RSSB Cross-industry Railway Information Systems Workshop
7th December 2012

Summary Report

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Thank you to all those who kindly volunteered their time to attend the workshop.

Executive Summary

The UK rail industry has begun work on several new initiatives designed to improve on existing Information and Communications Technology (ICT) capabilities; these include:

- Enhanced asset information (ORBIS);
- Cross-industry remote condition monitoring systems (XiRCM);
- Common defect reporting and management processes (DRACAS);
- Greater availability of engineering information for rolling stock (T&RS SMG);
- Improved access to traffic management systems (LINX TM);
- An industry gateway for GPS data.

In an effort to ensure that the maximum possible whole-system benefit is derived from these projects, the Technical Strategy Leadership Group (TSLG) requested that the Rail Safety and Standards Board (RSSB) hold a workshop to inform stakeholders on the current state of each of the initiatives, identify any commonalities that may exist between them, and elicit high-level future requirements for an industry-wide information architecture. This approach is supported by the recently released Rail Technical Strategy (TSLG, 2012), which states that "*…the rail industry would benefit from a coordinated approach towards system architectures, information management and information exploitation*".

The workshop was held at RSSB's offices on the 7th December 2012 and involved 20 participants selected to represent a broad cross-section of industry and governance roles. The day included presentations on the status of the six data initiatives, along with a series of group activities designed to identify overlaps between the projects, as well as to elicit the current and future high-level objectives for data integration within UK rail.

The workshop identified several key areas of overlap between the presented initiatives, with LINX, XiRCM, ORBIS and T&RS (R2) found to be particularly closely inter-related. While these relationships warrant the establishment of firmer links between the projects concerned, workshop participants were keen to emphasise that delivery of the individual project goals must not be unduly delayed by this process.

Major information gaps still facing the industry were found to include a reliable mechanism for automatic vehicle identification, the need for a common framework for information sharing/an industry-wide Enterprise Architecture, common data models, and clearer governance for whole-industry information systems planning and development.

Based on the areas of overlap and issues identified during the workshop, and with a view towards ensuring that the maximum potential benefits to be gained from closer cooperation between the projects are realised, it is recommended that:

1. There should be a further meeting of representatives of each project to:
   a. Establish whether there is scope for expanding the use of LINX to facilitate data exchange both within and between the projects. For example; could the various remote condition monitoring systems in use be linked to an analysis framework via LINX rather than having to establish new data exchange protocols to enable such linkages to be made? The requirements for LINX will be frozen in March 2013, with a formal specification due in June. It is therefore important that this meeting is facilitated during February;
   b. Examine in detail where further cooperation between the projects will be beneficial and agree and document how this will be achieved;
   c. Consider if there are other industry information system projects that could benefit from inclusion in such cooperation.

   Post-meeting note: ***RSSB has agreed to facilitate this meeting.***

2. Industry should cooperate to establish the potential benefits of and working arrangements for a high (director) level governance group to coordinate the efficient development and management of industry information systems.

   Post meeting note: ***RSSB has agreed to initiate initial discussions with Network Rail.***

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Introduction

In mid 2011 Sir Roy McNulty's report into value for money within the UK rail industry (DfT, 2011) was published. The study found that "*…the effectiveness of the (rail) industry's Information Systems (IS) is inhibited by a suite of legacy systems that are expensive to run, unable to communicate with new technology and encourage users to develop a wide range of bespoke local systems to overcome limitations. Many legacy systems were created and managed in company silos, with only a few systems crossing industry boundaries*."

In response to McNulty's findings, the UK rail industry has begun work on several new initiatives designed to improve on existing ICT capabilities; these include:

- Enhanced asset information (ORBIS);
- Cross-industry remote condition monitoring systems (XiRCM);
- Common defect reporting and management processes (DRACAS);
- Greater availability of engineering information for rolling stock (T&RS SMG);
- Improved access to traffic management systems (LINX TM);
- An industry gateway for GPS data.

In an effort to ensure that the maximum possible whole-system benefit is derived from these projects, the Technical Strategy Leadership Group (TSLG) requested that the Rail Safety and Standards Board (RSSB) hold a workshop to inform stakeholders on the current state of each of the initiatives, identify any commonalities that may exist between them, and elicit high-level future requirements for an industry-wide information architecture.

The workshop was held at RSSB's offices on the 7th December 2012 and involved 20 participants selected to represent a broad cross-section of industry and governance roles. The day was split into 2 main sessions, with the morning devoted to presentations and the afternoon session to a series of group activities. During the morning session, the keynote speech was provided by Professor Matthew West (Information Junction) who discussed his personal reflections on the sharing of engineering data in the oil and gas industry. This was followed by a series of 20-minute presentations from each of the invited data initiatives, during which the workshop participants had the opportunity to learn about the projects in terms of their aims, key stakeholders and information products to be produced.

The afternoon session built on this foundation via a series of activities; the activities aimed to:

- Identify similarities between the initiatives;
- Establish the potential contributions each initiative could make to a wider information architecture for UK rail;
- Provide a vision for information systems development over the next 20 years;
- Identify key actors and funding sources that might enable the vision;
- Consider the benefits of, and barriers to, the development of a common information architecture.

Morning Session

The morning session aimed to ensure that all workshop participants were adequately briefed on the aims, objectives and current status of the six data initiatives. The session began with a keynote speech, in which Professor Matthew West (Information Junction) discussed his own experiences on the sharing of industrial information while working for Shell and the development of that work into an internationally recognised ISO standard (ISO 15926). This was followed by six short presentations introducing each of the data initiatives, during which the audience had an opportunity to ask questions about the projects and learn about their current status. A summary of each of the presentations, including the keynote, is presented in the following sections.

Keynote Speech - "Reflections on Sharing Engineering Data"

Presenter: Matthew West, Information Junction.

Information

The correct use of information allows enterprises to identify opportunities, reduce risks and respond to change. Despite this, large organisations often find it difficult to justify investment in information systems and processes. Over time, the benefits of information-based decision making are often found to be embarrassingly large. However, if pressed to find justifications for investments in information management, remember that first and foremost information is used by businesses to reduce the risks of decision making; as such, the basic strategy to follow is:

- Identify areas of the business where decision making has gone wrong;
- Investigate the failures of information provision (e.g. incomplete or late data, inconsistent information from multiple sources etc.) that led to the problem;
- Determine the cost to the business of the failure to provide suitable information to the decision maker (wasted materials, repetition of work, lost opportunities).

Good delivery of information is all about quality, i.e. meeting agreed customer requirements for key properties of data such as accessibility, consistency, provenance, timeliness, accuracy, relevance and cost. If a customer has failed to state a requirement, then by definition the information supplier cannot fail to meet it. As such, careful specification of information requirements is vital when attempting to ensure information quality.

Data Standards

Standards describe established best-practice methods of performing tasks. In data sharing the use of standards provides a common language for communications based around a shared data model and reference data set; standards are a key enabler for data exchange between systems and parties. Implementing data standards can take many years and a substantial amount of money before the first benefits are realised. However, adaption and reuse of existing standards can help to both reduce development time and improve compatibility with other models.

Developed standards are in many ways repositories of the available knowledge in a field; therefore, data standards are in a continuous state of development as new domain knowledge is taken into account.

The development of new data standards requires that:

- A consortium of interested parties be established to guide the development and use the new standard;
- An independent body is identified to facilitate the development/provide administrative support;
- Sources of funding for development and maintenance are decided upon (voluntary donations, subscription etc.);
- The standards environment is identified (ISO etc.);
- Existing standards are adapted/developed where possible;
- The new standard is deployed.

Business Models

Developing business models for the adoption of new data standards can be difficult; contractors, for example, make money by selling man-hours and as such will resist efforts to make data exchange easier/reduce their workload. Software vendors too have something to loose from making it easier to move data out of their applications, as customers could then choose to switch to a competitor's system. In the oil industry, this problem had to be solved by brute force, with the industry announcing to vendors that it would only purchase software that supported the new standards. However this type of commercial issue is solved, it is vital when establishing standards within an industry that a business model is found which makes commercial sense for both the providers and receivers of data.

