



The Second Rail Industry Research Strategy



Executive Summary

- Research is a key part of the process of developing the technologies that can reduce the cost of the railway and improve the competitiveness of the industry.
- Strengthening research leadership is essential for driving fundamental improvements in the way research is organised in the rail industry.

Research and innovation are key issues for the rail industry

The railway system will play a key role in meeting the UK's future transport needs. However, in order to fulfil its potential, the railway will need to improve in many ways, particularly in terms of the '4Cs' – cost, capacity, customer and carbon. Reducing costs is a key priority and is an essential part of improving the competitiveness of the industry. The 4Cs have provided a framework that is now commonly used in the rail industry. Because of the increased focus on competitiveness, it may soon become a '5th C'.

Although the railway is clearly a very mature industry, the challenges it now faces mean that there are significant opportunities for innovation and the adoption of new technology. This implies that research and innovation will continue to be key issues for the rail industry. Some of the research will focus on the development of new technology specifically for the railway, but in many cases technologies being developed in other sectors can be successfully applied to rail. Recognising the importance of technology and research, the industry developed the Rail Technical Strategy (RTS) and the first Rail Industry Research Strategy (RIRS1).

Good progress has been made in taking forward the actions in RIRS1; most of these are now complete. Accordingly, the rail industry considered that it would be timely to review the strategy and, in particular, to update the action plan. A Steering Group of rail industry representatives was formed to undertake this review. The outcome of this process is this second Rail Industry Research Strategy (RIRS2), which both builds on the actions from RIRS1 and identifies new priority areas for action.

Purpose of RIRS2

The purpose of RIRS2 is to identify the really key issues for rail research, and in particular to:

- Help the rail industry identify and deliver the research and technology that can bring down costs and do "more for less".
- Present what the RIRS2 Steering Group (representing the rail industry) has agreed to do about the key issues; and
- Help make the case for rail research.

In developing RIRS2, the focus has been on identifying how the industry can work together to ensure that the benefits of research are realised.

The Case for Rail Research

Research is essential to reduce costs, enhance capacity, improve customer satisfaction and reduce the carbon emissions of the railway thus enabling the railway to play a full part in meeting the UK's future transport needs. This is the clear conclusion of a project sponsored by the Technical Strategy Advisory Group (TSAG) on technology route mapping¹. The route mapping project implies that there are potentially significant cost savings that can be delivered as a result of the technologies developed by rail research projects. Analysis of the data suggests that these cost savings might amount to as much as £4 billion per annum. However, if the investment in research does not take place to expand the capability of the railway in an affordable way, then the effectiveness of the UK transport system will be limited; this in turn will act as a brake on economic growth.

It is essential that the industry continues to work together to make the case for research and, in particular, to build the evidence base that provides the information about return on investment that makes the case for research compelling.

Areas of Focus

Technical Areas of Focus

The Steering Group acknowledged the detailed work that had already been done by the industry to prioritise research themes. Accordingly it concluded it was unnecessary to undertake a detailed review of technical areas of focus. However, the Group did affirm the following principles:

- The 4Cs remain the basis for deciding on technical areas of focus.
- The RTS long-term themes for change still provide a good basis for specifying the technical areas of focus for future research.
- Reducing the costs of the railway is currently the key priority for the industry, and the need for research to develop the technologies that achieve this goal is the over-riding aim.

¹ Technical Strategy Advisory Group project "Technology route-mapping to support the planning for rail's 30 year vision." (RSSB, 2009)

The Steering Group noted that the RTS is currently being reviewed. As part of the process of seeking industry views, TSAG have identified key technological interventions that are seen as having the potential for ‘changing the game’ for the rail industry.

The Steering Group examined what has changed since 2007 that may impact research priorities. The Group felt that the following are likely to become increasingly important:

- Low carbon and energy.
- High speed rail.
- Better tools for making decisions on rail investments.
- Whole system performance.
- Personal and rail system security.

Management Areas of Focus

The Steering Group identified three priority management areas of focus for enhancing the effectiveness of rail research. In each of these areas, specific Enabling Actions (EA) were identified as follows:

- *Strategic Direction*
 - EA1 - Leadership and Making the Case.
- *Knowledge*
 - EA2 – Knowledge Management.
 - EA3 – Collaborative Working.
 - EA4 – Engaging with European Research.
 - EA5 – Technology Transfer from Other Industries.
- *Route to Market*
 - EA6 – Enhancing industry capacity for innovation.
 - EA7 – Reducing the risks of introducing innovations.

“Strategic Direction” emerged as a new area of focus which could drive fundamental improvements in the way research is organised in the rail industry. “Knowledge” and “Route to Market” build on actions already underway as part of RIRS1. More details about the specific activities within each of the Enabling Actions are provided in Table ES1.

