CH012

National ERTMS Lessons Learnt Review

Independent Reporter (Part C)

Final Report on how the ERTMS Programme has taken forward the lessons learnt from the Cambrian Line implementation of ERTMS.

4 April 2012

EXECUTIVE SUMMARY

Halcrow Group Limited

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1 Executive Summary

1.1 Purpose

Halcrow is employed under the joint Office of Rail Regulation (ORR) and Network Rail (NR) Independent Reporter framework to undertake reviews of Network Rail's performance.

This review (CH012) focused on the lessons learnt from the implementation of ERTMS on the Cambrian Lines and how Network Rail was taking these forward for national rollout.

1.2 Scope

The overall objective of the review was to:

Understand the key lessons learnt from the implementation of ERTMS on the Cambrian Line and evaluate how these are being applied to the industry's proposals for a national rollout of ERTMS.

It was also agreed that the following were not in the scope of the review:

- evaluation of whether ERTMS was the right technical solution.
- evaluation of whether the programme management of the Cambrian ERTMS implementation could have been undertaken better.
- evaluation of the overall strategy for a national rollout of ERTMS.
- evaluation of the costs and business case for national rollout.

The review team interviewed Network Rail along with all organisations involved in the Cambrian implementation to capture their views on what could be done better for a successful national rollout.

1.3 Background

The Strategic Rail Authority (SRA) and Railway Safety established an integrated ERTMS programme team in 2002. The purpose of this was to plan for national rollout. A key outcome of this was that ERTMS was a complex and developing system and that implementing it directly on to the main line network was considered too risky until it was proven to operate safely with a good level of performance.

The SRA identified that an ERTMS Level 2 system without lineside signals would deliver the best business case and that retrofitting this to an existing line and existing rolling stock would cover many of the requirements for a national rollout. The SRA considered a number of locations for a first implementation of ERTMS and concluded that the Cambrian Lines should be used.

The SRA was abolished in 2005 and the leadership of the national programme team transferred to Network Rail. Network Rail project managed the Cambrian ERTMS implementation until it was commissioned in March 2011.

1.4 Cambrian Outcome

The Cambrian ERTMS implementation successfully demonstrated that an ERTMS Level 2 system without lineside signals can be retrofitted to existing infrastructure and rolling stock. This is currently the only retrofitted Level 2 system operational in Europe.

1.5 Capturing Lessons Learnt

The focus of this review was on how Network Rail had taken forward the lessons learnt from implementing ERTMS on the Cambrian Lines.

Network Rail undertook lessons learnt activities from late 2009 to 2011. During 2009 and 2010 these focused on activities to improve future commissioning and rollout and were largely Network Rail's internal reviews which were formally documented. During 2011, Network Rail initiated joint site visits and performance workshops and a two day stakeholders workshop was held in October 2011. As the Cambrian project was completed, key resources moved to different roles and to different organisations.

The lessons learnt activities showed the willingness of Network Rail to capture and plan for future success. However, with ERTMS knowledge spread across different organisations and individuals, there is a significant risk that experience is lost.

It is therefore recommended that a comprehensive risk register is developed covering all aspects of the Cambrian implementation. This should capture all the risks likely to arise on a national implementation drawing on the experience of what happened during the Cambrian implementation.

This should be supported by a technical issues register providing a list of all the technical issues which arose on the Cambrian implementation, how they were resolved, mitigated or avoided and recommendations for national rollout. The issues should be as detailed as possible and make reference to TSI specifications, standards and other relevant references so that where these documents change, the issues can be amended.

1.6 Key Recommendations

The review captured recommendations for a national rollout. The key outcomes are summarised below:

- The industry should establish and agree a comprehensive list of strategic and detailed requirements for the ERTMS system which should reflect technical, operational, safety, performance and cost requirements.
- Early agreement should be reached on the operations concepts for different configurations of ERTMS including running ERTMS with and without lineside signals and operating ERTMS fitted trains over non-ERTMS fitted networks.
- Agreement should be reached on TSI open points and any other open areas of specifications where there are options. Where appropriate, cost-benefit and risk assessments should undertaken to inform the decision.
- There should be a single industry testing and approvals strategy which defines how all relevant organisations can work together efficiently to deliver a safe system according to statutory requirements.

