existing bodies. These are covered in Appendix 7.

Option 3: Create a new independent systems and standards body and rationalise standards

Ref	Title	Implementation risk (H/M/L)	Timescale to impact (S/M/L)	Range of cost to implement (£m)	Range of cost efficiency impact (£m/year)
3	Create a new independent systems and standards body and rationalise standards	Medium	Medium/Long (within CP4 and during CP5)	30-45 per year	200-230 plus 10 - 300 per major investment scheme

Description

This option involves the creation of an independent industry systems and standards body which would have two separate and clearly defined roles:

- Systems options evaluation: to lead and co-ordinate the identification and evaluation of technology options open to the railway in addressing particular issues and strategy proposals for the railway as an integrated system.
- Standards role: own and manage and develop an integrated and consistent set of standards for the GB railways.

Systems role:

GB is an integrated and tightly coupled system in which the behaviour of any part has a profound effect on the operation of the rest of the system, in terms of performance, costs, safety, reliability and resilience. GB rail is, however, managed by separate commercial entities, each with different strategic priorities and with different timescales of management focus. Almost without exception the timeframe within which economic performance is evaluated is much shorter than the lifetime of the system components. Additionally, there are often opportunities for major through-life cost savings in one part of the system to be accessed via investment in another part of the system. Similarly, safety performance is delivered by an interplay of rolling stock and infrastructure. The decoupling between the commercial 'system' and the technological 'system' makes it impossible to achieve global optimisation today.

By creating a body to consider the railway as a system and to explore and evaluate solution options it becomes possible for industry stakeholders to see the wider picture, to understand the trade-offs to be made and to fully appreciate the cost, performance, safety, reliability and resilience aspects. The body would, for defined problem areas, generate and consider system solutions, their performance and costs, and then make its findings widely available. This would be done well in advance of projects so clearly separating the consideration of options from the time-limited and commercially driven projects that must be focused on well-defined deliverables.

At the core of the systems body would be a multi-disciplinary team of engineers and economists competent to do the detailed work of identifying, articulating, doing outline designs and costings for candidate solutions. The team would need to be skilled in communicating clearly the critical objectives, constraints and assumptions and then laying out options for the industry. A scalable structure would have a permanent core team with judicious use of external consultants for specific topic areas and specialisations. There could be opportunities for suppliers and system integrators to become involved in order to stimulate systems thinking from the supply side. The work of a team such as this will become particularly critical as control and 'intelligence' moves from track to train (e.g. ERTMS) in the future. Under conditions of budgetary stringency it will become particularly important to make the most effective investment allocation decisions, and the work of a function such as this would help identify where to get the best return within what is, after all, a tightly integrated system.

With the options clearly articulated then the industry becomes able to make more cogent decisions, recognising major opportunities to make better cost-benefit trade-offs across the system as a whole.

The governance of this function needs to be carefully designed. The function must be:

- Well-targeted, working on the most important opportunities, sufficiently early to shape the boundaries and objectives of major commercial projects.
- Clearly independent of any commercial bias.
- Able to have real influence by building commitment across industry stakeholders to better strategies and commercial trade-offs.

Finally, there needs to be a willingness by industry leaders to work together to craft the commercial arrangements to bring the better system solutions to fruition for the good of the industry to ensure its survival and long-term prosperity.

Standards role:

This role entails managing and delivering a coherent and well-designed portfolio of standards to support the operation of GB rail. The aim is a set of standards that are prescriptive where necessary to ensure compatibility and interoperability but which do not constrain innovative solutions. Doing this would include ownership and management of the "Notified National Rules" and those standards that are recognised as critical for interface management. Going further, by mandating this body to take on and manage the myriad standards currently owned and managed by NR, ROSCOs, TOCs and other duty-holders, the standards body can then rationalise and simplify the standards that block innovation, that delay and constrain good solutions and that add unnecessary cost to the industry. This task of rationalisation, simplification and clarification, with better separation of the mandatory and the advisory represents a major task. However, only by removing complexity, confusion and unnecessary constraints can the industry innovate better, make best use of equipment from other markets and exploit the investments made for other railways for better use in the UK.

The rationalisation of standards is widely recognised as desirable as a route to cost savings in the industry. Some work has been undertaken by RSSB on RGSs, and NR has also promised rationalisation as part of their Transformation programme[16]. However the unification of standards under a single body with system-wide authority provides the means for a much more far-reaching rationalization and impact.

[16] NT Transformation Programme (Confidential) 6 August 2010

If the standards are written in ways that clearly demand a particular level of performance or a specific interface, but do not mandate a particular solution then the number of derogations should fall. A derogation is, after all, not an excusal from a standard but instead an agreement of an alternative route to deliver the same outcome as that sought by the standard. Well-crafted standards should enable new approaches to solutions to be accepted on the basis of their performance, not their solutions route. Similarly, solutions already developed for other railways can be assessed against standards that focus on performance.

The intention is that specifiers and designers can call upon better standards that do not impose unnecessary constraints to innovation, to re-use or access to standardised designs from other railways. Note that the standards body would deal only with the standards themselves. Duty holders will, of course, still specify particular aspects of their procured items, for example, various aspects of the seating or internal finish details of rolling stock. Specifiers may demand of their suppliers attributes such as commonality and standardisation, perhaps of spares provision and so on. What is sought however is greater clarity to all involved, specifier, procurer and supplier, how much of the requirement is driven by performance standards to meet system requirements and how much of the requirement is driven by a desire for other attributes. One of the great opportunities in GB rail, that of standardisation should therefore be available, unconstrained by the current mishmash of standards.

The duty-holders would retain liability with respect to standards compliance and may still choose to use Nobos, Debos and ISAs as at present. Network Rail currently combines its processes of product selection and product approval as discussed elsewhere. The creation of a rationalised set of standards that support innovation may open up the way for Network Rail and its suppliers to separate the issues around demonstrating compliance with essential requirements and the issues around optimising the supplied product or system for requirements driven by needs other than safety and compatibility, such needs as aesthetics and cost-drivers.

There are a number of suboptions 3.1 to 3.4 which cover how such a body could be created with respect to existing bodies including RSSB, ORR, NR and DfT, each of which implies different ownership concepts. In essence, the potential cost efficiency impact of all these options is the same. For brevity these suboptions are covered in Appendix 7. The key success criteria for ownership and governance would include:

- Effective independence from other players in the system.
- Sufficient authority to provide overall systems and standards leadership.
- Governance that engenders respect from stakeholders and maintains organizational credibility.
- A minimum of constraints due to history, prejudices and perceptions.

It is beyond the scope of this study to define in more detail the structure, size and precise duties of the body. However it is possible to explore indicative staffing. The systems function would need a core staff of between 30-50 people. This is based on the experience of the CrossRail systems team of about a dozen and the need to explore a wider and more diverse range of issues, maybe on several topics in parallel. The standards function would need a staffing level that reflects a subset of the staff working on standards in RSSB and in Network Rail. We have estimated the RSSB staffing level attributable to standards and safety as approximately 150 assuming the same proportionality of headcount as budget spend (£19M of their £32M turnover on core services, i.e. not on R&D). If we assume that another 50% staffing would enable gradual rationalisation of the NR standards as well, we arrive at a standards staffing level of about 230-250. Hence one could envisage a systems and standards body of some **300-350 staff**. This body could be augmented as required by temporary staff and by consultants as appropriate.

It has been assumed that the body would not be also responsible for approvals, which would remain the responsibility of the sponsor (see also Section 3.2.4 and 3.3) as defined under the current legislation of the UK under the European Directives.

Comparisons might be made between this option and the former unsuccessful Strategic Rail Authority (SRA). However, unlike the SRA, this body would be primarily technical in its role and mission and would not have any of the commercial, regulatory or governmental oversight functions of ORR and DfT. The envisaged body does, of course, face the same primary issue of any new entity trying to set direction in the industry; to what extent should this be a body of the industry and by the industry, leading by example, insight and consensus and to what extent should this body be endowed with powers to mandate action and direction? The answer to this question will depend very much on the structure of the industry going forward.

Key constraints

The scale of this change would be very significant. Its feasibility or otherwise goes to the heart of broader questions about the structure of the industry and, in particular, the role and structure of NR. Consideration of these broader questions is outside the scope of this study.

Cost efficiency impact

There are four mechanisms by which this body will provide cost-efficiency benefit the industry:

- Enabling *system level innovation* and better system requirement specification through the systems body.
- Better *requirements definition* and hence more cost-effective procurement from a more coherent set of standards.
- *Reductions in the number of staff employed to check* others' interpretation of standards, embodiment in requirement, design and compliance, achieved through more simple and appropriate standards.
- *Acceleration* of projects and procurement that might typically experience delays due to difficulties in approvals.

In view of complexity of modelling these impacts we have provided a full rationale in Appendix 10. Please refer to this for further background.

In summary the cost-efficiency benefits are estimated as follows:

System level innovation

Based on an assumption of only 1% savings on typical major investment programmes (e.g. GWL Main Line Electrification, CrossRail, HS2) through better system-level innovation, savings could be between, say, **£10m to £300m** per major scheme.

Requirements definition

Better definition of requirements and explicit pursuit of standardised approaches, accessing commercial offerings tested in other markets, could lead to savings of about **£200m/year** in procurement and in rolling stock maintenance. This is based an assumption of some 5% saving in procurement cost.

Reductions in the number of staff employed to check

Based on an assumption that a 25% saving in compliance checking and approval staff could be achieved, and assuming a population of 100-200 staff across the industry, a saving of some **£2m-£3m/year** could be realised.

Acceleration of projects

For NR, acceleration by approx 2-6 months of "Enhanced Infrastructure Delivery" projects in NR's Transformation Programme could give a one-off benefit of some £60m -£180m. For TOCs, based on 1-2% saving on Opex expenditure, some £20m-£40m benefit may result, giving **£80m-£220m** in total. Over a total period of 10 years (CP4 and CP5), this could be expressed as approximately **£10m- £20m/year** on average.

The total savings therefore are approximately £200m - £230m/year, plus £10m-£300m per major investment scheme.

Cost to implement

The cost to implement can be split into set up and running costs. Set up costs could be between £5m to £10m including legal fees, consultations etc. Running costs would of course depend on the number of staff. For example RSSB, which has some 250 FTE, costs around £32m/year to run. Using a proportionate figure we would suggest that **£40m-£50m/**year would be a reasonable estimate for the new body. However, some of this would be offset by reduced expenditure at NR and RSSB itself on standards governance and management. We have assumed that this offset could be in the region of £5m- £10m for RSSB and a similar amount for NR, giving a net cost of **£30m - £45m/year.**

Benefits

- Major cost-efficiency improvement potential.
- Critical enabler for accelerating innovation onto the network, substantially more effective than other "committee-based" solutions to technology and standards leadership.
- Unified ownership and governance structure would overcome many current weaknesses in system-wide technological innovation capability.
- Would be seen as fully independent and objective.
- Would be aligned with other industry restructuring options.

Disadvantages

- Requires creation of a new public body.
- Relatively time-consuming and costly to set up, involving significant change.

Comparators and benchmarks

There are a number of examples of independent standards bodies in other national railways:

- In Belgium, the current railway National Rules reference company rules (e.g. Infrabel company rules) where there is significant overlap. A project is currently underway to extract out the rules from the company level and maintain them at the national level, with the aim of making the rules clearer and more explicit.
- The American Association of Railroads (AAR) is a membership-based organisation responsible for ownership and setting of standards for innovation, safety and technology for North America's railroads (refer Appendix 4). It also, through its subsidiaries the Transportation Technology Center (TTCI) and the Railroad Research Foundation (RRF), manages rail research programs. In this sense it provides similar functions to those envisaged by the independent systems and standards body, although it is a membership body (similar to RSSB therefore, except that it has ownership of all the industry standards including those relating to infrastructure). The TTCI may be seen as an exemplar in addressing Option 5, the management of R&D to demonstrator stage.
- In the Netherlands, Rail Alert is a new organisation aimed at improving safety and overseeing standards, and exists alongside the Netherlands National Safety Authority (Refer Appendix 5).
- Systems Integration Team (Thameslink)
  - As part of this major rail project, an embryonic team has been established to assemble a consistent set of requirements and to address cross-system aspects of system specification and performance. Their major contribution has been raising questions and offering options that have profound commercial implications.
  - The team is composed of secondees (about 12 people) from organisations associated with the project but, importantly, operates independently of those organisations.
  - The result has been a mechanism for early exploration of options and issues with potentially largely commercial consequences.

- Aerospace Innovation and Growth Team (AeIGT) and the Aerospace Technology Steering Group
  - In 2002, the Aerospace Innovation and Growth Team (AeIGT) was established to plan and guide the strategy for the GB aerospace industry.
  - The Aerospace Technology Steering Group (ATSG) provides technical leadership and the National Aerospace Strategy is becoming the de facto GB strategy for the sector.
  - The ATSG established subsidiary task forces to i) undertake detailed co-ordination of the delivery of the projects under the strategy and ii) create common collaboration agreements for partner organisations.

Option 4: Maintain current structure, adapt standards and provide guidance

Ref	Title	Implementation risk (H/M/L)	Timescale to impact (S/M/L)	Range of cost to implement (£m)	Range of cost efficiency impact (£m/year)
4	Maintain current structure, adapt standards and provide guidance	High	Medium/Long (within CP4 and during CP5)	10-15/year	100-120

Description

In this option there are no changes to structure or ownership of standards, so the status quo is maintained. A major programme of work would be undertaken to significantly modify and adapt both company design standards and RGSs for better consistency and cost-efficiency at the Company and RGS levels - goal seeking where possible, prescriptive where necessary or efficient. This has been undertaken by RSSB and has been promised by NR[17].

This option would also include complementary guidance. The main purpose and value would be to provide support for specifiers, for designers and for those needing to propose deviations from current standards. In effect, designers would be pointed to those issues that they need to consider in proposing alternative approaches, and in proposing their suggested deviations from the standards. This would be valuable to address the most pressing parts of the standards regime. It would require a coordinated effort by the owners of all the key Company-level Standards. It is recognised that there are already guidance documents for example relating to RGSs and NR standards.

There is also a call for the Industry Standards Coordination Committee to make more use of cost-benefit analyses in determining its priorities and its direction of focus. The ORR review explicitly identifies the need for consideration of effectiveness and efficiency implications as well as H&S implications. Some tell us that this is already underway. Again it is in the gift of the industry to drive the ISCC towards this end.

Key constraints

The work required is substantial, and there is a lack of any strong incentive for NR or any other company to make a significant investment in standards adaptations for consistency which would provide overall GB-wide system-level benefits, as opposed to Company level benefits. The imbalance between NR and other duty-holders, and the mix of commercial and technical compatibility issues inherent in NR standards and approvals, will remain a constraint. The lack of a unified ownership and governance structure could be expected to act as an obstacle to achievement of system-wide consistency and coherency, especially between RGS and company standards. The lack of any structural change may be interpreted as “business as usual” as far as standards are concerned.

[17] NR Transformation Programme (Confidential) 6 August 2010

Cost efficiency impact

Refer to Option 3 above. This option will access none of the benefits of the systems body and will provide only a proportion of the other benefits sought because of the loss of overall cohesion at organisational boundaries. Accelerating projects will, as in Option 3 depend upon the drive of individual organisations and may therefore be similar, say £80m-£220m, or £10-£20M/year. Local focus on standardisation could be expected to achieve only part of that benefit stream, say £100m/year (versus £200m/year in Option 3), reflecting that a continuing lack of focus on the overall standards framework may make savings much more challenging and therefore less likely to be delivered. Savings through reductions in numbers of staff would be relatively insignificant in comparison, hence the total saving would be roughly **£100m-£120m/year.**

Cost to implement

The cost of implementation of a major programme to adapt standards would be significant. As a very rough indication, one could suggest that the cost could be perhaps £25m-£50m over, say 3-4 years, based on the current number of standards (some 1250), and an assumption of, say £20k-£30k average cost per standard, representing 3-4 man months each. This would equate to some **£10m-£15m** per year, £40m-£60m over CP4.

Benefits

- Innovation and cost-efficiency improvement potential.
- No need for organisational restructuring, hence lower implementation cost and less disruption.

Disadvantages

- Lack of unified ownership and governance structure would be a major obstacle to achievement of goals.
- Unclear whether NR and other duty-holders with company standards could be suitably incentivised, coordinated and controlled.
- Does not tackle issues around blurring of commercial and technical/compatibility requirements embodied in NR standards and acceptance processes.
- Perception of “business as usual” could act as obstacle to change.
- Implementation cost is still significant, added to the activities of fully loaded engineering staff.

Comparators and benchmarks

- In Belgium, the current railway National Rules reference company rules (e.g. Infrabel company rules) where there is significant overlap. A project is currently underway to extract out the rules from the company level and maintain them at the national level, with the aim of making the rules clearer and more explicit.
- GM, Ford and Chrysler have aligned their EMC specs and worked with suppliers to develop common acceptance processes.

Option 5: Create more effective mechanisms to translate research into demonstrations of de-risked technology

Ref	Title	Implementation risk (H/M/L)	Timescale to impact (S/M/L)	Range of cost to implement (£m)	Range of cost efficiency impact (£m/year)
5	Create more effective mechanisms to translate research into demonstrations of de-risked technology	Medium	Long (CP5 onwards)	2-3/year + research funding dependent upon project portfolio	Enabling: included in Option 3

Description

This option focuses on the acknowledged gap in the product development cycle between concept and de-risked large- scale demonstration. Many stakeholders in the industry resent the fact that much of the research that is undertaken, especially by RSSB, does not seem to be adopted and exploited by players in the industry. In part this is because the industry at large does not fully understand the differences between the strategic research that is undertaken to explore technology options and the research that is undertaken specifically to support the development and refinement of standards.

The need is to create and manage a portfolio of research projects that aim specifically to create technology platforms, that demonstrate the potential of new technologies and that enable industry players to take the lessons and to adopt the technology with the assurance that the major uncertainties have been eliminated. In the context of the railway industry, research of this nature is likely to focus on systems issues, i.e. exactly those issues where industrial organisations are not incentivised to take the development risk themselves because of the uncertainties of how to monetise the results.

The need is to develop and maintain an industry strategy and to support research necessary to bring ideas to the point that their business case and future potential is proven. This will build naturally on the work of the Technology Strategy Advisory Group and of the DfT's strategic research to date.

It is important to differentiate between the purpose of this option (to ensure the effectiveness of R&D) and the purpose of the systems body described in Option 3 (to identify and characterise solution alternatives at system level in the railway). While research may well identify and contribute to the work of the system body its role is more focused. It is not the system body's role to choose and direct research programmes.

Managing research programmes to ensure participation from industry supply chains and to attract involvement from other suppliers of technology and innovation can be undertaken in a number of ways. Virtual networks and working groups can be created as had been achieved in the aerospace sector which has established innovation demonstrator projects that combine the resources and talents along the supply chain. At the other extreme entire development facilities can be created as has happened in the manufacturing sector. A middle option is to make use of a physical centre and to make good use of linkages with industrial partners and with research providers. This preferred option comprises the creation of a small and cost effective entity analogous to the Energy Technologies Institute (ETI) with active participation of industrial partners. Other industries have found effective means of achieving this, for example establishing innovation demonstrator projects that combine the resources and talents along the supply chain in the case of the aerospace industry.

Other less attractive variants which would be more applicable in a scenario where current industry structures are retained, include broadening RSSB's remit, or changing the purpose and power of the Technical Strategy Advisory Group.

Key constraints

Bridging the identified gap will require a degree of investment which will not pay off in the immediate short term. If, as seems likely, research budgets will be tightly constrained in the years to come, the targets set must focus on the usefulness of such work and the speed, effectiveness and extent to which insights are brought into practical use on the railway. Whichever mechanism is chosen, its targeting must be focused more on outcomes.

Cost efficiency impact

It is impossible to quantify the returns on this option individually. However it is, like the previous option, a critical enabler for accelerating innovation within the industry and therefore an essential element of any innovation strategy.

One school of thought holds that R&D funding that does not lead to exploitation in the industry is, in effect, wasted. Hence if this option improves the uptake of R&D into the industry then it eliminates that waste. Furthermore, R&D that is adopted and embodied by the industry leads to further funding by industry to develop products and services so this option may well lever in extra funding into the sector once the returns become more evident. If we assume a continuation of the current funding stream of £3M pa then the industry could be reasonably challenged to match this funding. However, it is not clear that continued research funding will be forthcoming, so the primary benefit here should be regarded as supportive and enabling of wider innovation in the industry in future.

Cost to implement

The implementation cost will depend on the scale of the entity developed. For example the ETI has some 50 staff managing a research budget of about £100M pa. We assume that the railway research budget will be rather smaller than that so assume a railway-specific body with, say 10-20 staff and the same cost profile as RSSB would indicate an annual cost of £2-3M. Such a body also depends upon a flow of research funding, for example the £15M of DfT strategic funding which should be explicitly coupled with contributions from industry participants. The funding stream needs to be large enough to ensure critical mass. A realistic funding stream to pursue meaningful demonstrator research should be identified in the light of a robust portfolio of candidate projects agreed to mesh with the industry's strategy and of a size to have a meaningful impact.

Benefits

- Critical enabling factor for greater innovation.
- Increased effectiveness of the application of research budgets, leading to greater VFM.
- Potential for greater involvement and partnership with key parts of the supply chain in product development – this partnership has worked effectively in other sectors such as aerospace.

Disadvantages

- Requires short-term investment to set up and a commitment to a continuing research funding stream, whilst returns will be in the longer term.

Comparators and benchmarks

- Energy Technologies Institute
  - The Energy Technologies Institute is an independent body developing a research strategy and funding research projects into new energy technologies.
  - The body has six large industrial partners providing contributing £1M pa each and by the government for £50M over five years. The governance is by a board composed of representatives from the contributor organisations, and the ETI is managed by a full time executive board.
  - The research work is contracted to industry participants and may or may not include the partner companies.

- Institute of Manufacturing Technology coordination initiative (currently under development)
  - This will provide a focal point for the revitalisation of automotive supply chain manufacturing by 1) pulling together a core of existing institutions and facilities, with revised and coordinated funding streams, and 2) using this as a blueprint for setting up a single framework for industry/university collaborative research.
- Aerospace Innovation Networks
  - The AINs involve central and regional Government, industry partners, universities and research establishments. They are led by industry, with participation open to GB companies for work undertaken in GB, funded jointly by industry and government. Each network is distributed across several facilities.
  - AINs focus on R&D themes from the National Aerospace Technology Strategy, on a rolling 5-year period.

3.2.4 Other Options Considered

- The option of **including an approvals role in the Systems and Standards Body** was considered. In this option the responsibility for approval of new products for use on the railway would also reside with the new body. This would have the advantage of overcoming current difficulties in NR's acceptance role (see section 3.3 below). However, under EU legislation the responsibility for certifying the safety of products has to remain with the organisation responsible for putting it into service (using Nobos for TSI compliance and Debos for National Rule compliance). Furthermore there would be practical difficulties from the point of view of liabilities and insurance were the approval role to be included.
- The option of **providing an opt-out clause into the TSIs for rolling stock** (where the TSI is not relevant) was also considered but was deemed not promising enough for more detailed consideration and inclusion. Such a change would require EU level agreement which would be hard to achieve. Moreover, there is no consensus that this would prove to be cost-saving, especially in the longer term.
- The option **to review SIL levels and produce better guidance that will be accepted by the industry and supported by case law** was also considered but not in detail. SIL "inflation" (that is, excessive conservatism in SIL level designation) could add unnecessary costs, TPWS being an example. However the option was not considered in more detail since the expected level of cost saving is expected to be insignificant.

3.2.5 Conclusions

- The creation of an independent systems and standards body provides the best means of achieving a more coherent and unified set of standards, whilst also dealing with the critical barrier to innovation resulting from lack of a body to provide leadership and incentives for system-wide innovation.
- The option of rationalising standards and providing guidance only, whilst lower cost and not involving any major structural change, has a high risk of being ineffective.
- The creation of a strategic capability to bridge the R&D gap between concept and de-risked demonstration will be a powerful means of encouraging innovation.

3.3 Approval and acceptance

3.3.1 Current situation

The responsibility to demonstrate safety and compatibility rests with the duty holder

The previous section provided an overview of the current standards regime. The Directives and the legislation are clear that it is the responsibility of an organisation wishing to introduce new equipment to demonstrate that it is safe and that it will be compatible with the other elements of the network. They do this in two steps:

- By demonstrating the ability of the equipment to meet 'the essential requirements', one of which is safety.
- By demonstrating compatibility.

The National Safety Authority, the ORR in GB, confirms the process by which the two steps were completed and then authorises the placing into service of the equipment. The use of the equipment, especially rolling stock, will be further governed, as appropriate, by commercial agreements, for example regarding track access charges. Two aspects are important:

- It is the responsibility of the intending user to demonstrate safety and compatibility.
- The safety and compatibility of the new equipment is authorised by the ORR – but the ORR is, and will remain, silent on the commercial attractiveness of the new equipment.

3.3.2 Analysis

The current process is recognised by most as a source of confusion and often delay

The approvals process is seen by most, especially those in the manufacturer supply chain, as contentious and the source of much confusion and contradiction in the industry. Some see it as a source of unnecessary and expensive delay while others see it as the foundation of some of the cultural malaise in the industry. Some of the confusion arises as a consequence of the continuing changes of legislation and interpretation. This confusion is recognised.

For example the European Railway Agency has recently issued a document[18] specifically because 'There are different understandings of the authorisation process of subsystems and vehicles provided by Directive 2008/57/EC and there is a significant risk that without a common understanding, this would frustrate the benefits and objectives of the Directive". Our discussions across the industry indicate that this new document, 'DV29', has yet further confused some.

In essence, DV29 seeks to clarify the responsibility for checking technical compatibility the safe integration of systems. It is the role of the duty holder who is introducing the new subsystem to demonstrate compliance with the TSIs and the notified national rules in order to show that the subsystem is safe. This is done by asking Notified and Designated Bodies to certify compliance with the TSIs and the notified National Rules respectively. It is also the role of the duty holder to initiate and manage the process by which compatibility with other elements of the network is assured. DV29 advocates that a DeBo provide an impartial check of compatibility. In GB this is currently achieved by following the process laid down in the Group Standard GE/RT82701 "Assessment of Compatibility of Rolling Stock and Infrastructure" in which those affected by compatibility issues provide information and comment but the Duty Holder assures compatibility.

Two separate issues have emerged from our discussion. The first relates to equipment that NR purchases for its own use on its own infrastructure. The second issue arises in the introduction of rolling stock onto the network.

[18] Working Document 08/57-DV29, The Authorisation Process of subsystems and vehicles under the Railway Interoperability Directive 2008/57/EC

With regard to infrastructure approvals, the NR process has no clear distinction between safety and commercial criteria, nor is there a clear distinction between product selection and product approval
Because NR is the monopsony purchaser of infrastructure equipment there is not a clear distinction between the process by which it demonstrates that the equipment is safe and compatible and the process by which it makes the commercial decision to buy and use the equipment. Both are combined it its product acceptance process. To quote from their website[19]:

"*NR standard NR/L2/EBM/029 mandates the process for the acceptance of products for use on or as part of NR infrastructure. This includes:*

- *New or modified products, materials, equipment, and systems.*
- *Change of application.*
- *Road Rail Vehicles/attachments and Rail Mounted Maintenance Machines, On-Track Machines, road plant and Portable and Transportable Work Equipment that could affect or interact with the infrastructure.*

NR/L2/EBM/029 describes in more detail the products that this process applies to…."

Further, the website states: *"The objective of the acceptance process is to provide NR with the assurance it needs that products authorised for use on the infrastructure are fit for purpose and have appropriate configuration control.*

In addition, as part of the wider product introduction process, it helps business objectives to be met through an assessment process that considers:

- *Business benefits (financial or equivalent)*
- *Safety assurance*
- *Asset protection*
- *Supply diversity*
- *Technology Readiness Levels"*

So it is clear that the NR acceptance process is a *de facto* approvals process that considers issues that are well beyond the essential requirements. For a supplier wishing to sell equipment to NR the difference alluded to above is irrelevant – without product acceptance it cannot sell. NR's decisions about its choice of standards, like its specification processes and procurement processes are a matter for NR in pursuit of its commercial objectives and fulfilment of its safety management system.

Whilst there has been considerable anecdotal evidence that NR's culture and behaviours in the past have made it difficult to introduce innovation into the industry, this is not intrinsic to the approvals process or to the split of standards between RSSB and NR. It is also acknowledged that NR's culture is already in the process of changing to address recognised problems.

It is also clear that suppliers themselves have a key role to play in facilitating the approvals process of duty-holders. For example certain suppliers who have engaged with NR at an early stage of product development and continued the cooperation during product development and testing, have reported that the approvals process has been very satisfactory. However, the fact remains that they are engaged in an 'approvals process' that entails proving a business case that is part of NR's commercial product selection process as well as demonstrating compliance with essential requirements.

[19] http://www.networkrail.co.uk/aspx/3262.aspx (Accessed 5/8/10)

With regard to rolling stock, NR apply an acceptance process whilst not being the duty-holder, in reflection of their belief that they have liability under the HSAWA act, as well as purely technical concerns

Turning now to the issue of the introduction of rolling stock, it is NR's belief (and, we understand, received legal opinion) that under Section 4 of the HSAWA Act they are still liable for and need to accept rolling stock onto their line. This is evidenced by their web page in which they clearly claim the need to manage the activities by which rail vehicles come into use[20].

"NR has procedures for the introduction of new rolling stock onto the rail network.

There are two parts to this:

- *Technical and Safety approval, dealt with by the NR Acceptance Panel (NRAP), resulting in a Certificate of Authority to Operate.*
- *Vehicle Change, which involves consulting other users of the network to identify any commercial issues created by the introduction of entirely new vehicles, or in some cases existing vehicles onto new routes.*

The process for obtaining technical approval for new vehicles is covered by a railway "Group Standard" – a documented procedure entitled "Assessment of Compatibility of Rolling Stock and Infrastructure" [reference GE/RT8270] available on line."

NR also highlights the technical impact of rolling stock on the infrastructure (for example the wheel/rail interface, gauge issues etc.). In the face of NR's stance and the industry's lack of clarity it easy to see how an atmosphere of confusion and risk avoidance has been created. In practice it could be argued that there is a degree of double-checking taking place. A recent study by the ERA[21] highlighted these issues across the whole of Europe noting that:

"The issue of technical compatibility is further made difficult because often a double-judgement approach is used. An ISA approves a safety case based on judgement and then the NSA/IM makes a second judgement on the safety case to authorise the vehicle. This approach lacks transparency and legal certainty as the judgement based approach means that:

- *A future applicant is unaware of what the NSA has accepted as "safe enough" for previous authorisations.*
- *An applicant has no certainty that what was accepted last time will be accepted this time.*
- *An applicant has no certainty that what has been accepted as part of an application by another party will be deemed acceptable for him.*

It is important to understand how and when MSs will migrate to a position where these open points in NRs will be filled and the potential for discrimination between applicants will be eliminated."

A rough estimate for the number of rolling stock approvals include:

- Approvals of new class of train (approximately 1 per year over the last 10 years[12]).
- Approvals relating to modifications (approximately 2-3 per year over the last 10 years[22]).
- Approvals relating to the movement of vehicles (approximately 3 per year[23]).

[20] www.networkrail.co.uk/aspx/1554.aspx

[21] Intermediate Report on Authorisation Processes, ERA, March 2010, www.era.europa.eu/Document-Register/Pages/Intermediate-Report-on-Vehicle-Authorisation-Processes.aspx

[22] Based on the modified version of the new classes introduced over the last 10 years

[23] Based on the assumption of 20 franchises, 7 years per franchise

Shortfalls in NR's immediately available knowledge of its infrastructure is often quoted as a source of delay in approvals

There is an associated and interrelated issue of the quality of NR's knowledge of its infrastructure and of the data that is immediately available to support the demonstration of compatibility of rolling stock and infrastructure. The ORR 2009 review of standards regimes explicitly refers (para 2.27) to problems with infrastructure asset knowledge[24]. There is anecdotal evidence to suggest that shortfalls in NR's data causes delay in demonstrating compatibility. Shortfalls in data quality may also force the Train Operating Companies to incur additional expense, choosing to pay to gather the required gauging information rather than face the delay of waiting for NR to provide it. NR have current programmes to address asset information shortfalls, though the remaining task is still huge, quoted as requiring in excess of £100m and requiring several years to complete.

The cost implications of approvals processes are seen as being very significant across Europe, not just in GB. Delays are indicated to cost anything up to £5m, but precise data is hard to find

The cost and delay implications of approvals processes are profound and are seen across Europe, though data are hard to establish. The ERA's Intermediate Report on Authorisation Processes concludes:

"It is difficult to identify precisely the costs and delay generated by the authorisation process. Effectively, most of the actors from the industry (manufacturers, applicants) are very cautious on that. The following figures are given as an indication only:

- *Up to an average of 2 years delay between the completion of the vehicle and the issue of the formal authorisation for PIS (for locomotives and coaches);*
- *Additional costs ranging from 100 to 1.500K€ for verifications and authorisation of modifications, and*
- *Additional costs ranging from 100 to 4.000K€ for additional authorisation in other MS."*

This is consistent with anecdotal evidence we collected that indicated delays costing anything up to £5M for the introduction of a new type.

Current acceptance processes act as a major obstacle to implementation of innovations onto the system

In section 3.2 above we highlighted two of three major blocks to innovation: lack of motivation and lack of strategic R&D capability. The third major block relates to acceptance processes: as described above, the processes by which innovations are brought onto an operating railway are poorly understood, often fail and are a source of great risk to innovators, undermining the motivation for innovation and the ability of the industry to effectively exploit innovation. Making these processes effective will reduce the innovation risk, so improving the incentives to innovation, and make innovation faster and cheaper. The risk of bringing a novel product or system into service is seen as a massive block to innovation. Some of these risks are attributed to acceptance processes that are opaque and difficult to manage. Others are attributed to the uncertainties surrounding obtaining derogations from standards. For example, the intent to bring Japanese innovation into GB with the Hitachi rolling stack encountered exactly these issues with the decision to use French braking subsystems and other critical components, including components from direct competitors. These selection decisions were driven by a desire to minimise the risks associated with acceptance in a GB environment. The risk is not just the cost of approval itself – it is multiplied by the consequences of a delay to the whole programme that might arise from a blockage in the approval of a subsystem. The absence of GB test facilities is quoted as a problem, exacerbated by difficulties in making effective use of test results and certification from other railways.