Governance Arrangements for RIRS2

The strategy requires clear governance arrangements to monitor progress in the implementation of the actions. The RIRS2 Steering Group believes that TSAG is the appropriate body to provide the governance and oversight of the implementation of the strategy. TSAG has agreed to undertake this role.

| Management Areas of Focus | Enabling Actions | Lead | Specific Objectives |
|---------------------------|--|------|---|
| Strategic Direction | EA1 – Leadership and Making the Case | DfT | <p>1.1 Establish research leadership/championing role (individual with support or empowered group).</p> <p>1.2 Obtain industry-wide and Government agreement on including a role for RD&D within the next High-Level Output Strategy (HLOS) for Control Period 5 (CP5).</p> <p>1.3 Develop a portfolio approach based on technology route maps.</p> <p>1.4 Consider how the RTS applies to High Speed Rail, and where needed develop specific additional research approaches.</p> |
| Knowledge | EA2 – Knowledge Management | RSSB | <p>2.1 Improve foresighting – a clear understanding of what knowledge is needed for what purpose.</p> <p>2.2 Make the outputs from current and legacy R&D projects more widely available across the rail industry.</p> |
| | EA3 – Collaborative Working | RSSB | <p>3.1 Develop collaborations with UK research funders.</p> |
| | EA4 – Engaging with European Research | NR | <p>4.1 Develop a more pro-active strategic approach to European-funded programmes.</p> <p>4.2 Explore opportunities for more bi-lateral collaboration within Europe (e.g. with France and/or Germany).</p> |
| | EA5 – Technology Transfer from Other Industries | RIA | <p>5.1 Raise awareness within the rail industry of benefits of applying technologies from other sectors.</p> <p>5.2 Participate in the new Knowledge Transfer Network for transport.</p> |
| Route to Market | EA6 – Enhance Industry Capacity for Innovation | TSAG | <p>6.1 Specific activities are being developed by TSAG as a follow-on to the report on Enabling Innovation.</p> |
| | EA7 – Reducing Risks for Introducing Innovations | TSAG | <p>7.1 Specific activities are being developed by TSAG as a follow-on to the report on Enabling Innovation.</p> |

Table ES1 - Enabling Actions and Specific Objectives



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1. Introduction and Background

- Our ambition for this second Rail Industry Research Strategy is to build on the first Research Strategy and gain an industry-wide consensus on the actions to be taken to improve the effectiveness of investment in rail research.

The railway system can play a key role in meeting the UK's future transport needs

Efficient and effective transport networks are essential for sustainable economic competitiveness. Good transport systems support the productivity of urban areas, encourage flexible labour markets, and allow businesses to reap the benefits of working together. Transport corridors are the arteries of domestic and international trade, boosting the competitiveness of the UK economy. Investment in transport supports economic growth.

Whilst generally the UK transport networks perform well, some parts are under severe strain. The economics of investing in the transport system are generally attractive, and well-targeted schemes offer good returns (HM Treasury, 2006). However, the returns from these investments are achieved over the long term, and the benefits usually accrue to society as a whole rather than to individual investors. As a result, making investment decisions in the transport sector is not straightforward and there is a need to show considerable foresight in developing and investing in transport infrastructure.

Rail is a key component of meeting future transport goals, particularly in relation to reducing carbon and reducing congestion. However, there is concern that the costs of the railway in Great Britain are high compared to elsewhere in Europe and that privatisation of the railway has not brought the reduction in costs that have been achieved in other privatised industries (Department for Transport, 2010a and 2010b). This could in turn have a negative effect on future investment.

Fulfilling its potential and using technology to deliver "more for less"

In order to fulfil its potential, the industry acknowledges that the railway will need to improve in many ways (ATOC et al, 2010). The industry has developed the '4Cs' framework – cost, capacity, customer and carbon - in order to define the scale of the changes that will be required:

- Cost - improving cost efficiency.
- Capacity - expanding capacity.
- Carbon - reducing carbon emissions.
- Customer - meeting customer aspirations for reliability, comfort and safety.

The 4Cs provide the basis on which the rail industry can improve its competitiveness.

Because of the increased importance of competitiveness to the rail industry, it is increasingly referred to as the '5th C'.

Normal incremental improvements in technology and business processes will make some improvements in each of the '4Cs'. However, the step-changes that will be required for the railway to meet its full potential, and meet the challenge of delivering "more for less", will require fundamental long-term change to the railway. Much of the step-change will only be delivered through technological developments and other innovations that are based on strategic and highly innovative research that go beyond the current product development pipeline.

Research and Innovation are Key Issues for the Rail Industry

Although the railway is clearly a very mature industry, the challenges it now faces mean that there are significant opportunities for innovation and the adoption of new technology. This implies that research and innovation will be even more important for the rail industry in the future. Some of the research will focus on the development of new technology specifically for the railway, but in many cases technologies being developed in other sectors can and should be applied. Although the experience of the railway in applying technology from other sectors is best described as 'mixed', improving technology transfer should be regarded as a key opportunity area for the rail industry.

Recognising the importance of technology and research, in 2007 the industry developed the Rail Technical Strategy (RTS) and the first Rail Industry Research Strategy (RIRS1). The RTS developed a vision for the rail industry for the next 30 years, whilst RIRS1 set-out a future direction for rail research and put forward mechanisms for the delivery of this agenda to complement arrangements that existed at that time. A key outcome of RIRS1 was the launch of the rail industry strategic research programme (RISRP). Details of the RTS, RIRS1 and RISRP are provided in Appendix A.

Building on RIRS1- The Second Rail Industry Research Strategy

Good progress has been made in taking forward many of the actions in the RIRS1 Implementation Plan, see Appendix B. In addition, a number of changes have taken place in the industry; examples of these changes are shown in Box 1.1.

Accordingly, the rail industry considered that it would be timely to review RIRS1 and, in particular, to update the action plan. The Department for Transport let a contract to TRL (Transport Research Laboratory) to facilitate this review.

The process adopted for developing RIRS2 involved a Steering Group (consisting of representatives from across the rail industry) participating in a series of facilitated workshops to discuss the key issues and jointly develop the updated strategy. More details about the process for developing RIRS2 are provided in Appendix C.