- Extensive simulation should be used to evaluate ERTMS configurations and therefore demonstrate system performance and capability prior to detailed infrastructure design and installation.
- Management of rolling stock fitment would be better undertaken by the relevant owner or operator.
- The industry should plan on the basis that any installed ERTMS system will require software and configuration changes during its life. Therefore the industry should ensure that suppliers provide a detailed system migration strategy and this is used to inform whole-life cost analysis.
- The industry should refine its governance arrangements and ensure sufficient tools are available for it to trade off technical, cost and performance requirements.
- The industry should plan for the long term continuation of ERTMS which will require the training and development of resources across the industry.

The recommendations made in this review are listed in the table below along with how the ERTMS Programme Control Board (PCB) responded.

The PCB is a cross-industry committee empowered with responsibility to deliver the ERTMS national programme under direction of the ERTMS Strategy Group (ESG). The PCB is chaired by Network Rail and includes members from the Department for Transport, Association of Train Operating Companies, Rail Safety & Standards Board, Rolling Stock Companies and the Rail Industry Association.

Halcrow has reviewed the PCB responses to form a view on whether it fulfils the recommendations.

- We have used 'Accepted' to mean it is accepted that the Industry is taking forward this recommendation.
- We have used 'Noted' to mean it is acknowledged that progress is being made, but that this will not necessarily fulfil the recommendation.
- We have used 'Disagree' where it is not accepted that the industry response is sufficient to address the recommendation.

We have also identified whether the recommendations are critical for the ERTMS programme to address in the next 6 months.

Ref	Recommendation	PCB Response	Critical?
1	Establish a comprehensive list of strategic requirements which establish the principles for a successful rollout of ERTMS in the UK. These strategic requirements should be extended to provide a process by which competing requirements can be evaluated and prioritised. (It is noted that there was a draft set of business requirements produced by ERTMS Programme).	ERTMS Steering Group (ESG) has endorsed the Business Requirements and DfT has to sign these off. NR advised that there are a subset of Route/Operator template requirements that sit below the high level Business Requirements. *Accepted, although no evidence of sign-off or route requirements provided.*	Yes

Ref	Recommendation	PCB Response	Critical?
2	A robust system engineering approach is developed to ensure a comprehensive mapping between specifications (TSI + others) and operating requirements.	NR stated that Thameslink already had a system engineering approach which would be taken forward with the national programme. *Accepted*. NR advised that they were intending to produce a series of ERTMS 'handbooks' which cover infrastructure, trains and plant. The handbooks will provide a one stop shop for information covering for operational integration underpinned by a safety framework. *Accepted, that handbooks will be essential to minimise integration risks.* *However, the overriding recommendation is that information from Cambrian can be used today to undertake this task and therefore provide a baseline for national rollout.*	No
3	Early agreement on TSI options and open points should be reached to inform suppliers (notably ETCS on-board suppliers) of the UK specification which should also help promote a competitive market.	NR advised that work is progressing with RSSB. NR was intending that as part of the NR GRIP 3 development contracts (let 29 Feb 2012), four suppliers will be allocated three areas to demonstrate how their systems would deliver a suitable solution for a period of 3 months. This would support UK specifications development and UK Operations Concept development that would in turn determine the TSI options to be selected, providing an agreed and common cross industry understanding. Testing at the HNIF would demonstrate each suppliers solution prior to a GRIP 4 – 8 contract and the start of the Delivery Phase. *Accepted, but having a fixed specification for HNIF is seen as critical in ensuring efficient engagement with suppliers / use of HNIF and also avoiding the risk of competition / commercial issues arising.*	Yes
4	The operation concepts should reflect all degraded and non-TSI modes of operation from all human perspectives. A clear system recovery path should be set out and used to inform system reliability calculations.	RSSB advised that the Operation Concepts were currently at a Conceptual level and a systems engineering approach would be used to develop detailed requirements. *Accepted, however this is seen as critical in ensuring that the system can be fully specified, key specification issues resolved and suppliers time used effectively.*	Yes, but industry plans are for late 2012.

