The Train Still Standing at Platform Six – HF & NTS Development in the Australian Railway Industry

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SUMMARY

The management and optimisation of human performance is considered a key part of rail safety. Recent Australian rail accidents have brought focus to this fact and the Australian industry with its widely diversified types of operations, organisations and environmental conditions, has moved to improve its performance in this area. The regulatory bodies have invested significant effort in developing Rail Resource Management (RRM) training for the industry. The RRM Program, a form of non technical skills (NTS) training includes comprehensive guidelines and a toolkit developed by the New South Wales Independent Transport Safety Regulator and Transport Safety Victoria. While a current study is underway to formally assess the uptake of RRM by industry this uptake appears generally slow. Queensland Rail is one rail operator which has taken the RRM program and keenly driven implementation of the training, using its safety management system (SMS) and a normal operations monitoring program to guide development. This effort appears to be delivering results with a comparative drop in the Signal Passed at Danger (SPAD) rate for new drivers receiving the training.

Part of the challenge in implementing such a program is that the Australian rail industry is inexperienced with human factors or non technical skills training. A great guideline and toolkit has made change available and easier, but embedding the optimisation of human performance in an organisation that has little prior human factors experience also requires significant cultural change. Kotter's "Eight Stage Process of Creating Major Change" appears to identify many of the challenges to change paralleled in the lessons learned from both RRM and previous Crew Resource Management implementation. The application of such a model within the Australian rail industry may provide the foundation required for enabling widespread adoption of the excellent tools available to manage error and optimise human performance. Effective cultural change will be required to embed HF and non technical skills training as an important risk control in a rail organisations' SMS.

NOTATION

CRM – crew resource management

HF- human factors

NTS – non technical skills

RRM – rail resource management

SMS – safety management system

SPAD – signal passed at danger

INTRODUCTION

As long as humans are involved in the design, operation and maintenance of the rail system, the management and optimisation of human performance will form a key part of rail safety. We may like to think that we can design the human out of the system, but that design in itself, while conducted by humans is prone to the human condition.

Efforts to design away human error in other industries and endeavours may give the impression they have solved the problem, only to be reminded of the pervasiveness of human error at the most critical of times. The NASA mission to Mars, the "Mars Climate Orbiter", having travelled nine months through space to reach Martian orbit in September 1999, burned up on entry into the Martian atmosphere as a result of ground based computer control which had been programmed by NASA personnel to produce output instructions in imperial pound force (lbf) rather than the metric units of Newtons (N) required[1]. The NASA mishap investigation identified communication between design teams as a contributing factor amongst other failures of system defences.

Such design efforts have also at times created conditions which can make the human interface even more challenging and leave more opportunity for error. The crew of flight QF32, the A380 aircraft that had the catastrophic engine failure on departure from Singapore in November 2010, were faced with just such a problem. The automatic management of failures in the aircraft's systems prioritises failures and presents them sequentially on a screen for the crew to deal with. There were 54 such identified failures due to the catastrophic failure of the engine spraying debris that impacted numerous systems [2]. Excellent knowledge, training, effective teamwork and leadership exhibited in their non-technical skills allowed the crew to manage the hitherto unpredicted and exceptionally complex situation. It is no exaggeration to state that the crew's actions prevailed over the technological limitations to save the lives of all those onboard.

The management of error and optimisation of human performance has also been recognised as a key part of the quest to make Australian railways safer. The detailed investigations of the Glenbrook and Waterfall accidents in New South Wales both contained recommendations to improve control and management of human error and improve human performance [3,4,5]. Since then the Australian rail industry and its regulators have made significant efforts to improve human factors and non-technical skills and this paper examines those efforts. The paper reflects on similar improvement efforts in other industries and considers lessons that may be learned for the implementation of future human factors training programs.

The Australian Rail Industry in context

The Australia rail industry has some particular characteristics which are important to understand for the influence they have both on the individuals who operate in the system and the efforts to manage the system itself. Australia is a large continent with a relatively small population and the term 'the tyranny of distance' is quite appropriate to describe the main transport and logistical challenge the country faces. While the rail network does not cover the whole country, which is approximately 7.6M Km^2 and 31.5 times the size of the United Kingdom, the routes linking major centres and regions are very long and often quite remote.

There is a broad mix of business in Australian rail, including the busy urban networks in major centres, intercity routes and the long regional passenger transport routes (Brisbane to Cairns is 1691km and the Indian Pacific route covers 4352km). There are a number of heritage train operators who operate trains, some on the main network, but most on their own dedicated rail tracks. There is a mix of private and publicly owned operations across the network, infrastructure and train operating organisations.