The outcome of this process is this second Rail Industry Research Strategy (RIRS2). In developing RIRS2 it has not been the intention to start from scratch. The aim has been to build on RIRS1 and take account of the developments in the rail industry since RIRS1 was launched. As with RIRS1, the aim is to achieve a cross-industry consensus on actions to be taken to further enhance the effectiveness of rail research in the UK.

Rail Research in the UK

RIRS1 provided a comprehensive review of rail research carried out in the UK at that time. A similar exercise has not been carried out for RIRS2, as there have been insufficient changes since then to warrant a further review.

A high-level review of R&D spend on rail in the UK has been carried out by RSSB (RSSB, 2007); this estimated that investment in rail-related research was

£54 million in 2005/06 which was about 0.8% of rail industry revenues. This is low compared to the UK average (across all sectors) of 1.7% (National Statistics, 2010), and much lower than technology based industries such as aerospace & defence (4.9%) and automotive (3.9%). It is similar to the level of R&D investment in the energy & chemicals sector (1%) and water utility companies (0.5%). Details of the investment in these and other sectors can be found in the Global Innovation 1000 (Booz & Co, 2009).

Other aspects of the rail research landscape in the UK are summarised in Appendix D. This provides details of the organisations involved in rail research and their respective roles.

- Development and launch of the Strategic Research Programme.
- The Technical Strategy Advisory Group (TSAG) has been established as the client group for strategic research.
- Development of Technology Route Maps by TSAG.
- Commitment to further development of High Speed Rail.
- Further electrification of the railway has been announced.
- Network Rail and ATOC have played a leading role in shaping European rail research through the European Rail Research Advisory Council (ERRAC).
- Greater collaborative funding for rail research – MoU with the Engineering and Physical Sciences Research Council established.
- A Knowledge Transfer Network (KTN) for transport has been established.
- The Rail Research UK Association (RRUKA) has been formed.
- The ORR review of RSSB has been published.
- The DfT/ORR has commissioned a Value for Money study of the railway.
- EPSRC/RSSB/DfT Strategic Partnership to support rail industry research and development has been established.

Box 1.1 – Examples of changes in the rail industry since the publication of RIRS1

2. Purpose, Assumptions and Challenges

- The GB rail industry is a difficult environment for research and innovation. The purpose of RIRS2 is to help the rail industry identify and deliver the research and technology that can help bring down costs and do “more for less”.

Purpose

The purpose of RIRS2 is to:

- Identify the really key issues for rail research, particularly those issues where the rail industry needs to work together;
- Present what the RIRS2 Steering Group (representing the rail industry) has agreed to do about these key issues; and
- Help make the case for rail research.

As a result, the rail industry will have a clearly articulated set of priorities and initiatives that will enable it to work together to enhance the effectiveness of rail research in the UK. This will help deliver the substantial changes that are needed to reduce costs, increase capacity, reduce carbon and meet the needs of customers.

In developing RIRS2, the focus has been on identifying how the industry can work together to ensure that the benefits of research are realised. This is achieved through the Management Areas of Focus (see Section 5).

A deliberate decision was taken to give less attention to Technical Areas of Focus (ie research themes) as these issues have been addressed elsewhere, particularly the Rail Technical Strategy (RTS) and the forthcoming review of the RTS.

The strategy will help the rail industry identify and deliver solutions where technology, innovation and research can help bring down costs and do “more for less”. Examples of other ways in which the re-statement of research strategy contained in RIRS2 will help the rail industry are listed in Box 2.1.

Assumptions

The assumptions that were made in developing RIRS2 were as follows:

- Timeframe – research that could have an impact over the next 30 years (i.e. up to 2040). The timeframe for taking action is 2 to 3 years.
- Geography – all of Great Britain is relevant, but the rail industry can learn from experiences across the world.

- Industry definition – included within the scope are Passenger, Freight, Metro, Light Rail, high-speed rail, and where rail interfaces with other modes. Excluded from the scope are trams, tram/trains, the non-rail components of door-to-door journeys.
- Research landscape – included are all types of research along the spectrum of applied, strategic and fundamental research, as well as research with a range of risk profiles.
- The 4Cs – customer, cost, carbon and capacity remain critical issues for rail. The challenges and opportunities for the rail industry will still be defined in terms of the 4Cs.
- Economic Climate – the current economic climate may affect the availability of funds for investment in the short term, but not in the long term. The focus of the strategy is both on increasing the cost-effectiveness of research and ensuring that the research contributes to reducing the cost of an effective rail industry. Accordingly the approach is well tuned to the increasing emphasis on value for money.
- Investment and Funding – current sources of investment and funding will continue to be available.

Challenges

During the discussions to develop RIRS2, there was general agreement that the GB rail industry is a difficult environment for research and innovation. Some of the reasons link to a culture of risk aversion and a preference for traditionalist approaches, whilst others relate to current structural/organisational issues within the industry:

- A Culture of Risk Aversion. Like other aspects of the UK’s transport system, the rail network is a complex system with long-life, capital-intensive assets. This means it is relatively inflexible in terms of adapting to new technologies and meeting new challenges. Overly prescriptive standards can inhibit

new approaches. The limited facilities for testing and trialling make it difficult for new technologies to be properly evaluated. There is a big leap in cost and resource in going from research/proof of concept to real-world application/testing (let alone commercial implementation). This applies in many sectors, but is particularly acute for rail.