Governance and Custodianship

Good governance of standards is vital if all involved parties are to follow the rules and changes are to be made to the standard over time. Establishing an effective framework for governance can however pose significant challenges, particularly in domains where authority is devolved (i.e. the rail industry). Governance may be achieved through voluntary or regulatory approaches; voluntary approaches have the advantage of development effort being contributed by the consortium on a voluntary basis. Unfortunately however, this may ultimately lead to longer implementation timescales, patchy implementation of the domain based on partner interests, and a lack of clear leadership in the event of disputes. Regulatory approaches provide clear leadership that can be used to force consortium members to contribute to development and adopt the resultant standard, however they risk alienation of partners and avoidance (attempts to work around rules disliked by particular stakeholder groupings).

All standards require a body to administer and maintain them after the initial development effort is completed. This role includes housekeeping of any master and reference data. The custodian of a standard must be independent, respected by the user base, follow defined rules and agreed processes, and operate a quality management process that ensures the standard remains relevant and consistent.

Invited Presentations on Key Data Initiatives in the UK Rail Industry

Offering Rail Better Information Services (ORBIS)

Presenter: Jeremy Axe, Network Rail.

Status: Building enablers - master data management, asset data store (including inventory and validation of existing data), rollout of mobile devices and productivity apps.

Approximate timescale: Scheduled to run to the end of CP5, plan presented in workshop to 2016.

The £330 million ORBIS programme aims to deliver improved asset information capabilities to the industry, enabling Network Rail to manage its assets more effectively and facilitating a move towards information driven, rather than time or condition driven, asset management policies. In the broadest context, the programme will have an impact on many areas of Network Rail's business and the industry in general (TOCs, FOCs, British Transport Police, European interactions), but it will also have a more direct relationship with both traffic management (e.g. by reporting real-time asset performance) and access planning (e.g. by supporting safer working). In the first year of the programme the ORBIS team have been putting in place the key enablers for the planned capability enhancements; these include master data management ("single sources of truth" on topics such as asset position over GPS, miles & chains, ELR), validation and cataloguing the information currently available on the asset base, roll-out of mobile devices and development of productivity apps. Work during the remainder of CP4 will build on these tools, creating essential services that support "predict and prevent" such as establishment of asset condition, "workbank" functions including task planning, and GIS tools for asset location. The ORBIS team believe that Network Rail already possess much of the information required to realise these goals and as such are currently focusing on joining up existing systems rather than developing an all-out replacement, with the existing systems being classified as either "tolerate", "invest", "migrate" or "eliminate". Moving into CP5, the vision is for the programme to provide information-based decision support for key industry processes (whole-life cost modelling, degradation and performance modelling etc.) and to support traffic management functions via novel information services such as a real-time sectional appendix and real-time driver advisory systems.

Cross-industry Remote Condition Monitoring (XiRCM)

Presenter: Amanda Hall, Network Rail.

Status: Expressions of interest for requirements work have been evaluated, invitations to tender to be issued soon.

Approximate timescale: 12 to 18 months.

The cross-industry remote condition monitoring steering group is a subgroup of V/VSIC and was formed in response to the rail value for money study, which supported the concepts of "vehicles monitoring infrastructure" and "infrastructure monitoring vehicles" with the data then shared amongst industry stakeholders in

order to improve reliability and work towards condition based maintenance. The XiRCM steering group is responsible for putting in place the enablers for these technologies and to date has successfully completed 2 R&D projects (T857 & T986) that provide an overview of areas in the industry where XiRCM may prove useful, along with estimates of costs vs. benefits and a business case tool.

The current project, T1010, gained authority from TSLG in September 2012 and will investigate four key areas:

- Principles and interface specifications for an RCM data sharing architecture;
- RCM business process mapping good practice guidance and commercial framework templates for data sharing;
- Standards for XiRCM;
- Extensions to the business case tool from T857.

Work is currently underway in the first of these areas and will involve a review of existing industry RCM systems with respect to system outputs, data formats used, communications protocols, analysis software and ICT requirements. This will then be extended to include interfaces between RCM and other areas of the rail business (e.g. asset information) and a review of RCM best practice in other industries (e.g. aerospace). The work will ultimately result in the development of a requirements specification and code of practice for the sharing of RCM data.

Defect Recording Analysis and Corrective Action System (DRACAS)

Presenter: Richard Barrow, RSSB.

Status: A set of high-level DRACAS process requirements has been created, stakeholder requirements & a business model have been established, roles have been defined and a feasible IT architecture has been produced.

Approximate timescale: Not stated.

As Control, Command and Signalling (CCS) systems become increasingly distributed and complex, there is a significant need for people throughout the industry to learn about the new technology. A Defect Recording Analysis and Corrective Action System (DRACAS) is an asset management and knowledge repository system that includes people, resources, tools and processes, which can help stakeholders make better decisions regarding the operation and management of assets. While individual, project-specific DRACAS processes already exist in some parts of the industry, the DRACAS working group and V/TC&C SIC believe that a single, common DRACAS process for CCS systems with a wide industry take-up would provide UK rail with substantial business benefits in the form of:

- Improved CCS system performance;
- Improved information sharing and collaboration between stakeholders;
- Better decision making;
- Industry-wide learning (creation of a single repository of system information over time - performance history, failure management etc.);
- Reduced effort and cost (more effective fixing of shared CCS faults).

Progress with the DRACAS to-date has included the creation of a set of high-level process requirements, determination of stakeholder requirements (T754),

establishment of a business model (T957), definition of high-level process roles for stakeholders and systems, and the publication of a feasible IT architecture design (T960).

Traction and Rolling Stock Systems Management Group (T&RS SMG)

Presenter: Jeff Brewer, RSSB & Simon Tonks, Porterbrook.

Status:

RIS - formal consultation completed, standard awaiting issue.

R2 - business case undergoing approval.

RSSA - candidate systems identified, proposed principles drawn up.

Approximate timescale:

RIS - to be issued March 2013.

R2 - new standards by December 2015.

RSSA - industry agreed system requirement specification by May 2013.

The Traction and Rolling Stock Systems Management Group presented 3 data initiatives all supporting TSLG's aspiration that '*collecting and sharing data across railway stakeholders will facilitate the introduction of whole system future technologies as well as enhancing current delivery of service*.' The initiatives presented were: a rail industry standard (RIS) for shared rolling stock data, an update of the two principle rolling stock information systems (R2), and a new rolling stock systems architecture (RSSA).

RIS

Limitations in existing rolling stock information systems have resulted in several industry organisations purchasing COTS software systems to manage fleet maintenance data. While the maintenance information is therefore captured within these systems, there is still a need to share the information with the wider industry. The T&RS SMG has produced a voluntary standard for the minimum rolling stock engineering data that should be shared across the industry. The standard, which captures information such as component data (wheelsets, engines, train protection systems), defect data, utilisation data, and information on modifications, has now completed a formal industry consultation process and is due to be issued in March 2013.

R2

Two principle information systems currently exist for rolling stock information, the Rolling Stock Library (RSL) and the Rail and Vehicles Records System (RAVERS). These systems are now outdated and the R2 project aims to bring significant benefit to the industry by replacing them with a new, web-based application that better meets the requirements of the rail industry. R2 will be capable of interfacing with a wide range of commercial depot systems, supporting RIS (the standard for shared data described above). The system will also meet current European interoperability directives and allow the linking of fleet data within operational data. Perhaps most importantly, R2 will support the easy transfer of vehicles between stakeholders,

allowing new operators to access the complete vehicle history and technical information. The business case for R2 is now undergoing approval, and development will be in 4 phases:

1. Transfer of core functionality & data (by September 2014)
2. Completion of new functionality and interfaces (by January 2015)
3. Business intelligence (by November 2014)
4. New standards (by December 2015)

RSSA

The Rolling Stock Systems Architecture (RSSA) is a response to TSLG's recommendation that '*a straw man long-term strategy for cross-industry rolling stock systems should be developed that could lead to reduced cost and appropriate integration (or disintegration) of rolling stock systems and make data available to support whole-system approaches*.' The initiative will draw on an initial catalogue of over 130 non-Network Rail industry information systems (the National Information Systems Catalogue, compiled by RSSB) in order to determine the current state of rolling stock information management in the UK. A draft set of principles for the rolling stock systems strategy has been developed and presented to TSLG. Based on these, and in conjunction with system users, owners and suppliers, an industry systems architecture will be proposed that can meet existing and future information requirements. The architecture will then be formalised, with a final system requirement specification and strategy for the RSSA due to be delivered by May 2013.