[24] http://www.rail-reg.gov.uk/upload/pdf/cons-rep_revstndrds_0808.pdf

3.3.3 Options for change

Two options are identified:

- Option 6: Making acceptance processes more accountable, visible and faster through either regulator intervention or restructuring.
- Option 7: Maintain status quo, but clarify and limit NR's approval responsibilities for rolling stock.

Option 6: Make acceptance processes more accountable, more visible and faster through either regulator intervention or more radical restructuring

Ref	Title	Implementation risk (H/M/L)	Timescale to impact (S/M/L)	Range of cost to implement (£m)	Range of cost efficiency impact (£m/year)
6	Make acceptance processes more accountable, more visible and faster through either regulator intervention or more radical restructuring	Medium	Medium (within CP4)	2-3/year	Enabling: included in Option 3

Description

This option comprises measures to streamline acceptance processes and to make their management more visible and more accountable. The primary envisaged route is through ensuring greater regulator intervention: A regulator (such as ORR) could be given the authority to apply and enforce performance measures on the acceptance processes run by duty holders, especially where such processes involve two or more organisations. On the basis of such measures the external body would then be able to push for improvements in both the quality and the timeliness of the process and its outcomes. The external body would also provide a route of appeal for organisations that regarded themselves as unreasonably blocked or disadvantaged by process delays.

As an alternative, the option of including an approvals role within the Systems and Standards Body (see Option 3 above) could also be considered. As mentioned in Section 3.2.4, this option has a number of key obstacles relating to EU legislation and liabilities.

Key constraints

Additional regulation would be required for this option. In practice the formulation of suitable performance measures could be difficult, given the diversity of products and approval issues. Further work would be needed to assess feasibility. Creating a separate body has obstacles as mentioned above.

Cost efficiency impact

This option is an enabler for accelerating innovation within the industry. Therefore its impact is in terms of reduced time to deploy cost-saving innovations onto the system. The cost efficiency impact of this has already been modelled under Option 3.

Cost to implement

The cost to apply greater regulator intervention would include the one-off costs of assessing feasibility, developing and introducing the regulation, and the ongoing costs of enforcing and applying it. We would assume a cost of £1m-£2m for feasibility and development, with ongoing costs of, say £1m-£2m/year for application and enforcement, assuming 10-15 ORR staff positions would be needed. Overall we have assumed £2m - £3m/year, so **£8m-£12m** during CP4.

Benefits

- Critical enabling factor for faster innovation.

Disadvantages

- Additional regulation.
- Complexity of applying performance standards for acceptance processes.

Comparators and benchmarks

- We are not aware of any direct comparators in European railways.

Option 7: Maintain status quo, but clarify and limit NR's approval responsibilities for rolling stock

Ref	Title	Implementation risk (H/M/L)	Timescale to impact (S/M/L)	Range of cost to implement (£m)	Range of cost efficiency impact (£m/year)
7	Maintain status quo, but clarify and limit NR's approval responsibilities for rolling stock	Low	Short	<1 (one off)	1-5

Description

The option comprises formal guidance being provided by ORR to NR about their duties and the actions they need to take to discharge their duties under the Health and Safety at Work Act. This option would clarify that TOCs have sole responsibility for managing the process by which compatibility with the infrastructure is demonstrated, including confirmation that NR should not double-check rolling stock. NR would still be called upon to deliver the data describing their compliance with the standard interface or providing data that allows parties to address the issue. NR is required by current legislation to gather and maintain this information, at its own cost. Indeed, the speed of provision and the completeness and accuracy of the data about infrastructure that NR supplies is critical to the success of this option.

NR would still be free to make commercial decisions about the products that they use, and how much of their own effort they wish to put into demonstrating safety and compliance with TSIs and NNTRs. In other words they may still use their 'product acceptance process', perhaps better described as 'product selection process'.

Key constraints

It is open to the ORR to provide formal guidance to NR to this effect. We understand that this possibility has been informally raised by ORR, and there may be evolving and recent information on the acceptability of this route. Previous informal guidance has not sufficed to change NR's position, and there may be legal issues that need to be resolved.

Cost efficiency impact

Although it is difficult to identify specific costs here it is clear that any double-checking performed by NR on rolling stock constitutes a delay. Their role should be restricted to the provision of information about their infrastructure so that compatibility can be shown or disproved. Any delays in rolling stock procurement are likely to be of major commercial significance simply because of the capital at risk and the likelihood that the project is running close to its critical path. Delays in the demonstration of compatibility have the potential to lead to costs that can easily run to millions of pounds. For this study we have simply assumed that the savings could be in the range £1m-5m though this is very hard to determine.

Cost to implement

The costs for this option are relatively low, and relate primarily to development of guidance. We have assumed a cost of <£1m therefore.

Benefits

- Cost efficiency advantage through immediate streamlining of processes.
- Simple change to bring corporate behaviour in line with documented legislation.
- Possibly clarifies the actual exposure to liability by reducing the number of parties involved in approvals. For example, does NR increase its exposure to liability by sharing the approvals process and, perhaps, responsibility, with the Duty Holder introducing the new vehicle?

Disadvantages

- Possibly legal issues to be resolved around NR liabilities.

Comparators and benchmarks

ProRail and the US railroad attempt to remove or limit any duplicate testing by either the infrastructure or rolling stock owner during product approval and acceptance (see Appendix 4). Pro Rail's approach to approving new technology and equipment is based on the premise of only testing its interface with the network and not the technology itself. Instead, it is the responsibility of the new technology provider to present Pro Rail with a certificate from an independent testing body as evidence of the technology's robustness and suitability. Similarly in the US, new equipment and technology for rolling stock must achieve AAR approval based on independent testing certification. Once approved, there is very limited further testing done by the rolling stock owners before incorporating the new technology. Other European railways generally follow the EU directives without the additional NR approval process that exists in GB.

As a further example from the automotive sector GM, Ford and Chrysler have aligned their EMC specs and worked with suppliers to develop common acceptance processes.

3.3.4 Conclusions

- The current process is recognised by most as a source of confusion and often delay, although both suppliers and duty-holders have a role to play in making the process more effective (for example by having dialogue early in the product development process).
- With regard to infrastructure approvals, the NR process has no clear distinction between safety and commercial criteria. With regard to rolling stock, NR applies an acceptance process whilst not being the duty-holder, in reflection of their belief that they have liability under the HSAWA act, as well as purely technical concerns.
- The cost implications of approvals processes are seen as being very significant across Europe, not just in GB. Delays are indicated to cost anything up to £5m, but precise data is hard to find.
- The options considered here, whilst they will improve the approval process, will not fundamentally alter the role of NR in approving infrastructure products.

3.4 Differentiated railway

3.4.1 Current situation

A further key issue relating to standards is whether GB should pursue a uniform or a differentiated railway

A well-established debate that has continued for decades concerns the profound choice that GB faces between, on the one hand a uniform railway of a single consistent standard and approach to engineering and, on the other, a railway of a number of different levels of performance each with different 'appropriate' approaches to engineering. Advocates of the uniform railway point to advantages of simplicity, of a large and single market across GB for vendors, and of consistency with Europe that make the market one of global significance. Hence GB becomes a magnet for innovation and cost-effective products that can be used across the network.

By contrast, advocates of the differentiated railway point out, as an extreme example, that a branch line in the more remote reaches of Wales does not need to incur the costs of the engineering necessary for the West Coast Main Line. A single track with two trains per hour travelling at speeds below 70 mph is a very different proposition to a high-speed line carrying trains running at 125 mph and simultaneously carrying 40% of GB's rail freight.

3.4.2 Analysis

The issue of whether to implement a "differentiated railway" is still to be addressed - it seems reasonable however to aim for a pan-European approach that allows for appropriate differentiation but on a consistent basis

Deciding between the extremes and selecting how many 'kinds' of railway GB needs is a massive study in its own right, with issues associated with all the themes of the VfM study. The area is also core to NR's strategy and their future responses to the demands of this and other Control Periods. For reasons of commercial confidentiality of their strategy they were unwilling to discuss the matter with us. The concept of a disaggregated railway is a theme under exploration in the DfT's strategic research programme[25]. The differentiated railway has key advocates, for example being a core element of the European Railway Technical Strategy of the European Rail Infrastructure Managers[25]. They suggest the following classification:

- Multi-purpose core network (under 250 km/h)
- High Speed Network (at 250 km/h or over)
- Heavy Freight network (<100 km/h)
- Regional network
- Suburban Metro
- Community/Rural Light network
- Tramway

They also suggest key parameters for the performance of the categories, driven by business needs.

Note that if it is decided to pursue a 'single railway' then there must be a credible plan for NR to bring the infrastructure to compatible standards. A lack of compatibility and a lack of knowledge of infrastructure status fundamentally undermines the proposition.

[25] "European Railway Technical Strategy - Technical Vision to guide the development of TSIs" Version 1.1, March 2007 www.eimrail.org/pdf/techpapers/ERTS%201.1_March%202007.pdf

Considering only the issues of safety, standards and innovation there are four topics:

- Interoperability and the TSIs
- Cross-acceptance and the TSIs
- The management of a suite of NNTRs, assuming a differentiated railway
- Innovation

It seems clear that there will always be a strong case for a core of the network that is interoperable as embodied in the concept of the TENS. This aspect is addressed by the current standards domain. However the TSIs have a profound effect on system architecture. Preliminary thinking by RSSB[26] indicates that design of the TSIs will be critical. For similar reasons, cross acceptance remains a primary element of future regulation and approvals and to maintain the philosophy and approach will require careful design of the TSIs. The management of NNTRS will, perhaps, be complicated by the creation of the classifications, for example requiring different values for various parameters. However, in principle the NNTRs will be able to encompass the differentiated railway. By adopting a pan-European approach as early as possible there is the greatest opportunity to minimise the number of NNTRs. The creation of the different classifications is equivalent to creating different operational and business ecosystems. Hence there are likely to be opportunities for innovation both from larger organisations offering products and services that apply across a range of categories and for the niche providers focusing on just one category. One would expect to see new impetus for innovation and it is this that underpins the argument for cost savings in the differentiated railway.

3.4.3 Options for change

We have identified one option in relation to this issue:

Option 8: Take an early initiative in the crafting of the categorisation of the differentiated railway

Ref	Title	Implementation risk (H/M/L)	Timescale to impact (S/M/L)	Range of cost to implement (£m)	Range of cost efficiency impact (£m/year)
8	Take an early initiative in the crafting of the categorisation of the differentiated railway	Low	Long	1-2/year	10-100

Description

Pursuit of the differentiated railway will be driven primarily by economic considerations of asset cost, asset management maintenance and by the optimisation of through life cost. Safety and standards issues do not represent a barrier to the option but could have a significant effect on the ease and effectiveness of implementation and thus on the realisation of benefits.

The specifics of the categorisation of the differentiated railway will have a profound effect on its future trajectory, the relative size of the opportunities in different categories and the way in which services in GB are delivered.

There is an opportunity here for the GB to engage actively with the development of thinking across Europe in order to shape the classification in a way that best suits the needs of the GB. There are new opportunities here to increase the effective market size – that shared between GB non-core railway and that of other countries that shares common characteristics. By seizing the initiative the GB can shape the debate.

[26] http://www.rssb.co.uk/pdf/rgs/iscc/08-05-08/Appendix%202%20-%20Standards%20Issues%20-%20Post%20Board%20Dicussion.pdf

Key constraints
Scale of study work required and coordination effort across Europe is major.

Cost efficiency impact
The imposition from the EU of categories that do not fit with the needs of the GB would be of significant cost and block access to many of the benefits envisaged. Whilst it is possible to identify the sorts of savings that could be made in principle, such as simpler, low-cost signalling for low intensity branch lines (see also section 4.2.1 below), quantification of possible impacts would need a separate study. Given the annual cost of the railways of ~£12bn, one could reasonable postulate that influencing the classification in a way that aligns better with GB needs could eventually be worth at least 1% of the renewal/enhancement asset cost of, say, around £5bn/year. This would give a value of, say £10m-£100m per year as a relatively conservative order of magnitude.

Cost to implement
The cost to implement indicated here is primarily associated with professional and management time necessary for increasing GB's degree of proactive input into the evolving debate and development. We could assume that, for example, the additional effort would be the equivalent of 10 -20 senior staff working full time. This would give a cost to implement of some £1m-£2m/year, or **£4m- £8m** over CP4.

Benefits
- Early involvement makes shaping the debate easier than trying later to shift entrenched opinion.
- Initial costs are low relative to the benefit that may ultimately be enabled.

Disadvantages
- If led by any of the currently competent and engaged bodies (such as RSSB or DfT) then priorities will need to be re-allocated.
- Impact will be only felt in the long-term as development work proceeds – hence this may be seen as an investment.

Comparators and benchmarks
Pro Rail claim to be very active and closely involved in European interoperability and development of the European Railway Technical Strategy. The Dutch railways have an advantage in that many of their standards and technologies are already aligned with the larger railways around them.

4 Reducing costs through changing asset design standards

In Section 3.2 we examined options for *accelerating* technological innovations through having more unified standards, a Systems Body to incentivise innovation, a mechanism to bridge the gap between concept research and full-scale demonstration, and faster approvals processes (refer Options 3 to 8).

In this section we cover options for *reducing the cost* of specific railway asset investments through changing standards, focusing on train protection, level crossings and rolling stock as examples of more general issues.

4.1 NR technological innovation projects already in progress

As part of NR's £3.3bn Transformation Programme, a number of technological innovation and development projects have been cited

NR has made significant commitments already in terms of technological innovations with cost saving potential. In particular the EID part of the programme which targets £2.2bn of net benefit in CP4 contains a series of projects covering new capex delivery solutions including items such as modular signalling, intelligent infrastructure, modular S&C and many others. A representative list of some of these projects including costs, benefits and anticipated timings is provided for reference in Appendix 8.

NR is also currently involved in an EC-funded research project Innotrack D1.4.8, which is aimed at reduction of track renewal and maintenance costs by 30%. Likely savings could be achieved in CP5 and beyond

NR's in-house research function is a major player in the European Innotrack research project, together with Banverket, DB and SNCF. This project aims to reduce track renewal and maintenance costs by 30% through developments such as S&C with new design, hollow sleeper and new monitoring techniques, premium rail, new grinding strategies, ballastless track, soil improvement and subgrade reinforcements. Anticipated savings would be in CP5 and beyond.

A number of other promising technology development projects were briefly reviewed as part of the study. For the most part these are already included in NR's Transformation programme

As part of the study we also sought to identify other promising technology developments, in addition to those provided to us by NR. Whilst there are a number of potential candidates, we briefly reviewed two in particular by way of example:

- Lightweight LED signalling and structures: This technology offers the opportunity to replace conventional filament lamp signal heads with lighter LED signal heads. The primary cost benefit lies in the fact that the LED technology weighs less and has much lower maintenance. The bulk of the cost of a conventional signalling installation is in the supporting, structures which include extensive maintenance access. The use of LED technology therefore enables much lighter, simpler and cheaper structures due to, for example, removal of ladders and reduced structural requirements both in terms of foundations & superstructures, and increased use of straight post signals in lieu of major cantilever & gantry structures. Early engagement between the developer and NR at the concept stage was cited as a key success factor for this innovation, which is about to commence field trials. During CP4 only, based on the anticipated SEU programme this technology could provide savings perhaps in the **£15m-£20m** range.

- Driver advisory systems: This technology provides cabin display data to the driver on optimum speeds, acceleration and braking profiles. At its simplest, based on track and rolling stock data this technology can help to optimise fuel efficiency by advising the best drive profile. However there are broader benefits to be obtained through linkage with traffic management systems, which could allow features such as real time flexing of timetables, network capacity optimisation and reduced cautionary signal running. The challenges with development of this technology are typical of a technology that crosses system boundaries: TOCs and NR respectively have different objectives and commercial benefits from the technology but it is in the long term interests of both sides to develop a common technical interface. NR advises that benefits would not be likely to be seen before CP5.

These and, we expect, other technologies in various stages of development, are included as part of NR's Transformation Programme alongside the technologies listed in the above table. For this reason, apart from the general innovation acceleration options (see Options 3 and its suboptions), we have not included any specific options with respect to these technologies in this review, and we have taken at face value the estimated net benefits advised by NR. It is not within the scope of the study to challenge or scrutinise these estimated benefits.

4.2 Train protection systems

4.2.1 Current situation and analysis

Safety and standards requirements for signalling and train protection systems are largely specified in international standards – there is little evidence that safety and standards requirements are leading to excessive cost, although approval, testing and verification/validation are seen as cost drivers

Whilst there are commonly held views in the supply chain that gaining approval for new items of signalling and train protection equipment is time consuming and therefore costly (refer also Section 3.3 on approval processes) it is not apparent that safety and standards requirements in themselves are leading to excessive cost – in any case it is very hard to separate out the costs of safety aspects since safety is deeply and inextricably embedded within design processes. Safety requirements are largely specified in common standards (CENELEC) which apply to all countries, and although the approvals process (SRP) can be more onerous, costs are not reported by signalling suppliers to be increased significantly as a result. However, it is clear that the testing and verification/validation of systems is seen by many as a driver for cost and therefore an opportunity for cost efficiencies. Previous research into the costs of interlockings approvals has found that approving interlockings for the GB network is not significantly costlier than elsewhere. This is mainly due to the highly safety critical nature of interlockings meaning that requirements to assure their safety are similar everywhere.

There is no potential to make significant savings on train protection systems including TPWS or ERTMS within the CP4 period

The primary short/medium term train protection strategy for GB mainline rail is to retain TPWS for an extended period; this will not require extensive investment so is not of interest for this study. The sunk cost of ca. £750m in TPWS therefore will continue to deliver safety payback for longer than was originally planned. In essence, this means that equipment will be monitored and checked and replaced as necessary, so significant cost savings will not be feasible. Part of the strategy provides for risk assessment using a newly developed model, Signal Overrun Risk Assessment Tool (SORAT), and using this to ensure that risk is managed to a level that is deemed reasonable (SFAIRP).

ERTMS implementation, within the next few years (CP4) is not planned to be extensive, with most of the plans being much longer term. The only scheme that has costs in CP4 is described in NR's March 2010 'Great Western Route Utilisation Strategy' which includes ERTMS and has been brought forward to align with the route electrification and other upgrades. For CP4, the plan is for some **£200m** of expenditure on ERTMS, with 867 ERTMS Signal Equivalent units (SEUs)[27]. Compared with the total estimated ERTMS costs, which do not appear until much later, this is relatively small. Because of this, and because the Great Western ERTMS scheme has been optimised to align with electrification and station remodelling programmes we do not believe that there is an option to reduce ERTMS costs within CP4. We assume that the savings associated with consolidation of signalling equipment and the potentially considerable savings in operational expenditure have been embedded within the business plans used to optimise the timing of ERTMS roll-out. Furthermore, we assume that Network Rail have established that bringing forward the opex savings from ERTMS has immovable constraints.

More broadly, there has been extensive debate about ERTMS rollout strategies across GB and the rest of Europe. The strategy[28] is to align infrastructure fitment of ERTMS Level 2 with life expiry of lineside signalling by route (ERTMS removes the need for lineside signalling moving the signalling to the train cab which provides a better business case). Aside from the Great Western mentioned above, there is no lineside equipment work scheduled until 2017 at the earliest with work on some lines not programmed to start until 2027. According to the plan, fitment will continue until 2042 by which time 72% of the infrastructure will be fitted.

Looking ahead in time, what are the future incremental capital costs of ERTMS Level 2 over and above the costs that would be incurred by replacing conventional lineside signalling? This is highly dependent on a large number of factors; Sweden is hoping for a lineside cost saving to be made due to the removal of cabling and lineside signals. There is a more pessimistic view that the ERTMS associated lineside infrastructure will cost more. Broad estimates of a the costs for a high-density traffic existing line are around £125k - 250k per km excluding interlockings which would need to be replaced whether or not ERTMS Level 2 was fitted. Fitting 72% of the network (11,500km of double track) would cost very broadly £1.5 - £3 billion.

What is clear is that the trainborne ERTMS equipment is costly – and depends on whether it is retrofitted or fitted as part of a new build. Given that the current strategy is for providing ERTMS to trains as part of new builds, it is reasonable to use the lower end of the cost estimates – so assume £150k (other European countries have suggested > €400k for difficult retrofit). There are approximately 4,000 trains in Britain, meaning that a total cost of trainborne ERTMS fitment would be around £0.6 billion.

The differentiated railway concept may offer some potential benefits in the future

The pursuit of a differentiated railway may open up options for fundamentally different philosophies applied to low-traffic density lines and hence opportunities for major local savings in signalling capex and opex. For example, a possible long term option for lines with low levels of traffic would be to move from lineside train detection to low cost, on-board train detection, as this is a radical innovation with significant potential. However the development of such a technology currently faces major challenges, notably showing that this is safe enough. This could be based on low cost, commercial of the shelf (COTS) systems that would enable the train to determine its location and then to use GSM(R) to receive movement authorities and transmit location data. Implementing such a system would mean challenging many of the established signalling concepts (such as continuous train detection and the use of safety integrity level 4 technology) but the capital and operational cost savings in terms of infrastructure fitment and maintenance could be significant. Our experience is that when previous attempts were made to suggest that, on low utilisation lines, lineside train detection be removed and the function be done in other ways this has failed (for example, the logical block control concept that was proposed on the Norwich-Cromer line).

[27] http://www.rssb.co.uk/SiteCollectionDocuments/pdf/vtsic_presentations/Taking%20safe%20decisions%20-%20Part1.pdf

[28] National ERTMS Implementation Plan, September 2007

However this could be re-examined in the light of the wish to keep such lines open and the need to reduce costs significantly while maintaining a reasonable level of safety. This is too speculative and long term to be considered as an Option in its own right, but it may be considered as one example of the benefits of pursuing the Differentiated Railway concept (see Option 8 above).

The concept of a differentiated railway (see section 3.4) offers the possibility of alternative train control systems for low density, lightly-used lines. It could be reasonably assumed that even in a differentiated railway, all trains would need to be fitted with ERTMS anyway, so that they are able to run on the main line. However there may be cheaper trackside options, such as the Swiss ETCS Level 1 LS (limited supervision), for the lightly used lines. Currently the UK is not investing is such an approach unlike Switzerland and possibly Germany, but if this approach were to be adopted by UK (as suggested in section 3.4) then there could be some benefits, albeit on a very long timescale.

4.2.2 Conclusions

With the exception of changes that could be made to approval processes (see Sections 3.2 and 3.3), we do not see any great potential for opex or capex cost-efficiencies in GB implementation of signalling and train protection systems within the next 5-10 years. One of the clear conclusions is that for high safety integrity level systems such as train protection and interlocking, because the standards are international and relatively prescriptive, the costs of implementation tend to be similar in all countries. The differentiated railway concept may offer some longer-term benefits. For the purposes of this study, it can be assumed that any such benefits are already covered in Option 8.

4.3 Level crossings

4.3.1 Current situation

NR has an annual average budget of £8m per year for level crossing safety upgrades

NR has a safety budget of £40m for CP4 (5 years) for the incremental safety components of level crossing upgrades (i.e. an average investment of £8m per year). Individual crossing safety upgrades to types offering higher levels of protection or modifications (e.g. AHB to MCB-CCTV) are justified on a cost-benefit basis using the All Level Crossings Risk Model (ALCRM). This model has been applied to all level crossings on the network and the risk assessments are upgraded periodically. This budget is only for the incremental cost of the upgrade or modification. For example – if a like for like AHB renewal would cost £750k, but an upgrade to a MCB-CCTV would cost £1m, then the £250k additional cost would fall within the remit of the safety budget and need to be justified by applying the ALCRM.

The total renewal budget for level crossings is likely to be around £19m per year, which is greater than the safety upgrade budget

In terms of renewing life expired crossings, there is a plan for 234 over the five-year CP4 (i.e. 40-50 per year) at a total projected cost of £154m. This volume seems reasonable given the number of crossings on the network divided by a 30-year life[29].

As for NR's CP4 renewal budget of £154m (£31m/year), this implies at average renewal cost of £0.66m (154/234), which is consistent with our previous work on level crossing costs which gave costs for technically protected level crossings of typically £0.5m - £1m each.

[29] The number of MCB, MCG, CCTV, AHB and MWL crossings is 1345, divided by 30 years gives 45 per year on average

4.3.2 Analysis

Level crossings in GB cost significantly more than overseas

Previous work on benchmarking costs of crossings[30] led to a number of conclusions and provided evidence that crossings in GB cost significantly more than overseas. For example, Germany provides similar standards at equivalent types of crossings (AHBs, MCB-CCTVs), but at around half the cost. In other countries, costs are several times lower than in GB, but the specification varies and is usually technically simpler than in GB. The previous work concluded that safety performance in GB was very good in comparison to that in other countries, but did not conclude whether or not the additional incremental cost was justifiable in cost benefit terms. It did, however, identify areas where specific cost reductions could be sought.

The costs of safety at GB level crossings are in-part driven up by a number of safety and standards related factors which may be considered for possible cost-efficiencies

Among other factors, costs are driven by a range of factors covering design, construction and testing. These are areas where cost-efficiencies may be sought:

- Independent train detection currently requires both track circuit and treadle, which is not generally a requirement in other countries (cost estimated at an average of approximately £100k per crossing).
- Level crossings on double track are required to be equipped for bi-directional working, requiring more signalling equipment, more complex design and testing (very approximately £50-100k additional cost per crossing).
- The status of some crossings (e.g. AHB) is required to be monitored – which is done by cable where local monitoring is not possible, which is expensive for distant crossings.
- Relocatable Equipment Buildings (REBs) have become a de-facto 'standard' at many crossings, and have large bases which can add significantly to overall cost, (up to £50k) with little consideration as to whether the benefits of doing so justify the potentially high costs compared with location cases.
- Design of level crossings is highly bespoke and complex in GB – NR have moved towards in-house designs recently but are reportedly not yet demonstrating tangible cost reductions.
- Level crossing components are often assembled on site; costs are therefore increased because of the relative difficulty of working near to a live running railway. Testing also takes place on site rather than at component level in the factory.

The previous work has highlighted other aspects of level crossing costs that are not related to safety or standards such as the costs of labour, project management, testing and installation, etc. These factors also drive costs of level crossings in GB to be higher than elsewhere, but are outside the scope of this workstream.

The risk of level crossings is predicted by NR to increase over time, justifying the need for some safety upgrade expenditure. The £40m safety budget for CP5 appears conservative but not unreasonable on this basis

In considering safety-related expenditure it is important to recognise that risk levels do not necessarily stay constant. In their Level Crossing Policy, NR state that they predict that over time risk would continue to increase at level crossings, due to:

- An increased number of people living in Britain (i.e. more crossing users).
- Increasing pressures for new residential and commercial development – particularly in the already densely populated South East.
- The requirement to run additional train services and convey more passengers.

[30] "The cost of level crossings - an international benchmarking exercise", T364, Arthur D Little for RSSB, June 2006

- Increased number of elderly drivers.
- Increased impatience brought about by the pace of modern life.

We have not modelled the scale of this risk increase. However, it can be shown that the £40m safety budget implies a required risk reduction of some 20% over 30 years (the life given to assets such as level crossings), assuming that VPF criteria are met. The calculation is as follows:

- The total current risk at level crossings is around 10 FWI/yr (7.3 of which is pedestrians and is evidently very hard to control given the freedom of movement that pedestrians have, and the large number of locations where they can cross the railway).
- The NPV of the total safety loss at all level crossings (10FWI/yr) is £190m over 30 years (making no allowance for indirect costs).
- Therefore, a £40m[31] safety budget for CP5 would imply a sustained average risk reduction target of some 20% over the 30 year period (40/190)[32].

However, recent trends have shown no or little reduction in risk year-on-year at level crossings. The Rail Strategic Safety Plan 2009-2014 actually predicts a negligible risk reduction from public behaviour at level crossings. The Plan states *"the trajectories for …level crossings predict either none or only a small reduction in the level of risk. The industry is however taking significant steps to reduce risk in these areas. The bulk of the cause of the risk lies outside the direct control of the industry and it is difficult to predict significant risk reduction based on the actions of the industry in isolation".*

Moreover, there is a practical consideration concerning whether the industry could actually achieve such a large-scale upgrade programme. Past experience would suggest not – the number of conversions per year has not been close to the level implied by the £40m safety budget.

For the £40m to be viewed as a reasonable safety budget, with the projected zero improvement in risk, the risk increase due to these factors would have to amount to some 20% on average over 30 years. We have not modelled the increase in risk, but on balance this assumption could be reasonable, if perhaps rather pessimistic.

4.3.3 Options for change

In this section we consider one overall option (which has a number of sub-components):

Note: At the time of producing this report, a level crossing accident with a sewage lorry and a two car diesel train had just occurred at Little Cornard near Sudbury, which resulted in a train derailment and passenger injuries. The options for cost reduction presented below would have no impact on the likelihood of occurrence of this specific accident.

[31] From an accounting perspective, the depreciation cost of the £40m investment over the 5 years of CP4 amounts to some £6.7m

[32] Discounted using NR model

Option 9: Reduce the technical complexity at level crossings

Ref	Title	Implementation risk (H/M/L)	Timescale to impact (S/M/L)	Range of cost to implement (£m)	Range of cost efficiency impact (£m/year)
9	Reduce the technical complexity at level crossings	Medium	Medium (within CP4)	1-2 (one off)	10

Description

In this option the costs of level crossing renewal are reduced by changing technical requirements to allow for less complexity. Examples include:

- Removing the requirement for bi-directional signalling at AHBs.
- Using lineside boxes rather than REBs as standard.
- Removing the requirement for two methods of train detection at AHBs.

A complementary part of the option is to reduce the budget for level crossing safety upgrades (as well as renewals). The reduction in technical complexity would enable a similar reduction on budget to be achieved for the same outcome.

Key constraints

Reducing the technical complexity of level crossings may meet with opposition from ORR and will require safety acceptance of different technical standards.

Cost efficiency impact

We estimate broad cost savings potential for *level crossing renewal* to be in the region of £5m -£10m per annum (25% to 50% of renewal costs) with a possibly insignificant impact on safety. Providing lower cost renewals would of course reduce the railways asset book value over time, and as such the annual depreciation rate. Further details of the most feasible savings are as follows (note we have calibrated this analysis to match the annual average renewal budget for CP4):

Table 8: Level crossing renewal cost saving model

LX type	Number	Life (yrs)	Renewals/yr	Current unit renewal cost (£k)	Total annual renewal cost (£k/yr)	Cost saving possible per renewal (£k)	Annual renewal cost if saving can be made (£k/yr)	Annual cost saving (non-discounted)
CCTV	380	30	13	750	9500	150	7600	1900
MCB	234	30	8	700	5460	150	4290	1170
MCG	191	30	6	700	4457	150	3502	955
AHB	452	30	15	500	7533	150	5273	2260
ABCL	48	30	2	500	800	50	720	80
AOCL	120	30	4	400	1600	50	1400	200
FP MWL	35	30	1	350	408	100	292	117
UWCMWL	88	30	3	350	1027	100	880	293
				TOTAL (£m)	£31m		£24m	£7 m

Source: RSSB risk profile bulletin for crossing numbers, Arthur D Little analysis

Further cost savings could be made if the railway made use of predictors in place of treadles and track circuits at AHB and MWL crossings. These are used in other countries to provide a means of detecting trains approaching, and are a good example of where GB requirements are different from those used elsewhere. Whilst it could be argued that the current GB standard for providing detection at AHB and MWL crossings is 'safer' than using predictors which offer no redundancy, it is arguable whether the additional costs can be justified as being value for money. We have assumed that the average unit upgrade costs for AHBs and MWLs would be reduced to £250k and £150k respectively if predictors were deployed whenever crossings were renewed. This would amount to a further average annual cost saving associated with renewals of approximately £2m, giving a total (combined with the savings in the table above) of around £9m-£10m. This may have a slight increase in risk although likely to be insignificant.

Cost to implement

The cost to implement would be mainly associated with the work need to revise standards, including the necessary consultation and regulatory acceptance. We have assumed that the total cost for this would be perhaps £1m - £2m (i.e. less 10-20 man years of effort).

Benefits

- Savings in level crossing renewal costs of some £10m per year.
- Greater simplicity of design and equipment.
- Closer alignment with arrangements overseas.

Disadvantages

- Possible increase in level crossing risk, though likely to be insignificant.
- Predictors are not currently accepted in GB for all applications (two suppliers predictors are approved but for non-electrified lines, and they are not compatible with all types of track circuits).
- Public perception may be that costs are being cut at the expense of safety – especially if there is another serious incident.

Comparators and benchmarks

Germany and Ireland have similar standards at equivalent types of crossings (AHBs, MCB-CCTVs), but these entail costs as low as half that of equivalents in GB. In other countries (USA, Denmark, Netherlands, Australia, Sweden, Switzerland), costs are several times lower than in GB, but the specification varies and is usually technically simpler than in GB.

4.3.4 Other options considered

No other options considered.

4.3.5 Conclusions

This is a reasonably attractive opportunity to save significant cost and introduce some asset simplicity onto the railway, more in line with railways overseas. The key barriers to overcome are that reducing technical standards are likely to be problematic in terms of gaining approvals and acceptance from ORR. Arguably, the most difficult change would be removing the requirement for two methods of train detection at AHBs; this is because an AHB is an unmonitored crossing and a wrongside failure is potentially very serious (compared with a manually controlled crossing where a failure will result in the train being stopped). A key enabler will be gaining wider approval of predictor technology if full cost savings are to be realised.

4.4 Rolling stock

4.4.1 Current situation

There is a considerable body of evidence that rolling stock costs more in the GB than it does in continental Europe and that technology is adopted later

There is compelling evidence[33] of the extra costs incurred in rolling stock, for example that locomotives associated with plant equipment cost 25% less in mainland Europe due to differences in specifications, safety and standards requirements and that GB trains cost an extra 15% due to crashworthiness requirements[34]. This implies an extra cost of **£80M** solely in the plant costs for track renewal activities, let alone other locomotive procurement. Our interviews confirmed that GB rail pays between 25% and 50% more than others due to the GB standards regime and the approach to specification and approvals. Maintenance costs are also higher as a consequence of the bespoke designs and the small market.