- “Not invented here”. There has been a reluctance within the industry to be pro-active in transferring technology from related sectors such as IT, defence and aviation. Clearly, there are aspects of the rail industry that are largely unique, such as the rail/wheel interface and pantographs; but equally there are many technologies used in other sectors, notably ticketing, systems engineering and information technologies, that could be more successfully applied to rail. As a result, there is too great a focus on solutions that are bespoke for the rail industry rather than using “commercial off-the-shelf technologies” which improve performance and reduce costs.
- Business Priorities. Railway companies themselves are primarily focused on relatively short-term objectives and meeting the immediate

business imperatives of delivering a successful service to customers. Medium term objectives focus around the requirements of specific Control Periods and the High Level Output Specifications. There are few incentives within the industry that encourage investment in R&D. Franchise lengths have not encouraged R&D investment by train operators, nor does the franchising regime itself require it. However, this trend may be reversed following a recent statement by the Secretary of State for Transport. The Department will in future let longer franchises, and typically these will be of at least 15 years duration (Department of Transport, 2010c).

- Organisational and Structural Issues. Many of the issues facing train operators that are amenable to R&D are common to all or most of the companies concerned, and the disaggregated nature of the industry makes R&D hard to justify for each company on its own. Collaborative research tends to favour a consensus-seeking approach and this does not encourage investment in the more speculative “high risk/high reward” projects.

Recognising the importance of innovation to the rail industry, TSAG has commissioned a study on “Enabling technical innovation in the GB rail industry – barriers and solutions”. The report of the study (RSSB, 2010) identifies a number of actions to promote innovation in the GB rail industry. This report and the associated actions formed part of the discussions that led to the development of RIRS2.

1. Support future investment in research
2. Identify benefits and value for money
3. Promote strong collaborative cross-industry research that results in pragmatic solutions to problems that companies cannot resolve on their own
4. Identify the specific roles and responsibilities for research and where different organisations can best work together
5. Maintain the technical knowledge-base of the rail industry
6. Meet the challenges of improving delivery in what is becoming a fast-changing, multi-faceted industry
7. Identify gaps and overlaps in research
8. Communicate effectively to achieve engagement/ownership
9. Address the challenges of High Speed Rail
10. Support “UK plc” through creating a leading edge rail industry

Box 2.1 – Examples of how the Research Strategy will help the Rail Industry

3. The Case for Rail Research

- Research is essential for meeting the 4Cs challenges and enabling the railway to play a full part in meeting the UK’s future transport needs.

Meeting the 4Cs

TSAG commissioned a major technology route-mapping study for the rail industry with the aim of developing a cross-industry collective view of rail technology in Great Britain over the next 30 years. The starting point was quantifying each of the 4Cs. The following values were selected, recognising that they represented a significant challenge to the industry:

- Capacity – 100% increase.
- Carbon – 50% reduction in carbon emissions.
- Customer – a 10-fold reduction in customer “failures”.
- Cost – 50% reduction in the costs of operating the railways.

These were to be achieved by 2038 and are compared to 2008 levels. The route mapping team then developed a consensus view on what could be achieved by the application of:

- Incremental improvements in existing technologies and business processes.
- Known/envisaged technologies resulting from investment in research.

The results are summarised in Fig 3.1 for both incremental/known technologies and for technologies resulting from investment in research. The former are shown in green and the latter in blue. In both cases, the levels of improvement are shown as a percentage of the respective 4Cs challenges.

The estimates of the improvements that can be made are based on the judgements of the experts who participated in the study. These estimates are intended to indicate the scale of what might be achieved by various technologies; they are not detailed or precise predictions. More information about the route-mapping project and the care that is required in interpreting the results are provided in Appendix E.

Full details of the route mapping project and the results obtained are available in a report from RSSB (RSSB, 2009).

The clear consensus from the group of industry experts undertaking the route mapping work was that improvements in existing technologies and processes would make only small improvements in the 4Cs – the improvements were in the range 10% - 30%. By contrast, implementation of new technologies resulting from strategic research results in significant improvements in the 4Cs.

For ‘customers’ and ‘cost’, the challenging targets can be met, or even exceeded; for carbon and capacity the targets are not reached, but there are improvements in performance of 80% - 90%.

The scale of the benefits that result from investment in research are most clearly illustrated by looking at the results for ‘Cost’. The current cost of the railway is about £12 billion per year (Department of Transport, 2010a); the results of the route mapping exercise suggest that cost reductions of 40% are possible if the necessary research is undertaken and the results implemented. This suggests that there are potentially over £4 billion per annum of cost savings that can be delivered. Clearly, this would only occur as a result of investment in research.

The costs of such investment are difficult to estimate. However, data provided by RSSB for a range of rail research projects suggests that the ratio of ‘weighted’ benefits to the costs of research is 4:1.

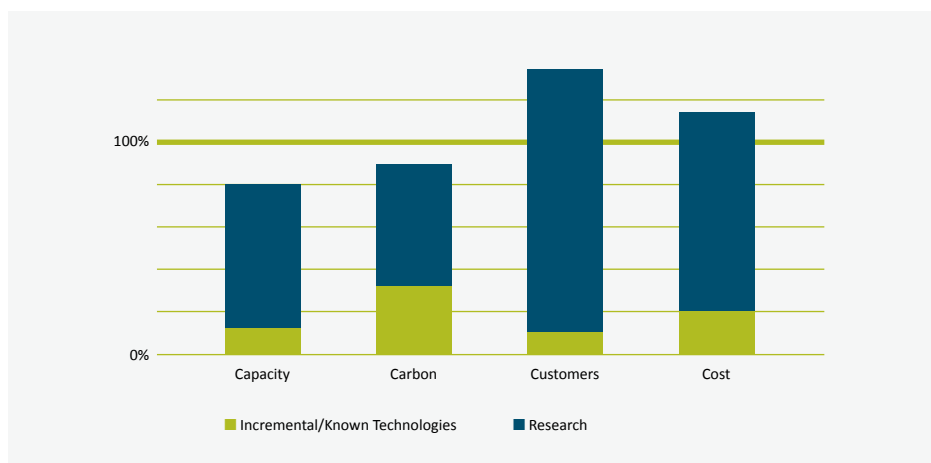


Fig 3.1 - Meeting the 4Cs

The weighting of the benefits reflects that not all research projects are successful, and that even for successful projects the benefits may not be fully implemented. The 4:1 ratio of weighted benefits to costs is a powerful case for investing in rail research.