Ref	Recommendation	PCB Response	Critical?
5	Extensive and thorough simulation of the operating rules and technical architecture should be undertaken to validate the system and help achieve buy-in from operators.	NR stated that the good practice from Thameslink will be used. The National Programme will buy tools for each route. *Accepted.*	No, although strategy could be agreed.
6	A standards policy framework should be established which sets out what and why documents are required (Standards, guidance, NTRs) and identify what, if any, derogations are expected.	RSSB advised that there is a standards plan for Group Standards and the requirements will drive standardisation. *Accepted*.	Yes
7	Network Rail should ensure that the ERTMS GRIP 3 'risk reduction' results in a clear understanding of the development requirements from each supplier and that the outcome of this is used to inform a UK specification.	See 4.3. *Accepted*.	No
8	The system should be evaluated to understand how speed profiles and braking curves affect overall system performance. On a wider point, NR should capture and understand the safety margins in each of the supplier's systems.	NR advised that the Baseline 3 braking model will be used. This clearly defines tolerances. A formal cross-industry Braking Group has been establish. This will report into the Systems Body. *Noted, and its important to ensure that the GRIP3 process captures how each of the suppliers' systems interprets the model and to use this as the basis for parameters used in simulation.*	No
9	Train performance modelling is undertaken (ideally using the simulator) to evaluate different track configurations to ensure these are optimised for performance. Worse case supplier system assumptions should be used.	The Thameslink model and approach to simulation will be adopted. *Noted, but the simulation requirements of Thameslink are significantly less demanding than GWML/ECML. Testing alone of all route permutations and degraded modes may require a different approach to simulation.*	No
10	Sufficient time should be built into the programme performance optimisation before commissioning.	The programme will convince stakeholders through a robust assurance process, utilising HNIF to prove that the Track/Train work correctly and through First of Class Dynamic testing, all bar high speed, tests, should be demonstrated and signed-off prior to route operation. *Accepted*.	Yes
11	The GSM-R scope of works should include wider ETCS QoS requirements.	There are no efficiencies to be made by increasing the National GSM-R programme scope. If anything it will be a distraction to the national delivery. *Accepted*.	No

Ref	Recommendation	PCB Response	Critical?
12	Fleet fitment is best managed by the train owner/operators.	Agreed, a working plan is in progress. ESG in February 2012 endorsed the Strategy. *Accepted*.	No
13	Further work should be undertaken to evaluate whether the franchise tender process is likely to be efficient for all franchises/fleets before and after 2015 (when a UK specification is agreed and a test track/area available for train manufacturers to test their systems).	Covered under 5.5. *Noted, although the recommendation is about the commercial risk associated with transferring procurement and installation to franchise bidders prior to having something they can accurately price.*	Yes
14	Develop a comprehensive testing and approvals strategy which sets out the roles of organisations, the deliverables required to support ROGs, RIR and internal processes. This strategy should set out how to address non-compliances, deviations and the process and scope for derogations.	The Programme is currently developing a cross-industry approvals strategy covering trains and infrastructure. The intention is that this will be included in the ERTMS Handbook(s). *Accepted*.	Yes at a strategic level.
15	Develop a detailed test specification (against all the specification requirements) so that all relevant parties (NoBos, ISAs, suppliers/certifiers/testing labs do not have ambiguous requirements.	High level test specifications have been developed for infrastructure and trains. Test cases will be developed following the Thameslink model and proven at HNIF by following a robust a robust V&V cycle. Some test scenarios will be UK specific e.g. coupling and un-coupling and 2 cabs open at the same time. *Accepted*.	No
16	Review the list of stakeholder recommendations (in Section 6) to establish whether these are applicable to improving the effectiveness and efficiency of ERTMS testing.	Agreed. This would be reported back through the PCB. *Accepted*.	Yes
17	The overall training approach appeared successful and would be a good model for future rollout. Training should reflect what to do in real scenarios, not just a description of the functionality provided by the system.	NR advised that ESG have requested that a National ETCS Academy is established covering all activities associated with an ETCS rollout. Scope will be defined in April 2012 and a report will detailing recommendations for re-skilling the GB railway will be produced in December 2012. *Accepted.*	No