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HS2 apply a 50% premium to the cost of a high speed locomotive by comparison with European costs to account for the redesign necessary to meet the requirement to run on UK conventional railway network and HS2[35]. Additionally they apply a 40% risk premium "reflecting the potential issues including design and approval risks and the commercial attractiveness" of a one-off fleet. In the case of HS2 this is equivalent to more than doubling the cost and an additional cost of **£27.5M** per trainset.

4.4.2 Analysis

There are various contributors to this situation - the involvement of several parties with differing incentives and an imperfect market are underlying factors

This situation is attributed to potential causes that include:

- Bespoke specifications, some of which are driven by real differences in GB and some driven by 'gold plating'.
- Differences in the system that make GB a relatively small and unattractive marketplace for global manufacturers.
- An approvals process that is still unclear within the industry and causes delay.
- A risk aversion that delays the uptake of new technologies.

The standards and approvals issues are addressed in Section 3.3.

Due to the dynamics of the market and its impact on the procurement of rolling stock the DfT is also a key player, in addition to the originally intended TOCs, FOCs and ROSCOs. Hence there is a diverse community associated with the procurement and introduction of rolling stock. It is important to note that each of these parties is driven by different motivations with incentives that will inevitably cause them to seek different optimal mixes of benefit and cost, benefit and risk and short and long term trade-offs of cost and return. Because of this diversity it is hardly surprising that there is a wide mix of outcomes in rolling stock cost effectiveness. As the DfT makes very clear in its submission to the competition commission,[36] the absence of a surplus stock of uncommitted rolling stock leads to a market in which there are only very imperfect market forces.

[33] Rail Infrastructure Cost Benchmarking – Brief LICB gap analysis and cost driver assessment," BSL, April 1st, 2008, www.networkrail.co.uk/browse%20documents/strategicbusinessplan/update/cost%20benchmarking%20assessment%20%28bsl%29.pdf

[34] More recent alignment of crashworthiness specifications may have reduced this differential

[35] "High Speed Rail London to the West Midlands and Beyond HS2 Cost and Risk Model", HS2, December 2009, www.dft.gov.uk/pgr/rail/pi/highspeedrail/hs2ltd/riskmodel/pdf/report.pdf

[36] "Market Investigation into the Leasing of Rolling Stock to franchised rail passenger services and related maintenance services" - Paper for Competition Commission, Department for Transport comments on Specification Issues arising out of Emerging Thinking, DfT, 7 February 2008, www.competition-commission.org.uk/inquiries/ref2007/roscos/pdf/responses_emerging_thinking_third_party_dft_paper.pdf (Accessed 7 August 2010)

Against that background it is obvious that commercial drivers for innovation are unlikely to work perfectly. Hence the presumption that market players will automatically push hard for innovation in rolling stock is potentially flawed.

The Foster review of the IEP programme[37] makes illuminating points. The programme was intended to be transformational and ambitious. Indeed the IEPs were specified to have functionality beyond that of trains made for any other market. In other cases there are instances of GB adopting technology later and less effectively. For example, some other countries, such as Germany, are reported by the ORR[38] as well ahead of GB in implementing GSM-R, using off-the-shelf commercial equipment rather than designing bespoke industry solutions. These issues have been recognised by ATOC who have prepared guidance notes encouraging a common approach to the issues of vehicle change and introduction among members[39].

It is difficult to separate out those costs attributable to real differences between GB and other markets and those costs attributable to unnecessary customisation. However both anecdotal and published evidence indicates causes such as a procurement process that focuses on requirements to the exclusion of a rational consideration of what is already available on the market. Others see instances of specifications drafting that is less competent than it might be, for example calling up conflicting, unnecessary, or irrelevant standards. For example, in the ORR's 2009 review of the standards regime[12], ATOC's contribution (Para 2.41), points out that "*the quality of specification drafting is another point at which the contracting entity can unwittingly introduce cost, by being too vague, too prescriptive or by requiring more than the standards require, and by interfering with the required verification process. The importance of putting competent effort into the specification stage of a project should not be underestimated*."

We hear of procurements that call up standards wholesale where customers fail to call up only those standards that are absolutely required and explicitly highlight those documents that are for guidance only. This behaviour creates what is described as 'soft law', those cases where guidance has become regarded as mandatory and therefore constrains innovation and often restricts engineering options even for easily achievable goals.

The late adoption of technology is attributed to risk aversion and to an unwillingness to engage with the derogation processes should that be necessary to manage the introduction of a new product.

4.4.3 Options for change

The **standards and approval regime** is a key area where change could be considered – this is already covered in sections 3.2 and 3.3 above. Outside of the standards and approvals regime, influencing the cost of procured rolling stock lies with the organisations conducting the procurement. Here the issue is how best to improve practice and the appetite for the benefits of managed innovation. Some of this will depend upon the incentive framework and the balance between the opportunities and the costs, the appetite for risk, the appetite for the work entailed in bringing innovation to market, and sheer competence.

We assume that options such as Lord Foster's suggestion for the creation of an independent procurement agency will be addressed by the asset management themes of the VfM study.

Because of the range of actors in this space, not only the TOCs, FOCs and ROSCOs but also the DfT itself, finding an option that will work is challenging.

[37] "A Review of the Intercity Express Programme", Sir Andrew Foster, June 2010, http://www.dft.gov.uk/pgr/rail/pi/iep/fosterreview/pdf/report.pdf (Accessed 7 August 2010)

[38] http://www.rail-reg.gov.uk/upload/pdf/wbps-rail-summary-reprt2.pdf

[39] "The ATOC Guide to Vehicle Change" ATOC, April 2008 www.atoc.org/clientfiles/File/publicationsdocuments/nps7AF_tmp.pdf

In essence we seek a multiplicity of behaviours that address the flaws identified above, including, *inter alia:*

- Development of the definition **of requirements that is driven appropriately by what is available on the market**.
- Building a **clear understanding of the through-life costs and implications** of each element of the set of requirements to allow judicious trade-offs to be made.
- **Early discussion with vendors and with other stakeholders** to understand the implications of the trade-offs considered.
- **Early engagement with approvals authorities** and with standards bodies to understand the options for derogations, the best approaches, risks, and risk mitigation strategies.

These behaviours are consistent with good engineering practice and hence the options we consider are ways to embed such practice within the industry – one the option of guidance and the second option being one of mandatory review.

Option 10: Provide best-practice guidance on specification, procurement and design of rolling stock in support of innovation and cost-effectiveness

Ref	Title	Implementation risk (H/M/L)	Timescale to impact (S/M/L)	Range of cost to implement (£m)	Range of cost efficiency impact (£m/year)
10	Provide best-practice guidance on specification, procurement and design of rolling stock in support of innovation and cost-effectiveness	High	Medium (within CP4)	1-2 (one off)	10-20

Description

Although procurement or innovative upgrade of rolling stock is undertaken relatively seldom there exists in the industry a collective pool of insights into best practice. There are also previous examples of guidance documents, such as ATOC's guidance for its members on vehicle change. The industry could develop guidance specifically in best practice in the development and bringing into service of rolling stock for GB rail. The guidance could also include validated examples of the traps that have created failures in the past. More usefully, the guidance could include contributions from experts in how best to avoid the traps, both real and those that arise from the lore of the industry.

Key constraints

This option relies on cooperation and willingness to engage; hence implementation risk has been rated as High.

Cost Efficiency Impact

Guidance in this area could promote better engineering in the following ways:

- More assessment of operational options and the cost-benefit impacts of different operating philosophies (e.g. the trade-off between a complex design to cope with electric and diesel operation versus a design for only one energy supply and an abandonment of the commitment to through trains).
- Requirements that draw more heavily on equipment that is already on the market.
- Requirements that invite suppliers to propose variations that would positively affect through-life costs.
- Reviews of applicable standards to ensure that, as far as possible, ambiguities and contradictions are eliminated and that there is a minimum of constraint of solutions and innovation.

- Procurement patterns that optimise the cost of the entire intended fleet, for example by maintaining manufacturing facilities at a common level.
- Design approaches that clarify at the very earliest opportunity where derogations might be required and processes that quickly and effectively clarify the risks and the cost-benefit trade-off to be met in innovation.

The creation and adoption of this guidance would parallel and augment the creation of better portfolios of standards and requires also a fundamentally different cultural approach to specification, design, procurement and risk management in the industry.

Cost to implement

The cost to implement would be mainly associated with the work need to develop and agree the guidance, including the necessary consultation and alignment with the regulatory regime. We have assumed that this would be in the range 10 -20 man-years of effort, so £1m -£2m. A key success factor would be the willingness of those involved to adopt the guidance and so there may need to be a campaign led by companies' senior management teams.

Benefits

- The guidance could be created relatively cheaply and quickly.
- Guidance would be more acceptable to stakeholders than a mandated set of requirements.

Disadvantages

- Those organisations not competent to learn would fail to adopt the guidance effectively.
- Would require 'selling' to the industry to ensure take-up.
- Would encounter concerns about disseminating the competitive advantages embedded in some good practices.

Comparators and benchmarks

Whilst other countries generally also have room for improvement in rolling stock standards and specification, we have heard a number of anecdotal case examples illustrating differences in rolling stock costs versus GB. We have already referenced corroborated examples in 4.3.1 above.

Option 11: Mandate reviews to drive best practice in specification, procurement and design of rolling stock in support of innovation and cost-effectiveness

Ref	Title	Implementation risk (H/M/L)	Timescale to impact (S/M/L)	Range of cost to implement (£m)	Range of cost efficiency impact (£m/year)
11	Mandate reviews to drive best practice in specification, procurement and design of rolling stock in support of innovation and cost-effectiveness	Medium	Medium (within CP4)	2-3/year	10-20

Description

This option is identical to that above, with the difference that its application would be mandated. Note that a similar idea is mooted in the Annex[37] to the Foster review of the IEP programme, noting that since the government as funder is ultimately accountable it should preserve the power to intervene as necessary.

The use of the guidance would be supported by mandated review of the processes and practices being followed in the procurement or development of rolling stock. This intervention would allow objective observers to assess the quality of the processes, of the decisions and, indeed, of the decisions themselves. The review could encourage organisations to adopt the guidance or to demonstrate that they use satisfactory alternative approaches.

Such an intervention would have many of the characteristics of the ORR's current use of Reporters. In the light of the role of the ORR as economic regulator as well as safety regulator, these interventions could be under the auspices of the ORR.

Key Constraints

It is an open question whether such reviews of private sector organisations could be mandated.

Cost Efficiency Impact

The cost impact is the same as for the previous option. There might, however, be a greater assurance of accessing the benefit.

Cost to implement

The cost to implement would be as per Option 10, except there would be an additional cost associated with enforcement. We could assume that this could require a further effort of, say, 5 staff per year or up to £0.5m/year, bring the cost to, say, **£5m-£6m** over CP4.

Benefits

- By mandating the review of the use of the guidance there is more assurance that organisations would adopt good practice.
- Intervention in DfT procurements could be seen as similar in kind to reviews by the NAO or those initiated by Secretaries of State.

Disadvantages

- Intervention in decisions and processes that, for TOCs, FOCs and ROSCOs, lie in the private domain would be seen as counter to much of the recent political philosophy.

Comparators and benchmarks

As per the previous option.

5 Reducing costs through changing operating standards

5.1 Possessions

5.1.1 Current situation

Studies show that track working and maintenance/renewals is often less efficient and more costly on the GB railway than across Europe

Multiple studies into track working and maintenance/renewals have shown that GB is often less efficient than its European peers[40]:

- The average renewal project in Europe is often up to 50% less expensive than in GB (2008).
  - £1.38m/track mile for NR versus £0.70m/track mile for Peers for rerail, resleeper and reballast.
  - £0.87m/track mile for NR versus £0.59m/track mile for Peers for rerail and resleeper.
- The management of available possessions is less efficient than good continental European practice (quotes from contractors in GB with international exposure):
  - *"GB gets approximately 3.5hrs of work from a 6hr possession, whilst the Swiss can get 7.5 hours of work from the same possession".*
  - *"The net productive time for front-line staff and equipment is sometimes less than half that of other European practices due to the effect of warning procedures on output and capacity utilisation".*

Safety and standards have a significant role in planning, take up, on-site working and hand back of the possession

Safety and standards are responsible for the safety of the track workers as well as ensuring the safety of the train operators and passengers by checking the work is correctly done. Safety and standards are also an influencing factor on one of the key cost drivers for non-work overheads associated with possessions – i.e. possession regimes (more effective working hours)[41].

NR has started an extensive review process of its possessions management including strategic reviews of key elements of a possession, improved planning and data.

A few months ago, NR initiated a programme to review the factors that influence the costs associated with possessions, including where safety and standards can influence the cost and time of a possession. This programme has three main workstreams:

- **Strategic reviews**. This focuses on reviewing the cost drivers for possessions with respect to axle counters and the need for sweeps, isolations and on-track machines.
  - ***Axle counters and sweeper trains***. Axle counters are currently installed on about 5% of the network (although on some of the busiest routes) with projections to increase them to 20% in the future. Standards require that where there are axle counters, sweeps must be done after every possession to ensure nothing is left on the track. The NR project is reviewing the need for sweeps, and early indications are that not sweeping means a saving of 65-90mins in every possession. This additional time can either be used for other work or else the possession can be cut shorter. Both have implications on cost efficiencies. Also, the contract for the sweeping landovers is currently about £2m a year, which could be saved if they are not used.
  - ***Isolations***. NR is trialling a revised approach to working within an isolation. Current safety standards state that work within an isolation must be conducted sequentially, however NR is currently testing the potential to conduct work in parallel. This would reduce the number of isolations needed by increasing the productivity. No safety cost efficiencies have yet been calculated for this project, although initial indications suggest between 10 and 180mins savings per possession which would improve productivity and utilisation.

[40] 2008, NR. Rail Infrastructure Cost Benchmarking – Brief LICB-gap analysis and cost driver assessment

[41] According to the 2008 Rail Infrastructure Cost Benchmarking, the other key cost drivers are Labour costs, Plant procurement costs, Economies of worksite scale (longer work-sites) and Transaction cost

- ***On-track machines (OTM working under signal protection)***. New on-track machines are currently being investigated to improve the speed and efficiency of certain renewals and maintenance activities (e.g. plain tamping only). This is aligned with the upcoming renegotiation of the tamper train contracts. If the new arrangements for on-track machines are implemented, it is anticipated that they will reduce the need for certain possession cost elements such as detonators, PICOPs on site as well as increasing flexibility and thereby reduce the overall need and therefore cost for the tamper machines. There are REDACTED tamper trains at the moment on the GB railway, costing about £REDACTED each. It is estimated by NR that this new approach could remove about £REDACTED of unnecessary equipment from a possession. Also, the cost of using a tamper in a possession could be reduced by £REDACTED per possession. There are REDACTED tamper shifts a year so that means a potential saving of £REDACTED. It is unclear whether this takes into account the cost of the on-track machines.

- **Data and performance**. NR are running trials on two routes to gather information from 400 possessions including the length of time certain jobs take, why and the factors that impact the variation in the timings between locations. It is anticipated that this information will feed into the better planning and optimising of track work (and therefore possessions) and into the delivery arrangements where appropriate. There are no cost efficiencies yet calculated for this activity.
- **Access Planning and design (including better prediction of time and cost modelling)**. Currently many possessions are planned based on experience and individual knowledge of how long certain jobs take. This workstream aims to make this process more automated, faster and more accurate. This is estimated to lead to significant cost efficiencies in terms of headcount, increased productivity in possessions, less disruption to the train service and up to £140m in CP4 from Schedule 4 payments due to fewer and shorter possessions. The impact of safety and standards on this activity is as of yet unknown and is the subject of a feasibility study expected later this year.

A fourth area of work is being undertaking by NR entitled Quick Wins. This has not been described here as its relevance to safety and standards is considered minimal.

5.1.2 Analysis

Possessions account for a significant proportion of the cost for NR's maintenance and penalties

Each year there are approximately 100,000 possessions taken on the GB Railway. For NR, the total budget for possession related activities is approximately £4.8bn a year[42]. The planning and executing of the possession itself is a significant cost contributor. The 2007 benchmarking of renewal unit costs for NR proposed that for the £686m spent in 2006/07, approximately 12% was due to structural factors (i.e. approximately £82m). In this report, it is proposed that possessions could account for up to 40% of the direct unit cost[43] for civil renewal projects and therefore £33m (40% of the £82m). If these proportions are applied to the 2009/10 total costs indicated above, then possessions costs could be approximately £231m.

In addition, in 2009/10 NR paid approximately £4.2m in penalties to the TOCs due to possessions overruns under Schedule 8 requirements.

[42] This is based on the budget approximation of maintenance, renewals, West Coast modernisation and enhancements minus activities that are unlikely to involve a possession e.g. plant machinery costs, IT costs, etc

[43] 2007 NR. Internal Benchmarking: Summary of findings

From existing research combined with discussions with stakeholders, it is apparent that safety and standards are perceived to be a cost driver for possessions

Safety and standards are often seen as the root cause of the relatively high cost and lengthy possessions. Indeed, the quote given above identifies the 'warning procedures', stipulated by safety standards, as a key reason for the lower productivity during the possession. Comments on possessions indicate significant time wastage due to slow processes and standards and the risk averse culture towards compensating for overruns:

- Possessions take much longer to set-up and remove than on other comparable railways.
- Possessions on the GB railway include 'a generous allowance in the timing of the possession' by the project managers to allow for the risks of not starting the possession on time e.g. late running trains.[44]
- The process for managing a possession is too complex, takes too much time and is prone to error.
- Too many people are required now to sign off the possession and more documentation layers are added, all of which require more time in the initial set-up and impact the productivity and cost of the possession itself.

Safety and standards are also potential barriers to the current NR possession initiatives

Many of the workstreams being conducted by NR will require a change to safety and standards, as well as the Rule Book. This is especially true for the changing in the use of Axle Counter Sweeps, Isolations and OTM working under signal protection. The current processes for changing standards will be a barrier to implementation of the new initiatives by introducing delays.

In addition, changes to possessions must overcome issues raised by the unions and balance the needs of the TOCs

Perceived barriers to significant changes in the efficiency and productivity of possessions are often cited as to include the unions and the needs of the TOCs. Previous proposed changes to possessions and the safety and standards have been challenged by the unions under the notion of reducing track worker safety. For example, to bring the GB railway in line with other European railways[45] it was proposed to remove detonators from the track during possessions, also other railways have reduced the number of look-outs used and instead rely more on the signaller to keep the track workers safe. It is believed that these proposals have been shelved after discussions with the unions.

Likewise, greater efficiency and productivity from possessions can be created through longer possessions and more disruption to the train timetable. Whilst this may have cost efficiencies with respect to the possessions, it would lead to greater disruption of the TOCs being able to deliver their service to customers as well as an increase in the Schedule 4 fees paid by NR.

[44] 2006 ORR. Possession benchmarking exercise report

[45] Based on benchmarking evidence from various reports

5.1.3 Options for change

Option 12: Provide support in the cost efficient and speedy changing of possession standards to support the findings from the NR workstreams

Ref	Title	Implementation risk (H/M/L)	Timescale to impact (S/M/L)	Range of cost to implement (£m)	Range of cost efficiency impact (£m/year)
12	Provide support in the cost efficient and speedy changing of possession standards to support the findings from the NR workstreams as appropriate	Medium	Short (within 18 months)	<1 (one off)	70-100

Description

The key tasks for this option should be:

- To involve a representative from RSSB's standards group into these workstreams in anticipation for proposing changes to the Railway Group standards and Rule Book.
- Review the process timeframes for changing the relevant standards to identify possible approaches to shorten the timeframe for approving some of the possession changes.
- Support the relevant Rule Book revision (link to Option 13).
- Clear and accurate calculation of the benefits and costs of each option to ensure a compelling business case is developed, as well as a risk assessment, to support the proposed changes.

Key constraints

The key barriers to this option are the current standards and Rule Book change processes and resistance from the unions should they oppose any of the proposed actions.

Cost efficiency impact

The ease of changing the appropriate standards should encourage the realisation of the expected benefits of approximately up to £100m a year.

Cost to implement

The cost to implement is relatively small and is associated mainly with management time. We have assumed that this would be less that 10 man-years, hence <£1m.

Benefits

The advantages of this option are the quicker achievement of the anticipated benefits, as well as continued cost efficiency potential for years to come as possessions become better planned and managed as well as more productive. It could also lead to:

- Less train disruptions to the TOCs and to passengers as fewer possessions will overrun. It may also make better use of the available whitespace in the timetable.
- Support for innovation as more data will be available to support business cases for new technologies and practices.
- Potentially safer conditions for track workers as less time is spent on the trackside.

Disadvantages

There are no significant disadvantages apart from the challenges of negotiating and agreeing a mutually acceptable course of action with the unions in respect of headcount reduction.

Comparators and benchmarks

Many other railways are reviewing their possession planning and delivery approach. For example, Pro Rail is aiming to separate man and track as much as possible. One approach is to limit the amount of Red Zone working done - NR is also working on this. Another example is the cost saving of up to €70m a year cost efficiencies for the Dutch railway due to improved planning of possessions. More information on this is provided in Appendix 4.

National Grid has established an effective risk-based prioritisation approach for planning asset maintenance, based on a comprehensive asset database linked to work planning processes. NR has plans to adopt similar best practices as part of the Transformation Programme (refer Appendix 4).

5.2 Rule book simplification

5.2.1 Current situation

The Rule Book has become overly complex and difficult to use as a result of very specific additions and changes since its inception in 2003

Since its introduction in 2003, the Rule Book has provided guidance to the industry on how to approach and deliver key activities safely. However, over time the Rule Book has become increasingly complex with multiple insertions and additions as a result of various accidents and near misses. It is widely recognised in the industry that the Rule Book has many issues associated with it[46], including:

- "the rules no longer let you think"
- "the rules are too complicated"
- "the rules are not suitable for today's railway"
- "the volume of instructions issued exceeds what the average person can mentally retain"
- "the rules are becoming encrusted with bullet points"
- "the rules do not clearly explain the inter-relationship between the arrangements and roles defined in the different modules"
- "there are now too many rules"……

A 'New Approach' is currently being developed and implemented in the industry to completely revise the Rule Book

These issues have led to a "New Approach" being proposed to the Industry Leaders group by Andrew Sharpe and Steve Roberts. As identified in the March 2010 briefing paper, the primary purpose of the New Approach is to review and revise the current Modular Rule Book with the aim of significantly rationalising its content and restructuring the document so that it is more accurately targeted at the skill sets of end users and clearly aligned with operational principles.

This revision of the Rule Book is progressing currently through 11 tranches of effort, each focusing on a specific area of operational activities, such as Possessions, Electrified Lines and Level Crossings. The first tranche (Basic competency for going on the railway) came into force in June 2010.

[46] A. Sharpe and S Roberts, 2010. The New Approach to the Rule Book - Briefing paper for the Industry Leaders

5.2.2 Analysis

The primary drivers of cost are perceived inefficiency of following the Rule Book, the process to propose and achieve change, and the costs from future anticipated additions

The Rule Book is recognised by many in the industry as driving costs into across the GB railway. The complexity and prescriptive nature of the Rule Book leads to extra time being spent following the Rule Book guidance and subsequently assuring compliance. It is also suggested that the prescriptive nature of the guidance can lead to situations where the appropriate action cannot be taken as the Rule Book must be followed, potentially leading to the higher cost option being implemented. Whilst it is hard to identify any hard evidence for this perception, it is widely agreed by most stakeholders consulted.

The process for changing the Rule Book is seen as overly time consuming. Frequent requests have been made to change and alter elements of the Rule Book to align it better with new practices and technologies. The volume and frequency of these change requests places a heavy demand on the expertise and time of RSSB and its members.

It is anticipated that the Rule Book, left as it is, would continue to expand and gain additional complexity as it is updated and amended based on accidents and near misses, as well as from the results of the various changes to specific operational practices.

The current cost to the industry of the Rule Book is not known, however it is perceived to be significant

Whilst it is widely recognised that the current Rule Book adds unnecessary cost to the industry, it is impossible to create an accurate handle for how big those costs are. This is primarily due to the costs being an integral part of other costs such as planning or conducting operational activities.

Implementing the New Approach is estimated at £30m-£50m, however the benefits are felt to outweigh these costs, both in the short and long term

The cost of implementing the New Approach is not insignificant. Initial estimations by RSSB place the cost at between £30m and £50m in total, with most of this spent within 10 years. This cost comprises the cost of actually reviewing and developing the new Rule Book, together with estimates on the new training required, printing of new guidance documents, culture change initiatives etc.

However, the RSSB estimated direct and enabled benefits are believed to outweigh these costs. The direct benefit from the New Approach is expected to largely match the costs, but with a positive return over a nine-year period (approximately £10m-£15m). These benefits will be realised through:

- Improved safety from fewer, clearer rules, targeted at specific groups of workers and presented in the most appropriate format. This will mean that the opportunity for misunderstanding or lapses is reduced.
- Opportunities for front-line users to exercise greater judgment in resolving operational issues, leading to better resilience and also improving safety.
- More efficient training of operational staff (including reducing driver training).
- Fewer changes to the rules and more efficient delivery of change.
- More efficient printing and publication.

It is the enabled benefits that are highlighted by RSSB as the strongest business case for delivering the New Approach. These significant enabled benefits are those that the new Rule Book is believed to support:

- Increased capacity by enabling the railway to be open consistently to train operations for longer periods especially in late evenings and at weekends. This is estimated to generate additional revenues of £105m annually (£58m for passenger operators and £47m for freight operators), although based on the experience of Virgin Trains on the West Coast Main Line this estimate is thought to be conservative.

- The maximisation of engineering work that can be carried out during infrastructure down time. The estimated benefit for CP4 of this enabled benefit is estimated at about £83m. This includes an estimated £15m over CP4 by simplifying the rules for setting up safe systems of work and £11m over CP4 from the simplification of the DC electrified lines instructions.
- The championing of performance improvements by enabling innovation and 21st century operating practices. This includes enables progress in initiatives such as:
  - Driving on sight.
  - Diversionary route driving.
  - Encouraging bi-directional working to overcome regulating dilemmas.
  - Maximising the benefit of mobile communications for the railway (GSM-R).
  - Re-vamping the rules around the provision of axle counters including removing the requirement for sweep trains following engineering possessions (as identified in the Section 5.1).

These enabled benefits are estimated to be approximately £180m in CP4 (considered a cautious estimate).

- Moving from lineside to on-board train detection is also an innovation with considerable potential. However the technology currently faces a number of major challenges, for example proving that the train is complete which may require devices to be attached to the rear of the train. The technology would also require an ERTMS level 3 signalling solution, which is not currently being developed by any manufacturer. We do not think that this technology is likely to be implemented within the timescales under consideration in this study.

The main barrier is the uncertainty of support from certain industry stakeholders and therefore the continuing concern that the New Approach will not be implemented

As previously stated this process is currently underway. We have discussed the possible acceleration of the process however there are concerns over the capacity of the industry to absorb the changes if done too quickly. This could lead to industry confusion and a negative impact on delivery of the anticipated benefits. The main barrier identified is the uncertainty of support for the changes from the industry and primarily the TOCs. The TOCs represent a very heterogeneous group of stakeholders with different views and opinions. The TOCs have the potential to delay the New Approach progressing forward at key milestones. These could have significant knock-on implications for the speed and payback horizons from the New Approach, as well as the knock-on effects on other initiatives.

5.2.3 Options for change

Option 13: Provide strong and overt support for the Rule Book New Approach including aligning stakeholders behind the activity

Ref	Title	Implementation risk (H/M/L)	Timescale to impact (S/M/L)	Range of cost to implement (£m)	Range of cost efficiency impact (£m/year)
13	Provide strong and overt support for the Rule Book New Approach including aligning stakeholders behind the activity	Low	Short (<18 months)	3-5/year	30-80

Description

The key activity is for DfT and ORR to demonstrate strong support for the New Approach, providing clear communication to the industry of the importance and likely benefits to all stakeholders, together with supporting activities to align key industry stakeholder groups better with this initiative.

Key constraints

The success of the New Approach depends to a large extent on consensus and industry support to ensure the anticipated benefits are not delayed. Currently some TOCs are lukewarm in their support.

Cost efficiency impact

A detailed description of the costs and benefits is provided in Appendix 9. Cost efficiencies are envisaged in increased capacity, streamlined operational processes, easier performance improvements, greater training efficiency and improved safety. Appendix 9 estimates broadly £300m-£800m benefit over 10 years, hence £30m - £80m/year. It should be noted that the numbers quoted refer to the rule-book simplification project as a whole, not this specific option of increasing support.

Cost to implement

The cost of implementation is estimated by RSSB as roughly £30m-£50m over 10 years, hence approximately £15m-£25m during CP4. Costs are primarily associated with additional training of staff, over and above existing training costs with the current rule-book.

Benefits

As identified in the New Approach paper the overarching advantages of this support would be:

- Increased capacity by enabling the railway to be open consistently to train operations for longer periods especially in late evenings and at weekends.
- The maximisation of engineering work that can be carried out during infrastructure down time.
- The championing of performance improvements by enabling innovation and 21st century operating practices.

The additional support effort would provide greater assurance of the likelihood of progress and the timely achievement of specified benefits.

Disadvantages

None other than the cost to implement the New Approach.

Comparators and benchmarks

Comparators and benchmarks are not appropriate for this option.

5.2.4 Conclusions

We have no grounds to question the benefits suggested by RSSB from rulebook simplification. However we do note a mixed response from TOCs. Within the scope of this study it is not possible for us to judge whether any of the criticisms levelled are really valid. What is clear is that without support from the industry the project is unlikely to deliver to its full potential. For this reason we consider strengthening of government and regulatory support as being the most worthwhile response at this time to improve likelihood of success.

5.3 Supplier assurance

This section is based largely on previous work on improving the cost-efficiency of the supplier assurance process. It should be noted that there are likely to be overlaps with the Supply Chain theme of the VFM study. We have not been able to cross-check any of the contents at this stage.

5.3.1 Current situation

There are over 3500 suppliers in the GB rail industry who are subject to assurance processes

Supplier assurance is an essential process in the GB rail industry that touches many other business processes including safety provision. All companies have an in-house supplier assurance process which, together with industry schemes consumes considerable effort every year. Link-Up[47] (one of seven assurance schemes in the GB rail industry) has a database of approximately 3500 suppliers and claims to cover 95% of the supplier base to the industry. Therefore, it can be assumed that there are approximately 3700 suppliers in the industry.

A project to reduce the costs to the industry of supplier assurance is underway and planned to move into implementation in early 2010

Following study work commissioned by RSSB in late 2008 that identified the potential for savings (see below), a change project is now underway led by RSSB. The project has so far established a set of principles for establishing a new supplier assurance framework and is consulting within the industry to flesh these out and gain consensus and support. A plan has been prepared which specifies implementation of the new framework starting in early 2011.

5.3.2 Analysis

The total cost to the industry of supplier assurance is estimated at £90m-£100m per year

A recent ADL report[48] identified the total cost expended in the GB rail industry in supplier assurance to be £90m to £100m per year. This cost consists of ~ 1000 man years of effort and direct costs such as scheme provider fees.

The two key cost drivers within Supplier Assurance are the number of schemes and the forecasted growth in the number of suppliers

There are many different supplier assurance schemes within the industry. In the Infrastructure supply chain Link-up is the most commonly mandated industry scheme, with an additional six other major schemes:

- ISO e.g. 9001, 14001, 18001
- GM/RT e.g. 2450, 2470
- Plan Assure
- ACOP 01003
- IRIS
- RISAS

[47] http://www.achilles.com/en/uk/sectors/transport/rail-industry/

[48] 2008, Arthur D. Little. Supplier Assurance Framework: Review and Analysis of Existing Supply Chain

Growth is forecast in the volume of activity in the supply chain although there is no clear consensus on future levels of supplier assurance interventions.

There are a number of areas where there is potential to improve the efficiency and effectiveness of the process

There are several areas where the efficiency of the supplier assurance could be improved, for example:

- Reducing duplications of effort and overlaps of purpose.
- Adopting a more flexible risk-based approach with fast-forward loops to allow certain parts of the process to be skipped if not required.
- Reducing the overall number of suppliers.
- Streamlining the process, reducing the number of failures.
- Improving KPIs.
- Improving IT systems.
- Improving partnership working with suppliers.

However there are barriers to be overcome, suggesting a realisable potential of 30% of the cost

The study identified some significant barriers to realisation of the full potential of savings including risk aversion to change, the number of parties involved, vested interests of assurance scheme providers and regulatory constraints. This has led to an assumption that whilst the theoretical savings potential could be over 50% of the £90m -£100m cost, the realisable potential is some 35%.

Phase 1 of the current project is nearly complete, with phases 2 and 3 planned to start in 2010

A team led by RSSB was formed early in 2010 to take the supplier assurance cost reduction project forward. We understand that Phase 1, comprising development and fleshing out of a series of principles by which a new supplier assurance framework would operate, is now complete. Subsequent phases 2 and 3 which will move into execution, are planned to start early in 2011. Experience so far in the project has been that progress is difficult in view of barriers and the need for consensus in order to have a chance of success.

5.3.3 Options for change

Option 14: Accelerate progress on supplier assurance cost reduction

Ref	Title	Implementation risk (H/M/L)	Timescale to impact (S/M/L)	Range of cost to implement (£m)	Range of cost efficiency impact (£m/year)
14	Accelerate progress on supplier assurance cost reduction	Low	Short (less than 18 months)	0.5/year	30 -35

Description

The most significant improvement activities are:

- Removal of duplications across categories of assessment and scheme/in-house assessments.
- Introduction of more flexibility and cross-acceptance between schemes.
- Consolidation to reduce the number of suppliers.

The option is concerned with identifying ways to accelerate progress. Fundamentally this would involve identifying a more directive and/or incentivised process that did not rely so heavily on consensus from stakeholders, some of whom obviously have vested commercial interests. Possible routes could be, for example:

- Establishing a DfT policy to "mandate" cooperation in the cost-reduction project.
- Establishing a suitable incentive/penalty framework via ORR to drive forward cooperation and progress.
- Reallocating responsibility to NR as the dominant prime in the supply chain, and incentivising NR appropriately.