Similarly, if the investment in research does not take place to expand the capacity of the railway then the effectiveness of the UK transport system will be limited. This in turn will act as a brake on economic growth.

The Case for Public Sector Support of Research

Much of the research in the rail industry is undertaken by individual (private sector) organisations for commercial reasons, e.g. to improve their competitive position, expand their business, or respond to legal requirements. In such cases the benefits of the research accrue to individual organisations and accordingly it is appropriate that they should meet the costs of investment in the research. However, there are many cases where the benefits of the research accrue to the rail industry (and the public) more widely and where investment cannot be justified at the individual company level. In such cases, investment may be provided in whole or in part from the public sector.

Examples where public sector support is appropriate are given in Box 3.1. In general, public sector investment will be appropriate where it aims to minimise the burden on the tax-payer and/or maximises the high social, economic and environmental value of the railway. The railway is a vital part of the nation's transport system. Accordingly, the Government, as part-funder of the railway, has a clear interest in seeing the industry carry out this role cost-effectively. The Government will also wish to see that its financial support for the industry is well managed, prioritised and represents value for money.

Benefits of Investment in Research

In order to better understand the benefits of rail research, DfT commissioned a research study to review the outputs and outcomes from a selection of GB rail research projects (TRL, 2009). A sample of 48 projects undertaken over the last 20 years was selected for analysis. The results of this study showed that for the projects included in the study:

- 81% of projects – utilisation of outputs was either strong or medium¹.
- 71% of projects – implementation of outputs was either in the short-term (<1 year) or medium-term (1-5 years).

The results from the DfT study are broadly similar to those from a study undertaken by the European Rail Research Advisory Council (ERRAC) of projects funded under European

Union Framework programmes (AGRRI, 2009). More details of the evaluations of rail research projects are provided in Appendix F.

Making the Case – A Continuing Challenge

A strong case already exists for investment in research. However, funds for investment may well be scarce and there will certainly be strong competition for the funds that are available. The industry will continue to need to work together to make the case for research and in particular to build the evidence base that provides the information about return on investment that will make the case for research even more compelling. AGRRI have already made a strong contribution to this process, and a discussion paper that they have produced is provided as Appendix G.

- To support good decision-making within Government and to inform strategy and policy, particularly in areas such as economic modelling and emissions from trains.
- To ensure that safety is regulated and given sufficient priority – for example, the Rail Safety and Standards Board's safety research programme was established in response to the Cullen report arising from the Ladbroke Grove Inquiry.
- To help the complex rail industry work together – join up those parts of the system that the industry cannot do on its own, particularly at the interfaces between organisations and railway systems.
- To help the rail industry get the most out of European research.
- To provide assistance where research is high risk or where the benefits are too long term for private sector companies to take on. This would include whole system research and issues relating to systems engineering, capacity modelling and demand forecasting. In addition, individual companies may not be able to take full advantage of the benefits of research, which may accrue to other sectors of the railway or to external third parties such as local residents.

Box 3.1 – Examples where public sector support is appropriate

¹ "Strong" is defined as clear evidence of widespread use of results, and "medium" as some evidence of use of results. These metrics are consistent with the metrics used at the European level by the European Research Advisory Council (ERRAC).

4. Strategic Direction for Rail Research

- Strengthening research leadership is essential for driving fundamental improvements in the way research is organised in the rail industry.

Fundamental principles

- An effective transport system is essential for securing economic prosperity and growth in GDP.
- The 4Cs provide the framework within which the future railway can meet its full potential in contributing to an effective UK transport system and perform well compared to international best practice/standards.
- The TSAG Route Mapping work shows that normal, incremental business improvements will not, on their own, meet the 4Cs targets.
- Strategic research to meet the 4Cs targets remains an important objective for rail industry research.
- Strategic research associated with known technologies can go some way towards meeting the 4Cs – but there is still a gap, particularly for capacity and carbon which can only be met by further, more fundamental, research to develop innovative solutions.

Our vision for the research landscape

Maximising value for money from research and ensuring that the results of research are fully implemented will be increasingly important.

Key ways of achieving this are:

- Different parts of the rail industry (including universities) working together on research and implementation projects.
- Smaller innovative technology companies working alongside established industry players.
- The funding organisations working together to maximise the use of limited funds.
- Applying solutions and technologies developed in other sectors to the rail industry.
- More international collaborations.

Leadership of research

- The need to improve leadership of research was identified by the RIRS2 Steering Group as a key issue.
- The fragmented nature of the rail industry has understandably led to a consensus-seeking approach. This has tended to lead towards doing non-adventurous research, rather than addressing the longer-term, more difficult, strategic issues.
- There was uncertainty as to whether the leadership function should be allocated to an individual champion or whether leadership should rest with a cross-industry group.
- The first step was to define in more detail (perhaps by developing “Terms of Reference”) the nature of the leadership role.
- There is also an opportunity to include a role for research, development and demonstration (RD&D) within the next High Level Output Strategy (HLOS). This would help secure a higher level ownership of research and research strategy within the industry. It would also ensure a greater commitment to implementing promising results from research projects when significant benefits are demonstrated.
- Strengthening the leadership and profile of research could drive fundamental improvements in the way research is organised in the rail industry. This in turn could have a significant impact on meeting the challenges of the 4Cs.