Layered INformation eXchange for Traffic Management (LINX TM)

Presenter: Roland Major, Network Rail.

Status: Concept (requirements by March 2013).

Approximate timescale: Specification by June 2013 leading to availability early 2015.

The LINX initiative aims to provide an abstracted access layer to Traffic Management Systems (TMS) in the UK, creating a "single view of the current truth" that can then be used to better inform Rail Industry Partners and customers on real-time changes to the timetable. Plans for LINX currently involve interfaces from a common data bus to 3 TMS and 46 other existing industry IT systems, 34 of which will be retained as-is with a further 12 being updated or superseded. IT systems involved include those responsible for timetable planning, performance and billing, access delivery, asset performance and train operations; with expected information involvement including planned and altered timetables, possession details, asset alarms and events, delay attributions, train crew rosters and vehicle availability. The requirements for LINX will be frozen in March 2013, with a formal specification due in June. Implementation is expected to commence early in 2014, with the system becoming available a year later.

Network Rail Industry GPS Gateway

Presenter: Simon Goodman, Network Rail.

Status: Principle agreed with key stakeholders, impact investigation underway.

Approximate timescale: Pilot deployment by Q3 2013.

While vehicle positioning in the UK rail industry is traditionally performed by systems such as track circuits or axle counters, around 25% of TOC services currently carry GPS equipment. GPS positional information from vehicles can give added value to the industry in a variety of scenarios; for example in areas where signalling infrastructure is limited, GPS-derived position information can be used to drive Customer Information Systems. Network Rail are proposing to gather together the GPS data currently being collected by train operators into a single industry gateway and then exposing this information via TRUST Movement Messages, enabling existing industry systems to take advantage of it and generating immediate business benefits. The gateway itself, which will be funded by Network Rail, will include adaptors for compatibility with systems provided by the main GPS suppliers (around 3 system types are expected). Data granularity will depend on the capacity of the communications networks involved but it is anticipated that the sampling frequencies already being used by train operators with GPS equipment installed will be fit for purpose.

The industry GPS gateway initiative has already been agreed in principle with key stakeholders and an impact analysis is underway. Assuming the project receives investment approval a pilot deployment is expected in the third quarter of 2013.

Afternoon Workshop Sessions

Building on the morning's briefings, the workshop sessions aimed to establish the degree to which the six data initiatives shared common requirements and goals, to determine their relationship to other industry systems and processes, to elicit the current high-level objectives for data integration within UK rail, and to identify potential roles for the initiatives within a future cross-industry information architecture. The workshop consisted of 5 separate activities, with every activity allocated a nominal 25 minutes. Participants were divided into four groups, each of which included representatives of a cross-section of industry and governance roles (see Table 1).

Table 1: Stakeholder and data initiative representation for each of the workshop groups.

Group	Stakeholders Represented	Data Initiatives Represented
A	RSSB, Network Rail, Interfleet Technology, DB Schenker	ORBIS, XiRCM, DRACAS
B	RSSB, Network Rail, Porterbrook, Technology Strategy Board	DRACAS, T&RS SMG, GPS
C	RSSB, Network Rail, First Group, Information Junction	ORBIS, T&RS SMG, LINX TM
D	RSSB, Network Rail, Porterbrook, Association of Train Operating Companies	XiRCM, DRACAS

The four groups were provided with pre-prepared worksheets for each activity in order to guide participant thinking and ensure the successful capture of the outcome of any discussions. The worksheet templates are included in Appendix A.

Figure 1: Workshop session 1.

Session 1 - Current Data Initiatives (Gaps and Overlaps)

Objectives

Workshop session 1 focussed on the initiatives presented during the morning and aimed to establish where, if anywhere, synergies might exist between them. In particular its objectives were the:

- Identification of overlaps between the data initiatives in terms of:
  a. Aims and objectives;
  b. Key stakeholders;
  c. Information services being provided;
  d. Existing information services being used.
- Identification of information gaps involving the initiatives in terms of:
  a. Additional information services that may be required in the realisation of the data initiatives presented;
  b. Areas poorly covered by existing information services, where the combination of one or more of the initiatives presented could deliver additional value.

Participants were asked to record their findings in a grid that showed all the possible pairings of the six data initiatives (see Appendix A), with overlaps recorded below the diagonal and information gaps above it.

Outcomes

Figure 2 shows a comparison of the number of potential areas of overlap between every possible pairing of initiatives as suggested by the workshop participants. The most highly commented-upon overlaps were, perhaps unsurprisingly, between remote condition monitoring and DRACAS, between rolling stock and DRACAS, and to a lesser extent between ORBIS and DRACAS, with all three initiatives seen as key information feeders to the DRACAS process. In particular, participants indicated that new services providing information relating to previous failures/historical condition of assets, configuration & maintenance information for vehicles (e.g. tracing of reconditioned components as they move from vehicle to vehicle, frequency of vehicle component failures/replacements relative to class norms etc.), and "supporting" condition monitoring information from other nearby RCM installations not directly affected by an incident would be of value to a DRACAS process.

Other "hotspots" of overlap were found to exist between condition monitoring and traffic management, between rolling stock and traffic management, and between ORBIS and traffic management. The high concentration of suggested overlaps between many of the data initiatives and traffic management is likely due to the central role that traffic management plays in many current business processes within the rail industry. Indeed, many of the specific comments in this area focussed on the provision of up-to-date asset and infrastructure condition information into the traffic management process, allowing action to be taken to minimise the impact of incipient faults and failures until maintenance can be performed. However, the volume of comments around this topic also suggests that this is an area where "low-hanging fruit" still exists in terms of potential new information services that could be provided to the wider industry (the resolution of the long-standing vehicle identity

question involving service headcodes, unit numbers & vehicle numbers when investigating a WheelChex detection is a prime example of this and could be addressed through better integration of traffic management and rolling stock systems).

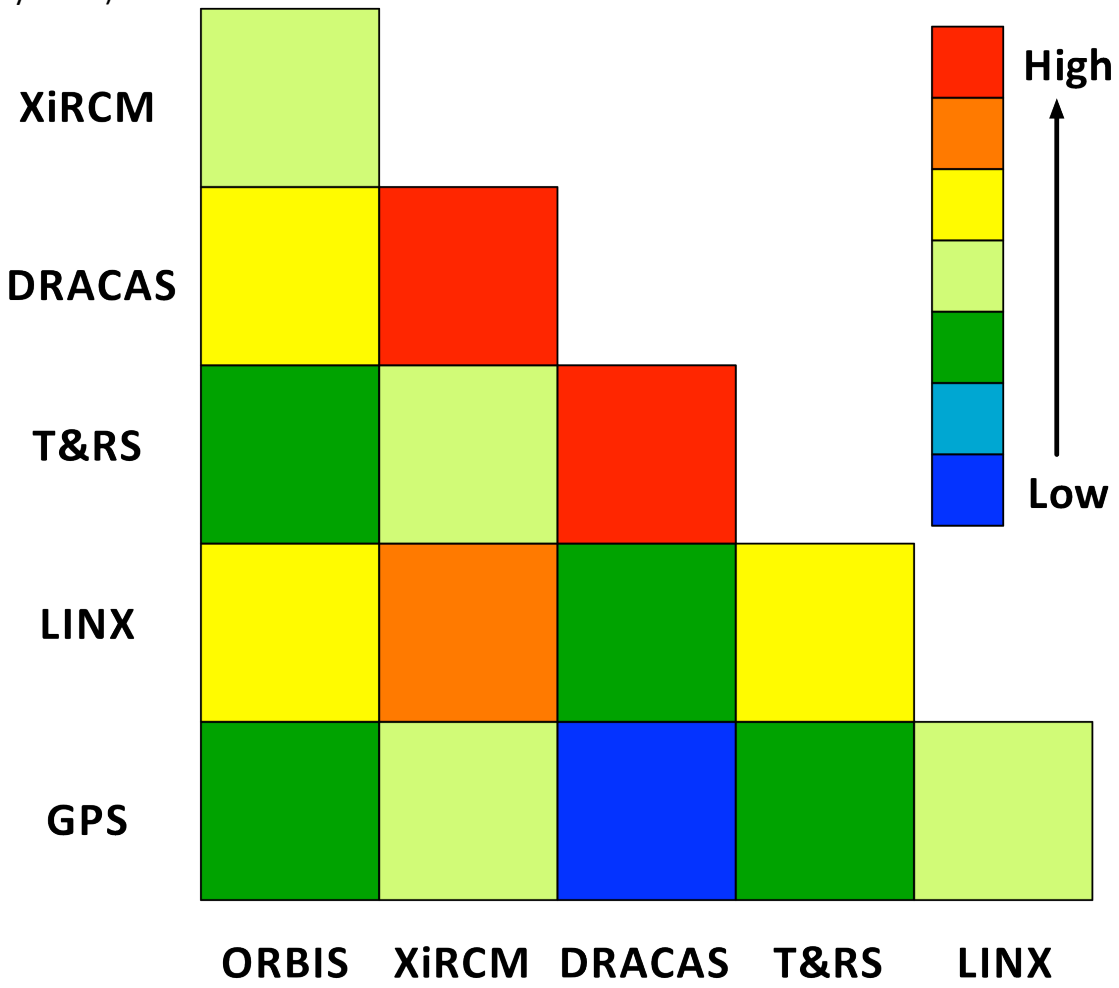

Figure 2: Comparison of numbers of suggested overlaps between initiatives.