Should the industry be significantly restructured, there may be an opportunity to use the change to kick-start greater progress. Changes in the safety targets and culture (see Section 6) would also help to achieve progress.

Key constraints

Barriers to realisation of the full potential of savings including risk aversion to change, the number of parties involved, vested interests of assurance scheme providers and regulatory constraints. Barriers to accelerating the project are primarily associated with the difficulty of DfT applying top-down direction, leadership and incentivisation in a situation with many players (though NR are clearly the dominant player). Allocating the responsibility to NR may not be acceptable to other duty holders.

Cost efficiency impact

Taking into account the barriers, realisable savings are estimated at approximately 35% of the total cost, some £30m-£35m. Without action to accelerate and drive forward change, this estimate may be seen as optimistic.

Cost to implement

The cost of this option is associated mainly with developing and implementing the appropriate means of achieving acceleration and driving change. We could assume that an additional effort equivalent to at least, say, 5 people for perhaps 3 years might be needed, approximately £1.5m-£2m over the CP4 period.

Benefits

- Savings of some £30m - £35m per year.
- Improving the reputation of the industry.
- Redirection of effort into high-value activities.
- Helping to encourage innovation.
- Reducing barriers to entry.

Disadvantages

- Difficulty in pushing forward implementation.
- Reliance on consensus.

Comparators and benchmarks

- In Belgium, Infrabel the rail infrastructure manager operates one single strategic-level assurance process, rather than many processes based on risk-level as in GB. SNCB the main train operator uses an in-house process which depends on nature of product/service. ISO and other country assurance schemes are also recognised.
- The global automotive industry operates within a risk based assurance framework that is clear, covers all levels of risk and has minimum overlap between schemes. There are three levels of assurance which range from basic qualification such as ISO 9001 to customer specific assurance such as Ford's Q1 process.
- Within the GB and Dutch Oil & Gas industry, suppliers register details in the FPAL database, which is a unified, risk-based approach. Suppliers are required to register details such as: Financials; Service offerings; Past performance; Quality assurance systems (including ISO/TS 29001).
- Within the GB Aeronautical industry there is an industry specific 'AS' standard which suppliers comply with. This is risk-based, and includes a small number of focused schemes which complementing IS. Sector specific standards also exist.

5.3.4 Other options considered

No other options were considered.

5.3.5 Conclusions

This is an attractive opportunity not only to save significant cost, but also greatly to improve effectiveness at the same time. The key issue for this item is the difficulty of implementation, and the need to overcome the lack of a suitable directive body and mechanism with teeth to "make it happen".

6 Changing safety culture

6.1 Current situation

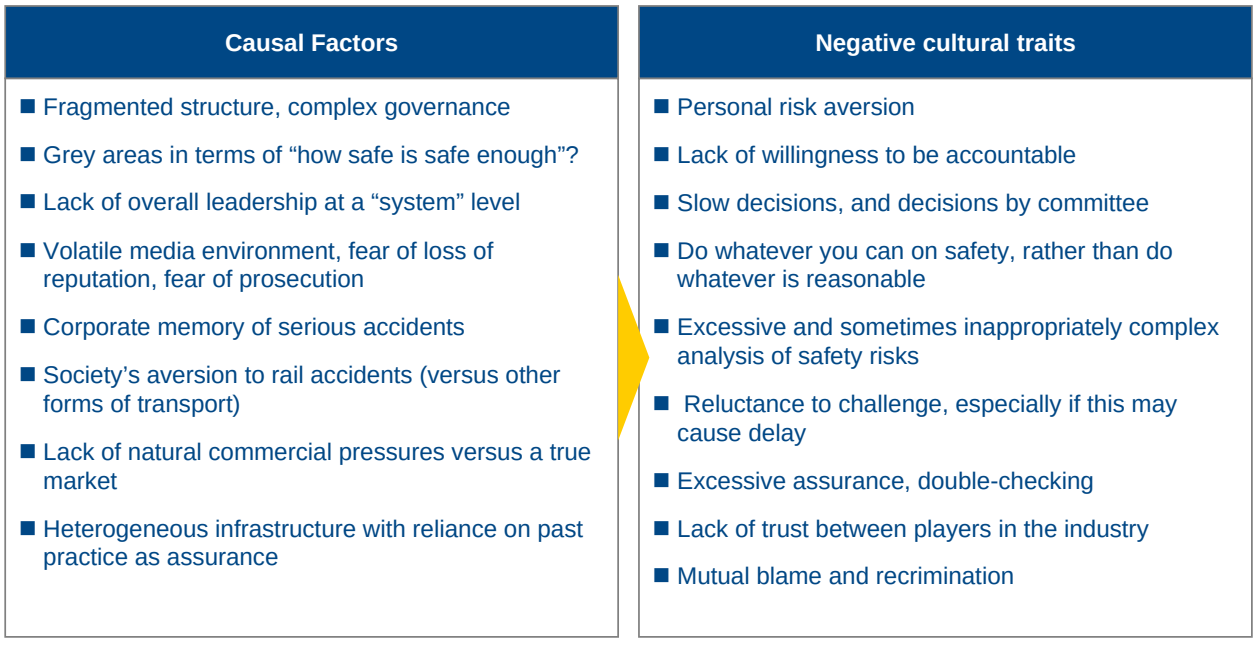
The GB rail industry has evolved and improved its safety culture over many years, and has enabled considerable achievements in terms of safety performance. These positive cultural attributes need to be carefully maintained

In the context of a cost-efficiency orientated study, it is perhaps too easy to overlook the big picture in terms of the major achievements of the industry in terms of improved safety performance, as mentioned in section 2.3 above. These improvements in performance have been made through continuous efforts in both technical and human domains. It is important when considering culture change, that the positive attributes of the current safety culture are not adversely affected. A balanced approach is therefore important which recognises that effective safety, business efficiency and cost consciousness should be mutually reinforcing.

That said, there is consensus that the current culture in the industry suffers from a number of traits which act as barriers to greater cost-efficiency and innovation. These are largely a function of the legacy, structure, and context of the GB rail industry over many years

In section 2.3 we already set out a number of barriers that related to the way the industry works with respect to safety and standards, looking at this as a "system" across the industry. From the same analysis we can create a view of how causal factors around legacy, structure and context lead to particular negative cultural traits, as shown in Figure 6 below.

Figure 6: Some negative cultural traits and causal factors



Source: Arthur D. Little analysis

This broad-brush picture is in reality more complex, with different parts of the industry being perceived to exhibit sometimes contrasting cultural norms, for example:" elitist experts", "commercially aggressive", "commercially naïve". Whilst risk aversion is certainly seen as a prevailing trait, there are also many examples of logical reasoned evaluation of risk and astute proportional management. Many in the industry articulate the view that the culture around safety is merely a reflection of societal preference – a profound societal unwillingness to tolerate loss or even risk of loss on the railways. Some feel that the risk aversion displayed by some organisations arises from a lack of confidence in their own capabilities and that their fear of prosecution in the face of incompetence should be well-founded. The fact that commercial pressures are greater today is also seen to lead to less decisive stances being taken by professional engineers. The perceived risk of the consequences of not having done everything one might to ensure safety means that in many cases cost benefit analyses are either not performed or are disregarded. This is true of even the biggest of the organisations in the industry.

Other observers have called for a "risk-policy reorientation" within NR[49] in an attempt to address the risk aversion issue. The impact of risk aversion was already being flagged up by RSSB as a result of their industry consultations in 2006, and even then the rise in the cost base of the industry was forecast[50]. The Nichols report into enhancement costs in station projects[51] is also clear on the problem:

> "*However, there is a concern that NR can be so sensitive to risk, especially to safety risk and the railway operations risks, that decision are overly conservative."*
>
> "*There is some evidence pointing to less than optimal decisions within NR, which appear largely motivated by a desire to reduce safety or operational risks to as great an extent as is possible, rather than to an acceptable level. There is strong anecdotal evidence that this approach to decision making is culturally ingrained. There is little evidence that NR regularly makes decisions based on a balanced assessment of cost versus risk."*
>
> *"This risk averse decision making increases costs. It also increases tension in the project environment. A number of interviewees were passionate about this issue. The supply chain in particular expressed deep frustration about instances where NR staff endorsed designs, or working methods, that were much more conservative than those proposed by the engineering consultants or contractors. The issue appears to be less that the decision was made, but that it did not seem to be made based on a balanced view of risk and cost. This increases projects cost and increases tension, both barriers to project delivery."*

The culture that leads to inappropriate risk aversion and conservatism is also one that undermines innovation. Innovation and cost-effective safety management both depend upon challenge and a willingness 'to stand up and be counted' in pursuit of approaches that are different, better, effective and efficient.

The widely reported tendency of reviewers to demonstrate their 'added value' by asking questions of fine detail or pushing for refinements, often in directions that consumes time but adds little real value, is also a block to innovation. In order to manage issues of risk in innovation and in major projects, NR has introduced processes to underpin development and approval, for example product assessment and GRIP (Guide to Railway Investment Projects). However, such processes can slow innovation if they are run to a calendar schedule, for example monthly, and where a single query can result in a failure to complete a gate.

[49] Rail Infrastructure Cost Benchmarking – Brief LICB gap analysis and cost driver assessment," BSL, April 1st, 2008, http://www.networkrail.co.uk/browse%20documents/strategicbusinessplan/update/cost%20benchmarking%20assessment%20%28bsl%29.pdf

[50] http://www.intlrailsafety.com/Dublin/25_October_2006_Papers/01_George_Bearfield.pdf

[51] "Comparison of railway enhancement costs in Great Britain and barriers preventing delivery of station projects by train operators" ORR Independent reporter Mandate CN007, Draft Report, 26 April 2007

Under such scenarios, a month's delay can be easily injected into a project. For those processes where agendas are filled in advance, such delays can run to a number of months.

6.2 Analysis

Culture change is an essential enabler for innovation and cost-efficiency to be improved. Achieving culture change requires a broad-based combination of measures, relating to both "hard" and "soft" systems

There is no shortage of management theory and practice on how to achieve culture change. Taking a pragmatic view, the way people behave will be determined by their perceptions of reality. These perceptions will be affected both by "hard" factors: policies, rules, procedures, management systems, organisational structures, incentives; and "soft" factors: perceived leadership behaviour, shared beliefs and values, personal motivations. Accordingly achieving culture change will require a combination of measures, including many of the options in the preceding sections, for example:

- Structural changes in standards and approvals governance: these will affect perceptions of authority and power in relationships between different parts of the industry. Changes which provide a more level playing field for true market forces to prevail are likely to be beneficial.
- Changes in safety governance arrangements: any changes which enable slimming down will be seen as a reflection of new leadership priorities reflecting safety excellence whilst driving down unnecessary cost.
- Changes in systems to encourage innovation: investment in, for example, systems leadership, technology development or new approvals processes will be perceived as reflecting a change in priorities.

In addition, a number of other measures may be considered to further underpin the required change, in areas such as goals, management style, and education. These are covered in the following section below.

6.3 Discussion of options

The options below are complementary to each other. As they relate to culture change they should be seen as enabling actions, for which cost-efficiency impacts cannot be directly assessed.

Option 15: Promulgate a new leadership culture of effective and efficient safety, including removing HLOS safety improvement target, changes to Railway Strategic Safety Plan and ORR/RAIB goals

Ref	Title	Implementation risk (H/M/L)	Timescale to impact (S/M/L)	Range of cost to implement (£m)	Range of cost efficiency impact (£m/year)
15	Promulgate a new leadership culture of effective and efficient safety, including removing HLOS safety improvement target, changes to Railway Strategic Safety Plan and ORR/RAIB goals	Low	Short/Medium (initial action immediate, impact will be longer term)	1/year	10-15 nominal, plus enabling impact for other cost efficiency improvements

Description

This option refers to a leadership drive to change the safety culture of the industry from "safety excellence (at any cost)" towards effective and efficient safety that drives out cost and delivers business value[52].

The starting point for this is clarity from the leadership of the industry with respect to how safety is viewed, supported by changes in high level targets and policies, for example:

- *HLOS target*: Specifically an option is already being considered to remove the HLOS safety improvement target of 3% in CP5 period – this was recommended by RSSB to the Planning Oversight Group on 21 June. Under this option the change would be made immediately in CP4. Whilst it will not necessarily directly lead to cost reductions in the short term, it will act as an important symbol of a change in philosophy.
- *Railway Strategic Safety Plan*: The RSSP is produced by RSSB to provide an overall picture of how safety can be expected to improve over a 5-year period. Despite its name, the plan is largely a collation of individual plans from the industry rather than a top-down strategy, and its primary purpose is for communication and demonstration of how safety expectations are being met by the industry. Currently the plan does not consider costs in its data gathering and reporting. Possible options would be:
  - Gather data and report on the costs of the actions contained in the plan as a reflection of a more balanced approach. This would need further study to establish feasibility in terms of data gathering (for example much cost data is commercially confidential), however it would help to provide greater transparency on what the industry is spending on proactive safety improvement and send a message of cost-consciousness.
  - Consider ceasing the RSSP altogether as a further indication of a shift in emphasis. This may lead to some reduction in expenditure on safety-related projects across the industry.
- *ORR and RAIB*: For ORR, options could be considered for finding greater linkage between safety and economic regulation, reflected in more emphasis on cost considerations in application of safety regulation. ORR has already made some steps to integrate safety and economic regulation, for example in terms of information systems and cross-working of inspectors. There may be options to combine regulation still further towards a single regulatory enforcement regime – this would need further exploration. Similarly RAIB could require its investigators to emphasise cost-efficiency more in formulating recommendations.

[52] Referred to in ORR's Review of RSSB, 2 August 2010

Key constraints

There are limitations in the degree to which both ORR and RAIB are able to focus on cost considerations without compromising their primary regulatory duties. Also, gathering of the cost data itself takes time and effort.

Cost efficiency impact

The impact is primarily enabling and is difficult to quantify – also data on the cost of the current safety measures being taken by the industry summarised in the RSSP is not available. As a proxy we could perhaps consider the costs of safety functional staff. If a typical TOC has 2000 staff and 10 safety functional staff, this means that very broadly 0.5% of staff costs are associated with safety functional specialists (excluding the safety duties of other staff within engineering, operations and management). We could extrapolate this to the industry as a whole which employs directly some 115000 staff, and conclude that some 600 -700 safety specialists may be employed. If we postulate that 15-20% of these positions could be eliminated through the measures proposed in this option, this equates to a saving of perhaps **£10m-£15m** per year. This would not take into account other indirect effects, although caution needs to be used to avoid double-counting.

Cost to implement

The cost to implement is relatively low, associated with actions to communicate, brief and disseminate the change in emphasis and targets. We have assumed that it would need less than £1m/year to conduct these activities, say £3m-£5m over CP4.

Benefits

- Coordinate leadership action can be powerful in effecting culture change – as long as leaders believe that there is a genuine change in policy in "hard" terms.
- Goal-setting and targets can send powerful messages through an organisation to help drive change.
- Relatively low cost to implement.

Disadvantages

- Overemphasis on cost aspects could compromise the clarity of messaging on safety.

Comparators and benchmarks

The European Rail Safety Directive does not require continuous risk reduction.

Option 16: Rejuvenate efforts at cost-conscious safety guidance and education, including interpretation of HSAWA

Ref	Title	Implementation risk (H/M/L)	Timescale to impact (S/M/L)	Range of cost to implement (£m)	Range of cost efficiency impact (£m/year)
16	Rejuvenate efforts at cost-conscious safety guidance and education, including interpretation of HSAWA	Low	Short/Medium (initial action immediate, impact will be longer term)	1-2/year	Covered in Option 16. Enabling impact for other cost efficiency improvements

Description

This option refers to rejuvenating and refreshing guidance, education, training and communications with respect to cost-conscious safety management. Examples include:

- **Characterising and publicising case examples** and the behaviour of role models where excellent professional judgement and personal accountability has been exercised in safety-related matters, and/or costs have been saved whilst maintaining or improving safety.
- Clarifying the process by which the Central Prosecution Service decides **whether or not to prosecute** – aimed at allaying fears of prosecution even when responsibilities have been discharged professionally.
- **Training/guidance** for:
  - Leaders in taking safe, cost-effective decisions.
  - Safety professionals to focus on balanced and cost-conscious advice.
  - Professional engineers who could be tasked with finding cost-effective innovative solutions[53].
- Further **dissemination of "Taking Safe Decisions**", the RSSB guidance on safety-related decision making.
- Guidance on careful **use of language in safety communications**: for example terms such as "continuous improvement" and "world class" can be misinterpreted.
- Clear **public statements that today's safety performance levels need to be maintained** – but that further improvement has to be consistent with available funding[54].
- Initiating **public debates or campaigns**, for example 'safety for the right reasons' – which are to reduce risk at a cost that the country can afford, not to do things that add cost for almost no benefit.
- Create **new instructions or guidance on the application of the HSAWA** to the railways that may help make its application to this sector less risk averse. This could be done through comparing approaches used in other sectors. A key aspect of this would be **application of VPF criteria.** These are exactly the same for all forms of transport, but in road transport the VPF criteria are applied to prioritise a set of projects, after which a selection is made based on available budget – rather than to determine whether a particular spend is "compulsory" based on interpretation of HSAWA.

Such communication programmes could be very tightly targeted, with messages to and from the key stakeholders (including ORR, DfT, HSE[55] and CPS). The shift in opinion would be measurable. Impact on only one large railway project that, for example, shortened its approval cycle or led to a lower cost solution would repay the costs of such a programme.

[53] Perhaps quoting Alex Kummant, President of Amtrack "There's an old definition of engineering I love which is 'to be able to do for $1 what any damn fool can do for $2'. http://www.reuters.com/article/idUSSIB27628520080612

[54] For example, the recent report on ORR's review of RSSB suggests that RSSB's role should be articulated as "achieve excellence in health and safety management in Great Britain, and in doing so drive out unnecessary cost and improve business performance"

[55] Note the HSE's attempts to counter inappropriate risk aversion and the current review to address unhelpful aspects of culture: http://news.hse.gov.uk/lau/2010/06/22/announcement-of-health-and-safety-review-by-lord-young/

Key constraints
Guidance, training and communication approaches are often only of limited effectiveness unless they are accompanied by significant change in the business – for example structural changes – otherwise they can be thwarted by "business as usual" inertia.

Cost efficiency impact
As with Option 15 the impact is primarily enabling but nevertheless critically important. We would consider the impact to be rolled up in Option 15.

Cost to implement
Cost would be incurred through delivery of training, new guidance and communications. We envisage that this could require something of the order of £1m-2m/year during CP4, say **£5m-£10m** in total.

Benefits
- Relatively low cost.
- Will help to ensure better understanding and clarity amongst stakeholders and the public with regard to any cost efficiencies, to mitigate the problems of unfounded accusations of "cutting corners on safety".

Disadvantages
- Measures need to be accompanied by genuine change.
- Requires continued and frequent reinforcement over an extended period of time to be effective.

Comparators and enablers
Pro Rail: Culture change across an entire railway industry has been pursued by Pro Rail in what they describe as their biggest single initiative of the last few years to improve safety levels through higher degrees of awareness of safety and management and behaviours. They have conducted awareness and education programmes, with the support and enrolment of senior leaders across the industry. They have seen results across the organisation, for example in the more thoughtful and detailed planning of possessions.

6.4 Other options considered

Two other options were identified but are considered to be not promising enough for further detailed consideration:

- **Changing the VPF:** The option of changing the benchmark Value to Prevent a Fatality (VPF), currently set at £1.661m, was considered but rejected. Contrary to the perception of some, this value is the same for all forms of transport – it is not set at a higher level for Rail. VPF is one of a number of considerations in making safety-related decisions (refer Taking Safe Decisions), and the feedback we have received is that changing the value itself would not materially affect most major decisions in practice. There would be no rational argument for reducing VPF below the current levels used for other forms of transport. Application and interpretation of VPF is covered in Option 16 above.
- **Taking GB railways out of HSAWA:** The radical option of taking the GB railways out of the HSAWA regime was considered but not taken forward. This option has the potential to enable a different approach to safety-decision making to be taken, for example:
  - The principle of duty-holder responsibility could be changed to better align with railway situations (for example the issue of whether NR is responsible as a duty-holder for train operation risks when a train is using NR's infrastructure).
  - The ALARP principle, and the accompanying criterion of "gross disproportionality" could be replaced with a more "black-and-white" principle to facilitate decision-making.

By way of comparison, road planning is not covered under HSAWA, although this has partly a historical background. This option was not considered feasible for two reasons:

- HSAWA would have to be replaced with alternative bespoke legislation – this would be excessively complex, time consuming and costly.
- There is no clear or compelling rationale for taking the railways out of HSAWA. The Act applies to the rest of GB industry, and is widely viewed as being highly beneficial in its impact on health and safety performance. Any such move would be strongly resisted by senior safety professionals in the industry.
- There is a substantial body of opinion that it is the *interpretation* of HSAWA, not the act itself that is a driver of cost in the railways. This issue is covered in the selected option above.

6.5 Conclusions

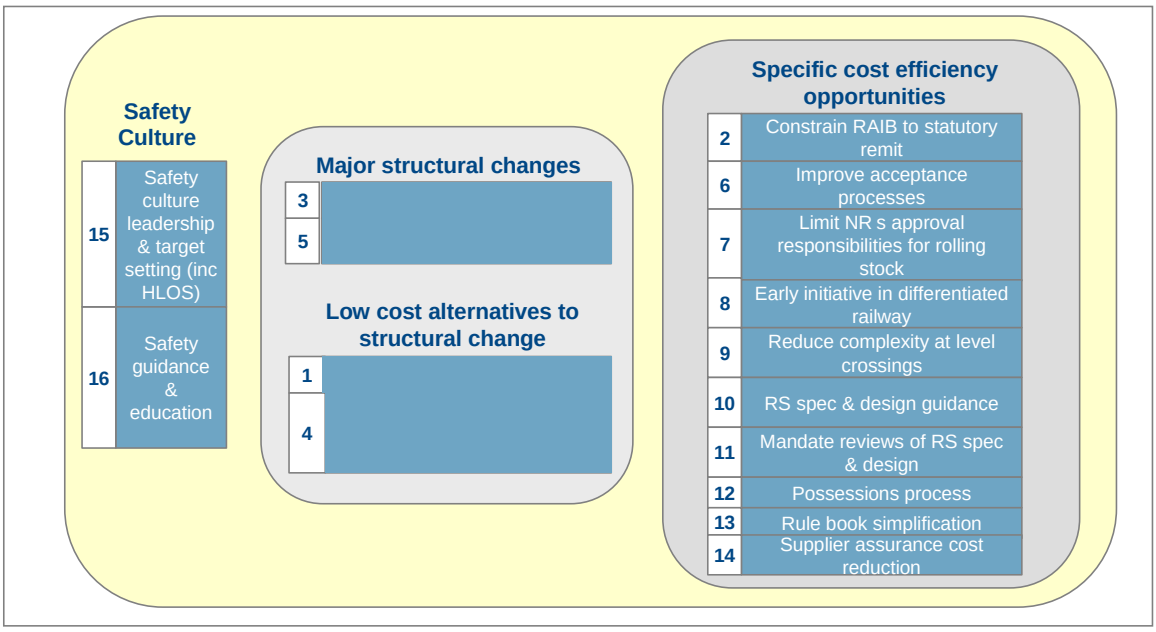
Determined and co-ordinated attempts to change culture can be effective, as evidenced by Pro Rail. They depend upon the articulation of a credible and consistent message, with the input of key stakeholders, especially the ORR, the CPS and safety professional bodies. Engaging with industry leaders will provide the organisational backup that will be needed to make such a programme work. The resistance to this form of culture change may well arise from experienced professionals concerned about what they see as a watering down of levels of safety. Instead of fighting this head-on, a more constructive approach will be to enrol such professionals as key contributors to the debate, seeking to clearly differentiate between personal value judgements and the outcomes of rational assessments of benefits, costs and the ultimate affordability of the railway. Whilst it is easy to dismiss culture change actions as being soft or fuzzy and therefore perhaps less important that other types of intervention, experience in many industries shows that culture is vital to address if change is to be successful.

7 Overall conclusions

7.1 Overall map of options

Overall, 16 options for further improvement of cost-efficiency have been identified which can be mapped into four categories: Major structural changes; Low cost alternatives to structural change; Specific cost efficiency opportunities; Safety culture

Figure 7: Map of options



Source: Arthur D. Little

It may be seen from Figure 7 that Options 3 and 5 both constitute major structural changes to safety, standards and innovation. Options 1 and 4 are low cost (and lower impact) alternatives to Option 3 which broadly address similar issues. The specific cost efficiency opportunities in the right hand box are options which could be carried out anyway, irrespective of whether the major structural change options are adopted. Finally, Options 15 and 16 refer to enabling measures to change safety culture. These will be important as critical enablers for the other options to be successful.

7.2 Summary list of options

A summary listing of the options is provided in Table 9 below.

Table 9: Summary of cost-efficiency options and potentials

Area	No	Title	Implementation risk (H/M/L)	Timescale to impact (S/M/L)	Range of cost to implement (£m)	Range of cost efficiency impact (£m/year)	Category
Safety, standards and innovation governance	1	Reallocate functions currently provided by RSSB	Medium	Short (within 18 months)	6-8 (one off)	10-15	Low cost alternative to structural change
	2	Constrain RAIB's work to its statutory remit and streamline its operation	Medium	Short (within 18 months)	1-1.2 (one off)	3-10	Specific cost efficiency opportunity
	3	Create a new independent systems and standards body and rationalise standards (Note: See Appendix 7 for suboptions)	Medium	Medium/Long (within CP4 and during CP5)	30-45/year	200-230 +10-300 per major investment scheme	Major structural change
	4	Maintain current structure, adapt standards and provide guidance	High	Medium/Long (within CP4 and during CP5)	10-15/year	100-120	Low cost alternative to structural change
	5	Create more effective mechanisms to translate research into demonstrations of de-risked technology	Medium	Long (CP5 onwards)	2-3/year + research funding dependent upon project portfolio	Enabling: included in Option 3	Major structural change
	6	Make acceptance processes more accountable, more visible and faster through either regulator intervention or more radical restructuring	Medium	Medium (within CP4)	2-3/year	Enabling: included in Option 3	Specific cost efficiency opportunity
	7	Maintain status quo, but clarify and limit NR's approval responsibilities for rolling stock	Low	Short (within 18 months)	<1(one off)	1-5	Specific cost efficiency opportunity
	8	Take an early initiative in the crafting of the categorisation of the differentiated railway	Low	Long (CP5 onwards)	1-2/year	10-100	Specific cost efficiency opportunity

Area	No	Title	Implementation risk (H/M/L)	Timescale to impact (S/M/L)	Range of cost to implement (£m)	Range of cost efficiency impact (£m/year)	Category
Reducing costs through changing asset design standards	9	Reduce the technical complexity at level crossings	Medium	Medium (within CP4)	1-2 (one off)	10	Specific cost efficiency opportunity
	10	Provide best-practice guidance on specification, procurement and design of rolling stock in support of innovation and cost-effectiveness	High	Medium (within CP4)	1-2 (one off)	10-20	Specific cost efficiency opportunity
	11	Mandate reviews to drive best practice in specification, procurement and design of rolling stock in support of innovation and cost-effectiveness	Medium	Medium (within CP4)	2-3/year	10-20	Specific cost efficiency opportunity
Reducing costs through changing operating standards	12	Provide support in the cost efficient and speedy changing of possession standards to support the findings from the NR workstreams as appropriate	Medium	Short (within 18 months)	<1 (one off)	70-100	Specific cost efficiency opportunity
	13	Provide strong and overt support for the Rule Book New Approach including aligning stakeholders behind the activity	Low	Short (less than 18 months)	3-5/year	30-80	Specific cost efficiency opportunity
	14	Accelerate progress on supplier assurance cost reduction	Low	Short (less than 18 months)	0.5/year	30 -35	Specific cost efficiency opportunity
Changing safety culture	15	Promulgate a new leadership culture of effective and efficient safety, including removing HLOS safety improvement target, changes to Railway Strategic Safety Plan and ORR/RAIB goals	Low	Short/Medium (initial action immediate, impact will be longer term)	1/year	10-15 nominal, plus enabling impact for other cost efficiency improvements	Safety culture
	16	Rejuvenate efforts at cost-conscious safety guidance and education, including interpretation of HSAWA	Low	Short/Medium (initial action immediate, impact will be longer term)	1-2/year	Covered in Option 15. Enabling impact for other cost efficiency improvements	Safety culture

Source: Arthur D. Little analysis

The above table provides a complete list of the options. As shown in 7.1, Options 1 and 4 are alternatives to Option 3.

7.3 Overall cost-efficiency potentials

We estimate a potential cost-efficiency saving of £250m-£400m/year at a cost of £45m-£70m/year, with an additional significant upside savings potential for future major national railway investment projects

Table 10: Cost efficiency potentials including major restructuring options

Options	Title	Implementation risk (H/M/L)	Earliest year of savings	Range of cost to implement (£m)	Range of cost efficiency impact (£m/year)	Category
3	Independent systems and standards body and rationalise standards	Medium	2012	30-45/year	200-230 +10-300 per major investment scheme	Major structural change
5	Translate research into demonstrations of de-risked technology	Medium	2012	2-3/year + research funding dependent upon project portfolio	Enabling: included in Option 3	
2	Constrain RAIB to statutory only	Medium	2011	1-1.2 (one off)	3-10	Specific cost efficiency opportunities
6,7	Improving acceptance and approval processes	Medium	2011	2-3/year	1-5	
8	Differentiated railway	Low	2015	1-2/year	10-100	
9	Reduced technical complexity at level crossings	Medium	2012	1-2/year	10	
10,11	Best practice in rolling stock spec/procurement/design	Medium	2012	2-3/year	10-20	
12,13,14	Accelerating possessions, rule book and supplier accreditation improvements	Low	2011	3-6/year	130-215	
15,16	Safety culture improvements	Low	2011	2-3/year	10-15 Enabling for others	Safety Culture
			Totals (£m/year)	**45-70**	**370-600**	
				Excluding Options 12-14	**250-400**	

Source: Arthur D. Little analysis

It may be seen from the above table that the cost-efficiency improvement potential is some £370m-£600m including Options 12-14. If these options are excluded on the basis that they are pre-existing, then the potential becomes £250m- £400m. Broadly speaking, these numbers exclude items already in the NR Transformation Plan, although in reality there may be some overlaps.

It should be noted that there is an additional anticipated potential benefit for major railway investment schemes of tens or hundreds of millions of pounds, depending on the scheme, arising from the contribution of the proposed standards rationalisation and system-based innovation.

Excluding the major structural change items, the savings potential is £150m-£300m at a cost of £25m-£40m

Table 11: Cost efficiency potentials excluding major restructuring options

Options	Title	Implementation risk (H/M/L)	Earliest year of savings	Range of cost to implement (£m)	Range of cost efficiency impact (£m/year)	Category
1	Reallocate/resize RSSB	Medium	2012	6-8 (one off)	10-15	Low cost alternative to structural change
4	Maintain current structure, adapt standards and provide guidance	High	2012	10-15/year	100-120	
2	Constrain RAIB to statutory only	Medium	2011	1-1.2 (one off)	3-10	Specific cost efficiency opportunities
6,7	Improving acceptance and approval processes	Medium	2011	2-3/year	1-5	
8	Differentiated railway	Low	2015	1-2/year	10-100	
9	Reduced technical complexity at level crossings	Medium	2012	1-2/year	10	
10,11	Best practice in rolling stock spec/procurement/design	Medium	2012	2-3/year	10-20	
12,13,14	Accelerating possessions, rule book and supplier accreditation improvements	Low	2011	3-6/year	130-215	
15,16	Safety culture improvements	Low	2011	2-3/year	10-15 Enabling for others	Safety Culture
			Totals (£m/year)	**25-40**	**280-510**	
				Excluding Options 12-14	**150-300**	

Source: Arthur D. Little analysis

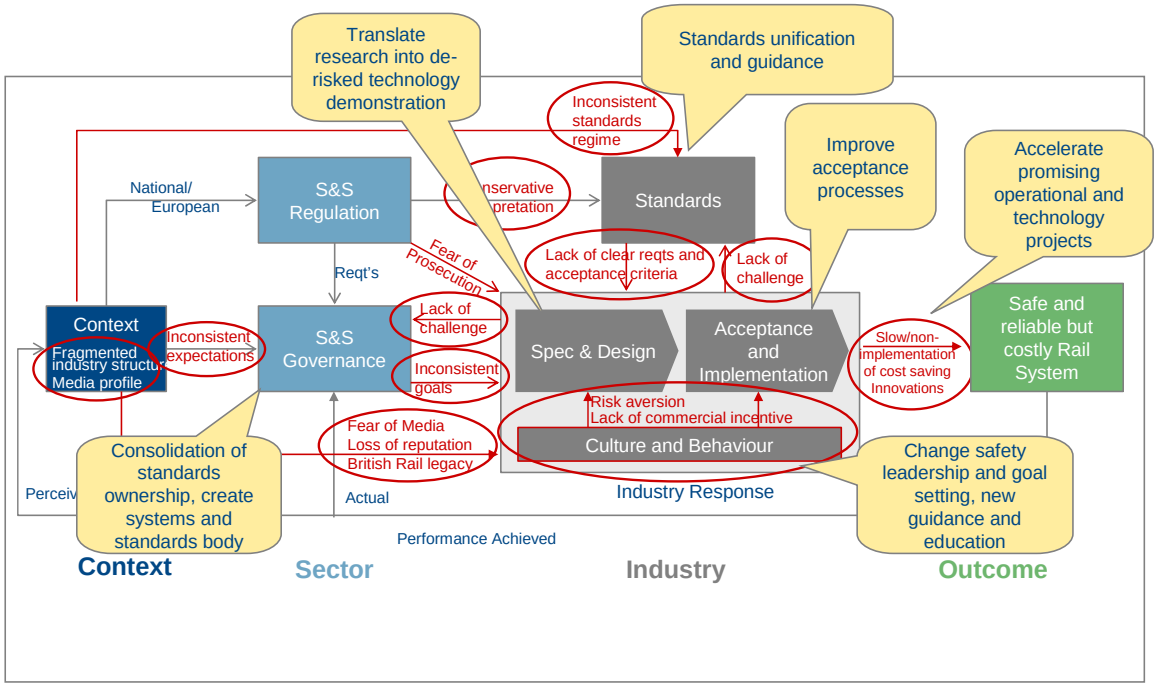
If the low cost alternatives to structural change are pursued, the savings potential goes down to some £150m-£300m. It should also be recognised that the risk of failure to achieve these benefits goes up considerable, due to barriers inherent in the current safety and standards ownership structures.