What needs to happen next

- Now that the broad strategic direction has been set and routes for delivering the strategy outlined (see Section 5), the next step is to secure the funding, procure and deliver the research, whilst ensuring that routes to market are in place.
- This requires research programmes that are industry-led, but there is an important role for Government, and specifically Government funding, in making all of this happen. As explained in Section 3, without Government funding, individual companies will not invest in research where the benefits accrue to other companies, or the general public, or in a time-frame longer than industry incentives.

5. Areas of Focus and Implementation Plan

- Three Management Areas of Focus have been identified. “Strategic Direction” is a new Area of Focus, whilst “Knowledge” and “Route to Market” build on actions already underway as part of RIRS1.

The Steering Group noted that the RTS is currently being reviewed. As part of the process of seeking industry views, TSAG have identified key technological interventions that are seen as having the potential for ‘changing the game’ for the rail industry (TSAG, 2010). Information about these key technological interventions are provided in Box 5.2. More information about the review of the RTS and the TSAG game changer research is provided in Appendix A.

The Steering Group examined what has changed since 2007 that may impact research priorities. The Group felt that the following are likely to become increasingly important:

- Low carbon and energy.
- High speed rail.
- Better tools for making decisions on rail investments.
- Whole system performance.
- Personal and rail system security.

Reducing the costs of the railway is the key priority for the industry currently. The Steering Group re-emphasised the need for research to develop the technologies that achieve this goal.

Technical Areas of Focus

In discussing the Technical Areas of Focus, it was recognised that a considerable amount of in-depth work had already been done to prioritise research themes:

- For the Rail Technical Strategy, eight long-term themes for change had been identified, see Box 5.1.
- For RIRS1, eight strategic research themes had been identified.
- As part of the Route Mapping Exercise, 50 strategic research “applications” had been identified, of which the top 10 had been identified as priorities for action, see Appendix E.

Accordingly, the Steering Group concluded it was unnecessary to undertake a detailed review of technical areas of focus. However, the Group did affirm the following principles:

- The 4Cs remain the basis for deciding on technical areas of focus.
- The RTS long-term themes for change still provide a good basis for specifying the technical areas of focus for future research.
- Reducing the costs of the railway is the key priority for the industry, and the need for research to develop the technologies that achieve this goal is the over-riding aim.

1. Optimised track–train interface.
2. High reliability, high capacity.
3. Simple, flexible, precise control system.
4. Optimised traction power and energy.
5. An integrated view of safety, security and health.
6. Improved passenger focus.
7. Rationalisation and standardisation of assets.
8. Differentiated technical principles and standards.

Box 5.1 – RTS Long-Term Themes for Change

Establish next generation traffic management - centralisation of rail traffic control into a single system or ‘guiding mind’ to optimise the network’s capacity and increase customer satisfaction, reliability and safety.

Optimise energy strategy - making savings on the railway’s annual £500m traction energy bill through better exploitation of new and existing technology.

Build in whole system reliability - a business case for a whole system strategic approach to reliability is needed. This would help reduce the £600m annual cost of delays.

Provide smarter data and communications - promoting a strategy for rail mobile communications which relies on commercially available, off-the-shelf systems.

Box 5.2 – Key Technological Interventions Identified by TSAG

Management Areas of Focus

A number of research management issues were identified as contributing towards improving the effectiveness of rail research. These were explored, prioritised and grouped into the following three Management Areas of Focus:

- Strategic Direction.
- Knowledge.
- Route to Market.

Strategic Direction is a new Area of Focus which could drive fundamental improvements in the way research is organised in the rail industry. Knowledge and Route to Market build on actions already underway as part of RIRS1.

The new Enabling Actions (EAs) that emerged for each of these Areas of Focus are identified below. More information about challenges and key issues are provided in Appendix H. Specific objectives for each of the Enabling Actions are summarised in Table 5.1. The new Implementation Plan associated with these Enabling Actions is presented in Table 5.2.

Enabling Actions

Strategic Direction

Aim: Promote a positive culture in which research is encouraged so that the future railway can meet its potential.

Key Benefits

- Support future investment in research.
- Identify benefits and value for money.
- Identify the specific roles and responsibilities for research and where different organisations can best work together.
- Address the challenges of High Speed Rail.

Key Discussion Points: This is not a technical issue – it focuses upon leadership, ownership and how

commitment to rail research is embedded within the industry. The role of all the key players needs to be well defined so that decision-making is not inhibited.

Relevant Enabling Actions:

- EA1 – Leadership and making the case.

Knowledge

Aim: Enable the rail industry to be better at foresighting, enabling collaboration, and knowledge sharing within a fragmented industry structure, and with other industries and centres of knowledge.

Key Benefits

- Promote strong collaborative cross-industry research that results in pragmatic solutions to problems that companies cannot resolve on their own.
- Maintain the technical knowledge-base of the rail industry.
- Identify gaps and overlaps in research.

Key Discussion Points: Improvements will deliver greater access to existing information and encourage better communication between the rail industry and “problem solvers”.