The bulk freight (heavy haul) rail business is a key service to the Australian resource sector, hauling coal in the Hunter Valley in NSW, minerals and coal through Northern Queensland and massive movements of iron ore in the Hamersley Ranges of Western Australia. Bulk freight accounts for 89% of the total railway freight task [6]. In the Hamersley Ranges axle loads up to 40 tonnes are the norm and trains are pulling in excess of 35,000 tonnes of iron ore at a time. General intermodal (non-bulk) freight operations in Australia are generally not as efficient as the bulk systems and also face significant competition from road haulage.

As a result of the historical development in different States, the Australian rail industry has also faced the challenge of various rail gauges for over 150 years. The industry still utilises 'standard gauge' (approximately 17,678 km, mainly in NSW and for the uninterrupted operation of interstate trains on the Inter Capital Rail Network) narrow gauge (approximately 15,160km in Queensland, Western Australia, Tasmania and some of South Australia) and broad gauge (approximately 4,017km mainly in Victoria).

The first fatal railway accident in Australia occurred on 10 July 1858, involving the Sydney Railway Company on the Great Southern Line, near Parramatta. The first Royal Commission occurred after the deaths of 27 people at Murrurundi on the Northern Line out of Sydney, when runaway trucks hit an oncoming passenger train in September 1926. The rail disaster at Granville, a suburb in western Sydney on 18 January 1977 remains Australia's worst rail accident, based on loss of life, with 83 people perishing and more than 210 injured. More recently the Glenbrook Accident on 2 December 1999 and the Waterfall Accident on 31 January 2003, resulted in major investigations (including Special Commissions of Inquiry), both of which made findings with respect to human factors and contributed to significant regulatory change [3,4,5]. Each of the accidents mentioned involved significant human performance issues. There has been considerable effort in recent years to advance the understanding of human factors and improve the management of these issues. These activities will be examined in more detail shortly.

While adding to the impetus to improve human factors, these later accidents also placed significant focus on the regulation of the rail industry, with the Special Commissions of Inquiry leading to the establishment of improved and independent regulatory bodies and new regulations based on safety management systems, including specific HF regulations. Most recently, a single National Rail Safety Regulator to replace seven existing regulators has been established by the agreement of the Commonwealth, State and Territory governments. The National Rail Safety Regulator is expected to commence in January 2013 and will oversight a single National Rail Safety Law.

Australia then, has a rail industry which is widely diversified in types of operations, organisations and environment it covers.

Human Factors and Non Technical Skills Development and Initiatives

As a result of the need to respond to recommendations from Special Commissions of Inquiry, the issue of human factors and as it was then known Crew Resource Management (CRM) training was tackled in 2005. The major initiative in Australia since then has been that of the Independent Transport Safety Regulator (NSW) and Transport Safety Victoria which have collaborated on behalf of the Rail Safety Regulators Panel, to produce an applied human factors training package, based on CRM. The project, called Rail Resource Management (RRM) included a review of best practice in CRM and production of RRM guidelines and a generic training toolkit [7]. The RRM guidelines and toolkit were officially launched at the close of 2007. A pilot program was conducted with Australia's largest regional public transport operator, V-Line in Victoria in early 2009 when external facilitators delivered three courses. The trainees were from all different 'operational' parts of the organisation and received a one-day course covering; threat and error management, workload and task management, and finally communications and teamwork. A program evaluation was completed later that year.

The results of the program were mixed but generally favourable for an initial course. Feedback from participants suggested the most useful elements were training in situational awareness and communication, the opportunity to discuss issues in groups and the cross role interaction that occurred [8]. The less favourable feedback surrounded issues which are common with implanting new CRM programs, such as the importance of using facilitators with local knowledge and credibility, wider staff involvement and the relevance of information to the individual rail operator. The non-contextualisation of HF/NTS programs is one of the most common criticisms and areas for improvement, not only in HF/NTS training but in many other adult learning situations. The issue relates to the need to use situated cognition to actively engage the adult learner. This presents a big challenge for any new program implementation where organisations that do not

already have suitably qualified or experienced personnel and so was a predictable observation for the V-Line pilot.