The provision of GPS data attracted a significantly lower number of suggested overlaps than the other initiatives. In part, this is probably due to the comparatively limited scope of the project, however it is likely it also reflects the fact that GPS data is still viewed as a "supplementary" information source by the railway industry at large, with existing, more safety-critical positioning systems (track circuits etc.) still taking precedence for the time being at least. The exceptions to this opinion seem to be in the fields of condition monitoring, where fine-grained positioning of vehicles was thought to be needed to relate detected defects to specific sections of infrastructure, and in the tracing of the movements of individual vehicles, particularly freight wagons, for operational reasons such as mileage determination, scheduling of maintenance (when near an appropriate depot) and allocation to new services for onward journeys. Interestingly, the final application alone justifies the creation of a common industry portal to vehicle GPS information, with vehicle keepers, entities in charge of maintenance (ECMs), train operators, freight operators, rolling stock leasing companies and Network Rail all seen by workshop participants as key stakeholders in these processes.

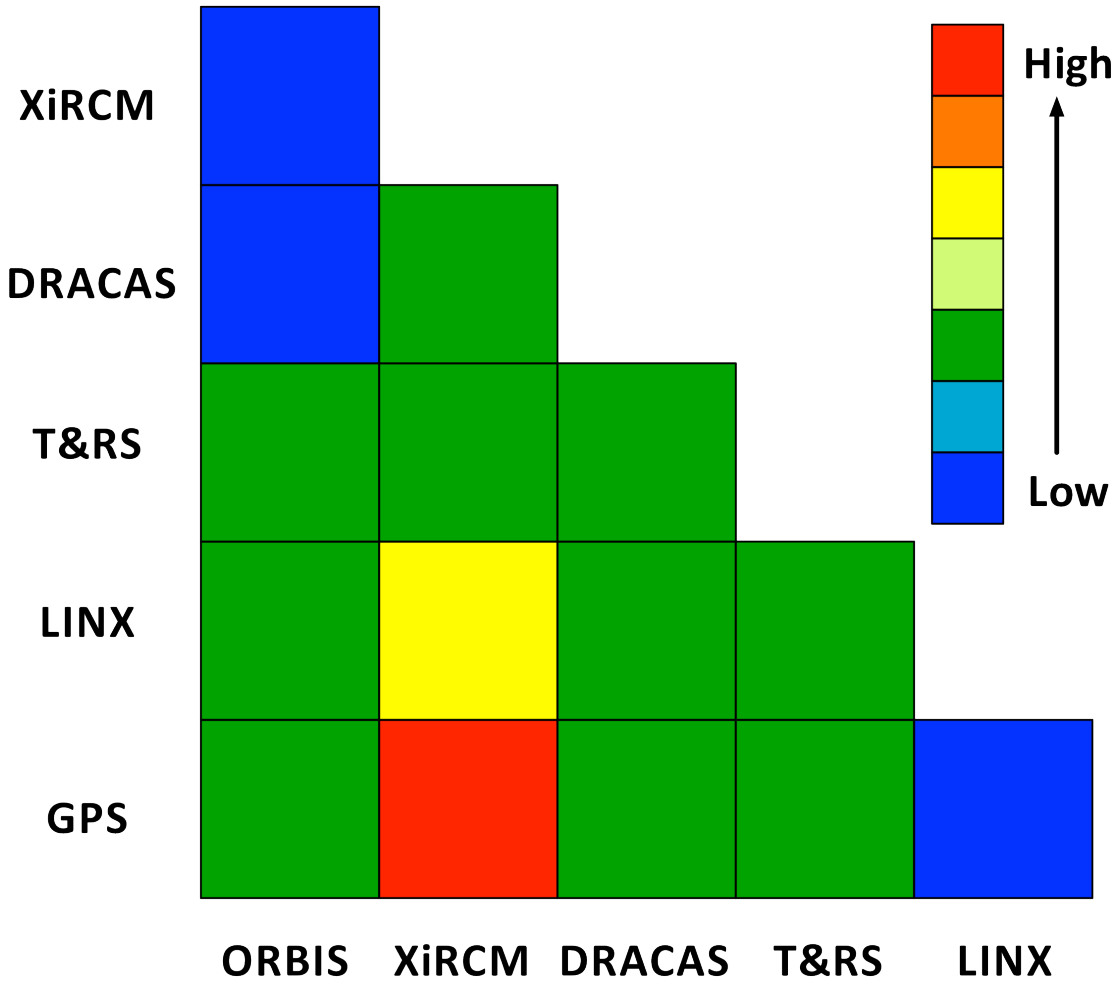

Figure 3: Comparison of numbers of suggested information gaps between initiatives.

Figure 3 shows the frequency of suggested information gaps involving the initiatives. The obvious point to note here is the relationship between XiRCM, GPS and LINX, with several groups pointing out that there is a need for a reliable mechanism through which defect positions can be recorded and translated into different measurement systems (WGS84, miles & chains to reference point etc.). The need to identify vehicles at condition monitoring sites was also a major feature in many of the comments and development of automatic vehicle identification (AVI) was seen by participants as a key enabler in establishing the relationship of records across systems. A less highly commented upon shared need was seen to exist between ORBIS, LINX and T&RS, with up-to-date integrated information on the formation of vehicles that make up a service along with their loadings seen as key to determining the impact that service would have on infrastructure assets. The provision of this information is currently seen to be limited by the lack of a straightforward method of automatically relating vehicle numbers, consist information and service headcodes.

A major information need that was identified as applying to all the initiatives was the requirement for a common architecture over which data could be shared between systems. Key stumbling blocks to the development of such an architecture were

thought to be the lack of common “master data” for the rail network as a whole, the absence of reliable models for translating data between the various representations used in existing industry processes & ICT systems, a poor understanding of how business models for such a system can be created, a lack of appropriate governance and contractual structures, and a requirement for better business process maps.

In discussions following the end of session 1, there was general agreement amongst the workshop participants that while there was clearly a significant degree of commonality between many of the data initiatives, care must be taken to ensure that changes to ongoing programmes of work designed to exploit these relationships do not significantly delay any of the projects in reaching their current objectives. Despite this, it was felt that several of the possible relationships should be investigated; in particular, it was noted that at least 4 of the 6 initiatives would require a data bus and that reusing technology developed in a more advanced project, such as LINX, would have the potential to speed up development in the other initiatives. Matthew West, the keynote speaker in the morning session, reminded the participants that care must be taken when considering this type of gearing, since specific stakeholder requirements and the need to adapt within projects can mean that solutions that are otherwise technologically very simple do sometimes need to be implemented twice.

Session 2 - Contributions to a Wider Information Architecture

Objectives

Workshop session 2 aimed to determine the extent to which services to be provided by the presented initiatives could meet the data needs of a range of different information usage scenarios. Where the data needs were not completely met, participants were challenged to identify the remaining gaps. The formal objectives of session 2 were the:

- Alignment of the information services proposed by the presented initiatives with a general set of “integrated information” usage scenarios devised by industry stakeholders;
- Identification of information gaps that still exist despite currently planned activities.

In order to maintain a degree of generality in the information usage scenarios and avoid them being too biased towards the application areas already represented by projects present in the room, participants were invited to choose from a list of scenarios taken from a 2011 workshop set up to investigate the value a common data model might offer the UK rail industry (Roberts, 2011). As with the other activities, participants were asked to record their discussions using a pre-prepared template (see Appendix A).