Relevant Enabling Actions:

- EA2 – Knowledge management.
- EA3 – Collaborative working.
- EA4 – Engaging with European research.
- EA5 – Technology transfer from other industries.

Route to Market

Aim: Enable relevant innovations to be brought into use swiftly and cost-effectively.

Key Benefits

- Meet the challenges of improving delivery in what is becoming a fast-changing, multi-faceted industry.
- Support “UK plc” through creating a leading edge rail industry.

Key Discussion Points: The recent study for TSAG on Enabling Innovation in the GB Rail Industry was extensively used to inform the discussion and develop the Enabling Actions. The challenges of the 4Cs are big and require big steps. Innovation is one of the key levers for achieving the 4Cs. In many cases, the collective benefit to the rail industry as a whole of investment in research is greater than the sum of the benefit to the individual companies. Research tends to address medium-term/longer-term issues whereas the industry is (understandably) focussed on shorter-term operational priorities. As a result, a lot of research does not lead to implementation projects and the costs of the railway as a whole remain unnecessarily high. A summary of a paper on “Encouraging the implementation of research” which was submitted to the EPSRC/RSSB/DfT Strategic Partnership Steering Group is provided as Appendix I.

Relevant Enabling Actions:

- EA6 – Enhancing industry capacity for innovation.
- EA7 – Reducing the risks of introducing innovations.

These two Enabling Actions are identical to those being taken forward under the enabling innovation aspects of the TSAG game changer initiative.

Implementation

An outline implementation plan for the Enabling Actions is provided in Table 5.2. For each Enabling Action this identifies:

- Measurable targets.
- Lead responsibility.
- Timeframe for completion.

Also identified is whether a proposed activity is already part of a programme being undertaken within the rail industry, or whether it is a new activity.

| Management Areas of Focus | Enabling Actions | Specific Objectives |
|---------------------------|--|--|
| Strategic Direction | EA1 – Leadership and Making the Case | <p>1.1 Establish research leadership/championing role (individual with support or empowered group).</p> <p>1.2 Obtain industry-wide and Government agreement on including a role for RD&D within the next High-Level Output Strategy (HLOS) for Control Period 5 (CP5).</p> <p>1.3 Develop a portfolio approach based on route maps.</p> <p>1.4 Consider how the RTS applies to High Speed Rail, and where needed develop specific additional research approaches.</p> |
| Knowledge | EA2 – Knowledge Management | <p>2.1 Improve foresighting – a clear understanding of what knowledge is needed for what purpose.</p> <p>2.2 Make the outputs from current and legacy R&D projects more widely available across the rail industry.</p> |
| | EA3 – Collaborative Working | <p>3.1 Develop collaborations with UK research funders.</p> |
| | EA4 – Engaging with European Research | <p>4.1 Develop a more pro-active strategic approach to European-funded programmes.</p> <p>4.2 Explore opportunities for more bi-lateral collaboration within Europe (e.g. with France and/or Germany).</p> |
| | EA5 – Technology Transfer from Other Industries | <p>5.1 Raise awareness within the rail industry of benefits of applying technologies from other sectors.</p> <p>5.2 Participate in the new Knowledge Transfer Network for transport.</p> |
| Route to Market | EA6 – Enhance Industry Capacity for Innovation | <p>6.1 Specific activities are being developed by TSAG as a follow-on to the report on Enabling Innovation.</p> |
| | EA7 – Reducing Risks for Introducing Innovations | <p>7.1 Specific activities are being developed by TSAG as a follow-on to the report on Enabling Innovation.</p> |

Table 5.1- Enabling Actions and Specific Objectives

Table 5.2 – Outline Implementation Plan

| Enabling Action | Lead for Enabling Action | Specific Objective | | | | Lead | Indicative Timeframe |
|--------------------------------------|---|--|----------------------------------|--|---------------|--------------|----------------------|
| | | Description ('what') | Is it a new or existing activity | Measurable Targets ('How') | | | |
| EA1 – Leadership and Making the Case | DfT | 1.1 Develop Terms of Reference to establish research leadership/championing role (individual with support or empowered group). | New | <ul style="list-style-type: none"> Determine industry governance arrangements as support for leadership role. | DfT | By July 2011 | |
| | | | | <ul style="list-style-type: none"> Establish an open but effective structure/framework (with defined accountabilities). | | | |
| | | | | <ul style="list-style-type: none"> Explore with the 'professional' institutions how they might play a role in 'leadership' for rail research. | | | |
| | | | | <ul style="list-style-type: none"> Appoint research leader/champion. | | | |
| EA2 – Knowledge Management | DfT | 1.2 Obtain industry-wide and Government agreement on including a role for RD&D within the next HLOS/CP5. | New | <ul style="list-style-type: none"> Discuss ideas with key players in the rail industry and develop consensus approach. | DfT | By July 2011 | |
| | | | | <ul style="list-style-type: none"> Submit ideas to ORR and DfT HLOS team. | | | |
| | | | | <ul style="list-style-type: none"> Place contracts through RSSB/TSAG. | | | |
| EA3 – Collaborative Working | RSSB | 1.3 Develop a portfolio approach based on route maps. 1.4 Consider how the RTS applies to High Speed Rail, and where needed develop specific additional research approaches. 2.1 Improve foresighting – a clear understanding of what knowledge is needed for what purpose. 2.2 Make the outputs from current and legacy R&D projects more widely available across the rail industry. 3.1 Develop collaborations with UK research funders. | Existing | <ul style="list-style-type: none"> Disseminate results across the rail industry. | TSAG | By Oct 2011 | |
| | | | | <ul style="list-style-type: none"> Discuss research requirements with HS2. | | | |
| | | | New | <ul style="list-style-type: none"> Capture requirements in scoping document. | HS2 | By Oct 2011 | |
| | | | | <ul style="list-style-type: none"> Build on current technology watch/horizon scanning activities. | | | RSSB |
| Existing | <ul style="list-style-type: none"> Develop R&D "Clearing House" giving industry central point for accessing R&D outputs and plans. | RSSB | By July 2011 | | | | |
| | <ul style="list-style-type: none"> Develop MOU with the Economic & Social Research Council (ESRC). | | | RSSB | By April 2011 | | |
| Existing | <ul style="list-style-type: none"> Develop partnership and greater dialogue with the Technology Strategy Board (TSB). | RSSB | By April 2011 | | | | |