7.4 Conclusions

Our overall conclusions from the study are as follows:

1. ***There is potential to make cost-efficiency savings of perhaps some £250m-£400m/year at a cost of some £45m- £75bn/year in safety, standards and innovation through a combination of major structural changes, specific opportunities and changes to safety culture***
   Notwithstanding the significant uncertainties inherent in the savings and cost estimates, we conclude that there is potential for significant savings. A balanced set of interventions including structural changes to the governance of standards and innovation, technical and operational changes and accelerations, and critical enabling measures on safety culture will have the greatest likelihood of achieving sustainable cost-efficiency improvement. In Section 2.3 we proposed a model to illustrate how safety and standards work as a "system" in the GB rail industry, and what were the current barriers within the system. In Figure 8 below we illustrate how the key options proposed above would help to address these barriers:

Figure 8: System model for safety and standards – illustrating barriers and interventions



Source: Arthur D. Little analysis

As stated in Section 2.3, because there are multiple, interrelated barriers causing the problems that are recognised today in safety and standards, it is important to consider possible solutions in a comprehensive, balanced way that addresses "system-level" issues.

2. ***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***

   There is wide consensus that the current complex regime of standards under multiple ownership leads to delays, constrains innovation and adds unnecessary cost. Whilst rationalisation, simplification and clarification will be a major task, the unification of standards under a single body with system-wide purview provides the most effective means of making it happen. Such a body could be effectively combined with a second key role to explore and evaluate system-wide, through-life technological innovations which could have a profound impact on the future of the railway. Today, these innovations are significantly hindered by interface barriers between different players in the rail system. There are several options for how an independent standards body could be achieved in practice, including creating the body through ORR, RSSB, DfT or as a subsidiary of NR. Key ownership and governance criteria include independence, sufficient authority and stakeholder credibility. The new body would be very different to the former unsuccessful Strategic Rail Authority, in that its role would be primarily technical rather than commercial or regulatory. Further consideration of the structure, size and powers of the new body is beyond the scope of this study.

3. ***The provision of a mechanism to bridge the R&D gap between product development and large-scale demonstration is a further important measure to enable cost-saving technologies to be deployed***

   The gap in the product development cycle between concept and de-risked large-scale demonstration is widely acknowledged. The need is to develop and maintain an industry strategy and to support research necessary to bring ideas to the point that their business case and future potential is proven. This will build naturally on the work of the Technology Strategy Advisory Group and of the DfT's strategic research to date. Examples such as the Energy Technologies Institute provide a pointer to how this could be achieved.

4. ***There are many technological innovation projects already in the pipeline which have significant cost-efficiency potential. Some minor additional opportunities have been identified relating to level crossings and rolling stock. The concept of the "differentiated railway" also provides potential but on a longer timescale***

   There are many technological innovation projects in the pipeline with collective potential savings opportunities in the £billions. In this study we have only counted the one-off benefit of *acceleration* of these projects in our cost-efficiency potentials in order to avoid "double-counting". Other opportunities have been identified in this study including simplifying level crossing designs and best-practice guidance in rolling stock specification. The concept of the "differentiated railway " which is still in early stage of development could lead to the possibility of simpler technology (e.g. low cost off-the-shelf signalling systems) for low-density lines. However this is considered too speculative and long term to be included as an option in this study. In the meantime we do not see new opportunities for cost-efficiencies in train protection systems, including ERTMS or TPWS, within the CP4 period.

5. ***There are opportunities for accelerating existing projects to reduce safety-related operating costs***

   The study identified the potential to accelerate current projects relating to possessions, rule book simplification and supplier accreditation, all of which face barriers associated with the need to align objectives and interests, and secure consensus among multiple stakeholders in order to proceed. Acceleration opportunities will require additional high-profile leadership and support, as well as changes to standards.

6. ***Changing safety culture is a key enabling measure to underpin cost-efficiency improvement, and important options have been identified to support culture change***
   Whilst GB Rail safety culture has many positive attributes which have supported significant safety performance improvement over many years, there is a widely held view that attributes such as personal risk aversion, lack of individual accountability and excessive "double-checking" are barriers to greater efficiency and innovation. In addition to some of the other "hard" measures suggested in this report, it will be important to promulgate a leadership drive towards efficient and cost-effective safety. Options are suggested for changing goal-setting philosophy, (e.g. removing the HLOS safety target) and for education and guidance on cost-conscious safety.

7. ***Options for changing safety governance bodies generally provide only limited cost-efficiency benefit***
   In themselves, the costs of running the safety parts of ORR, RAIB and RSSB are relatively limited compared to the overall costs of the GB railway. Whilst there will always be opportunities to continue to improve efficiency and reduce budgets, the degrees of freedom for significant change are limited, for example:
   - ORR acts as the National Safety Authority, and the safety regulatory function will always be required.
   - RAIB, as the independent accident investigation body, is also required by law. However there are some opportunities to reduce its scale and scope, also supported by comparisons with other European railways.
   - RSSB, which was set up in response to Cullen, is not required by law. However its functions would, for the most part, still need to be carried out somewhere in the industry even if RSSB did not exist. These functions include: a research programme, safety information reporting, education and training, the Safety Risk Model, and Group Standards. Options for RSSB are closely connected with other major restructuring options.

8. ***Based on the evidence we judge that with due care it is possible to make significant improvements in cost-efficiency whilst at least maintaining, and possibly enhancing control of safety risks***
   As part of this study we have examined selected relevant comparators and benchmarks including, amongst others: safety and standards governance regimes in four European and two non-European countries; one European railway (Pro Rail); the US Railways; the Aerospace sector; and the National Grid. These comparators and benchmarks have been used to help assess the feasibility of individual options.

   In addition we have conducted over 40 interviews covering GB railways including NR, TOCs, FOCs, ROSCOs, suppliers and regulatory/governance bodies. We have also examined and assessed GB rail safety trend data. Finally we have drawn on our broader experience in consulting and advising on safety, risk management and innovation across the rail and other sectors internationally. Based on this evidence we can conclude that:
   - There is a shared consensus that current GB rail safety and standards arrangements are not optimal from the point of view of duplication, efficiency and effectiveness. There is also evidence from across private sector industry that the best performing businesses commercially also tend to have high safety performance, so there does not have to be a trade-off.
   - There are many examples from comparators which would tend to support the feasibility of proposed cost-efficiency options.

- Based on trend analysis, the spend on safety that would be "justified" to meet future safety performance requirements is less than what has been spent up to now. This is because of the effect of "diminishing returns", given the very significant improvements in safety performance that have already been made since privatisation. This is the case even taking into account increased risk levels due to additional future traffic.

9. ***Overall, any argument for reducing spend on safety-related activities needs to take account of societal and commercial factors, including possible sudden changes in societal preference in the event of a major accident or incident***
   The justification for spend on safety depends not only on legal duty (including the principle of reducing risks SFAIRP), but also on commercial and policy issues. In commercial terms, a duty-holder may decide in certain circumstances that more money should be spent than would be required to meet legal requirements – for example if the risk is perceived to be something that could have a detrimental effect on company reputation, or if powerful stakeholder groups have a particular interest in the issue. In policy terms, the industry may decide to implement safety measures which significantly exceed legal obligations for reasonable practicability (i.e. costs are grossly disproportionate to safety benefits), purely because of the expressed or inferred preference of society, often as interpreted by political leadership.

7.5 Follow up and implementation

A stepwise approach will be needed to take the results of this study forward

This study is one of a number of VFM themes, and as stated in the introduction there are a number of potential overlaps with other themes. Moreover, the evaluation and selection of options and schemes as suggested in this report will be part of a broader evaluation of options for the GB railways as a whole. The options themselves have only been outlined in very broad terms, given the stage of development of the project – perhaps best described as a "pre-feasibility" stage.

We envisage that the following initial steps would be therefore needed for implementation:

- Integration of study findings with those of the other themes, including rationalisation of data and clarifications where needed.
- Review of overall structural and policy options by government.
- Articulation and agreement of an overall strategy for GB rail.

At this stage it would be necessary to re-examine the combination of options which has resulted from this exercise, across all the relevant themes. In the case of the options outlined in this report, there are many areas where further work would be needed to take the option(s) to the next stage. This would include, for example:

- Further feasibility studies to provide a better definition of objectives, scope, risks, costs and benefits.
- More in-depth examination of particular restructuring options.
- Fleshing out of key scope items.
- Consultation on critical items.

Clearly a communications and stakeholder engagement plan would also have to be a key early priority in further work.

Appendix 1: List of respondents

Organisation	Number of interviewees
Infrastructure Manager (NR)	16
Train and Freight Operating Companies and Associations	8
Suppliers	5
RIA	1
DfT	3
ORR	1
RSSB	4
RAIB	1
TCCI/AAR (US)	2
ProRail	2
Aerospace Industry	1
Total	**43**

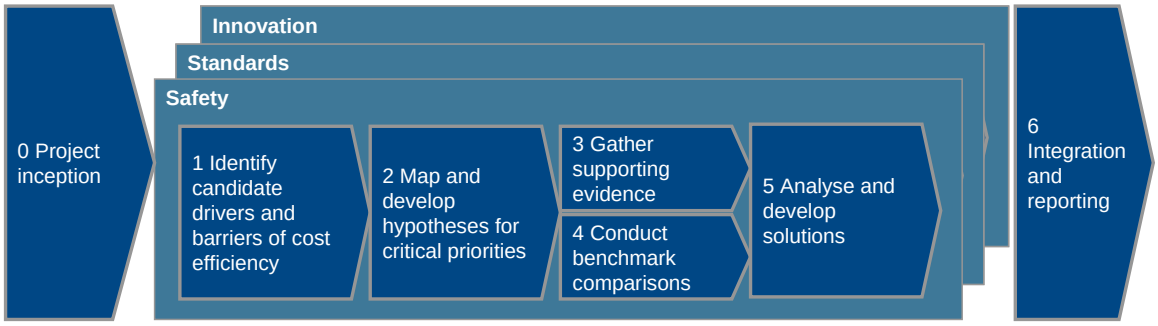
Appendix 2: Methodology

This appendix provides further details on the methodology used for the work.

Overall approach

The study was conducted over a period of approximately 12 weeks from early June to late August 2010. A stepwise approach was taken as illustrated below.

Figure 9: Overall study approach



The work included:

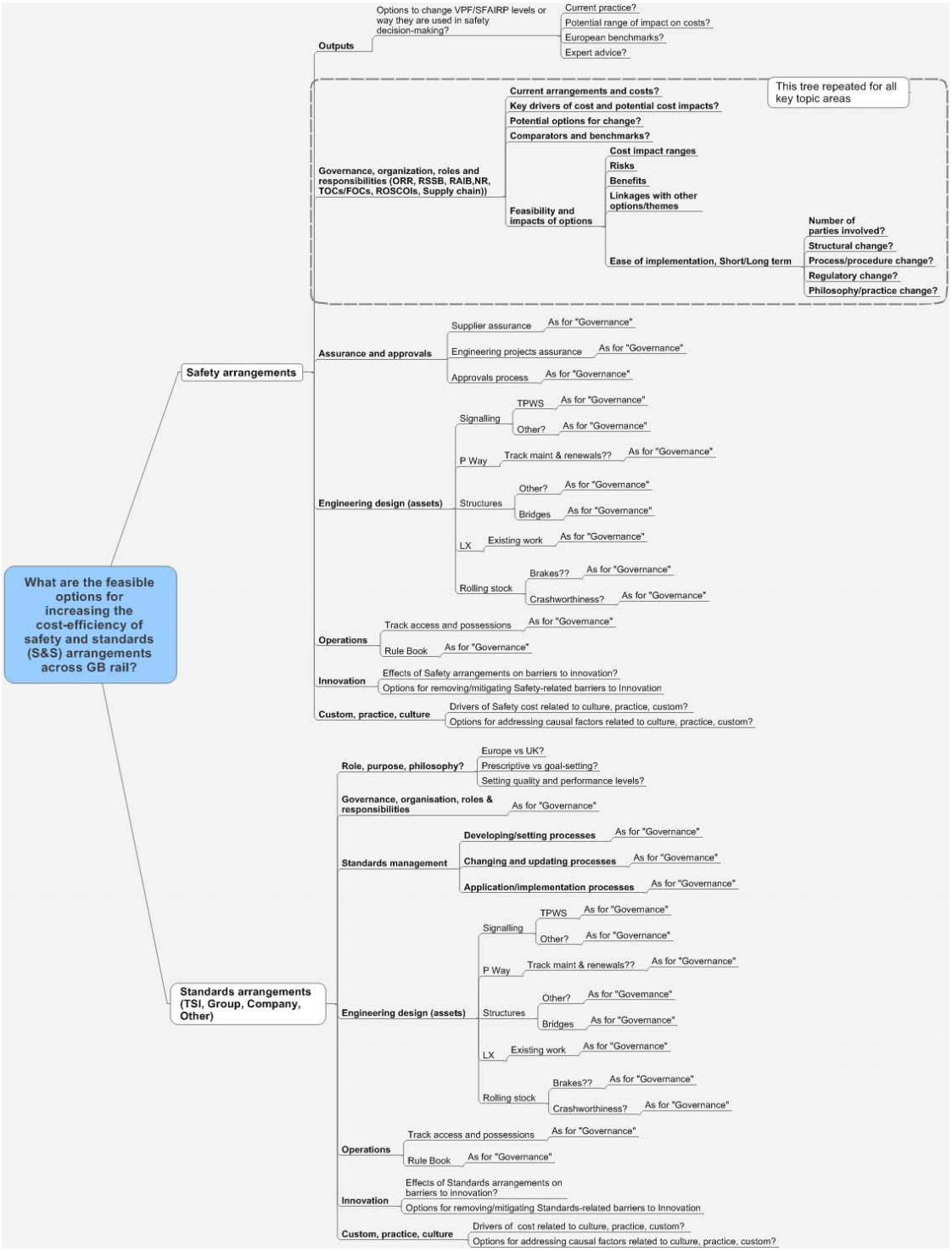
- Documentation and literature review.
- Interviews and discussions with over 40 stakeholders (see Appendix 1).
- Gathering of comparative benchmarking data.
- Integration and analysis.
- Report preparation.

In order to help structure the study, an Issue Analysis was conducted (refer Figure 10).

Interview and benchmarking guides were also prepared to support the execution of the study.

Regular progress meetings were held with the joint DfT/ORR project supervision team.

Figure 10:Issue analysis



Appendix 3: References

A comprehensive document review was conducted during the course of the study. The following documents and websites are specifically referenced in the main body of the report (given in order of occurrence):

- Taking Safe Decisions - How Britain's railways take decisions that affect safety. RSSB, 2009, http://www.rssb.co.uk/SiteCollectionDocuments/pdf/vtsic_presentations/Taking%20safe%20decisions%20-%20Part1.pdf
- The Ladbroke Grove Rail Inquiry – Part 2 Report, 2001, http://www.railwaysarchive.co.uk/documents/HSE_Lad_Cullen002.pdf
- Accident Investigation notification and reports Database, http://pdb.era.europa.eu/safety_docs/naib
- Review of Standards Regimes in use on the Nation Rail Network, ORR, 2009, http://www.rail-reg.gov.uk/upload/pdf/cons-rep_revstndrds_0808.pdf
- www.dft.gov.uk/pgr/rail/interoperabilityandstandards/interoperabilityfaqs/interoperabilityfaq1?page=1
- www.rssb.co.uk/RGS/Pages/DEVIATIONS.aspx
- NR Transformation Programme (Confidential) 6 August 2010
- Working Document 08/57-DV29: The Authorisation Process of subsystems and vehicles under the Railway Interoperability Directive 2008/57/EC
- Assessment of Compatibility of Rolling Stock and Infrastructure, RSSB, 2007, www.rgsonline.co.uk/Railway_Group_Standards/Rolling%20Stock/Railway%20Group%20Standards/GERT8270%20Iss%202.pdf
- http://www.networkrail.co.uk/aspx/3262.aspx
- www.networkrail.co.uk/aspx/1554.aspx
- Intermediate Report on Authorisation Processes, ERA, March 2010, http://www.era.europa.eu/Document-Register/Pages/Intermediate-Report-on-Vehicle-Authorisation-Processes.aspx
- "European Railway Technical Strategy - Technical Vision to guide the development of TSIs" Version 1.1, March 2007, http://www.eimrail.org/pdf/techpapers/ERTS%201.1_March%202007.pdf
- Standards Issues – Follow-Up to Board Discussions, Industry Standards Coordination Committee, 2008, http://www.rssb.co.uk/pdf/rgs/iscc/08-05-08/Appendix%202%20-%20Standards%20Issues%20-%20Post%20Board%20Dicussion.pdf
- "The cost of level crossings - an international benchmarking exercise", T364, Arthur D Little for RSSB, June 2006
- Rail Infrastructure Cost Benchmarking – Brief LICB gap analysis and cost driver assessment," BSL, April 1st, 2008, www.networkrail.co.uk/browse%20documents/strategicbusinessplan/update/cost%20benchmarking%20assessment%20%28bsl%29.pdf
- "High Speed Rail London to the West Midlands and Beyond HS2 Cost and Risk Model", HS2, December 2009, www.dft.gov.uk/pgr/rail/pi/highspeedrail/hs2ltd/riskmodel/pdf/report.pdf
- "Market Investigation into the Leasing of Rolling Stock to franchised rail passenger services and related maintenance services" - Paper for Competition Commission, Department for Transport comments on Specification Issues arising out of Emerging Thinking, DfT, 7 February 2008, http://www.competition-commission.org.uk/inquiries/ref2007/roscos/pdf/responses_emerging_thinking_third_party_dft_paper.pdf (Accessed 7 August 2010)
- "A Review of the Intercity Express Programme", Sir Andrew Foster, June 2010, http://www.dft.gov.uk/pgr/rail/pi/iep/fosterreview/pdf/report.pdf (Accessed 7 August 2010)
- ORR Best Practice Study: A report on the programme of international visits carried out by ORR between July – October 2007, ORR, http://www.rail-reg.gov.uk/upload/pdf/wbps-rail-summary-reprt2.pdf

- "The ATOC Guide to Vehicle Change" ATOC, April 2008 www.atoc.org/clientfiles/File/publicationsdocuments/nps7AF_tmp.pdf
- Rail Infrastructure Cost Benchmarking – Brief LICB-gap analysis and cost driver assessment 2008, NR
- Internal Benchmarking: Summary of findings, 2007, NR
- Possession benchmarking exercise report, 2006, ORR
- A. Sharpe and S Roberts, 2010. The New Approach to the Rule Book - Briefing paper for the Industry Leaders
- Achilles UK, http://www.achilles.com/en/uk/sectors/transport/rail-industry
- Supplier Assurance Framework: Review and Analysis of Existing Supply Chain, Arthur D. Little, 2008
- Report on ORR's review of RSSB, ORR, 2 August 2010, http://www.rail-reg.gov.uk/upload/pdf/rssb-review-report-020810.pdf (accessed 6 August 2010)
- Rail Infrastructure Cost Benchmarking – Brief LICB gap analysis and cost driver assessment," BSL, April 1st, 2008, http://www.networkrail.co.uk/browse%20documents/strategicbusinessplan/update/cost%20benchmarking%20assessment%20%28bsl%29.pdf
- http://www.intlrailsafety.com/Dublin/25_October_2006_Papers/01_George_Bearfield.pdf
- Comparison of railway enhancement costs in Great Britain and barriers preventing delivery of station projects by train operators, ORR Independent reporter Mandate CN007, Draft Report, 26 April 2007
- http://www.reuters.com/article/idUSSIB27628520080612
- http://news.hse.gov.uk/lau/2010/06/22/announcement-of-health-and-safety-review-by-lord-young/
- www.aar.org
- http://www.dft.gov.uk/pgr/rail/
- http://www.rail-reg.gov.uk/server/show/nav.75
- http://www.rssb.co.uk/Pages/Main.aspx; http://www.rssb.co.uk/AboutUs/Pages/default.aspx
- http://www.futurerailway.org/Pages/home.aspx
- http://www.era.europa.eu/The-Agency/Values-and-Mission/Pages/home.aspx
- http://www.bea-tt.equipement.gouv.fr/rubrique.php3?id_rubrique=39
- http://www.securite-ferroviaire.fr/fr/
- http://www.era.europa.eu/Document-Register/Pages/NSA-Annual-Report-2008-FR.aspx
- http://www.era.europa.eu/Document-Register/Pages/NSA-Annual-Report-2008-DE.aspx
- http://www.era.europa.eu/Document-Register/Documents/NSA-Annual-Report-2008-ES.pdf
- PRC - Railway Emergency Management System Study, May 2010
- http://www.era.europa.eu/Document-Register/Pages/NSA-Annual-Report-2008-NL.aspx
- http://english.verkeerenwaterstaat.nl/English/
- http://www.onderzoeksraad.nl/en/index.php/over/

Appendix 4: Comparator case examples

This appendix contains descriptions of a number of comparator case examples which are of relevance for the study. The examples include:

- Safety, standards and innovation approaches of Pro Rail (Dutch railways).
- US Rail approach to standards.
- GB aerospace safety approvals process.
- National Grid approach to risk-based asset prioritisation.

In general the focus has been on comparison of processes, approaches and structures relevant for safety, standards and innovation. We have not sought to benchmark quantitative performance parameters or other indicators.

1 Pro Rail

This section provides information on the various approaches to safety, standards and innovation identified during visits and interviews with Pro Rail and Rail Alert for the Netherlands railway.

1.1 General information

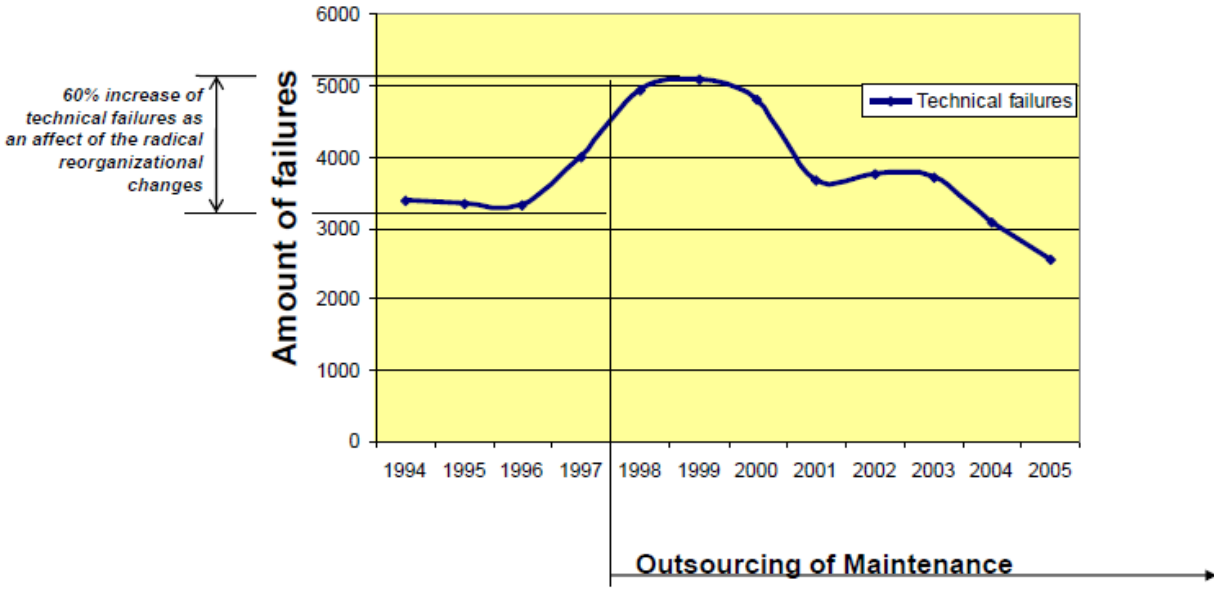
The Dutch railway is a relatively small network compared to GB with approximately 70% less train km per year and passenger km per year. The Dutch railway has had fewer derailments, employees killed/seriously injured, broken rails and wrong side signal failures per million train km than GB. However, GB has a better performance with respect to fewer collisions, passengers killed/seriously injured, SPADs and train buckles. It should be noted that some variations in the performance between the two railways may be due to differences in reporting and definitions of KPIs.

Pro Rail is the asset owner for the Dutch railways and therefore has a similar remit to NR. It is a public enterprise 100% owned by the Dutch government. Operating with a budget of €1.3bn in 2009 (excluding large green-field projects), Pro Rail has 3200 employees and is responsible for traffic control, capacity management and infrastructure management (rail and stations).

One of the key differences with the GB railway is that in the Netherlands there are 4-5 main external contractors to deliver the maintenance and renewals work for Pro Rail. Pro Rail are of the view that these few but large external contractors provide various advantages relative to NR through access to new innovations, price competition and new working practices as the contractors must win competitive contracts. Benefits of this approach to outsourcing the maintenance can be identified, for example there has been a fall of approximately 25% over 8 years (after an initial turbulent transition period) in the number of failures.

Figure 11:Effect of outsourcing maintenance on failures across the Dutch railway

Effect on the number of failures



Source: Pro Rail 2010

For NR, the decision to bring all maintenance and renewal work in-house in CP3 following Potters Bar has led to significant cost efficiencies (up to 35%), however it could be argued that in so doing it has lost some of the new innovation potential that Pro Rail has had access to.

Rail Alert is a new organisation aimed at improving safety and overseeing the safety rules and standards. In this regard it is similar to part of RSSB's remit. Rail Alert has 3.5 FTEs and is currently funded by Pro Rail and the industry. However, the expectation and future plans for Rail Alert are that it will become self-sufficient in 3-4 years time through the provision of paid services to the industry, for example certification of training and delivery of the training itself. The role of Rail Alert is not to direct Pro Rail, but to act as a mirror to challenge Pro Rail and make Pro Rail reflect on their decisions as to whether they are the right ones with respect to safety. Rail Alert is the leading organisation with respect to the safety culture improvement initiative discussed further below. Also, whilst SILs are currently owned by Pro Rail, it is anticipated that these will be passed over to Rail Alert in the near future.

1.2 Safety governance, organisation and philosophy

As discussed in Appendix 5, the safety governance structure in the Dutch railways consists of five main organisations:

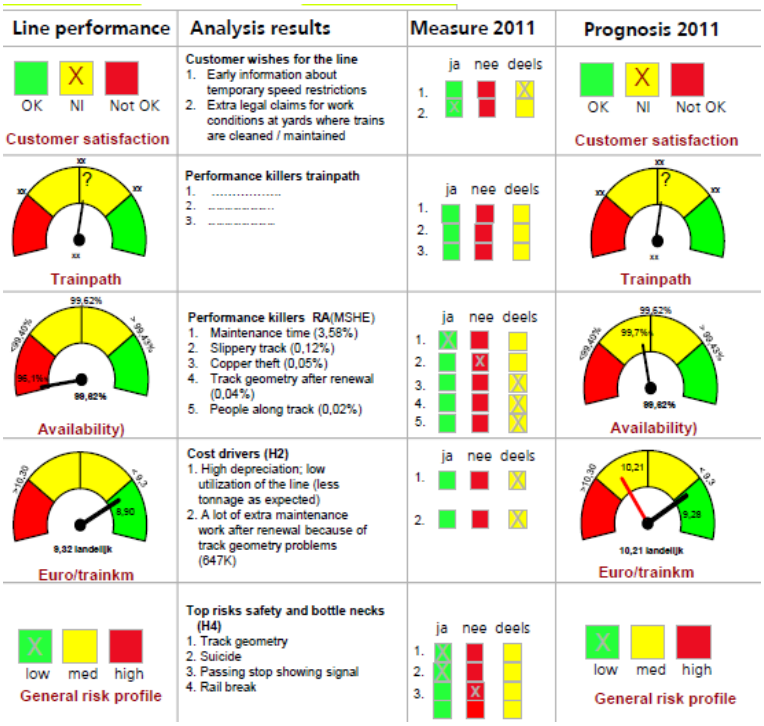
- The Netherlands Railway National Safety Authority (NSA)
- The Dutch Safety Board
- The Netherlands Competition Authority
- The Labour Inspectorate
- Railway Police

This does not include Rail Alert at this time (see notes in 1.1above).

For Pro Rail, safety and standards are considered directly and indirectly in their performance metrics:

- Directly – for example the top safety risks are identified.
- Indirectly – safety and standards have an impact on Availability, for example through maintenance time and people along the track.

Figure 12:Key performance metrics and targets for Pro Rail



Source: Pro Rail 2010

Value to Prevent a Fatality (VPF) is generally not used by Pro Rail in its decision-making process relating to renewal and maintenance activities. A strict risk assessment approach is used to make decisions, which does not incorporate a VPF figure.

At this time there are no specific safety standards and innovation related cost efficiency initiatives across Pro Rail. The main focus for Pro Rail over the past few years has been on cost efficiencies in track work, possession planning and the continued evolution of the contractor contracts. All of these are more relevant to the Asset Management theme of the VfM study than to this theme, although there are overlapping links for safety and standards with respect to possessions and track work which are discussed below.

The most significant safety initiative in the Dutch Railways has been led by Rail Alert, and focuses on driving and embedding a safety culture across the railway from the senior management down to the front line staff. Cost efficiencies have not been a primary goal of this activity although it is expected efficiencies will be indirectly derived. Further detail on this initiative is provided below.

1.3 Safety assurance and approvals

The safety assurance and approvals processes for Pro Rail differs from those on the GB railway because of the focus on the interaction with the network only

Contractors are expected to develop new ideas, innovation and technologies and then present them to Pro Rail. Before presenting, the contractor will engage an independent testing company, such as Lloyds, to provide them with a certificate of assurance on the reliability of the equipment. This certificate provides a technical evaluation/assessment and approval of the new technology which is then included in the business case presented to Pro Rail. It is the technology company that pays for this independent testing. Pro Rail largely accepts these third party certificates on the durability and reliability of the new technology and therefore concentrates their own testing on its interface with the network. This may provide a quicker and more cost efficient route for the introduction of new technologies than on the GB railway as NR tests the technology itself as well as its interface with the network.

If the technology fails in service, it is ultimately Pro Rail who is responsible and therefore they always conduct an investigation into the failure. However this investigation is perceived to be more focused on identifying root causes rather than allocating blame.

Approval of new technologies already implemented on other railways is assessed on a case-by-case basis

Pro Rail welcomes new technologies from other European railways, especially if they are compliant with the European regulations and therefore a certain standard is assured. However, each technology is still reviewed on a case-by-case basis and its implementation on a different railway does not mean it is automatically approved and accepted for the Dutch railway without further testing. Pro Rail justifies this subsequent testing because of the various differences between the Dutch and other railways that must be taken into account. However, this testing is still only focused on the interface of the new technology with the Dutch network and not on the technology itself.

It is not known whether suppliers think this approach is efficient and works well

This benchmarking has not been able to discuss this process with suppliers to the Dutch railways and therefore all the evidence provided is based on discussions with Pro Rail.

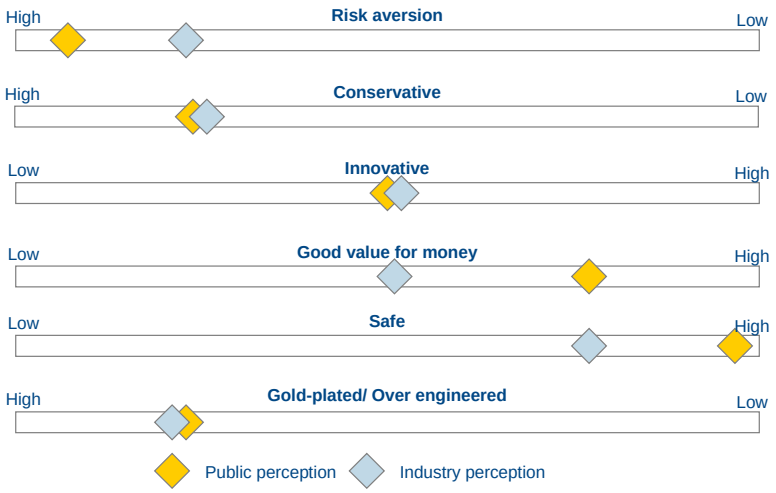
1.4 Safety culture

The safety culture on the Netherlands railway is becoming more similar to that of GB in that risk aversion is increasing, but there appear to be differences in the perceived level of gold-plating

Based on our discussions with Pro Rail and Rail Alert, Figure 13 shows that the public's perception and the industry's perception of the safety culture are in many aspects similar to GB. Whilst historically risk aversion has been less of an issue in NL, it seems that this is now changing and there is now an increasing perception of conservative attitudes towards safety.

The biggest difference with the GB railway is the perception of gold-plating or over-engineering of assets. It is identified elsewhere in this report that for certain assets there is a perception of gold-plating which can lead to relatively high costs (e.g. level crossings). On the Dutch railway, this perception does not exist. Pro Rail point to goal-focused specification standards as a factor in this (see later).

Figure 13:Public and industry perception of the safety culture in the Netherlands



Source: Discussions with Pro Rail and Rail Alert

The single biggest improvement activity for Pro Rail has been on improving safety culture
Previously, it was perceived on the Netherlands railway that safety rules were not always being followed by track workers. It was felt to be due to workers often working in the same teams each time, that they knew each other too well, that many didn't like the rules and that there was the culture of "if the boss was not around….". Also safety was not embedded outside of the track workers and into their line managers, the track work planners and the senior management of the companies.

Approximately one and a half years ago, Rail Alert and Pro Rail met with the main contractors to discuss this issue and developed a set of five overarching guidelines for the safety behaviours they want in the industry. These five guidelines were kept simple and clear and each stakeholder formally signed up to them. Their intention was to drive safety out of only the safety manager's responsibilities and into the line managers and the planners.