Outcomes

Group A chose to investigate 2 usage scenarios, establishing how assets are degrading over time, and ways in which government departments can gain a more complete view on the working of the railway. In the case of asset degradation, the team felt that many of the initiatives had a role to play, with XiRCM providing recorded data on the performance of the asset prior to failure, ORBIS providing

information on the configuration of the asset and its history (maintenance etc.) in the case of fixed assets, T&RS providing the equivalent engineering information for vehicles, GPS providing information on where mobile assets failed, and DRACAS bringing that information together in the investigation of the root cause of the failure. Remaining information gaps for this scenario were felt to be the provision of AVI, allowing RCM data recorded on the trackside to be related to a specific vehicle. Moving on to the government view of the railway scenario, the group felt that all the initiative inputs described in their previous answer were relevant, as by improving visibility of asset degradation they were also supporting the more effective making of investment decisions in areas such as infrastructure renewal. In addition to this, the group felt that ORBIS would be able to provide information of whole-life asset costs, that DRACAS would allow strategic performance analysis to take place, and that LINX could be used to monitor performance (actual vs. timetable). Remaining information gaps in this scenario were seen to be a lack of services that allowed data on the railway to be viewed in a "whole-system" context.

Group B chose to consider the provision of end-to-end ticketing for cross-modal journeys as their usage scenario. Key components of this scenario would include shared timetables and tariffs, along with more refined information on service expected arrivals (GPS, LINX), knowledge of the network & locations (ORBIS network model translation), information on delays caused by equipment failures (XiRCM), and matching of on train facilities to passenger needs - onboard shop, lack of steps etc. (T&RS). The group also noted that they felt this scenario would be an important step towards capacity management through behaviour modification, with other key elements being customer information systems, m-commerce and variable pricing. Remaining gaps in the implementation of this scenario were seen to be the available of suitable communications technologies including near-field communications (NFC) and 4G cellular networks, passenger loading information on services, and a "TransportML" data model, which could serve as a common framework for the exchange of information at a whole transport system level in much the same way that RailML is starting to within the rail operations domain.

Group C elected to develop two scenarios, the joining up of core business processes across the industry, and the establishment of infrastructure condition in real-time. Within the joining up of core business processes, the group felt that LINX, ORBIS, T&RS and DRACAS all had important roles to play, but that significant gaps still existed in the provision of timetables, ticket sales figures and other business services. Moving to the real time infrastructure condition scenario, the group indicated that GPS, XiRCM and DRACAS were the key contributing initiatives but that information would also be needed on current weather patterns and known seasonal variation in the area. Improvements in the accuracy of geo-location by GPS would also be needed, to a precision of around +/- 1m. Currently this type of positional resolution is often obtained by supplementing GPS information with data from map matching or an inertial measurement unit on the vehicle.

Group D looked at three different usage scenarios, determination of asset condition, asset lifecycle planning/costing, and cross-industry business solution sharing for modifications. In the case of the determination of asset condition, the group felt that XiRCM could contribute a view of the current and historical asset condition, that

ORBIS could provide information on asset type and maintenance history for fixed assets, that DRACAS could provide information on known failure modes for assets of the same type, and that T&RS could provide information on maintenance history etc. for mobile assets. The main information gap in this area was seen to be provision of reliability information for "normal examples" of different asset types, information on the effectiveness of maintenance, and benchmark tests. Moving on to asset lifecycle planning, the group felt that either DRACAS or T&RS could provide asset history, LINX could provide information on asset usage, and RCM could be used to alert maintainers to potential problems. Provision of information on predicted usage/growth of services over the medium term was seen as a key information gap in this scenario, along with resource information on the availability of replacement parts etc. Finally, looking at business solution sharing, DRACAS, ORBIS, and T&RS were all seen as key contributing initiatives, with the provision of information regarding lessons learnt maintaining assets of that type, and 10-year histories seen as information gaps to be filled.

Session 3 - A Roadmap to 2033 (Future Systems and Requirements)

Objectives

Workshop session 3 aimed to develop a vision for the development of more integrated UK railway information systems at 5, 10, 15 and 20-year horizons. Participants were asked how the presented initiatives would contribute to their vision, what other enabling information services, processes and technologies might be needed, and what the timescales for development of such services might be. Specifically, the objectives of session 3 were the:

- Production of a vision for the development of industry information systems over the next 20 years;
- Identification of key enabling technologies and services;
- Prioritisation of information service developments.

Participants were asked to record the results of their discussions on timelines that were provided (see Appendix A), although the original dates (2018, 2023, 2029 and 2033) rapid had a year added to them so they fitted with expected control periods.

Outcomes

Group A began by describing their view of current industry information systems as fragmented, poorly understood and suffering from inconsistent data input. By 2019, they believed that the situation would have improved, with systems still fragmented but their interactions now being more fully understood; information systems would be based around business services and data analysis, with an Enterprise Architecture and a common ontology allowing information to be passed between systems. The group felt that the initiatives presented at the meeting would all be important enablers of this vision, along with the development of an Enterprise Architecture. Moving forward to 2024, the group envisaged completely open rail data services for the industry, delivered to users via personalised information screens. To achieve this, the group felt commercial and cultural barriers within the industry would need to be overcome and the efforts would need to be led by strong governance in the form of ORR, DfT or ERA policies and a more integrated railway industry with a common IT

and Engineering policy. In the longer term, the group suggested that by 2029 we should expect a fully understood, fully integrated railway within Europe, and that by 2034 that system should include the other major public transport modes.

Group B were quite specific in their vision, with 2019 seeing the new rolling stock system implemented, TOPS replaced, smart ticketing and business models established for cross industry working. They also felt that a common industry architecture would by this point have been agreed on, at least in principle, and that examples of multimodal integration would be being developed. Enablers for all this would include clear governance, improved communications (4G, NFC, software defined radio), cloud computing, use of the semantic web (including industry ontology) the Internet of things, energy harvesting and ubiquitous computing. By 2024 the group felt that ORBIS would be fully implemented and the benefits realised, that TRUST would have been replaced, a new TMS would be complete, that there would be full multi-modal integration, and that there would be flexible brokerage with freight services traceable across the entire network. By 2029 the group thought that transport planning would be purely driven by demand rather than pre-defined timetabling, with trains run automatically.

Group C felt that 2019 would see 2 industry Enterprise Architectures, one for vehicles and one for infrastructure, linked by a universal data bus. TOPS and TRUST would be replaced and master data would be available for both network infrastructure and vehicles. Key enablers of this would include new EA tools, adoption of cloud computing, data warehousing and new standards for data exchange (messaging and the database itself) and for Internet services. By 2024, the group felt the vehicle and infrastructure systems would have merged into a single Enterprise Architecture, with ERTMS and driver-only operation fully implemented along with systems akin to the previously proposed LiveTrain initiative. For this vision to be realised, the industry would need to establish clear funding models for shared services and put in place new governance. Mobile devices would need to be more widely adopted and a switch to high-band radio would need to have taken place. Moving forward, the group felt the trend would be towards fewer, more integrated industry information systems, based around a common Enterprise Architecture with known business processes and well understood information requirements.

Group D expected that XiRCM, DRACAS and ORBIS would all be fully implemented by 2019, along with the introduction of ERTMS and some interoperability with European services in place. The key enabler for this was thought to be greater investment in the network. By 2024, the implemented systems would be operating in a more integrated fashion, with wider deployment of ERTMS, further moves towards European working, and pan-European databases being developed. By 2029, the European databases would be implemented, with new vehicles running on a network maintained by robots with demand managed on a more real-time basis. Assets would be intelligent (self-monitoring etc.) with the whole system displaying improved reliability and with ERTMS firmly established. Further investment would enable these changes. By 2034, worldwide databases would be in place, with common technologies and vehicles running on all networks. Seamless multimodal journeys will be possible worldwide. Enablers will include alternate power sources, infrastructure based communications and satellite links.

Session 4 - Key Actors and Funding Models

Objectives

Workshop session 4 aimed to build on the ideas generated in the previous activity by identifying key actors (information providers, service operators, custodians, user groups etc.) and sources of funding that could drive forward the development of enabling services, processes and technologies from session 3. The objectives of session 4 were the:

- Identification of the key actors in the development of enabling technologies and services from roadmap;
- Identification of appropriate funding sources for development of enabling technologies and services.