Queensland Rail (QR) is currently running a NTS program for frontline staff developed in house to suit the local context and based on the RRM Guidelines. This program involved considerable effort in tailoring content to meet the QR training needs analysis and in the recruiting and training of in-house facilitators. The course has also been targeted well through integrating the findings of normal operations monitoring (similar to the aviation based Line Operational Safety Audit observations) called CORS (Confidential Observations of Rail Safety) [9]. This considerable effort appears to have "paid off in spades" or more specifically "paid off in SPADS". Results so far indicate that among new drivers, 26.32% of drivers who did not receive RRM training were involved in a SPAD, whereas for those who had received the training, the percentage dropped to 13.71%. The program cannot yet exclude other factors, but currently the RRM training appears to be showing positive results, as well as being well received by staff.

Lessons from Rail HF NTS uptake

There have been a number of lessons identified from the undoubtedly ambitious Australian RRM program, which has been implemented in what could be considered virgin territory. In the early phase of the project it was identified that there were few "CRM" programs for rail in the English speaking world and while the project had considered the lessons from these previous programs, new lessons also became apparent.

It was recognised early in the program that the fact the initiative was being launched by the "regulators" could be seen as an obstacle in itself, with critical examination of the role of the regulator in "prescribing" regimes for industry members [7]. In Australia "regulation" is enacted under a "co-regulatory model" and this resulted in some level of discomfort within the rail industry over the regulators taking such an active step to raise awareness and education. This resulted in some mistrust and resistance to the program. At the time there were also seven state Regulators whose opinions needed to be considered, requiring increased consultation during the development process. This last point of course will in the future be less of an issue with the creation of the single National Rail Safety Regulator.

The project also recognised that considerable effort and consultation was required from those individuals who believed in RRM and the aims of the program – so called "RRM champions" [7]. Importantly it was recognised that for the project to really take hold, RRM needs to be championed by rail operators themselves and not just the "HF believers". This point can be related back to the experience in V-Line where the use of external facilitators was seen as a drawback to the pilot program.

The lack of foundational knowledge about CRM principles and human factors was also recognised as a challenge to the project. It is reasonable to state that at the time the program was launched the general awareness and knowledge of HF in the Australian rail industry was overestimated and in many cases the program provided the first introduction to HF and its various real and potential applications in rail. In retrospect, this finding is not surprising, given the history of development of CRM in the aviation industry. The first "cockpit resource management" courses were developed in the late 1970s after a series of terrible aviation accidents, including the Tenerife tragedy in 1977 (with 583 fatalities it is still the worst airline accident in terms of loss of life) where fully functioning and serviceable aircraft were involved in disaster. Since that time CRM training has gone through thirty years and "six generations" of development resulting in the present day non technical skills programs which equip crews with the skills, knowledge and ability to manage threat and error identified through both their own skills and fully effective safety management systems. To expect that an industry without these years of HF experience would easily absorb such training, without some type of bridging program to establish a base level of understanding of the principles, could be considered optimistic.

After the pilot the program was released to industry as a whole with presentations, website information, workshops with safety managers, industry briefings, an official launch and the development of plans for encouraging take-up by industry. Facilitator training courses were also held in February 2011 to give the

participants the knowledge and skills to run a local program. The lessons drawn from the pilot program were also included in updated “how to go about implementing RRM” guidance [10]. Many of the lessons learned from the pilot were included in the implementation guide provided to industry and currently both ITSR and TSV are conducting a further study to assess what the residual uptake effect has been. This report will be published in late 2012. In the end the major challenge for this project which was instigated and driven by the regulators was deciding when to “let go” and leave industry to take the initiative forward. The current study should provide some indication of whether industry really has taken hold of the reins in implementing RRM.

Lessons from implementation of HF/NTS in other industries

As mentioned above, aviation has had a lengthy period in which to develop its understanding the gamut of human factors and their effects on human performance in the workplace. In particular, there is recognition through the different generations of development of human performance training that error is pervasive and ubiquitous in any human activity and especially in aviation, but also that it can be managed and mitigated [11]. This resulted in a fundamentally different approach to training, which had previously focused on the purely technical aspects of the tasks at hand. There was also a clear recognition that such training needs to be ongoing and reinforced, as without this, attitudes and practices decay and also (as was identified in the Australian RRM pilot) the training must be contextually relevant to the organisation in which it is applied [12].

There have also been many painful lessons learned from focusing on the human performance aspects of accidents and incidents and the results of these lessons are changed practices or standards which act as error management controls. A simple example of this is the radio–telephony standards which require use of set phraseology when communicating by radio, so that the risk of ambiguity is reduced as every phrase used has a specific and commonly understood meaning. These factors in combination have resulted in a professional culture where human performance limitations are accepted as a fundamental part of aviation operations and error is accepted, and controlled appropriately.