Figure 14:The five key safety culture principles – with English translations

Source: This was developed from the original Rail Alert document by the contractor BAM Rail bv

These guidelines are currently under the ownership of Rail Alert, however Rail Alert is not responsible for ensuring there are embedded into every organisation. Instead, it was made clear from the beginning that it would be the responsibility of the company to implement the guidelines with Rail Alert's help.

The benefits of this programme are not yet identifiable due to the timescales of the actions and culture changes

There are signs that this desired shift in culture is taking place. Track work planners are now considering safety and risk assessments in their activities much more frequently than before. Also, it has been known for contracts to be turned down by contractors because the work was deemed unsafe by the Managing Director.

However, there have been no marked improvements in the key safety KPIs measured by Pro Rail to date. This is likely to be because it is too soon to see the benefits from a culture change programme. Also, Pro Rail state that the current low number of safety incidents means any changes will be difficult to see.

It should be noted that whilst this initiative was not focused on cost efficiencies, it is expected that there are anticipated savings from improved safety and better work planning by contractors. These benefits have not been quantified or formally identified by Pro Rail or Rail Alert because the focus was not on cost efficiencies but improving safety.

1.5 Innovation

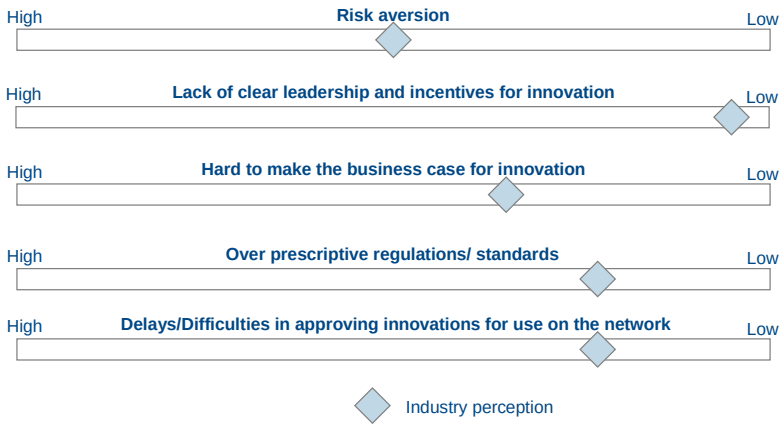
The industry, not Pro Rail, is perceived to be the source for most innovations

The organisation of the Dutch railway and the outsourcing of the renewal and maintenance work to a few main contractors mean that the main sources for innovation in the industry are not perceived to be Pro Rail. Pro Rail provides the customer for the innovation, but is generally not the instigator. Pro Rail can influence innovation through their guidance and conversations with contractors. For example, it was decided to avoid Red Zone working almost entirely on the Dutch network. It was therefore down to the contractors to develop innovative new practices which could deliver the same work and keep cost efficiencies.

Many of the barriers to innovation seen in GB are not considered barriers by Pro Rail on the Dutch railway

Based on the perceptions of Pro Rail (and not discussions with any contractors or suppliers), many of the barriers to innovation seen on the GB railway are not a significant barrier for the Dutch (Figure 15).

Figure 15:Perceptions on the barriers to innovation



Risk aversion in the industry is relatively high, however this situation is perceived to be improving largely due to fewer technicians being involved in the approvals process. Previously, the approvals committees and boards were populated with technically-minded individuals from the railway. Whilst this worked well and technical knowledge is valuable, over recent years some of these people have been replaced by more business-focused individuals. This is seen to have helped to improve the process of bringing innovation in to the industry.

Difficulty in making the business case for innovation is relatively high for the Dutch Railways, however it is still considered a minor barrier. This is probably due to the approvals process and approvals committee make-up described above. In addition, it is understood that Pro Rail has a relatively good understanding of, and has data on, its assets. Contractors can pay to access this data to support their business case development.

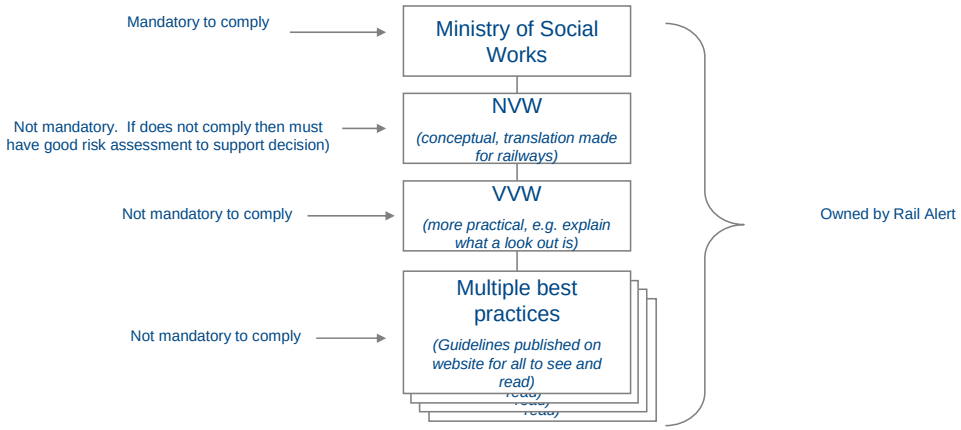
The only common barrier is the lack of testing and trialling facilities. There are no such facilities in the Netherlands and therefore tests and trials must be conducted elsewhere. However this was not seen as a significant barrier - this links into the approvals process described above.

1.6 Standards

In the Netherlands, there is mixture of mandatory overarching guidelines and non-mandatory standards, all of which are owned by Rail Alert

There are essentially four levels to the hierarchy and ownership of safety standards in the Dutch railway (Figure 16).

Figure 16:Safety standards owners on the Netherlands railway



Source: interviews with Pro Rail and Rail Alert

Mandatory standards are developed by the Ministry of Social Works at the top level. These standards or guidelines feed down into the creation of NVWs where compliance is not mandatory but a risk assessment must be provided for any non-compliant activities. These then feed down into VVWs which go into more practical detail of how the NVWs should be implemented. Finally, this system is supported by multiple best practices. These best practices are intended to come from the industry and there is a public website for companies to upload, share and review best practices. However it should be noted that to date, only one best practice has been uploaded.

Dutch rail standards are focused on goals rather than providing detailed specifications
In the Netherlands, most standards are aimed at providing information on the goal or objective of the activity addressed by the standard. Therefore, they often give detail on the situation and background to a practice or technology and then the overarching goal, for example the train must not derail. At a certain level down in the standards hierarchy details such as track geometry are included, but overall it is up to the contractor to decide which practice or technology to use to achieve the goal. However, recent track worker deaths have led to more detailed and severe safety rules and standards.

Challenging and changing standards can be done based on a sound risk assessment
The process for challenging and changing a standard is perceived by Pro Rail and Rail Alert as relatively simple. The contractor (often the proposer of a change) must provide a detailed risk assessment of why a certain standard will not be complied with or how it should be changed.

Generally, compliance with European standards (TSIs) are not considered a problem in the Dutch railway
During the development of TSIs, Pro Rail is very active in proposing amendments and seeking to help guide the final document. This provides them with an opportunity to ensure the TSIs are not significantly different to their current state and also to anticipate coming changes from the new TSIs.

TSIs are considered to be relatively quickly accepted on to the Dutch railway. Due to the size of the railway, many of their standards as well as practices and technologies are taken from the larger railways around them. This means that often the TSIs are developed closely to the Dutch way due to the influence and direction provided in the TSI development by the larger railways.

1.7 Safety and standards in asset design and implementation

The impact of safety and standards is considered minimal in adding extra cost to most structures, except tunnels
The impact of safety and standards on the cost of tunnels on the Dutch railway is considered “ridiculous”. Tunnels must include essential safety features to respond to fires, floods, accidents etc. However, Pro Rail thinks that the current standards are adding up to 10% to the cost of new tunnels as they are overly specified and risk averse. For 2010, the Pro Rail budget for new tunnels and bridges is estimated at about €47m, whilst maintenance on tunnels and bridges from 2006 was approximately €18m. This provides an estimate spend of about €55m a year on tunnels and bridges. If you assume half is for tunnels, this equates to a budget of €27m. If 10% of the cost for a tunnel is considered as unnecessary because of overly restrictive standards, then this could equate to a saving of up to €3m from the annual budget each year. Better benchmarks are being considered by Pro Rail, including the EuroTunnel and other tunnels in Europe.

Signalling on the Dutch railways is modularised to a certain degree but the biggest savings come from scrapping plans to install new technologies
At the moment, a lot of the Dutch railway utilises older technology in their signalling systems. A programme to upgrade the signals was agreed and work had started. However, earlier this summer a decision was made by Pro Rail to halt the renewal of the signalling equipment and to instead continue with the older interlocking (rather than the new electronic interlocking). This decision was made on the basis of the new system costs approximately 2.5 times more than the traditional interlocking.

It is not known what the impact of safety and standards is on Rolling Stock as Pro Rail has little involvement in this.

1.8 Safety and standards in operations

New technology has led to more accurate access charging for TOCs and efficiencies in maintenance planning

The only element of rolling stock that Pro Rail is involved in is rail wear and wheel profile as these influence and impact the condition of the track. Over the past few years, Pro Rail has led an initiative to introduce new technology to the network, based on the rail-wheel interface to improve access charging as well as asset data. A unit fitted to the side of the track captures train data, including axle loading, the number of wheels, wheel roundness, speed, weight and loading. Based on this data, Pro Rail has improved their access charging to take better account for usage and wear and tear by certain train services. This extra level of data has also benefitted Pro Rail by providing near-time track asset data and to prioritise maintenance work. For example, the length of time a track has been laid is no longer the key determinant for when maintenance should be carried out. Likewise, this also has had an impact on the need and frequency of inspections.

The TOCs are also seeing a benefit from this data and are paying Pro Rail for access to it to input into their internal planning and train maintenance schedules.

On the Dutch railway, there are approximately 42 measuring units which can provide data on 95% of the network in 3 days. Each measuring unit costs Pro Rail approximately €25,000. Therefore, if you assume a similar ratio of measuring points to track km between the Dutch and the GB railways, this would lead to a need for about 192 measuring points for the GB railway at a cost of €4.8m. The benefits achieved in terms of more accurate access charging, better planning and prioritisation of maintenance and improved asset data have not been calculated, however this could provide an interesting business case for further investigation. Similar technology is being considered currently in GB.

Improvements in possessions have led to up to €70m a year cost efficiencies for the Dutch railway

Currently, the cost for maintenance on the Dutch railway is approximately €280m (this is viewed as high by Pro Rail). Pro Rail believe they have been able to drive about 25% of this cost down, equivalent to saving about €70m a year, based on improving the planning of possessions.

The use of timetabled white space has been a key enabler of more productive possession planning, together with more accurate and up-to-date asset information (for example from the 42 measuring units across the network). The impact of the safety culture initiative (mentioned above) is also identified as a key reason for improving productivity by driving safety into the planners and ensuring they ask themselves “how do I deliver this work safely”.

In addition, Pro Rail has invested into the delivery of several mobile maintenance units which are currently being used extensively to raise track worker safety and also improve productivity of the possession. NR is also looking at mobile maintenance units, however the business case and costs of the units appear too high at the moment.

2 US railway standards management

The Association of American Railroads (AAR) is the standard setting organisation for North America's railroads

AAR is a membership organisation overseeing 140,000-mile rail network. It sets standards for innovation, safety and technology and includes the major freight railroads in the United States, Canada and Mexico, as well as Amtrak. The primary focus is the interoperability of rolling stock, including locomotives, and their components. AAR owns two subsidiary organisations as well as one research foundation[56]:

- Transportation Technology Center (TTCI) is the world's leading research, development and testing facility that develops next-generation advancements in safety and operation efficiency (the focus of this benchmarking).
- Railinc Corporation, AAR's information technology hub, uses one of the world's largest data networks to help customers track shipments.
- The AAR's Railroad Research Foundation (RRF) manages many of the government's rail research programs in the safety and security, communications and train control areas as well as infrastructure improvement programs.

Supporting the AAR, TTCI provides technical input as well as standards ownership

TTCI is a wholly own subsidiary of the Association of American Railroad and has three primary roles:

1. To ensure AAR members are treated fairly and evenly in relation to new regulations or bills created at the national level.
2. To deliver research on behalf of AAR into new technology and practices for a safer and more efficient railroad. This research is focused on applied research rather than 'blue sky' research.
3. To take ownership of the industry standards.

In relation to industry standards, TTCI is responsible for developing and maintaining the industry standards for freight cars and locomotives, under the direction of AAR. TTCI's Technical Standards group provides technical expertise, coordinates the development of new standards, manages the industry's certification and quality assurance programs, and publishes AAR's Interchange Rules and Manual of Standards and Recommended Practices.

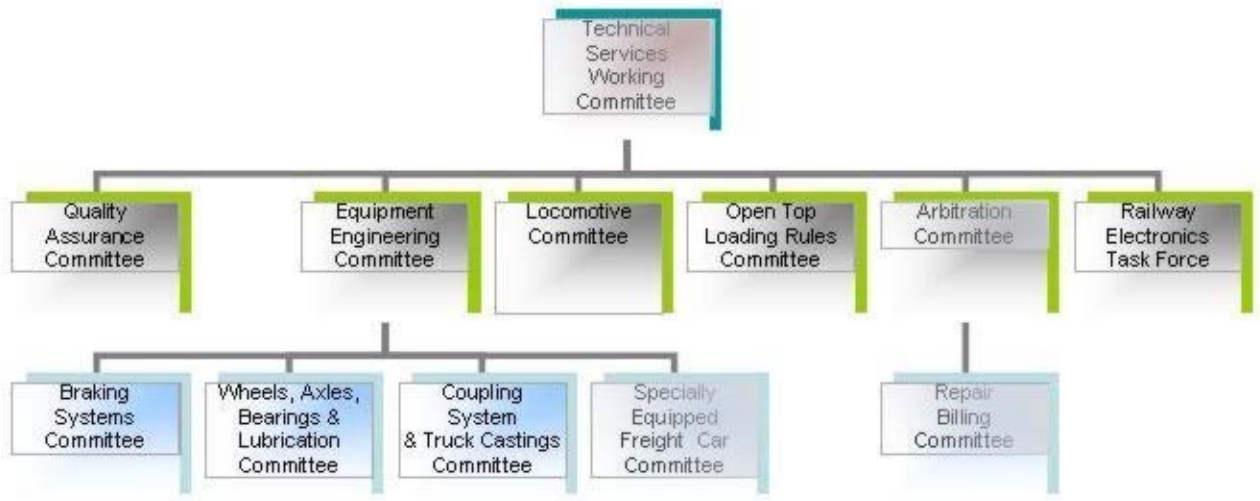
Standards in this case refer to an industry minimum requirement for technology and equipment for rolling stock. Rolling stock companies may have company-specific standards underneath these industry standards, but most rely on the AAR standards. However, these are mandatory standards that the industry must comply with.

Development and management of the rolling stock standards is based on a set of focused technical and industry-representative Committees

Standards are developed through the economic analysis of a new technology combined with the various Standards Committees. TTCI provides management and coordination of the Technical Services Working Committee and eleven specific committees.

[56] www.aar.org

Figure 17:AAR Standards Committees



www.aar.org

Each of these Committees provides an expertise group for specific areas of the railroads for rolling stock. A TTCI representative sits on each Committee with responsibilities including:

- Responding to all inquiries relevant to that Committee's scope and remit including applications for approval of facilities and components.
- Maintaining the relevant sections of the AAR Manual of Standards and Recommended Practices.
- Interpreting technical specifications and serving as a liaison to railroad officials and other industry stakeholders.

Suppliers are sometimes invited to sit on these Committees, however they have no voting rights so as to remove any commercial bias. They are allowed to discuss the technical aspects of a new standard.

Standards are prescriptive to give a minimal requirement but not so prescriptive as to inhibit new suppliers and innovation

The standards are prescriptive to an extent to allow clear specification but also to ensure a level playing field for all suppliers. For example, standards are created by each of the Committees and published in document form on their website. The level of prescription is intentionally not too detailed. For example the Wheels, Axles, Bearings & Lubrication Committee will provide standards on the acceptable wheel wear profile or the brake shoe thickness required before replacement. These standards provide a 'field manual' for workers in the industry to use to help them make decisions relating to maintenance schedules and safety.

The standards are also a key part of the relatively simple approval and acceptance process for new technology and equipment

If a supplier wishes to introduce a new or modified piece of technology on to the rolling stock, then they must seek approval from AAR. Individual rolling stock owners are not allowed to approve technology themselves without AAR, this is because of the need for rolling stock to interchange across more than one railroad infrastructure owner during its journey. Therefore variations may cause some rolling stock to be limited in their movements.

The supplier must inform the relevant Committee as to the new technology and then follow the analysis guidelines provided in that Committee's manual. This analysis can be done by the company itself and includes analysis such as FMEA. These results are submitted to the Committee and then further in-situ testing can commence. By the end of this the supplier must provide certification of the new technology's reliability and robustness from an independent laboratory. AAR provides guidance on the level and type of testing required to meet their standards for new technology. The choice of external laboratory is up to the supplier as it will depend on the most cost-efficient option for them – the AAR does not have a list of approved facilities. This is believed to give the supplier more flexibility in where and which organisations provide the certification. However, if the proposed facility is not well known by the Committee then an AAR observer may be present to ensure the testing is conducted correctly. TTCI can provide this testing for new suppliers. The testing can take two weeks or two months as it depends on the guidance provided by the Committee and the technology.

Once the testing is completed successfully, the technology receives AAR approval at which point it can be then sold to individual rolling stock owners. In the vast majority of instances, it is believed that the rolling stock owners do not conduct further testing but rather accept the AAR approval as sufficient evidence that the equipment works correctly.

If the technology is already certified and approved for use on the European railways, it must be recertified to meet AAR's requirements.

Changing standards is also perceived a relatively straight forward

To challenge an existing standard, the supplier (or whoever is proposing the change) must provide a risk assessment and analysis of the proposed change including revenue service projections. This is then discussed at the relevant AAR Committee. If a change is proposed, then a written communication is sent out all relevant stakeholders in the industry and a 30-day feedback period initiated for any objections or issues. The Committee will then discuss any feedback and vote on the proposed changes. No individual can veto a proposed change and the voting works on a majority basis.

The rationale for having an independent, cross-industry approvals group is cost efficiency as well as commonality of equipment implemented across a fragmented industry

The creation of the AAR approvals process and a cross industry, separate organisation to manage the approvals is perceived to deliver a number of benefits to the North American freight railroads. The industry is quite fragmented with multiple players, so a single approvals organisation provides consistency and ensures variation between stakeholders does not occur. It also provides a single point of approval for suppliers to certify their equipment rather than multiple approvals at individual rolling stock companies. This saves time and cost for approving new innovations.

Infrastructure standards are much less formal and are overseen by the American Railway Engineering and Maintenance-of-Way Association (AREMA)

Infrastructure standards are managed by AREMA. Formed in 1997, AREMA was the result of a merger of three engineering support associations, namely the American Railway Bridge and Building Association, the American Railway Engineering Association and the Roadmaster's and Maintenance of Way Association, along with functions of the Communications and Signals Division of the Association of American Railroads. Infrastructure standards and approvals are not mandatory and instead based on common understanding of good practice and recommendations.

3 Aerospace safety approval management

The safety approval process in GB aerospace industry is relatively centralised (compared to the GB rail industry), with the following bodies acting as the key responsible parties:

- The European Aviation Safety Agency (EASA), who sets regulations and standards for the EU region and provides safety approval.
- The original equipment manufacturers (OEM), who act as the *de facto* design authority and could provide compliance verification.

Type certification

An aviation product - aircraft, engine or propeller - is issued a type certificate (comparable to a safety case in the rail industry) if the product is properly designed and manufactured, performs properly, and meets the prescribed airworthiness[57] standards. It is the OEM's responsibility to verify that its aviation products comply with such standards. Based on satisfactory verification by the OEM, the EASA may then approve the product as being airworthy and issue the type certificate.

Post certification: configuration control and mid-life refit

Once a type-certified aircraft is transferred from the OEM to the airline, the latter takes up configuration control responsibility. In theory, the airline is responsible for (1) implementing modifications to aircraft and (2) verifying that any such changes comply with the relevant standards. However, in reality airlines often commission third parties - OEMs or Continuing Airworthiness Management Organisations (CAMOs) - to undertake such activities as they possess the necessary technical expertise. The modifications will finally be approved by the EASA, who will issue a Supplemental Type Certificate (STC) for the modification, based upon verification of compliance. Therefore the OEM, in some cases, acts as the *de facto* design authority in the aerospace industry.

The same process is also applicable to mid-life refit of aircraft (also known as 'Progressive Technology Insertion' in the aerospace industry).

Cross acceptance

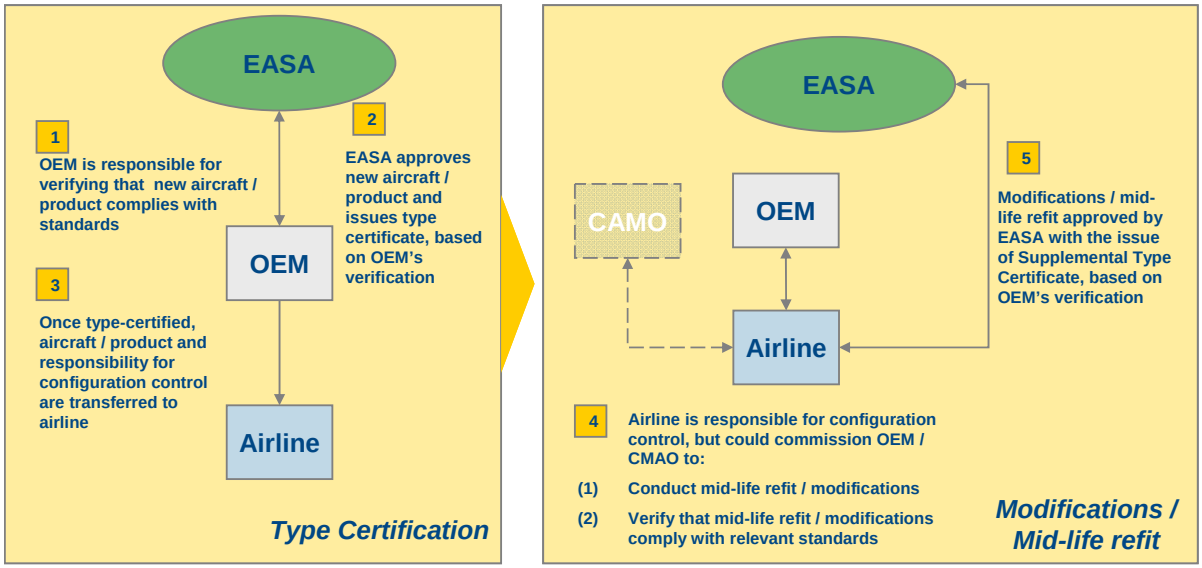
Currently, EASA is responsible for type certification of aviation products within the EU. In order for products to be traded or operate between jurisdictions, bilateral agreements could be set up to facilitate the airworthiness approval or acceptance of these products exported from one country to another. This is intended to allow the civil aviation authority of the importing country to give maximum practicable credit to the airworthiness certification functions performed by the authority of the exporting country using its domestic certification system.

Comparison with GB rail industry

As a summary, the approval and certification process of the GB aerospace industry is presented in Figure 18. This is compared against the process for the rail industry (Figure 19).

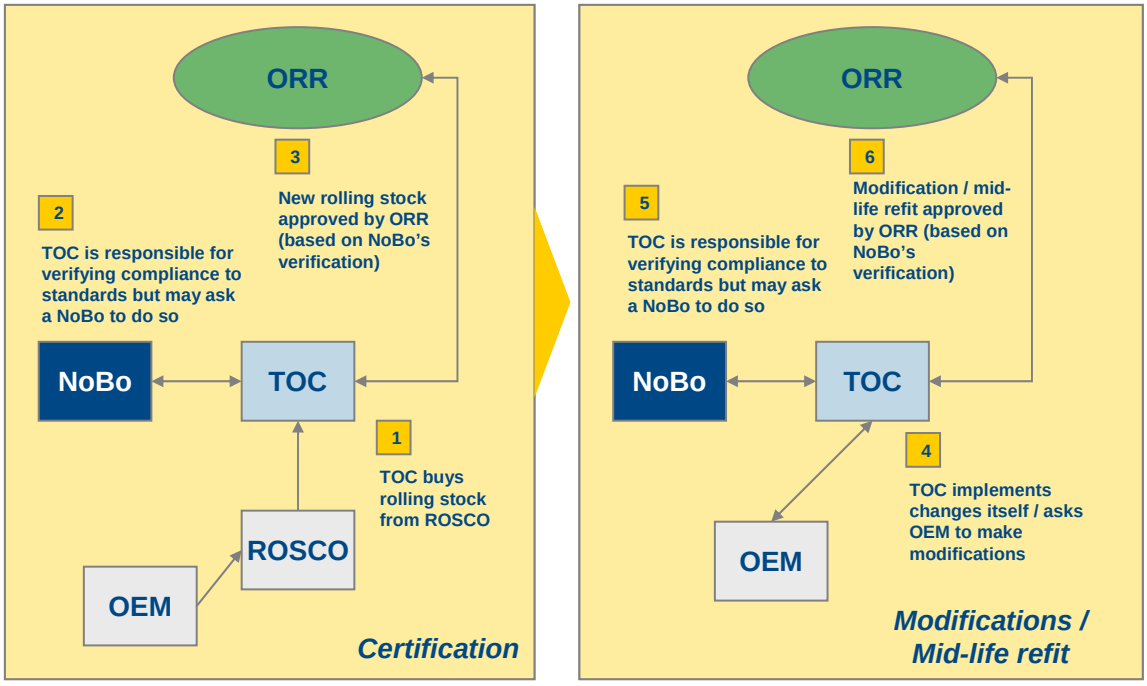
[57] Airworthiness is a term used to indicate whether an aircraft is worthy of safe flight

Figure 18: Approval and certification process of GB aerospace industry



Source: Interview with Marshall Aerospace; EASA; ADL analysis

Figure 19: Approval and certification process of GB rail sector



Source: ADL analysis

A major difference between the processes of the two industries is that aerospace OEMs have a much higher degree of involvement in approval and verification activities. They are, in many cases, the *de facto* design authority responsible for verifying that their own aircraft or products/modifications to their aircraft or products comply with the relevant airworthiness standards.

On the contrary, train manufacturers in the GB rail industry are detached from the safety approval process. TOCs, as the duty holder, are responsible for demonstrating to the ORR that any new rolling stock/equipment or their modifications comply with standards. They often commission notified bodies to undertake such verification activities.

As a result, in comparison the GB aerospace industry has a more centralised approval process with the OEMs and the EASA being the two major bodies responsible for compliance verification and safety approval.

The differences between rail and aerospace approval and certification processes can be attributed largely to the different structure of the industry: the aerospace sector has a small number of very dominant OEMs (e.g. Boeing and Airbus) who lead technology development, selling to a large number of customers across the world. The rail sector has (generally) only one dominant customer in each country that controls the national rail infrastructure, and there are significant differences between the infrastructure in each country.

4 National Grid risk-based prioritisation

Introduction

As part of the benchmarking for this study, a brief comparison was made of National Grid's processes and practices for risk-based asset management, and those used by NR for railway assets. The premise behind this comparison is that National Grid (NG), which owns and manages the GB natural gas pipeline infrastructure, faces similar issues to NR in terms of the need to assure asset integrity over an extensive network, and prioritise the deployment of limited resources to manage hazard and risk to the public. From previous work providing expert witness in public inquiries as a result of accidents, we are aware that the National Grid risk-based prioritisation system has proved to be robust to scrutiny, and is generally acknowledged to amongst best practice in its field. We are grateful to Steve Featherstone, Director Infrastructure Maintenance of NR (formerly of British Gas), who provided the content for this comparison.

There striking similarities in the asset management task, as well as a few differences

There are a number of striking similarities between the tasks faced by NR and NG:

- Both the gas and railway networks have a long history with pioneering work done by entrepreneurs in different ways in different parts of the country, hence there are legacy issues in both cases.
- Both networks are safety critical, metallic, suceptible to environmental conditions and are in continuous operation.
- Both networks involve large numbers of industrialised and unionised staff, with service provision separated from infrastructure provision.

There are also some differences:

- Real-time customer involvement is higher in NR and control rooms more integrated.
- The product is much more heterogeneous in rail (i.e. rolling stock) than in gas supply (i.e. gas), with more real competition between suppliers in gas than in rail. Unionisation is also different.

NG has evolved a sophisticated risk-based asset management system over many years - but note that the cost per life saved is circa £100m

- Nearly 40 years of development, agreed with HSE and Ofgem, following a series of explosions in the early 70s.
- Asset data systems and knowledge is now strong, with decision support tools in place to help engineers decide risk-based renewals priorities.
- Assets are predominantly underground – hence the absolute necessity of developing a comprehensive asset database.

NR is evolving its risk-based asset management systems using similar principles, and estimate a cost of £100m to £200m to take NR to an equivalent level

- NR is on a journey to develop asset database and fix systems and processes ready for likely automation in CP5.
- NR claims certain areas where it is already more advanced than NG, including work management systems, workforce productivity, continuous work patterns, fatigue management, long/medium term work planning and internal benchmarking.
- However, there is still a way to go, with NR estimating £100m to £200m to take NR to the equivalent level in terms of systematised asset knowledge and decision support.
- This is part of NR's Transformation Programme.
- NR has recruited an NG expert to assist in its journey.

We conclude that the comparison with NG is useful, and clearly NR have already taken the step to transfer NG's lesson learned in risk based asset-management to the GB railways.

Appendix 5: European governance regimes

Introduction

Within the rail industry of any European country, there are a number of key industry governance roles that must be fulfilled, for example:

Overall governance tasks (typical)

- Strategy development
- Planning and approvals
- Funding
- Legislation development and enforcement (EU and Member State level)
- Certification and provision of operating licences
- Competition regulation and enforcement
- Measuring performance

Safety & standards related (typical)

- Ensuring interoperability
- Creation of industry safety and technology strategies
- Safety reporting
- Accident investigation
- Safety, standards and technology research and development
- Standards and rule development and enforcement

EU legislation significantly influences key elements of the overall governance regime. For example, the European Railway Safety Directive states that each member state must establish a National Safety Authority (NSA) which is independent from railway undertakings, infrastructure managers, applicants for certificates and procurement entities. Legislated responsibilities of the National Safety Authorities include a duty to authorise, and in the case of rolling stock keep a register of, new and changed components of the railway and ensuring relevant technical specifications for interoperability (TSIs) are met. The NSA is also required to develop a safety regulatory framework, including a system of national safety rules, and to produce an annual safety report to ERA. The Directive also requires member states to establish independent rail accident investigation bodies and sets out the principles of mandatory investigations of serious accidents and incidents.

Current arrangements in Great Britain

In Great Britain, the specific roles are distributed across the following organisations:

- The ***Department for Transport (DfT)*** is the government department responsible for the English Transport network and transport matters in Scotland, Wales and Northern Ireland, including rail related activities. The Department has 5 strategic objectives that support its overall objective of a transport system that balances the needs of the economy, the environment and society. Of particular relevance to this study is the objective to contribute to better safety, security and health and longer life-expectancy through reducing the risk of death, injury or illness arising from transport, and promoting travel modes that are beneficial to health. DfT's rail group aims to work in partnership with the industry, to secure "the railway the country wants at a price it can afford". DfT Rail Group objectives include:

  - Ensuring delivery of improved operational and financial performance, and safety, by the railway.
  - Securing appropriate rail passenger services at an acceptable price through effective specification and procurement.
  - Developing and delivering a robust, affordable and sustainable strategy for the development of the railway that supports wider transport objectives.
  - Ensuring the cost-effective and timely delivery of major rail projects.
- We understand that there is currently a team of 10 working on rail safety and standards and 2 on related R&D activities. DfT's internal rail related expenditure is estimated at £180m of which approx. £1m is estimated as being safety and standards related.
- The ***Office of Rail Regulation (ORR)*** is the independent safety and economic regulator for Britain's railways. The ORR is GB's National Safety Authority. The ORR is led by a Board appointed by the Secretary of State for Transport. The ORR aims to apply independent, fair and effective regulation to enable the railway to be safe, well maintained and efficient and to ensure that it provides value for money for users and for its funders. Key objectives are to improve health and safety performance, to secure improved efficiency and performance, to secure robust plans for 2009 and beyond, to improve and align relationships and its incentives in the industry and to establish ORR as a combined safety and economic regulator. ORR's expenditure is currently £32.1m per annum. ORR currently employs 298 FTE of which 126 relate to standards and safety related activities.
- The ***Rail Accident Investigation Board (RAIB)*** is GB's independent railway accident investigation body. Its remit involves investigating railway accidents and incidents on GB's railways to improve safety and prevent further accidents from occurring. Investigations are entirely independent and are focused solely on safety improvement – they do not apportion blame or liability, enforce law or carry out prosecutions. The Railways and Transport Safety Act 2003 enabled the Secretary of State to establish the Rail Accident Investigation Branch (RAIB). The Railways (Accident Investigation and Reporting) Regulations 2005 (RAIR) detail the provisions about the RAIB's powers and duties, the scope of its work and its dealings with other people and organisations involved in rail accidents. Additionally, the regulations transpose into GB law, Articles 19 to 25 of the Railway Safety Directive (2004/49/EC), which requires member states to establish independent rail accident investigation bodies by 30 April 2006 and sets out the principles of mandatory investigations of serious accidents and incidents, above a defined threshold level. The regulations came into force for mainland GB on 17th October and the RAIB became operational on that date. Operations were further extended to cover the Channel Tunnel from 31 January 2006. The Railways (Accident Investigation and Reporting) Regulations 2005 (SI1992), which were laid in Parliament on 20 July 2005, complete the legal framework within which the Branch operates.
- ***RSSB*** facilitates the railway industry's work to achieve continuous improvement in the health and safety performance of the railways in Great Britain, and thus to facilitate the reduction of risk to passengers, employees and the affected public. It is a not-for-profit company owned by industry stakeholders. The company is limited by guarantee and is governed by its members, a board and an advisory committee. RSSB's expenditure is £32m per year with a team of over 250 FTE. It is independent of any single railway company and of their commercial interests. RSSB's remit includes:
  - The responsibility for managing Railway Group Standards across the industry.
  - Leading the development of the industry's long-term safety strategy.
  - Proposing change through facilitation of the research and development programme, education and awareness.
  - Measuring and reporting and informing health and safety performance, intelligence, trends data and risk.
  - Supporting cross-industry groups in national programmes which address major areas of safety concern.
  - Facilitating the effective representation of the GB rail industry in the development of European legislation and standards that impact on the rail system.