Participants were asked to record the results of their discussions in pre-prepared tables (see Appendix A).

Outcomes

Group A selected Enterprise Architecture and AVI as their enabling technologies. In the case of Enterprise Architecture, they felt that strong governance would need to be put in place, and in particular a single "controlling mind" would need to guide the development. All industry stakeholders would need to be involved, as well as customers and suppliers. Funding would preferably come from the DfT owing to the cross-industry nature of the initiative; however, some support from stakeholders may also be appropriate. The next steps needed to move the initiative forward were seen to be setting of policy, supported by "wicket rolling" from individual industry stakeholders, the group also emphasised the importance of overcoming short-term thinking within the industry if the initiative was to be a success. Network Rail was seen to be the key actor in the development of AVI, with funding being made available by NR, ROSCOs, TOCs and FOCs. Trials of the technology were seen as an appropriate next step, leading to a formal tendering process.

Group B chose ontology & a common industry data bus, and the ability to insert contemporary communications technologies as their enablers. In the case of ontology/a common data bus, the group believed that EU standards groups had a strong role to play, along with NR and industry governance bodies. The ability to insert contemporary communications technologies into the network would need to be led by the communications supply industry, with NR, the ROSCOs and Ofcom all being involved. In both cases (ontology/common data bus and insertion of contemporary communications) funding would be provided by synergy of opportunities and by release of resources as systems became due for replacement. The next steps would be the development of integrated communications across the industry and the establishment of new governance mechanisms.

Group C believed that all their enablers would require the support of UK rail and the European and global supply chains if they were to be successful. Funding would come from the industry itself as well as from the EU and DfT, and delivery of the technologies by the rail delivery group (RDG) would be the appropriate next step.

Group D chose new trains, standardisation and open IT for infrastructure as their enabling technologies. The key actors in development would be the government, the industry and standards bodies. It was felt that longer franchises would be needed if the investment were to be justified, along with a commitment to the vision by the industry. Funding would come from government sources, banks and PFIs, along with industry stakeholders and increased fares. Next steps included a significant period of investment, along with political lobbying, long-term planning from the industry and a more integrated transport policy.

In further discussions at the end of this session it was noted that access to information can be a serious barrier to the adoption of new technologies; for example, participants had tried to access materials on InteGRail but were unable to find them. Catalogues of ongoing industry-relevant research, such as SPARK, are a solution to this problem but only if they are well publicised and have whole-industry (including research) buy-in.

Session 5 - Benefits of, and Barriers to, the Implementation of an Industry-wide Information Architecture

Objectives

Workshop session 5 aimed to bring together the outcomes of the first 4 activities by asking participants to identify the formal benefits of, and barriers to, the development of an industry-wide information architecture for UK rail. Barriers were grouped as either commercial, legal or technical, and participants were asked about what, if anything, could be done to mitigate each barrier they identified. The formal objective of session 5 was the:

- Identification of the set of key benefits of, and barriers to, a common information architecture for the UK rail industry.

Participants were asked to record their discussions on pre-defined worksheets (see Appendix A).

Outcomes

Benefits

A number of potential benefits of an industry-wide information architecture were identified by the workshop participants. Amongst these were:

- Lower operation expenditure on ICT/more efficient use of ICT resources;
- A faster route to market for new initiatives (lower capex. costs);
- The development of a market for services;
- An improved focus on business process;
- A more mobile workforce with IT skills that are transferable across the industry;
- Evidence-based decision making;
- Improved customer experience (leading to increased revenue from ticket sales);
- The creation of a “single version of the truth” leading to less time spent reconciling datasets.

Commercial Barriers

This activity generated by far the largest number of suggested barriers to the development of an industry-wide information architecture. First and foremost amongst these was the view that the industry structure made it difficult to correctly apportion investment in a system that would bring a whole-system benefit. Even if all industry stakeholders were convinced to contribute, striking the right balance of payment represents a significant challenge. Business models for the ongoing use of the architecture would also need to be established that make it worthwhile for stakeholders to provide services via the common architecture. Further complicating this issue is the franchise system, with many stakeholders currently only able to commit to investments that will pay off in the comparatively short-term. Protectionism amongst existing suppliers was also seen to be an issue, with the supply chain unlikely to make the necessary technological moves to support a common architecture with some incentive. The need for the industry to work with other sectors was also thought to be a challenge, with external entities not having access to the common architecture.

Legal Barriers

Suggested legal barriers included software licensing, management of intellectual property, the structure of the industry, the terms and conditions of franchise agreements, regulated fare structures and requirements to provide interoperability with other systems - in particular those in other European countries.

Technical Barriers

Interestingly, very few of the participants felt that there would be many significant technical barriers to the development of an industry-wide information architecture, instead believing the majority of issues to be commercial or legal. The few technical barriers that were suggested included security, system obsolescence, the availability of sufficient communications bandwidth, and the number of iterations/time that would be required to move from the current set of industry systems to the common architecture.

Other Barriers

Many of the participants suggested that there might, in actuality, be four, or even five categories of barrier. Suggestions for cultural barriers certainly featured heavily, with the risk-adverse nature of the industry and traditionally slow pace of change both seen as potentially serious issues.

Mitigations and Next Steps

The appropriate next steps were perhaps less clear-cut than some of the suggested barriers, although it was apparent that the participants all felt there was a need for strong, cross-industry leadership and governance of such an initiative. One group went as far as to suggest that regulatory support should be sought in the first instance, enabling stakeholders to set aside some of their commercial concerns in light of new rules for working in the industry. There was also a general feeling that business strategy would need to lead technical advancement, with a focus on process driving the development of services.

Communication was also seen as critical, both amongst stakeholders and between stakeholders and their staff; this would ensure that there was both an agreed, common view of what needed to be done, and that the workforce understood the reasons for the changes. Opinion was split on who should be responsible for taking the initiative forward, with some believing that IT infrastructure naturally fell into the domain of NR with the costs built into their funding model, and others believing that the DfT (via the Rail Delivery Group) should ultimately be responsible.

Discussion

While several sets of commonalities were found to exist between the data initiatives presented at the workshop, two stood out as clear targets for further investigation. Firstly, that there is a need to develop and maintain a relationship between the DRACAS project and those initiatives seen by the workshop participants as obvious feeders to it (XiRCM, T&RS SMG and ORBIS). Some participants went as far as to suggest that the core of R2 could serve as the industry DRACAS, however the representatives of the T&RS SMG suggested that implementation issues involving the underlying data warehouses may make this difficult.

The second area of clear commonality was between LINX and those initiatives that could provide information on either rolling stock or the real-time availability/status of infrastructure, namely XiRCM, T&RS SMG and ORBIS. As the requirements for LINX are due to be frozen in March with the full specification due in June, it is important that the relationships between the projects are investigated in detail soon so that any necessary provisions can be made before the specification goes out to tender.

The location of defects found via cross-interface condition monitoring technologies, both in terms of precise "on the ground" locations for defects detected by vehicles, and in terms of the identity of "culprit" vehicles triggering alarms in infrastructure-mounted CM systems like WheelChex, were seen as a major information gap that a combination of the presented initiatives had the potential to address. Here, the real-time positioning of known vehicles achieved via either a combination of GPS & LINX, or some sort of lineside AVI system, would feed vehicle identity and positional information to XiRCM. Asset condition reports would then be logged in ORBIS, R2 or the industry DRACAS as appropriate.