While a large amount of work and research has been conducted on the technical detail of what should and shouldn’t be covered in HF and NTS training and how it should be approached (for example see the review of best practice conducted in preparation for RRM [13]), what is often overlooked are the real cultural differences between industries - and indeed organisations - and the fact that such training provided in isolation may not be effective in improving human performance in the long term. What is really needed is organisational change that results in an improved safety culture, inculcating human performance optimisation into the business. There are real lessons to be had in taking a macro approach to the organisational change required and there are many different models available to do this. In this paper the Kotter model of change is considered relevant to the challenge of implementing HF or RRM into the rail industry in Australia.

John Kotter postulates that any method used for effecting successful organisational change faces numerous challenges preventing it from occurring easily [14]. Kotter identified common errors in change efforts and their consequences and it is useful and revealing to relate these lessons to those challenges that have already been identified in the Australian HF/NTS program(s) as described above. Kotter’s observations of the errors included;

- complacency (where there is insufficient urgency created amongst managers and employees for the change to commence)
- failing to create a sufficiently powerful guiding coalition to lead the change
- underestimating the power of a sensible and coherent vision and purpose for the change
- under communicating the vision (by a large degree) to key stakeholders
- allowing obstacles to block the pathway
- not providing compelling evidence that change is occurring early in the piece

- relaxing the effort and pressure for change too soon after the first evidence of success
- not embedding the change through the organisation sufficiently so it actually becomes “the way we do things around here”

It is easy to recognise some of the issues Kotter highlights when considering the observations made earlier on the lessons from RRM implementation in Australia.. Complacency was characterised by the rail regulators being the agents for the change effort and while there was considerable industry involvement (once invited to be part of the program) it is debatable whether those involved were at a senior enough level in their target organisations. Similarly, whether RRM’s industry champions had a suitable “coalition” in their own organisation is unclear. Management commitment - be it in implementing an Safety Management System (SMS), HF NTS program or other similar safety change effort - is universally recognised as being essential. The lack of trust indicated by the questioning of the regulators involvement in the program is an indication that a coherent vision was not shared by all participants.

While there are other parallels that can be drawn or inferred, the final one considered here is the provision of compelling evidence that change is occurring. With the best intentions, the RRM project managers ran the pilot with V-Line to validate the program, but how much this provided evidence to support other organisations to take up RRM is not yet clear. It is clear there was sufficient confidence for Queensland Rail to invest in a program. While it has traditionally been seen as difficult to measure performance outcomes for HF NTS programs, Queensland Rail has demonstrated recently it is possible to do so. The planning of both leading and lagging safety performance indicators as part of the program would be an essential part of a successful implementation. It would also have the added benefit of providing a clear key into the organisations SMS for the program as part of the safety assurance process and thereby demonstrating the effectiveness of the risk control.

Even if the case for implementing the change is clear through effective performance monitoring (or in the Australian situation, required as a result of a Special Commission of Inquiry recommendation), bureaucracy, introverted cultures, local politics, a lack of trust, inadequate leadership, poor teamwork, arrogance and fear all have to be overcome to ensure change occurs and persists. The change method must address these challenges and attack them at their root by altering strategies, processes and standards. The Eight-Stage Process of Creating Major Change (Figure 1) [14] shows the steps associated with managing what are considered to be the fundamental errors that can forestall change efforts. Future efforts to introduce HF/NTS training across the breadth of the Australian rail industry appear to have been provided with the tools to implement the technical aspects of HF/NTS training. Perhaps in the future, we need to focus more on the bigger picture and look outside our own domains for effecting permanent change to the organisational safety culture and making the optimisation of human performance, and the management of threats and errors “the way we do business around here”. Models such as Kotter’s can help us do this.