- RSSB also manages the rail industry strategic research programme on behalf of the ***Technical Strategy Advisory Group (TSAG***), a cross-industry expert group facilitated by RSSB and funded by the Department for Transport. TSAG was created in response to the Department for Transport White Paper 'Delivering a Sustainable Railway'. TSAG has an overview of the work of System Interface Committees that assist the railway industry to manage all aspects of identified system interfaces in the most cost effective and efficient way.
- ***The European Railway Agency (ERA)*** was devised in 2004 to create a competitive European railway by increasing cross-border compatibility of national systems, in parallel to ensuring the required level of safety. It works closely with the European Commission and Member States, in particular the National Safety Authorities. Start of full operations has commenced mid-2006. The organisation employs just over 100 members of staff. The Agency also acts as the system authority for the European Rail Traffic Management System (ERTMS) project, which has been set up to create unique signalling standards throughout Europe.

Arrangements in other European Countries

While elements of the overall organisational structure are largely dictated by the European Railway Safety Directive, implementation of the directive and associated governance arrangements vary across European countries. A summary of the key components is given in the following sections.

Arrangements in France

National Safety Authority

- The French National Safety Authority is the ***Établissement Public de Sécurité Ferroviaire, (EPSF).*** It acts on behalf of the Ministry of Transport within the framework of national regulations in line with the Rail Safety Directive. EPSF satisfies the need for an organisation with the required rail safety competences that was also independent of railway operators. EPSF assures harmonised technical and operating safety conditions, and contributes to the interoperability of European rail networks. It is responsible for issuing authorisations and for ensuring that the requirements that it sets out are complied with via audits and inspections, whilst also guaranteeing equitable treatment for all operators.
- EPSF's main safety related functions are:
  - Issuing and delivering safety certificates.
  - Publishing audit regulation and its agenda.
  - Creating a database for incidents and developing safety indicators.
  - Defining public technical conditions and rules related to railway safety.
  - Elaborating an annual report related to railway transport safety.
- ESPF has 96 staff (2008).

Accident Investigation

- The Land Transport Accident Investigation Bureau (**Bureau d'Enquêtes sur les Accidents de Transport Terrestre, BEA-TT**) is in charge of accident investigations. It covers investigations covering all forms of land transport.
- In the event of such accidents, a two-phased investigation approach is required: a judiciary inquiry to identify liabilities and, if necessary, to determine compensations for the victims, and a technical investigation to prevent similar occurrences.
- The BEA-TT's activities cover a wide variety of areas. This diversity in investigations to be conducted necessitates for the BEA-TT to call upon temporary investigators and experts whenever necessary in order to secure all required competencies.

- On the 1st January 2009, the authorised workforce of the BEA-TT was 13 employees: 2 senior managers, 7 permanent investigators, three clerks and 1 vacancy for an investigator. Two doctors from the General Transport Labour Inspectorate were also seconded to it to deal with medical aspects. In addition, 12 commissioned non-permanent investigators also contributed to the work of the BEA-TT in 2008. In 2008, 18 investigations were started within the rail sector.
- Its operating budget totalled approximately €374,000 in 2008.

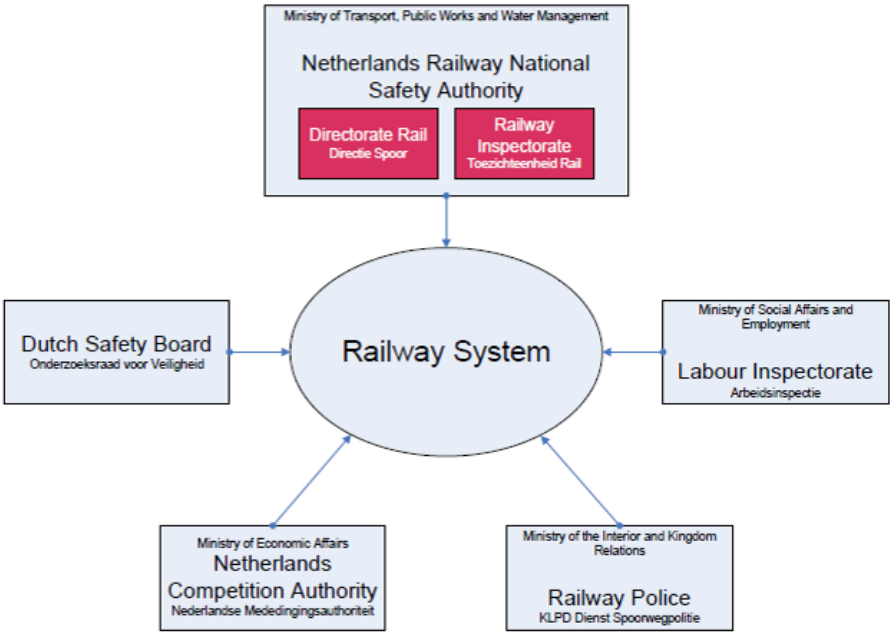
Arrangements in the Netherlands[58]

- The Netherlands Railway National Safety Authority (NSA) is the ***Ministry of Transport, Public Works and Water Management***. The NSA activities are performed by two of the Ministry's constituents: the ***Railway Inspectorate*** and the ***Directorate Rail*** of the Directorate-General for Mobility (see Figure 20). The Directorate Rail is responsible for promoting and developing rules and legislation in order to improve railway safety. The Railway Inspectorate is responsible for admission of railway undertakings and rolling stock and maintaining the railway safety rules. The Railway Inspectorate has 63 FTE's.
- The ***Dutch Safety Board*** is a fully independent investigation board that investigates serious incidents and accidents in order to find structural safety deficits. The Board is an autonomous administrative body set up under a Kingdom Act. It is authorised to investigate incidents in any conceivable field but in practice is currently active in the following sectors: aviation, shipping, rail transport, road transport, defence, healthcare (human and animal welfare), industry and networks, pipelines, construction and services, water, and crisis management and aid provision. Governmental bodies are obliged to respond to recommendations of the board. The Dutch Safety Board investigates approximately 1 to 2 railway-related accidents per year. These investigations run parallel to the investigations of the Railway Inspectorate. The Board consists of five permanent board members. They represent the Board to the general public. The small number of permanent members facilitates rapid decision-making as to whether an incident should be investigated, thereby enhancing the Board's operational efficacy. Additional staff support the operation activities.
- In addition, the NSA investigates serious incidents and accidents with the purpose to inform the public and to encourage the companies involved to structurally improve safety. All railway actors are obliged to inform the Railway Inspectorate on incidents and accidents. In 2008 there have been 800 incident pre-investigations. In total 22 accidents and incidents have been fully investigated by the NSA. In total 79 incidents have been investigated by the companies involved and 294 SPAD incidents and level crossing accidents have been evaluated using checklists. Approximately 14 FTE of NSA staff are involved.
- The ***Netherlands Competition Authority*** ensures a level playing field for all actors in the railway industry. The activities of the Netherlands Competition Authority have very little connection with the activities of the NSA. In some cases safety arguments are used in business conflicts between actors. In these cases the Railway Inspectorate can advise the Authority. The Netherlands Competition Authority is part of the Ministry of Economic Affairs.
- The ***Labour Inspectorate*** has the task to supervise the worker's safety and to maintain the Labour Health and Safety Act. For the Railway field, this is particularly of interest to Train Drivers, Train Managers, Track Workers and Shunt Workers. The Labour Inspectorate and the Railway Inspectorate work closely together on issues that are relevant for the worker's safety. The Labour Inspectorate is a part of the Ministry of Social Affairs and Employment.
- ***Rail Alert*** is a new organisation aimed at improving safety and overseeing the safety rules and standards. Rail Alert has 3.5 FTEs and is currently funded by Pro Rail and the industry. However, the expectation and future plans for Rail Alert are that it will become self-sufficient in 3-4 years time through the provision of paid services to the industry, for example certification of training and delivery of the training itself. The role of Rail Alert is not to direct Pro Rail, but to act as a mirror to challenge Pro Rail and make Pro Rail reflect on their decisions as to whether they are the right ones with respect to safety.

[58] Based on the 2008 NSA report. According to this report a major restructuring programme is anticipated

Rail Alert is the leading organisation with respect to the safety culture improvement initiatives. Also, whilst SILs are currently owned by Pro Rail, it is anticipated that these will be passed over to Rail Alert in the near future. See Appendix 4.2 for more information.

Figure 20:Dutch Railway governance structure

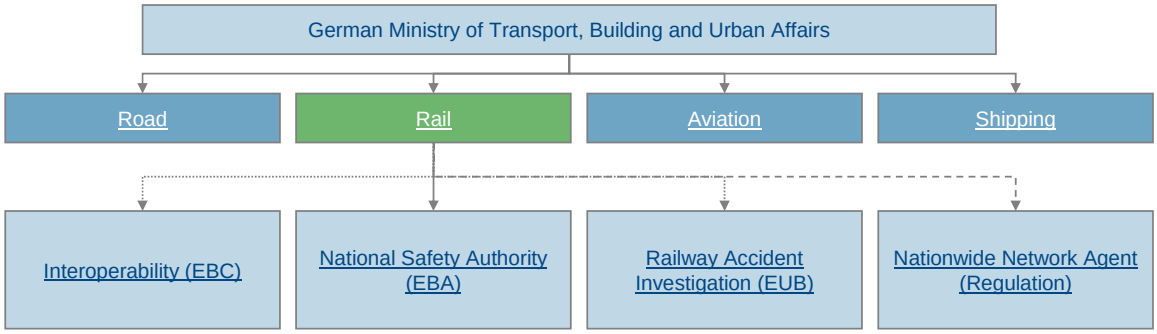


Arrangements in Germany

National Safety Authority

- The ***Federal Railway Authority (EBA)*** is responsible for the supervision and authorisation in the rail sector.
- Its main tasks include:
  - The planning approval for railway installations.
  - The Railway Inspectorate.
  - Operating facilities for the supervision of the railway.
  - Issuing and revoking licenses.
  - Laws and regulation enforcement.
  - The preparation and implementation of agreements.
  - Pursuing the technical investigation of dangerous events in the railway operation.
  - The granting of federal funds to promote rail transport and inter-modal transport.
- As the state finances the railways infrastructure, the EBA grants and supervises the State contributions for infrastructure investment in infrastructure of railway infrastructure companies owned by the Federal Republic of Germany.
- EBA currently has 1008 FTE (1250 employees in total).

Figure 21:German Railway governance structure



Accident Investigation Body

- The investigation of dangerous incidents is conducted objectively and autonomously of any internal or external organisation – EBA has an internal body **EUB** that is responsible for the investigation of accidents.
- EBA relies on its own team of trained specialists, which has eliminated the need to depend on railway employees' assistance.
- The management of the EUB lies with the Federal Ministry of Transport, Building and Urban affairs (BMVBS), while operative tasks are conducted by the EUB.

Other bodies

- ***EBC*** is a Notified Body for the area of interoperability and tests and certifies compliance with the European rules for interoperability of the Rail system.

Arrangements in Spain

National Safety Authority

- In Spain the National Safety Authority is the Directorate General of Railways, working within the Ministry of Transport, Its main tasks include:
  - Preparation, monitoring, supervision and inspection of operational planning of railway infrastructure and the corresponding railway plans.
  - Validating safety methods and safety objectives and approving training centres for railway staff.
- The Directorate General of Railways has approximately 260 staff (including non-NSA staff), with NSA activities supported by an additional 30 staff from other companies and organisations.

Accident Investigation

- In Spain, the Committee for the Investigation of Railway Accidents is a specialised Professional Association affiliated to the Ministry of Public Works through the Secretariat of State for Infrastructure.
- It performs its activities independently of the Directorate-General of Railways, ADIF, and any railway undertaking, notified or certifying body, or the Railway Regulating Committee.
- The Committee for the Investigation of Railway Accidents establish the scope and procedures to be followed in each railway accident investigation and carry out the investigations.

Arrangement in non-European Countries

Arrangements in the USA

National Safety Authority (equivalent)

- The Federal Railroad Administration (FRA) was created by the U.S. Department of Transportation. The main purposes are:
  - Promulgating and enforcing rail safety regulations.
  - Administering railway assistance programs.
  - Conducting research and development for supporting improved railway safety and national rail transportation policy.
  - Consolidating government support for rail transportation activities.

Accident Investigation

- National Transportation Safety Board (NTSB) is a governmental investigative agency responsible for civil transportation accident investigation.
- In this role, the NTSB investigates and reports on aviation accidents and incidents, certain types of highway crashes, ship and marine accidents, pipeline incidents, railway and railway accidents when requested.

Arrangements in Japan

National Safety Authority (equivalent)

- In Japan, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) is in charge of Japanese railway legislation and safety supervision. The department was established as part of the administrative reforms of January 6, 2001, which merged the Ministry of Transport, Ministry of Construction, Hokkaido Development Agency and the National Land Agency.

Accident Investigation

- Japan Transport Safety Board (JTSB) was established by integrating the Japan Marine Accident Inquiry Agency (JMAIA) and the Aircraft and Railway Accidents Investigation Commission (ARAIC) in order to enhance and combine investigation capacities for dealing with the causes of aircraft, marine and railway accidents/incidents and to prevent their recurrences.
- The JTSB conducts investigations to determine the causes of aircraft, marine and railway accidents, serious incidents and damage caused by them.
- Based on the findings of the investigations, the JTSB provides recommendations or opinions to relevant ministers or parties involved, concerning the measures to be taken to prevent accidents/incidents and to mitigate damage caused by accidents.

Arrangements in South Korea

National Safety Authority (equivalent)

- In Korea, the Ministry of Land, Transport and Maritime Affairs (MLTM) is responsible for defining railway:
  - Budgets
  - Policies
  - Targets
  - Safety case policies
  - Safety plans
  - Standards

Accident Investigation

- In Korea, the Aircraft and Railway Accidents Investigation Board (ARAIB) is part of the MLTM and is in charge of railway accidents investigation.
- It works in close cooperation with other national railway organisations to perform other functions like emergency response, establishment of security and terror response system and advertisement on emergency response.

Information sources:

This research draws on publicly available information including organisation websites, annual reports (including those submitted to the ERA), and Arthur D. Little interviews.

DfT: http://www.dft.gov.uk/pgr/rail/
ORR: http://www.rail-reg.gov.uk/server/show/nav.75
RSSB: http://www.rssb.co.uk/Pages/Main.aspx; http://www.rssb.co.uk/AboutUs/Pages/default.aspx
TSAG: http://www.futurerailway.org
ERA: http://www.era.europa.eu/The-Agency/Values-and-Mission/Pages/home.aspx
France: http://www.bea-tt.equipement.gouv.fr/rubrique.php3?id_rubrique=39; http://www.securite-ferroviaire.fr/fr/; http://www.era.europa.eu/Document-Register/Pages/NSA-Annual-Report-2008-FR.aspx
Germany: http://www.era.europa.eu/Document-Register/Pages/NSA-Annual-Report-2008-DE.aspx
Spain: http://www.era.europa.eu/Document-Register/Documents/NSA-Annual-Report-2008-ES.pdf
Multiple: PRC - Railway Emergency Management System Study, May 2010
Netherlands: http://www.era.europa.eu/Document-Register/Pages/NSA-Annual-Report-2008-NL.aspx; http://english.verkeerenwaterstaat.nl/English/; http://www.onderzoeksraad.nl/en/index.php/over/vacatures/

Appendix 6: What is an appropriate amount to spend on safety improvement?

This Appendix contains further details on the trend review conducted by Arthur D. Little to help inform the answer to the question of what is an appropriate amount to spend on safety improvement.

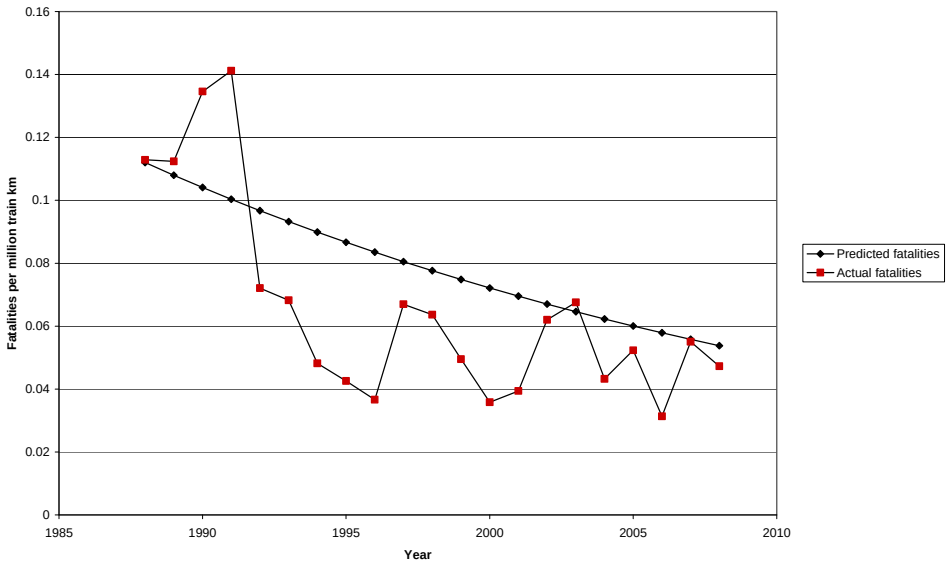
The analysis starts by reviewing the safety benefits from past expenditure by comparing actual safety performance between 1994 and 2008 with historical trends prior to 1994. It then goes on to estimate the expenditure which might be justified for further improvement in safety performance in line with HLOS requirements and the need to stop risk from increasing. The significance of this estimate is that it provides a theoretical benchmark indication of what could be an appropriate amount to spend on safety improvement.

1 Comparison with historical trends

Professor Andrew Evans' work on safety improvement since privatisation 'Rail safety and rail privatisation' has shown that the rate of safety improvement has increased post-privatisation. He did this by looking at the historical fatality rate on the railways from 1967 (which he takes as a start date as it is approximately the end of steam traction) to 1993 and then reviewing the fatality rate since privatisation and comparing them.

It is possible to use this same approach to provide a broad estimate of the safety improvement gained as a result of the additional safety arrangements implemented post privatisation, and thus determine the value of the gain. To do this we can compare the long term trend for 1967-1993 found by Professor Evans projected forward in time against the actual accident trend since 1994. Professor Evans calculated that the long term rate of safety improvement since 1967 was about 3.6% per year, which is very similar to figures that Arthur D. Little has calculated in previous work for other clients. Figure 22 shows that since privatisation the observed accident rate per million train kilometres has been lower (with one exception) than would have been predicted based on the trend over the previous 27 years.

Figure 22:Predicted fatality rate compared with actual fatality rate



Source: Andrew Evans, ORR, Arthur D. Little analysis

Using this data it is possible to estimate the safety benefit of all the additional work that has been undertaken in improving safety over this period. While doing so should not be taken as a precise valuation it does give some view as to the safety benefit gained.

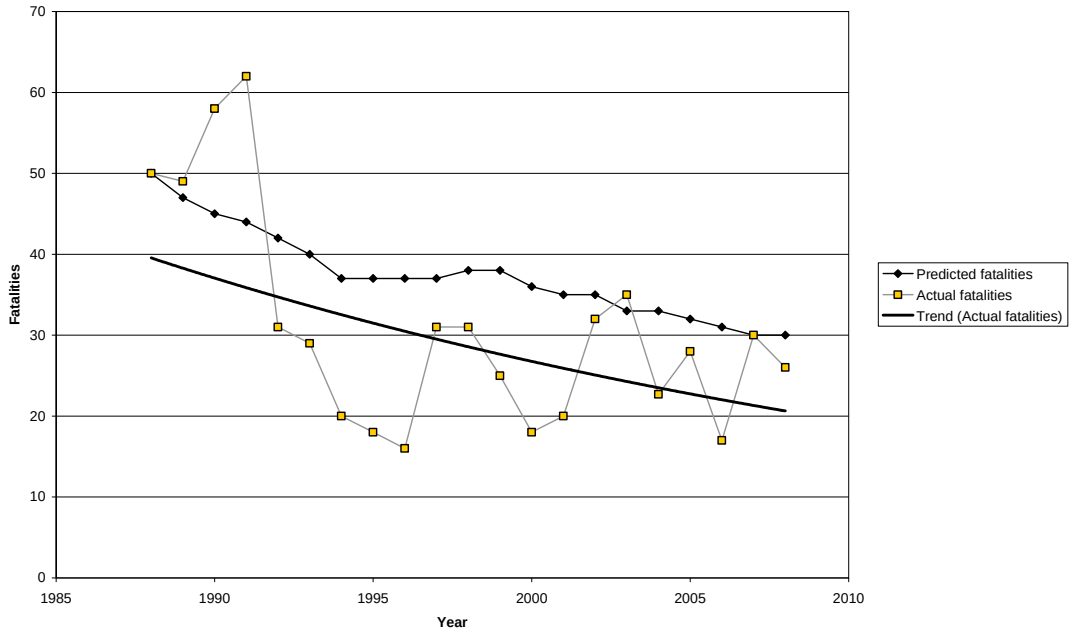
2 Improvement over historical trend

Over the period 1994 to 2008 there is a difference of roughly 150 lives, or an average of 10 lives per year, between the actual fatalities and the fatalities predicted based on the trend over the period 1967-1993.

By using the value of preventing a fatality (VPF) it is possible to estimate the value of the statistical lives saved. The VPF for 2009 is £1.661m, so if this is used[59] we can estimate that the value of the statistical lives saved would be, in current financial terms, roughly £250m over the period. This benefit represents the additional safety benefits above the long-term trend so it would have resulted from additional safety expenditure – both in terms of hard assets and the softer management system arrangements – above the "normal" rate of safety expenditure.

The current accident rate now seems to be somewhat lower – about 8 lives per year – than the rate that would be predicted by extrapolating the trend between 1967-1993, as shown by the trend line in Figure 23. If it is assumed that this difference is the result of the work done over the past 15 years and that it will continue then this return on investment should be added to the figures given above suggesting a greater safety benefit. For example, if the 8 lives per year difference were to continue over the years 2009-2020 this would add another 96 statistical lives saved or £160m (approx. £15m per year) to the safety benefits. This may be seen as an optimistic estimate, since there is an indication that the actual and predicted curves are approaching each other (refer Figure 23). This could be expected, since not all of the investment in the period post-privatisation (1993) will continue to deliver benefits in the long term beyond the current period.

Figure 23:Predicted fatalities compared with actual fatalities



Source: Andrew Evans, ORR, Arthur D. Little analysis

[59] VPF has varied over the period 1994-2009, with higher values used during some periods for multi-fatality accidents. Therefore for simplicity we have decided to use the 2009 value throughout

This safety benefit does not take into account any benefits associated with the indirect costs of the accidents avoided. Professor Evans's work included train accidents (collisions, derailments, overruns and train/road vehicle collisions), movement accidents (i.e. involving a moving train, so train accidents are part of these) and non-movement accidents on the railways. Train accidents are likely to have highest indirect costs, while non-movement accidents may have the lowest indirect costs. Estimating the indirect costs is very difficult and ranges of 5 to 10 have previously been suggested by the GB Health and Safety Executive. This would suggest that, based on the statistical lives saved, the total saving over the period 1994-2008 once indirect benefits are included could be in the range of £1,500 to £2,500m. Therefore, potentially over the period 1994-2020 total benefits could be in the range of £2,000 to £4,000m, or £75m per year to £150m per year, again based on the 2009 VPF.

As well as those killed in accidents it is practice to consider the people injured in accidents in the analysis of the benefits gained from safety investments. Taking injuries into account could change the figures discussed above but we are not confident that the decrease in fatalities will have been fully mirrored by a decrease in injuries, since the profile of the risk that has been reduced is unlikely to have an identical impact on fatalities and injuries. For simplicity and to avoid any such difficulties we have therefore not included injuries in the analysis.

3 Additional safety expenditure

To judge value for money for the additional safety benefits discussed above there is a need to identify additional safety expenditure above the typical safety expenditure prior to privatisation. This should only consider the additional expenditure on top of the normal expenditure needed to manage safety and to ensure that the assets of the railway (people, equipment and processes) were maintained so as to deliver safe operation. Safety expenditure therefore came in a number of areas:

- Expenditure prior to 1994.
- Setting up and manning new or improved safety management systems and activities in the (post-privatisation) new railway companies.
- Setting up new safety bodies, such as Railway Safety, (then later) RSSB, RAIB, or increasing the size of existing bodies such as HMRI.
- Carrying our additional safety research and development, notably after the creation of RSSB.
- Investments made principally in order to improve safety, for example TPWS, level crossing upgrades, layout risk assessments and resulting risk reduction measures.
- Incremental costs in other investments that have created safety benefits, such as train door improvements.
- Behavioural and training programmes such as driver defensive driving.
- Incremental costs in other activities that have been justified for safety reasons even if they have created no safety benefit (so called 'gold plating').

The costs of such additional safety expenditure is very difficult to find but it is possible to develop a rough estimate which would indicate a broad cost of around **£1.5bn** over 15 years, as shown below.

Table 12: Estimation of the additional safety expenditure

Item	Estimated cost	Total cost over 1994-2009 (£ million)
Investments prior to 1994 (ATP trials, door interlocks, etc.)	£250m	250
100 extra people	50k per person per year	75
Development of Safety Management Systems (SMS)	50k/SMS	5
Safety R&D	£5m per year for 6 years	30
TPWS	£600m	600
Level crossing upgrades	£10m per year	150
Junction risk reduction (incl. Ladbroke Grove)	£5m per year	75
Other safety investments		250
	Total	**1,435**

Comparing the direct and indirect benefits of lives saved in the period 1993 to 2008 (£1.5bn to £2.5bn) with this additional expenditure would indicate that the post privatisation effort broadly provided value for money – although clearly the analysis is rough. So we now need to look at how we continue to ensure value for money now that safety has improved substantially.

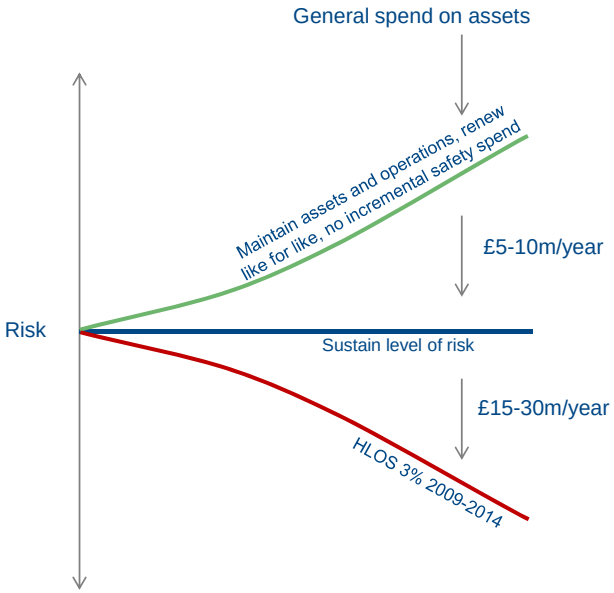
4 Future expenditure for safety improvement

Estimating future expenditure for safety improvement requires consideration of a number of factors, as shown in Figure 24.

- There is a basic need to fund the general spend on the assets of the railway (including people, equipment and processes) so as to ensure that they are in a fit state to deliver the functions of the railway in safe manner.
- We then need to consider the funding needed to meet the HLOS requirements.
- However there is also the need to consider that if the assets of the railway are simply maintained 'like for like' risk will rise (for example as traffic on level crossings increase) so there is a need to fund some safety improvement to manage this potential increase in risk.

This section estimates the funding needed to address the last two items.

Figure 24:Future safety expenditure



Source: Arthur D. Little

5 Expenditure to fund HLOS requirements

The current version of the Safety Risk Model (SRM v 6) predicts an annual rate of roughly 100 fatalities and weighted injuries (FWIs) per year on the railway (excluding trespass). HLOS requires a 3% reduction in risk by 2014 and thus we should be funding this reduction. The level of additional funding (which may come from investment depreciation or expenditure) can be estimated using a similar approach to that used above.

If the 3% is applied to the full 100 FWIs then the resulting reduction would be 3FWIs by 2014, which using the 2009 VPF would be worth roughly £5m in 2014. If indirect benefits were also taken into account then this would be worth between £25m and £50m in 2014.

It should be noted that the actual HLOS requirement is to deliver a 3% reduction in risk for passengers and staff, which make up only 83% of the 100FWIs discussed above so this would imply a funding of £12.5m to £25m per year. However The Railway Strategic Safety Plan contains initiatives that are believed to be sufficient to ensure that the HLOS requirements are met so it predicts that risk will fall at a rate at least as much as the HLOS requires. To reflect this we have used the figure of £15m to £30m per year.

Assuming this improvement were built up linearly over the control period 2009-2014 (i.e. in year one there is a 0.6% reduction, year two a 1.2% reduction, etc. resulting in a cumulative total of 9%) a total of 9 FWIs would be saved over the control period giving a saving of £15m in safety terms or £75m to £150m if indirect costs are taken into account. This would then justify a level of funding of £15m to £30m per year. This would cover the areas of:

- Running the functions within the safety bodies, such as RSSB, RAIB, RI, that seeks to improve safety.
- Safety research and development aimed to improve safety.
- Depreciation on new investments made in order to improve safety, for example layout risk assessment leading to installation of TPWS+, use of ALCRM to assess level crossings and delivery of level crossing upgrades.
- Depreciation on incremental costs in other investments that are justified for their safety benefits.

6 Expenditure to stop risk from increasing

At the same time there are certain risk areas on the railway that may increase if the railway does not spend to keep them at their current level. These risks include:

- Passenger train collision with road vehicle on level crossing.
- Non-passenger train collision with road vehicle on level crossing.
- Track worker struck/crushed by train.
- Member of public pedestrian struck/crushed by train on level crossing or footpath crossing.
- Workforce involved in road traffic accident whilst on duty.
- Passenger assault.
- Workforce assault.
- Member of public assault.

These may increase as, for example:

- Level crossing risks go up because certain roads and rail lines get busier, people increasingly misuse them.
- Assaults tend to go up in line with increases in rates of violent crime.
- For track workers if there are more trains then they need to do more maintenance and the time available is reduced.

Of the total 100 FWIs discussed above, we estimate that the risks that may increase make up about 25% of the total (based on review of the SRM). If nothing were done to manage these risks then it is possible that over a five-year period they would increase so there will be a need to fund work to keep them under control – i.e. maintain risk at the current level. On the assumption that they would increase at 3.6%/yr if nothing were done (this was the historical rate of risk reduction found by Professor Evans) the increase would be about 0.9FWIs/year, which would justify funding £1.5m per year from a safety point of view to keep them under control or £5m to £10m per year taking into account indirect costs to maintain these risks at their current level.

This would be spent in such areas as:

- Running the functions within the safety bodies, such as RSSB, RAIB, RI, that seeks to maintain safety.
- Safety research and development aimed to maintain safety.
- Depreciation on upgrades made in order to maintain the current risk level safety, for example level crossing upgrades.

By ‘doing nothing’ in the above analysis we mean making sure that the railway as currently configured and operated is maintained to the same standard. Like for like replacement of assets is done when they are life expired, and maintenance and operations continue to provide assets, systems, processes and staff that continue to function as currently required. The cost of doing this is not part of the safety costs discussed above as it was discussed in Section 2.1. Of course in reality like for like asset replacement is rare – rolling stock fleets will be replaced by newer units with better crash-worthiness, signalling will be replaced by higher reliability systems etc. However, it is necessary to define the base ‘do nothing’ case, in order to provide a point from which *incremental* safety activities can be measured.

7 Expenditure to maintain current level of risk

This analysis suggests that the combination of funding to improve safety to meet the HLOS objectives and spending to maintain safety would justify an overall expenditure on safety in the order of £17.5m to £35m per year with roughly 1/3 spent on maintaining safety and 2/3 on improving safety.

This clearly is on top of the expenditure required to maintain the assets (people, processes and systems) of the railway in their current condition.

Appendix 7: Suboptions for creation of a Systems and Standards Body

This Appendix contains suboptions 3.1 to 3.4 which relate to how a Systems and Standards body could be created from existing bodies including RSSB, ORR, NR and DfT, each of which implies a different ownership concept.

Suboption 3.1: Modify RSSB to create a new independent systems and standards body

Ref	Title	Implementation risk (H/M/L)	Timescale to impact (S/M/L)	Range of cost to implement (£m)	Range of cost efficiency impact (£m/year)
3.1	Modify RSSB to create a new independent systems and standards body	Medium	Medium/Long (within CP4 and during CP5)	30-45	200-230 +one off benefits 10-300

Description

This Suboption specifically refers to modifying RSSB to provide the required role. RSSB already manages RGSs, although it does not provide authorisations. As RSSB is owned and governed by the industry, this option would necessarily require full industry support. The current consensus-led approach to decision-making would need to be reviewed as this would not sit easily with a role as a Systems Body. We note that the current ORR review of RSSB has recommended greater use of majority voting, beginning with voting at board level and including the development of standards.

Key constraints

RSSB does not have authority as a leadership body, and the current governance structure and consensus-based approach is not appropriate for this type of role. The culture of RSSB as an organisation that facilitates, researches and advises may not be suitable, and RSSB may lack a degree of credibility in this role amongst the rest of the industry. Additional competencies and resources would be needed. Finally RSSB currently does not cover CTRL or High Speed Rail.

Cost efficiency impact

If successful, the impact would be similar to the main Option 3.

Cost to implement

The costs of implementation would be similar to the main Option 3.

Benefits

- As per the main Option 3.
- RSSB already owns and manages RGSs, existing organisation.