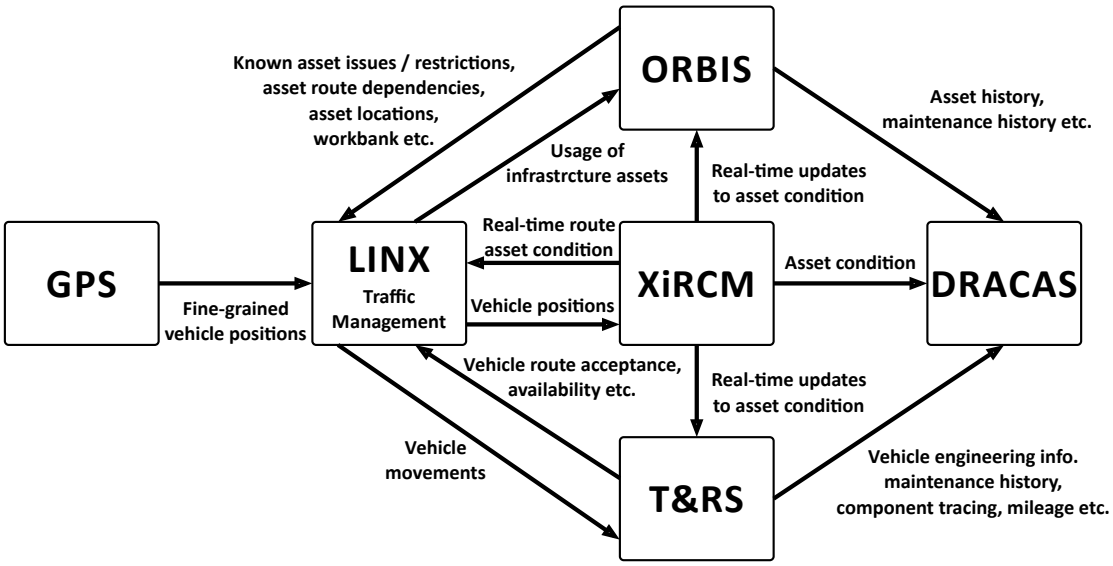

Figure 4: An example of the relationships between the data initiatives/the key functionality they enable based on the three scenarios discussed above.

The prolific appearance of the phrase "data bus" throughout the presentation session was apparent to all in the room and generated a significant degree of

comment. This was reinforced later in the day by one of the major "information needs" reported during the first activity – namely the lack of a common architecture over which data could be shared between stakeholders. The idea of common information architectures is already well established in other large-scale infrastructure-based industries, and common architectures are a key theme of the recently released Rail Technical Strategy (TSLG, 2012). Enterprise or Service Oriented Architectures, in which end-user tools are driven with data from one or more information service endpoints via a common messaging bus, are widely accepted within the IT industry as an appropriate architectural pattern for this type of large ICT system. A simple architecture of this type for the rail industry was demonstrated by the InteGRail project (Umiliacchi, 2007) in 2008; within the InteGRail platform a number of typical railway information sources (condition monitoring, infrastructure information, timetabling etc.) and end-user tools were connected together via a common bus (ICOM) and communicated with each other using a shared ontological data model. The RTS is supportive of the InteGRail approach, stating that "*the common standards proposed in InteGRail and the TSIs Telematics applications for passenger services (TAP) and Telematics applications for freight (TAP) would support European interoperability as well as provide useful guidelines for the development of open architectures for the rail sector in Britain.*" and the suggested need for a common information architecture linking the presented initiatives offers an opportunity for this work to be taken forward. One method of achieving this would be the inclusion of a requirement such as "build to InteGRail standards" in the specification of a data integration centred project (for example the industry DRACAS). Many workshop participants felt that, in the short term at least, the data bus due to be developed as part of LINX could be shared between several of the initiatives, offering savings in cost, complexity and overall development time across the set of initiatives as a whole.

A move towards business process led ICT was seen to be an important aspiration for the future of the industry, with any future information architectures needing to be flexible enough to adapt to changing business realities and thereby avoiding a repeat of the current situation ten years from now. Enabling this change will require the development of process maps for key rail industry business functions, with care being taken to ensure that the core functionality of the processes are kept separate from tasks that are required today due to limitations of ICT infrastructure.

Interactions with external stakeholders featured heavily in many of the workshop discussions. In particular, a common information framework was thought to offer the industry benefits in terms of improved visibility to governance and regulatory bodies, who would find it easier to obtain whole-system views of the rail network. Data model discussions also mainly revolved around external interactions and in particular multi-modal journeys and end-to-end ticketing, as in these use cases information must be removed from its rail context and merged with information from other domains. Suggestions here included the development of a "TransportML" data model, building on the existing progress of the RailML standard that is now gaining wider acceptance around Europe. Other data model themed suggestions included the creation of an industry ontology that would offer future compatibility with Semantic Web applications and serve as a context-aware "glue" translating

information between other industry data representations (RailML, TAF/TAP TSI, SDEF etc.), albeit with a longer development cycle than more traditional XML models (estimated to be around five years (Roberts, 2011)).

The sharing of evidence-based “best practice” amongst the industry was felt to be a major information gap, particularly in terms of effective maintenance. While this is an area that several on the initiatives are already considering in their plans (ORBIS, T&RS, DRACAS) further discussions aimed at creating an integrated set of services around this topic may be necessary if whole-system benefits are to maximised.

There was little consensus amongst workshop participants on appropriate sources of funding for the development of industry information services in the future, with all of the usual suspects suggested (NR, TOCs/FOCs, ROSCOs, passengers via increased fares, the UK government and the EU). Suggested key actors were better aligned, with many participants feeling that leadership in this area was primarily the responsibility of the Rail Delivery Group (RDG) or RSSB board, and recognising the need for a high (director) level information systems management group. Technical decision-making was felt to fall primarily within the domain of Network Rail as the infrastructure manager (assuming a suitable funding arrangement could be put in place), potentially in consultation with the owners of rolling-stock related systems.

While the suggested benefits of a common information architecture raised during the workshop were pretty much what might be expected (lower overall expenditure, a market for information services, increased workforce mobility and evidence-based decision support), the barriers were more of a surprise. In particular, the fact that most participants saw the technical and legal issues with the creation of a common data architecture as largely solvable suggests that with sufficient work in the areas of business model development and engagement with the industry, the majority of the barriers to architecture development could be resolved.

Conclusions and Next Steps

The workshop described in this report aimed to establish the degree of commonality between a number of rail industry data initiatives established in response to the 2011 rail value for money/McNulty report. The workshop was held at RSSB's offices on the 7th December 2012, and involved 20 participants who represented a broad cross-section of industry and governance roles.

The workshop identified several key areas of overlap between the presented initiatives, with Traffic Management/LINX, XiRCM, ORBIS and T&RS (R2) found to be particularly closely inter-related. While these relationships warrant the establishment of firmer links between the projects concerned, workshop participants were keen to emphasise that delivery of the individual project goals must not be unduly delayed by this process.

Major information gaps still facing the industry were found to include a reliable mechanism for automatic vehicle identification, the need for a common framework for information sharing/an industry-wide Enterprise Architecture, common data models, and clearer governance for whole-industry information systems planning and development.

Based on the areas of overlap and issues identified during the workshop, and with a view towards ensuring that the maximum potential benefits to be gained from closer cooperation between the projects are realised, it is recommended that:

1. There should be a further meeting of representatives of each project to:
    a. Establish whether there is scope for expanding the use of LINX to facilitate data exchange both within and between the projects. For example; could the various remote condition monitoring systems in use be linked to an analysis framework via LINX rather than having to establish new data exchange protocols to enable such linkages to be made? The requirements for LINX will be frozen in March 2013, with a formal specification due in June. It is therefore important that this meeting is facilitated during February;
    b. Examine in detail where further cooperation between the projects will be beneficial and agree and document how this will be achieved;
    c. Consider if there are other industry information system projects that could benefit from inclusion in such cooperation.

    Post-meeting note: ***RSSB has agreed to facilitate this meeting.***

2. Industry should cooperate to establish the potential benefits of and working arrangements for a high (director) level governance group to coordinate the efficient development and management of industry information systems.