Table 5.2 – Outline Implementation Plan

| Enabling Action | Lead for Enabling Action | Specific Objective | | | Lead | Indicative Timeframe |
|--|--------------------------|---|----------------------------------|---|------|-------------------------|
| | | Description ('what') | Is it a new or existing activity | Measurable Targets ('How') | | |
| EA4 – Engaging with European Research | NR | 4.1 Develop a more pro-active strategic approach to European-funded programmes. | Existing | <ul style="list-style-type: none"> • AGRRI to develop with NR, ATOC and RIA an industry-wide approach. • RSSB to work with AGRRI to establish greater sharing of knowledge, co-ordination and co-operation. | NR | By Oct 2011 |
| | | 4.2 Explore opportunities for more bi-lateral collaboration within Europe (e.g. with France and/ or Germany). | New | <ul style="list-style-type: none"> • Identify topics likely to be of mutual interest. • Discuss with industry representatives in other countries. | | |
| EA5 – Technology Transfer from Other Industries | RIA | 5.1 Raise awareness within rail industry of benefits of applying technologies from other sectors. | Existing | <ul style="list-style-type: none"> • Develop case studies showing success stories on application of technologies from other sectors. • Ensure knowledge management activities cover other technologies and other transport sectors. | NR | By April 2012 |
| | | 5.2 Participate in new KTN for transport. | Existing | <ul style="list-style-type: none"> • Secure agreement for rail industry participation in KTN. • Agree who should represent the rail industry within the KTN. | | |
| EA6 – Enhance Industry Capacity for Innovation | TSAG | 6.1 Being developed by TSAG. | Existing | <ul style="list-style-type: none"> • Specific activities are being developed by TSAG as part of the process of taking forward the report on Enabling Innovation (RSSB,2010). | TSAG | Being developed by TSAG |
| EA7 – Reducing Risks for Introducing Innovations | TSAG | 7.1 Being developed by TSAG. | Existing | <ul style="list-style-type: none"> • Specific activities are being developed by TSAG as part of the process of taking forward the report on Enabling Innovation (RSSB,2010). | TSAG | Being developed by TSAG |

6. Governance and Risk Management

- The RIRS2 Steering Group believes that TSAG is the appropriate body to provide the governance and oversight of the implementation of the strategy.

Governance

The strategy requires clear governance arrangements to monitor progress in the implementation of the actions. The RIRS2 Steering Group believes that TSAG is the appropriate body to provide the governance and oversight of the implementation of the strategy. TSAG has agreed to undertake this role.

Risk Analysis

The risk analysis is summarised in Table 6.1 which ranks the major risks and identifies appropriate mitigation.

Critical Success Factors

- Consistent promotion of the strategy emphasising the cost-savings and other benefits that flow from research.
- Using existing structures and organisations (eg TSAG, RSSB) to build collaborative working.
- Develop a step-by-step approach, starting with clear Terms of Reference.

| Risk | Impact | Likelihood | Overall | Mitigation |
|---|--------|------------|---------|---|
| 1. The strategy does not gain the attention of the rail industry. | H | M | H | <ul style="list-style-type: none"> • Consistent promotion of the strategy emphasising the cost-savings and other benefits that flow from research. |
| 2. Current economic climate means that industry focuses on short-term operational issues. | H | M | H | |
| 3. Insufficient public sector funding for investment in research. | H | M | H | |
| 4. Fragmentation of the industry & legal structures inhibit collaboration. | H | M | H | <ul style="list-style-type: none"> • Using existing structures (eg TSAG, RSSB) to build collaborative working. • Feed into the consideration of rail industry re-structuring as part of the McNulty review. |
| 5. Complexities of research leadership not resolved. | H | M | H | <ul style="list-style-type: none"> • Develop a step-by-step approach, starting with clear ToRs. |
| 6. Other research funders not interested in rail. | H | L | M | <ul style="list-style-type: none"> • Explain linkages between rail and other issues. |
| 7. Standards and legacy perspectives inhibit transfer of technology from other sectors. | H | M | M | <ul style="list-style-type: none"> • Develop information exchange (including case studies) that demonstrate benefits. |
| 8. Initial investment costs act as a barrier to action. | H | M | M | <ul style="list-style-type: none"> • Emphasise through examples the investment case for research. |
| 9. Changes of Government transport policies on congestion and carbon. | H | L | M | <ul style="list-style-type: none"> • Maintain close connection with developments in Government policy. • Provide quality evidence to help Government develop policy. |
| 10. Different aspirations and timelines make European collaboration difficult. | M | L | L | <ul style="list-style-type: none"> • Understand European perspectives and develop bi-lateral collaboration with closer alignment of perspectives. |

Table 6.1 - RIRS2 Risk Analysis

7. References

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