Disadvantages

- Would need significant new competences and resources, especially from NR.
- Mismatch between authority role and governance structure.
- Would need full industry consensus.
- Unclear if RSSB would be seen as credible by all of the industry in this type of role.
- Reversal of the industry-backed strategy to minimise the set of Railway Group Standards and to pass duty holders' standards across to them to manage.

Comparators and benchmarks

- The American Association of Railroads (AAR) is a membership-based organisation responsible for ownership and setting of standards for innovation, safety and technology for North America's railroads (refer Appendix 4). It also, through its subsidiaries the Transportation Technology Center (TTCI) and the Railroad Research Foundation (RRF), manages rail research programs. In this sense it provides similar functions to those envisaged by the independent systems and standards body although it is a membership body (similar to RSSB therefore, except that it has ownership of all the industry standards including those relating to infrastructure).
- In the Netherlands, Rail Alert is a new organisation aimed at improving safety and overseeing standards, and exists alongside the Netherlands National Safety Authority. In this sense it is analogous to the option envisaged here for RSSB to manage standards.

Option 3.2: Modify ORR to create a new independent systems and standards body

Ref	Title	Implementation risk (H/M/L)	Timescale to impact (S/M/L)	Range of cost to implement (£m)	Range of cost efficiency impact (£m/year)
3.2	Modify ORR to create a new independent systems and standards body	Medium	Medium/Long (within CP4 and during CP5)	30-45	200-230 +one off benefits 10-300

Description

This option is as Option 3.1, except it refers to modifying ORR to provide the required role. ORR is the national safety and economic regulator. Adding the function of RGS and company design standards management and approval would appear to be feasible, although the Systems Body role would be problematic.

Key constraints

There have been in the past some objections on principle grounds to combining the roles of safety regulator and standards: the Ladbroke Grove Inquiry[60] rejected this model, concluding that this could lead to the safety regulator being unable to maintain the necessary distance from the affairs of the industry to exercise suitable regulation. This would be especially difficult for the systems leadership (technology strategy) dimension of the role. A further constraint is that ORR would need additional competencies to be able to exercise this content-intensive technical role.

Cost efficiency impact

If successful, the impact would be similar to the main Option 3.

Cost to implement

The costs of implementation would be similar to the main Option 3.

Benefits

- As per the main Option 3
- ORR already acts as a certifying and enforcement body, existing organisation.
- Compliance with TSIs and other standards would be managed by the same body.
- Would unify standards and safety regulation in a single independent regulatory body.

[60] Ladbroke Grove Inquiry Report Part 2 Chapter 9.44 " …combining the two authorities deprives the process of a necessary and very valuable interaction or even tension which would be the spur to constant renewal and improvement of the standards"

Disadvantages

- Would need significant new competences and resources, especially from NR.
- Placing detailed technical standards with safety regulation was not favoured by the Cullen inquiry with respect to the regulator becoming too closely involved in industry affairs. However ORR already has economic as well as safety regulation, and other European countries already use this structure. It could therefore be argued that this issue has already been superseded. The systems leadership role would be an even greater problem from the point of view on maintaining distance.
- If suppliers sought approval from the body before submitting their products to NR they may incur costs for products that NR declines to purchase. While this is a commercial risk anyway, it is more pronounced when there is a single customer for the product.
- ORR would probably not be suitable to also fulfil the Systems Body role, seen as a key enabler for greater innovation (see Option 17).

Comparators and benchmarks

As mentioned under Option 3, there is a current project in Belgium to unify rail standards including extracting company standards and managing them at a national level. These will be owned and managed by the SSICF (a part of the Department for Transport which also acts as the National Safety Authority. This set up would be similar to the ORR option.

The option also has some similarity to the CAA set up, although with the very important difference that in the aviation sector, detailed technical standards are written by aircraft manufacturers not the CAA itself. This reflects the different structure of the aerospace industry with a small number of very dominant manufacturers (e.g. Boeing and Airbus) selling to a large number of airlines, as opposed to the rail industry where there is only one Infrastructure Manager.

Option 3.3: Create a new independent systems and standards body as a wholly-owned subsidiary of NR

Ref	Title	Implementation risk (H/M/L)	Timescale to impact (S/M/L)	Range of cost to implement (£m)	Range of cost efficiency impact (£m/year)
3.3	Create a new independent systems and standards body as a wholly-owned subsidiary of NR	Medium	Medium/Long (within CP4 and during CP5)	30-45	200-230 +one off benefits 10-300

Description

This option is the same as Option 3.1 above, except that the body would be created as a subsidiary of NR. In order for this to be feasible, a new subsidiary would have to be created within NR outside the direct control of the NR executive board – for example with a reporting line bypassing the Chief Executive. This arrangement would be similar in nature to the former "Safety and Standards Directorate" of Railtrack.

Key constraints

The primary constraint for this arrangement is the degree to which the rest of the industry would be willing to support the concept of a part of NR owning mandatory industry standards and setting system-wide technology strategy. The means of assuring independence from NR's commercial relationships and the chosen governance arrangements would therefore be critical for this option to succeed. The EU Interoperability Directive requires member states to have responsibility for National Rules. This can be delegated (as is the case with RSSB in GB) although there may be objections if delegation appears to be to the Infrastructure Manager.

Cost efficiency impact
If successful, the impact would be similar to the main Option 3.

Cost to implement
The costs of implementation would be similar to the main Option.

Benefits

- As per the main Option 3.
- Expertise on company standards already resides largely within NR, whilst RGS expertise could be transferred from RSSB.
- Restructuring required would be more limited than other options, less upheaval and faster transition.
- Could be treated as a stepping stone to a fully independent stand-alone standards body.

Disadvantages

- Likely to be seen by some industry players (e.g. TOCs, ROSCOs, others) as allowing NR to take too much power, compromising the commercial position of others in the industry. This would be especially true of the role of Systems Body was also allocated to the body.

Comparators and benchmarks
We have identified no other European railways that have National Rules owned and managed by the Infrastructure Manager organisation. This largely reflects EU legislation.

Option 3.4: Create a new independent systems and standards body as an arms-length body accountable to DfT

Ref	Title	Implementation risk (H/M/L)	Timescale to impact (S/M/L)	Range of cost to implement (£m)	Range of cost efficiency impact (£m/year)
3.4	Create a new independent systems and standards body as an arms-length body accountable to DfT	Medium	Medium/Long (within CP4 and during CP5)	30-44	200-230 +one off benefits 10-300

Description
In this option a new arms-length body would be created, accountable to DfT. The required expertise and resources would be transferred across from existing parts of the industry, notably NR and RSSB. This option would be particularly relevant for any scenarios involving major restructuring of NR (not further considered within the scope of this Theme).

Key constraints
The option would give rise to the formation of a new public body, for which robust rationale and justification would be needed.

Cost efficiency impact
If successful, the impact would be similar to the main Option 3.

Cost to implement
The costs of implementation would be similar to the main Option.

Benefits

- As per the main Option 3.
- Would be seen as fully independent and objective.
- Option could be linked with reallocation of RSSB functions (refer Option 1).

Disadvantages

- Requires creation of a new public body.
- Would need new competences and resources, especially from NR but also RSSB.
- More time consuming and expensive to set up a new body than to adapt existing bodies.

Comparators and benchmarks

France and Germany have NSAs with staff numbered in the thousands.

Appendix 8: NR technological innovation projects with cost saving potential

This appendix provides a summary listing of selected technological innovation projects reported to us by NR. These projects are incorporated into the NR Transformation Programme.

Table 13: Summary of current NR technological innovation projects with cost-saving potential

Technology	Description	Benefits	Timing for implementation	Risk (H/M/L)	Approx. cost in CP4 (£m)	Approx. benefit in CP4 (£m)	Net benefit in CP4 (£m)
Modular Signalling	Use a modular approach to reduce and rationalise choices in project development (use of best fit models) and enables use of design modules across multiple projects (generic assurance process).	Reduced signalling Renewal Capex and Maintenance Opex. Also enables future O&CS Opex savings if technology used for consolidation	2012/13	M	3.6	65.4	61.8
High Output Plant Optimisation	Make the HO/MOBC (high/medium output ballast cleaner) systems achieve (and go beyond) a low unit cost of track work renewals delivery by maximising the utilisation of the HO/MOBC plant. This enables a lower unit cost of operation when delivering the track renewals and spreading the high fixed cost of the plant across a greater volume of work	Reduction in unit rate of HO track renewals. Supports increased network availability and customer benefits. Enhanced engineering compliance. Reduced whole life maintenance costs. Enhanced safety performance. Reduction in Schedule 4 impacts	2011 - 2012	M	10.5	504.6	494.1
Standard Plain Line Track Delivery	Faster and cheaper plain line track renewals through optimisation of current best-practice delivery methods and development of new standard delivery techniques.	Reduction in Track Renewals Capex and a reduction in possession times. Reduction in waste leading to increased productivity	2011 - 2013	L	0	244.4	244.4

Technology	Description	Benefits	Timing for implementation	Risk (H/M/L)	Approx. cost in CP4 (£m)	Approx. benefit in CP4 (£m)	Net benefit in CP4 (£m)
Intelligent Infrastructure	Implement Remote Condition Monitoring (RCM) solutions to enhance the asset management capability of selected NR assets. A second phase will address the next wave of priority assets according to their contribution to delay minutes	Reduction in the level of delay minutes resulting from Points and Signalling Power Supply failures. Long term, the project will enable improved product and setup design for the NR infrastructure and may help to reduce inspection frequencies on some assets	2010 (Phase 1) 2012 (Phase 2)	Not specified [61]	11 (Phase 1[62])	30 (Phase 1)	21 (Phase 1) 10 (Phase 2[63])
Track Friendly Trains	Develop and prove products and technologies to reduce the initiation of Rolling Contact Fatigue in rails	Reduction in costs associated with future re-railing costs, track defect rectification, enhanced RCF inspection and grinding	2011 - 2014	Not specified	7.7	15.9 (69.9 in CP5)	8.2
Modular S&C	Develop modular concept for installation of switches and crossings (S&C) to enable faster and cheaper track renewals	Reduced S&C Renewals Cost. Ongoing Maintenance Opex savings	2010 - 2012	M	0	166	166
Optimised data collection	Introduce new or optimise the use of existing technology to remove or reduce the need for manual inspection of the infrastructure	Removal or reduction in the need for lineside inspections of the infrastructure and hence improve safety. A reduction in the number of staff required by automating the inspection and thus a reduction in Opex. A reduction in the amount of rerailing required. Reduction in the spend on contractor staff for track renewals. Improved reliability and a reduction in Opex	2010 – 2012	Not specified	Not specified	11.5	Not specified

[61] Not provided by NR. Assessment of risk out of scope of this project

[62] £11m implementation cost include a significant proportion of 'sunk cost' that will enable subsequent phases of the programme to be delivered at a lower net cost

[63] Not Phase 2 not fully analysed

Technology	Description	Benefits	Timing for implementation	Risk (H/M/L)	Approx. cost in CP4 (£m)	Approx. benefit in CP4 (£m)	Net benefit in CP4 (£m)
Standard Designs	Develop and assess new and more effective ways of delivering standard designs and minimising the scope of schemes in order to meet the aesthetic and functional requirements, by avoiding preferential engineering	Savings in the specification and design process	2011	L	0.3	59.0	58.7

Source: NR

Appendix 9: New Approach to the Rule Book – An estimation of the associated costs and benefits (RSSB document)

New Approach to the Rule Book

An explanation of the associated major Costs and Benefits

1. Background

The New Approach to the Rule Book aims to provide operational and safety performance improvements as a result of proper knowledge and understanding of simpler rules and procedures.

The Cost Benefit Analysis (CBA) for the New Approach seeks to quantify project costs and benefits in monetary terms. The table below details the principal costs and benefits which have been derived from internal and stakeholder workshops and a variety of RSSB and industry sources. The major cost is training although there are also substantial training benefits. The evaluation of the data uses investment appraisal techniques underpinned by the DfT and RSSB guidance on CBA projects.

There are a number of qualitative benefits to the project which have not been amenable to quantification. Examples include better professional development and competence management, as an individual's development is based upon the company's competence management system rather than knowledge of the Rule Book; and greater company control over process when they do not rely on cooperation for safe operation of the railway. The business case includes direct benefits, and those for which the New Approach is an enabler: these 'enabled' or 'unlocked' benefits are by far the larger component.

As each tranche of the New Approach is progressed, it is expected that further efficiencies and savings will be identified. The business case is currently being reviewed and is likely to evolve as the New Approach progresses.

2. Cost Benefit Evaluation

Three cases are presented for the New Approach over two time periods of 10 and 25 years. 'The Best case' is a baseline and represents the most optimistic scenario. It does not include any Optimism Bias (OB) which is applied, as in the 'Worst case', to redress a historically observed tendency for project appraisers to overstate benefits and understate timescales and capital and operational costs. The 'Most likely case' includes OB adjustments based on the views of subject matter experts, as a result of which it is between the best and worst case scenarios.

		10 Years			25 Years		
		Best case	Worst case	Most likely case	Best case	Worst case	Most likely case
Costs	**Industry Implementation Costs:**						
	New Approach training costs for implementation	£29.7	£49.3	£37.1	£29.7	£49.3	£37.1
	Industry immediate costs – New Approach RSSB development costs	£2.3	£2.7	£2.5	£2.3	£2.7	£2.5
	New Approach printing costs	£1.3	£2.2	£1.9	£1.34	£2.3	£1.9
	Costs of changes to Company Competence Management Systems (CMS)	£0.3	£0.5	£0.3	£0.3	£0.5	£0.3
	TOTALS:	**£33.6**	**£54.8**	**£41.8**	**£33.6**	**£54.8**	**£41.8**
Benefits	**Industry Benefits:**						
	Increasing capacity	£582.3	£198.0	£465.9	£1,323.3	£449.9	£1,058.6
	Optimising the use of the Railway	£88.7	£30.2	£71.0	£201.6	£68.6	£161.3
	Championing performance improvements	£55.5	£18.9	£44.4	£126.0	£42.8	£100.8
	Training efficiency benefits	£39.1	£13.3	£31.3	£101.8	£34.6	£81.5
	Improved operational resilience	£8.7	£3.0	£7.0	£19.8	£6.7	£15.9
	Safety Benefits	£1.4	£1.4	£1.4	£3.5	£3.5	£3.5
	Other quantified benefits	£0.6	£0.5	£0.6	£2.0	£1.8	£1.9
	TOTALS:	**£776.3**	**£265.3**	**£621.6**	**£1,778.0**	**£607.9**	**£1,423.5**

Figures in £ millions

Major Costs and Benefits of the New Approach to the Rule Book

2.1 Industry Implementation Costs

New Approach training costs for implementation - The roll out of the New Approach requires all staff that use the Rule Book to undertake training to understand the changes. This is an additional training requirement over and above the regular need for briefing of day to day rule changes, and results from the radical nature of the effects of applying the New Approach. These changes will include such issues as elements of the rules that will apply to staff, handbooks relevant to a role and also a degree of 'unlearning' in certain cases. Costs to industry are calculated in terms of time spent attending training sessions which may not necessarily be required if the New Approach was not implemented. Costs have been derived from the cost of employment of infrastructure and operational staff, multiplied by the number of industry staff and the extra days required for training. Cost and training needs were obtained by producing estimates based on discussions with industry stakeholders at workshops.

Industry immediate costs – New Approach RSSB development costs – These are the costs incurred by RSSB in progressing the project through the various phases from concept through to delivery. They are mainly staff costs including secondees from other organisations.

New Approach printing costs - The implementation of the New Approach requires a review of all existing Rule Book modules. The review will lead to modules being updated or withdrawn and the introduction of role specific handbooks. Estimates have been made of the number of copies of modules/handbooks required by industry and associated prices have also been estimated. This has been done in consultation with Willsons the printers.

Costs of changes to Company Competence Management Systems (CMS) - The New Approach will result is changes needing to be made to Company CMS and other-company procedures. Based upon the inputs and discussions at industry workshops, it is assumed that there are 200 CMS across the industry. In terms of the time required to change them, 70% are assumed to take 1 day and 30% 10 days with a cost per day of £500. The phasing of these costs is assumed to be split equally over the 4 years that the New Approach is introduced.

2.2 Industry Benefits

Increasing capacity – 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 that enables the network to be available consistently to deliver the timetable. The impact will lead to increased capacity and consequent revenues and modal shift. Additional revenues have been quantified at £105m (undiscounted) per year.

Optimising the use of the Railway – The New Approach will contribute to the streamlining of the process for setting up safe systems of work, including engineering possessions. This includes supporting the use of On Track Machines outside of possessions. Impacts will be increased capacity and revenues, more efficient delivery of infrastructure maintenance, less disruption to train services and lower possession costs. Benefits of £83m (undiscounted) have been calculated over the Control Period 4 (CP4): for the purpose of the model benefits have been quantified at £16m (undiscounted) per year.

Championing performance improvements – The New Approach will enable innovation by making it easier to change the operational concept to accommodate new technology and/or better operational practices, and then to make the consequent detailed rule changes. This will lead to improved performance whilst reducing performance delays and manpower used during degraded mode working. Benefits are quantified at £10m (undiscounted) per year.

Training efficiency benefits – The New Approach asserts that the Rule Book is not a training document in itself. Training should be task based and linked to a company's competency management system. Training efficiency benefits will cover rules specific training in a shorter timeframe, enabling industry to utilise training time to cover additional aspects which will add value to their organisation or indeed to make savings in overall training duration. This benefit is expected to reach a value of £8.8m (undiscounted) per year from 2014.

Safety Benefits - Changing from the current Modular Rule Book to the New Approach will improve safety risk control. The New Approach reduces the number of rules required for safe operation of the railway, thus leading to increased staff competence and a reduction in track worker injuries and fatalities. As the figures in the table are derived from the safety risk model (SRM) no OB is applied.

Appendix 10: Option 3 Systems and Standards Body – Cost Efficiency Benefits

This Appendix provides further background and rationale for the cost efficiency impact modeling for Option 3 of the main report, setting up a Systems and Standards body. There are four mechanisms by which this body will provide cost-efficiency benefit the industry:

- Enabling *system level innovation* and better system requirement specification through the systems body.
- Better *requirements definition* and hence more cost-effective procurement from a more coherent set of standards.
- *Reductions in the number of staff employed to check* others' interpretation of standards, embodiment in requirement, design and compliance, achieved through more simple and appropriate standards.
- *Acceleration* of projects and procurement that might typically experience delays due to difficulties in approvals.

System level innovation

The objective of the systems body is to identify the best cost-benefit options related to, for example through life cost and safety. Obviously it is impossible to predict the magnitude of this saving because this depends upon the details of the future programmes and procurement. However, with programmes of the size of Great Western Main Line and Manchester-Liverpool electrification (£1bn), CrossRail (£16bn), and HS2 (order of magnitude £30bn depending on options selected) it is clear that only a few percent savings translate into huge amounts of money saved. Assuming a 1% saving on the above schemes one sees savings of **£10m**, **£160m and ~£300m**. Such savings would be an excellent return on the work of the new body. The same thinking can be applied to operational issues, achieving savings on annual costs as well.

While it is difficult to predict the future it is, however, possible to look at the possible impact of past decisions. The evolution and truncated procurement of the Intercity Express Programme (IEP) might have been different had a group considered a range of wider systems implications. For example, one design objective embedded in the procurement was a commitment to trains capable of running through-journeys. This implies the ability of a train to use both electric and diesel power. A Systems Body of the kind envisaged here would have explored the implications of relaxing this objective. What would be the cost savings of procuring trains optimised for a single energy source? What other approaches could be envisaged for making journeys as seamless as possible? If massive savings could be made from procuring a more conventional design, perhaps using designs already in service, would this have allowed the funding of different timetabling of connecting trains? Foster, in his review of the IEP procurement highlighted the absence of considerations such as these.[64]

The IEP was also specified with a particular scenario of future electrification in mind. Given the magnitude of the investment envisaged the question might be asked of different electrification options and timing. Indeed the key role of the system body may be to trigger the important debates. Foster notes[65] that the whole electrification debate seemed to be stimulated by a single critical letter that initiated a process that developed over almost two years.

To quantify these issues, Foster notes that alternatives could deliver "more than half of the benefit on the East Coast route, and probably around three quarters of it on the Great Western routes, could be captured for between 40% and 60% of the cost". This represents a potential saving of some £2bn or more.

[64] Page 6 of "A Review of the Intercity Express Programme", Sir Andrew Foster, June 2010, http://www.dft.gov.uk/pgr/rail/pi/iep/fosterreview/pdf/report.pdf

[65] Page 38 of "A Review of the Intercity Express Programme", Sir Andrew Foster, June 2010, http://www.dft.gov.uk/pgr/rail/pi/iep/fosterreview/pdf/annex.pdf

To consider another example, there has been consideration of the costs required to achieve the robustness of GSM-R. This has focused on using layers of technology within GSM-R to increase robustness, albeit at added cost. What other approaches might be possible, for example using different channels of communication to augment the resilience of the system to the point that might allow significant reductions of cost from using more widely available equipment?

A Systems Body would explore the implications of removing constraints, of alternative scenarios and seek options with quite different cost-benefit trade-offs. Highlighting such options then opens up the potential for the industry to choose different approaches and to unleash innovation on a wider basis.

Requirements definition

Better requirements definition would arise from a more coherent set of standards, where there is less potential for confusion and delay during the procurement process. The analysis discussion in Section 4 highlights some of the issues of complex and contradictory standards and the negative impact of these on specification drafting. Estimating the potential cost savings here is difficult but past history gives some indications.

Anecdotes tell of past delays of 12 months while requirements were reconsidered and appropriate standards discussed leading to costs of the order of £5m within a batch procurement of approximately £100m. These costs did not include the engineering staff time, estimated at a team of three to five dealing specifically with the issue and representing a further cost of some £150k-£250k per year. If that is mirrored within the client organisation, linking back all the way to requirement and specification review then this number could easily be doubled to some £0.5m per annum of delay. Clearly, financing costs dwarf salary costs in this case.

Another source of savings here, perhaps the most significant, lie in the opportunities for the procurement of more standardised equipment and equipment that has been already demonstrated on other railways. In these cases there are potential economies of scale and the development costs may also have been amortised. We have assumed that asset expenditure is around £5bn/year (including renewals and enhancements, excluding maintenance). We have excluded track renewal, approximately £1bn, as being less likely to be positively impacted by standards rationalisation and by further standardisation. Section 4.4.1 identifies extra costs in GB rolling stock over Europe of 25-50%, attributing much of these to smaller purchases and unique standards. If we were able to liberate only one fifth of this cost as a benefit of standardisation we might expect cost saving of 5-10%. Benchmarking of infrastructure projects shows a 14% difference in cost to Europe even after labour and material cost differences have been accounted for.

Hence assumptions of only 5% savings in procurement costs would give approximately **£200m** per annum of potential saving once the impact had time to work through in terms of asset renewals.

Total costs of rolling stock over a 30-year life divide into 1/3 Manufacture, 1/3 Light maintenance (routine), and 1/3 Heavy maintenance. More standardized fleets could reduce the maintenance cost in particular by some 10-15%. Based on a rule of thumb of a whole life cost of some £4.5m per unit, and more than 250 new units every year, this implies savings of £75-£150M across the life of the vehicles, say £2.5 to £4M per annum.. There is likely to be equivalent savings in the maintenance of infrastructure where the proportion due to maintenance is closer to 40%[66], but the installed value is very much higher.

[66] "Total Cost of Ownership of Rail Signalling Systems", www.westinghouserail.co.uk/whitepapers/I300203_Invensys_CostOfOwnership_WhitePaper.pdf

Reductions in the number of staff employed to check

Discussions with senior leaders in the industry reveal that some can identify savings of up to 50% in the staffing levels associated with their processes of compliance checking and approvals. However, it is clear that such a level of reduction could well impose delays in the management processes. Therefore we have more than halved this assumption, suggesting a 10-25% saving in the staff associated with checking of standards and the procurement issues driven by standards as a consequence of a more rational set of GB standards and hence more simple procurement. Assuming the involvement in requirements definition, procurement and approvals of typically 5-10 staff from each of GB rail's 20 or so railway companies, plus double that number from Network Rail (covering both products and projects) one might estimate a community of 100-200 across the industry, representing an annual cost of some £5-10m. If 25% of these can be redeployed as a consequence of streamlining checking processes enabled by a better standards regime then savings of £1m-£3m per annum could be realised.

High transaction costs seem to be endemic in the UK industry, estimated at 10% in benchmarking studies,[67] and with management, planning, design and legal costs reaching 25% for major scheme projects[68]. Savings of up to 5% in project management costs were envisaged by the SRA given a radical change in UK approvals processes[69]. This seems a large prize worth addressing and suggests that the benefits identified above are not excessive.

Acceleration of projects

The mechanisms by which time is saved include the following:

- Reduced complexity in the design requirements embodied in standards leading to shorter development cycles – because there will be a simpler regime with more technology-independent standards and less conflicts or inconsistencies, and a lower degree of risk for the innovator.
- Fewer design modifications, rework and resolution of conflicts– because there are less inconsistencies in standards and clearer requirements.
- Reduced time for demonstrating compliance and achieving acceptance – because there will be a unified and more coherent set of requirements.
- Increased commercial drivers to accelerate innovation – because there will be better mechanisms to reward these innovations, and the Systems Body will remove a number of barriers towards innovation as mentioned above.

This is perhaps best considered in two parts: Impact for NR and impact for the rest of the industry.

Impact for NR

NR's Transformation Programme includes an "Enhanced Infrastructure Delivery" (EID) programme that aims to provide a target saving of £2.2bn over CP4 through major changes in delivery of the capex and maintenance programme, focusing on technology and process innovations. Based on the £2.2bn target we can assume that the annual benefit in the latter years for CP4 will be around £500m/year. We have been advised by NR that the Opex/Capex split of the benefits is around 80/20, so the Opex benefit would be **£400m** for a one-year acceleration, or £33m per month of acceleration. In other words every month of acceleration would give an additional benefit of some **£30m**. Clearly this magnitude of benefit opportunity is only available for a limited number of years whilst EID is being implemented, although other innovations at earlier stages of development would continue to be fed into the pipeline.

[67] Page 43 of "Rail Infrastructure Cost Benchmarking – Brief LICB gap analysis and cost-driver assessment, BSL,", April 2008, www.networkrail.co.uk/browse%20documents/StrategicBusinessPlan/Update/Cost%20benchmarking%20assessment%20%28BSL%29.pdf

[68] "High Speed Rail – an international comparison", The Commission for Integrated Transport, cfit.independent.gov.uk/pubs/2004/hsr/research/pdf/chapter4.pdf

[69] ibid. However, note that this assumption encompassed changes in environmental and planning approvals processes

There will also be benefit in terms of reduced Capex in the case of some innovations such as lightweight LED signalling technology, modular S&C and many others. It is assumed that the Capex benefit of acceleration is effectively the cost of capital related to funding of the Capex saving, not the Capex itself. Assuming a conservative WACC of 4%, and an annual Capex sum of £100m, the Capex benefit for a 1-year acceleration would be £**4m**, or around **£300k** for a month, which is relatively insignificant in comparison to Opex.

Impact for the rest of the Industry:
The above numbers cover NR savings only. We know that TOC annual expenditure is approximately £4bn (excluding track access charges and ROSCO payments). Acceleration of some innovations will also have Opex benefits for train operations (for example driver advisory systems can provide fuel efficiency savings of some 5-10% for a TOC). Since the NR EID target saving is some 7% of total NR spend (£500m/£6.7bn),could assume conservatively that, say, 1-2% of Opex expenditure might be saved by the TOCs through accelerating innovation, hence some **£40-80m** for a year's acceleration or **£3m- £6m** for a month's advance of all programmes across the TOCs.

For rolling stock, GB pays some 25% more than the rest of Europe (see section 4.4). A "rule of thumb" average manufacturing cost per unit is £1.4m, and the UK purchases some 250/year, so approximately £350m/year. The potential savings on rolling stock are covered later in Section 4.4 and are excluded here to avoid double-counting.

We could assume, conservatively, that it would be possible at least within 2-3 years, to achieve an acceleration of between 2 to 6 months in the current innovation projects. A 6-month acceleration would mean an improvement of some 17% in for a typical 3-year duration development project - such accelerations are commonplace in product or process improvement projects in transport or engineering sectors. This assumption would therefore provide a one-off further cost saving due to acceleration of between £60m-£180m for NR, as well as a saving of £20m - £40m for TOCs (1-2% of Opex as above). This is roughly **£80m - £220m** in total, excluding rolling stock, over and above NR's targeted Transformation Programme benefits. Over a total period of 10 years (CP4 and CP5), this could be expressed as approximately **£10m-£20m/year** on average.

Overall
In summary we see a combination of one-off and annual savings. Systems-level innovations could offer savings in excess of figures between £10m and £300m per major investment scheme depending upon the size of the scheme and the scope of the opportunity. Accelerating projects by, say 2-6 months, across the portfolio of projects in the UK achieved through streamlining may offer one off savings of between £80m and £220m (£10m-£20m/year on average). Better definition of requirements and explicit pursuit of standardised approaches, accessing commercial offerings tested in other markets, could lead to savings of about £200m per annum in procurement and up to £4m/year in rolling stock maintenance. Streamlining processes and reducing the number of staff employed in checking others' work could release about £3m/year in savings.

The total savings therefore are approximately £200m - £230m/year, plus £10m-£300m per major investment scheme.

Appendix 11: Glossary

AAR	Association of American Railroads
ABCL	Automatic barrier crossing locally monitored
ADIF	Administrador de Infraestructuras Ferroviarias (Spain)
AeIGT	Aerospace Innovation and Growth Team
AHB	Automatic Half Barrier
AIN	Aerospace Innovation Networks
ALARP	As Low As Reasonably Practicable
ALCRM	All Level Crossings Risk Model
AOCL	Automatic open crossing, locally monitored (AOCL)
ARAIB	Aircraft and Railway Accidents Investigation Board
ARAIC	Aircraft and Railway Accidents Investigation Commission
AREMA	American Railway Engineering and Maintenance-of-Way Association
ATOC	Association of Train Operating Companies
ATSG	Aerospace Technology Steering Group
BEA-TT	Bureau d'Enquêtes sur les Accidents de Transport Terrestre
BMVBS	Federal Ministry of Transport, Building and Urban Development (Germany)
CAA	Civil Aviation Authority
CAMO	Continuing Airworthiness Management Organisations
CBA	Cost Benefit Analysis
CENELEC	European Committee for Electrotechnical Standardisation
CPS	Crown Prosecution Service
CTRL	Channel Tunnel Rail Link
DfT	Department for Transport
EASA	European Aviation Safety Agency
EBA	Federal Railway Authority in Germany
EMC	Electromagnetic Compatibility
EPSF	Établissement Public de Sécurité Ferroviaire
ERA	European Railway Agency
ERTMS	European Rail Traffic Management System
ETI	Energy Technologies Institute
EU	European Union
EUB	German Railway Accident Investigation Body
FMEA	Failure Modes and Effects Analysis
FOC	Freight Operating Company
FPAL	Oil and Gas Industry Supplier Database
FP MWL	Footpath Crossing with Miniature Warning Lights
FRA	Federal Railroad Administration
FTE	Full-time equivalents
FWI	Fatalities and Weighted Injuries
GB	Great Britain
GRIP	Guide to Railway Investment Projects
GSM-R	Global System for Mobile Communications - Railway

H&S	Health and Safety
HSAWA	Health & Safety at Work Act
HLOS	High Level Operating Statement
HO/MOBC	High/Medium Output Ballast Cleaner
HSE	Health and Safety Executive
IEP	Transportation Technology Centre
IM	Infrastructure Manager
IP	Intellectual Property
ISA	Independent Safety Assessor
ISCC	Industry Standards Co-ordination Committee
ISO	International Standards Organisation
JMAIA	Japan Marine Accident Inquiry Agency
JTSB	Japan Transport Safety Board
KPI	Key Performance Indicators
LED	Light Emitting Diode
LICB	Lasting Infrastructure Costs Benchmarking
MCB-CCTV	Level crossing manually controlled barrier protected by closed circuit television
MCG	Level crossing manually controlled gate
MLIT	Ministry of Land, Infrastructure, Transport and Tourism
MLTM	Ministry of Land, Transport and Maritime Affairs
MS	Member State
MWL	Mini-Warning Lights
NAO	National Audit Office
NG	National Grid
NNTR	National Notified Technical Rules
NPV	Net Present Value
NR	Network Rail
NRs	National Rules
NSA	National Safety Authority
NTSB	National Transportation Safety Board
NVW	Safety Standards (The Netherlands)
O&CS	Operations & Customer Service
OEM	Original Equipment Manufacturers
Ofgem	Office of the Gas and Electricity Markets
ORR	Office of Rail Regulation
OTM	On-Track Machines
PICOP	Person In Charge of Possession
R&D	Research and Development
RAIB	Railway Accident Investigation Board
RAIR	Railways (Accident Investigation and Reporting) Regulations
RCF	Rolling Contact Fatigue
RCM	Remote Condition Monitoring
REB	Relocatable Equipment Buildings
RGS	Railway Group Standards

RI	Railway Inspectorate
RIA	Railway Industries Association
ROSCO	Rolling Stock Leasing Company
RRF	Railroad Research Foundation
RS	Rolling stock
RSSB	Rail Safety and Standards Board
RSSP	Railway Strategic Safety Plan
S&C	Switches and Crossings
SFAIRP	So Far As Is Reasonably Practicable
SIL	Safety Integrity Level
SMIS	Safety Management Information System
SNCB	Société nationale des chemins de fer belges
SORAT	Signal Overrun Risk Assessment Tool
SPAD	Signal Passed at Danger
SRM	Safety Risk Model
SRP	Safety Review Panel
SSICF	Service de Sécurité et d'Interopérabilité des Chemins de Fer
STC	Supplemental Type Certificate
TENS	Trans-European Networks
TOC	Train Operating Company
TPWS	Train Protection Warning System
TSAG	Technology Strategy Advisory Group
TSI	Technical Specifications for Interoperability
TTCI	Transportation Technology Center, Inc.
US	United States
UWCMWL	User-worked crossing protected by miniature warning lights
VVW	Safety Instructions (The Netherlands)
VfM	Value for Money
VPF	Value of Preventing a Fatality