    Post meeting note: ***RSSB has agreed to initiate initial discussions with Network Rail.***

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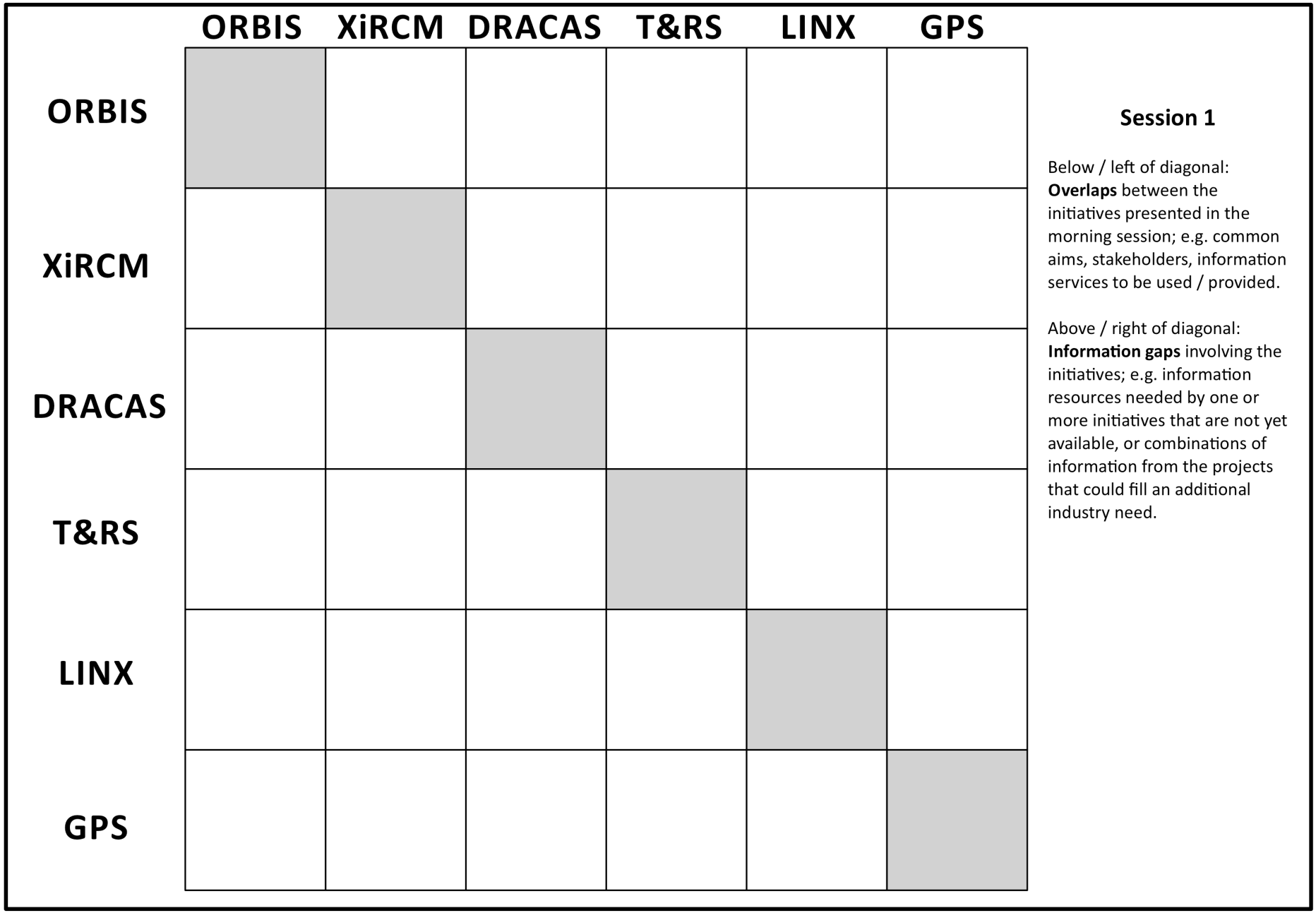
Appendix A – Worksheet Templates

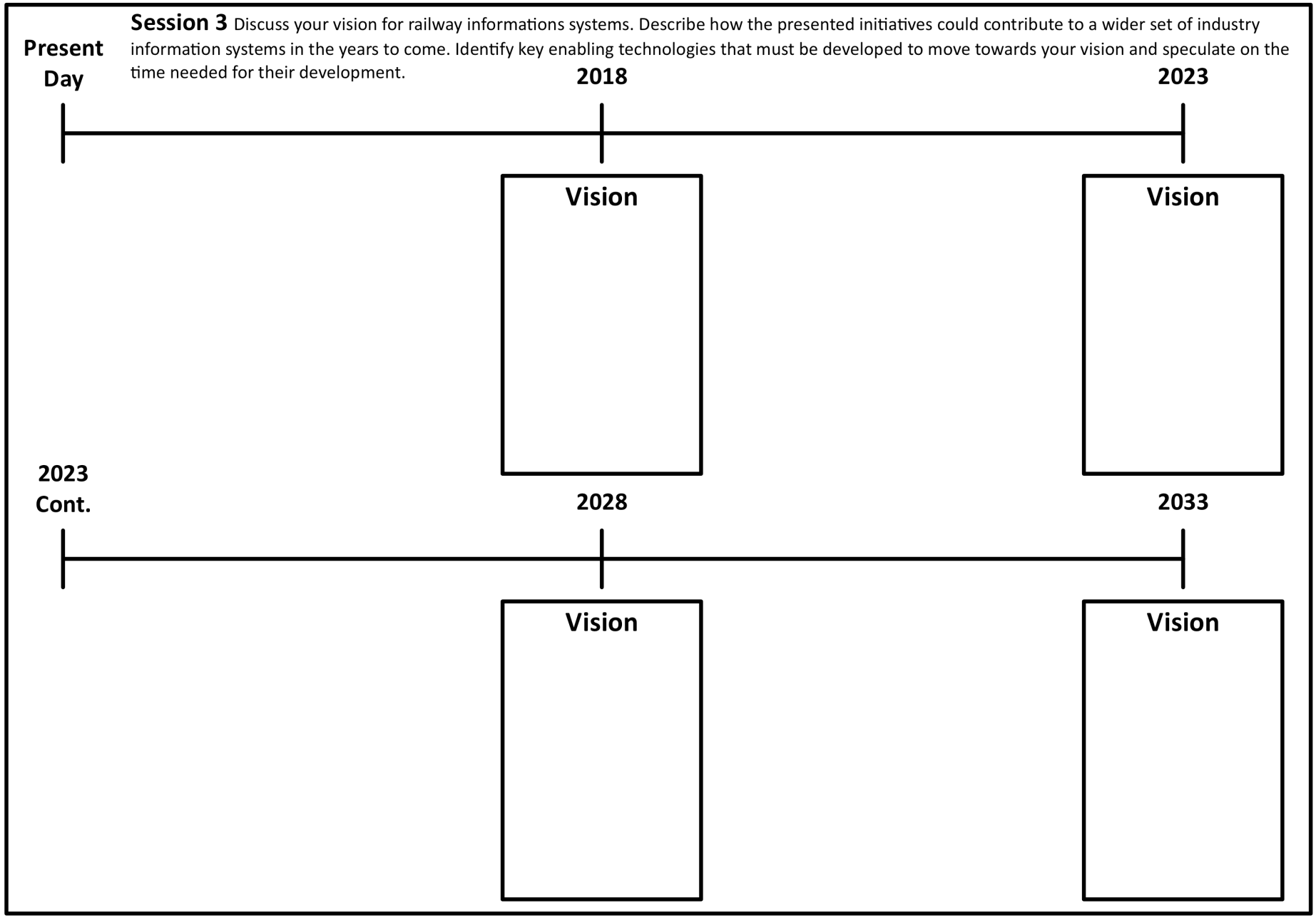

ORBIS
XiRCM
DRACAS
T&RS
LINX
GPS
ORBIS
XiRCM
DRACAS
T&RS
LINX
GPS
Session 1
Below / left of diagonal:
Overlaps between the initiatives presented in the morning session; e.g. common aims, stakeholders, information services to be used / provided.
Above / right of diagonal:
Information gaps involving the initiatives; e.g. information resources needed by one or more initiatives that are not yet available, or combinations of information from the projects that could fill an additional industry need.

Usage Scenario	Contribution	Remaining Gaps

Session 2

How could the initiatives presented fit with the information usage scenarios on the sheets provided? Which information services could contribute to the use cases and where do information gaps still exist that would prevent the scenarios from being realised?

Session 3 Discuss your vision for railway informations systems. Describe how the presented initiatives could contribute to a wider set of industry information systems in the years to come. Identify key enabling technologies that must be developed to move towards your vision and speculate on the time needed for their development.



Enabling Technology	Key Actors in Devel.	Potential Funding	Next Steps

Session 4

How might the enabling technologies from session 3 be taken forward and developed? For each technology or service identify key actors that would be involved in the development, potential sources of funding and the next steps that should be taken.

Benefits

Session 5

Based on the use cases explored in session 2, what benefits might a common approach to information management offer the industry?
What barriers exist that would prevent such an approach being realised?
How could the industry go about addressing these challenges and who should be responsible for championing such activities?

Barriers

Commercial	Legal	Technical

Mitigations & Next Steps