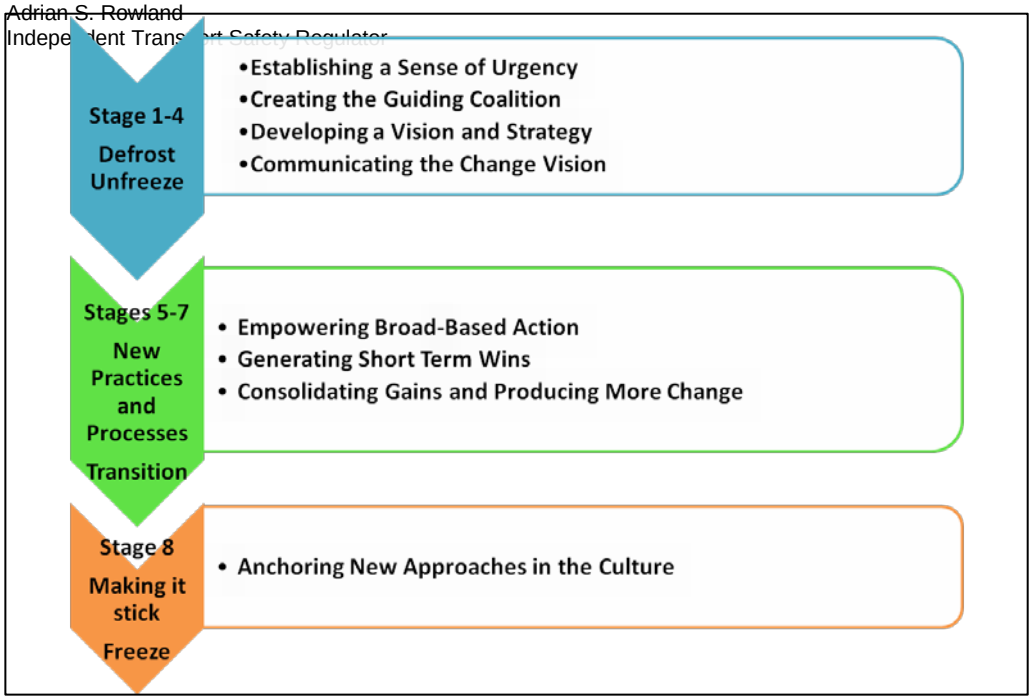

Figure 1: Kotter's Eight-Stage Process of Creating Major Change [14].

How HF/NTS initiatives can be applied and integrated in Australian Rail Industry in the future

HF/NTS training can provide effective risk controls but to be effective they must be integrated into your SMS and other systems, and their control effectiveness measured. Developing effective leading safety performance indicators and measuring performance before and after training are essential parts of the program. The real challenge is not in developing the NTS training course content – there is plenty of content available from practitioners, not just academics, and the resources available under RRM are excellent. The real challenges for organisational initiatives in the future lay in:

- absent leadership
- bureaucracy
- introverted cultures
- local politics
- trust
- poor teamwork
- arrogance
- fear

These blockages can be found in any business and organisations need to look beyond their human factors expertise for solutions to these issues. Kotter's model as detailed above is a good place to start but the change will not happen without significant effort and leadership. Each organisation must share a clear vision of what it is trying to achieve and what the end state looks like. A broad commitment at both the macro and micro levels needs to be secured, but especially at the head of organisations. Don't underestimate the scale of cultural change required. One RRM program won't change a culture and don't underestimate the importance of contextualising and localising the programs – there is no one size fits all solution at any level. Finally, if a knowledge and experience gap exists, it is essential that you build a bridge across the gap before you run your program.

CONCLUSION

As long as humans are involved in the design, operation and maintenance of the rail system, the management and optimisation of human performance will remain a key part of rail safety. Recent Australian rail accidents have brought focus to this fact and the Australian rail industry with its widely diversified types of operations, organisations and environmental conditions, has moved to improve its performance in this area. Significant effort has been invested by the regulatory bodies in developing Rail Resource Management training for the industry. The program, including comprehensive guidelines and a toolkit were fully and professionally developed by ITSR and TSV. While a study is underway to formally assess the uptake by industry this uptake appears slow. Queensland Rail as an organisation has taken the RRM program and really driven the implementation of the training, with the support of its SMS and guidance from a normal operations monitoring program called CORS. This effort appears to be delivering results with a comparative drop in the SPAD rate for new drivers who have received the training.

Part of the challenge in implementing such a program is that the industry itself does not have a great deal of experience with such training or indeed human factors training. Parachuting in a great guideline and toolkit makes change available, but embedding the optimisation of human performance in an organisation with little prior experience requires cultural change. The Kotter Eight Stage Process of Creating Major Change appears to identify many of the challenges to change paralleled in the lessons learned from both RRM and CRM implementation. The application of such models within the Australian rail industry may provide the next step to getting the excellent tools available adopted and used to manage error and optimise human performance. Effective change will embed HF/NTS training as an important risk control in organisations' SMS and also make it part of the way we do business around here (and "Down Under"!).

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APPENDIX 1:

APPROVAL TO PUBLISH PAPER

I/We Adrian Rowland of the Independent Transport Safety Regulator, NSW, Australia hereby give permission to the International Railway Safety Conference 2012 (IRSC 2012) to publish the paper titled:

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To be presented at the IRSC 2012 conference to be held at the St Pancras Renaissance Hotel, London, England on 8 - 12 October 2012.

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