Ref	Recommendation	PCB Response	Critical?
18	The industry should expect and plan for significant reliability growth before commissioning and that this will need to be considered in the context of commercial contracts.	NR has already carried out analysis and have Predicted Reliability Growth Requirements. Recommendation 5.3 identifies whether the performance is good enough to go and this recommendation provides continued growth. *Accepted*.	Yes
19	The industry should establish the requirements for fault reporting and that this information should be provided by suppliers without commercial restriction.	The PCB recommends that a national DRACAS needs to be established. *Noted, but specifically the ERTMS team need to specify to suppliers the information they need and will continue to need through the life of their equipment, regardless of whether there is a national DRACAS in place or not.*	No
20	A maintenance and migration strategy should be established (based on supplier's systems) which sets out the principles for how system maintenance and upgrades will be undertaken. This should establish indicative working practices, timeframes and fall backs. This should then inform reliability and availability assessments.	Agreed. *Accepted*.	Yes at a strategic level.
21	Network Rail should comprehensively capture the issues arising from Cambrian (and emerging from Thameslink) and how they were addressed to provide a reference base (perhaps as a risk register) for national development and avoid losing industry knowledge gained during implementation. This would provide a framework to test national requirements and specifications.	Disagree. NR advised that risk reviews for Cambrian and Thameslink have been captured in a Programme Risk Register. The GRIP 3 study includes lessons from Cambrian. The output of the GRIP 3 study should reduce risk costs. *Noted, but from discussion only high level risks were discussed and no evidence was provided. We would expect that this would be undertaken comprehensively to provide a baseline for national rollout.*	Yes
22	A clear development path is established setting out all the common and different requirement between Cambrian and GWML. This should consider a comparison between key project documents (Operations Concepts; Specifications; testing and approvals Strategy, Traffic Management, RAMS etc). The purpose of this is to ensure that there is sufficient time and resource to deliver within the timescales.	NR advised that it is acknowledged that getting the right organisation in place is key to delivering the programme and although we are not completely there at the moment plans for a "Core Development Team" are being progressed. *Accepted*.	Yes

Ref	Recommendation	PCB Response	Critical?
23	The business case should be fully updated with a transparent assumptions document which links to ERTMS requirements, Cambrian (and other) costs and timeframes. The business case should be at a level of detail to support effective decision making on ERTMS implementation and scope options.	NR note that the Business Case is Reviewed by the DfT. *Noted, but the business case needs to be in a position to be able to trade off any cost and performance issues arising through the requirements, specification and technical development phases.*	Yes
24	Establish a governance framework that is effective in resolving and agreeing key ERTMS decisions.	The Governance structure of the programme in terms of Programme Control Board (PCB) and ERTMS Strategy Group (ESG) are well understood and communicated. Recent developments include the addition of the System Body and Train Fitment Steering Group. *Accepted. However, the key test is whether this is an effective and efficient structure to deliver a national programme through the different development to implementation and rollout stages.*	Yes
25	Develop a comprehensive ERTMS briefing pack setting out ERTMS background, directives, terminology and objectives to provide the basis for a programme 'new starter pack'.	An ERTMS briefing pack is currently being developed by the Programme. *Accepted*.	Yes
26	Achieve Ministerial buy-in for ERTMS based on its benefits for passengers, drivers and maintainers.	NR has discussed this already with the minister and the DfT advised that ERTMS is policy and will be included in the June 2012 HLOS. *Accepted*.	Yes

Table 1.1: Recommendations

1.7 Conclusion

The industry has learnt significantly from implementing ERTMS on the Cambrian Lines. The Cambrian ERTMS implementation demonstrates that an ERTMS Level 2 system without lineside signals can be retrofitted to existing infrastructure and rolling stock.

There is a wealth of knowledge and experience across the industry which will enable a national rollout to be undertaken with reduced risks and a greater chance of delivering within time and budget. However, it is strongly recommended that the risks and issues from the Cambrian implementation are comprehensively captured to provide a baseline for national rollout and that these are agreed by the industry.

Halcrow acknowledges that the industry continues to develop ERTMS. It is therefore recommended that an ERTMS programme review is undertaken in Autumn 2012 to review the critical recommendations identified above to form a view on whether the current proposals for national rollout are achievable.