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REAPING THE BENEFITS – HOW RAILWAYS CAN BUILD ON LESSONS LEARNED FROM CREW RESOURCE MANAGEMENT

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Abstract

Recent accidents and incidents in the Australian rail industry have highlighted a need to improve the 'non-technical skills' of rail safety workers. These include specific behavioural competencies such as team communication and co-ordination, planning and contingency management, critical decision-making, situational awareness, and workload management.

Although rail safety workers are provided with adequate technical and procedural training, there has been comparatively little focus on those non-technical skills that enable operational staff such as drivers, guards, train controllers, signallers and track workers to effectively manage hazards and errors in the workplace. Programs to address such skills were originally developed in the aviation industry and are widely known as 'Crew Resource Management' training (CRM).

The Independent Transport Safety and Reliability Regulator of New South Wales (ITSRR) and Public Transport Safety Victoria (PTSV) have conducted, in partnership with the rail industry, a national project to develop an applied Human Factors CRM-based package (Rail Resource Management, or RRM) that draws on the experience and learnings from other industries and adapts them to the Australian rail environment. To ensure that the program would be appropriately customised to the needs of the Australian rail industry, considerable research, analysis and consultation with stakeholders was undertaken. The project deliverables included a best practice review, RRM Guidelines, and a generic training toolkit.

The RRM Guidelines and training toolkit were officially launched at the end of 2007. While the development part of the project is complete, ongoing work is required to market the guidelines and toolkit to industry and raise awareness. Future activities will see a rail transport operator pilot RRM training in their organisation.

This paper broadly describes the program and discusses the lessons learned from its development and implementation in the Australian rail industry.

Keywords: CRM, training, error management, Rail Resource Management

1. Introduction

In the late 1970s the aviation industry experienced a number of accidents in which a major contributing factor was a lack of aircrew coordination, that is, an inadequate use of available resources. In the early 1980s the international aviation community introduced a series of cockpit resource management programs, which came to be called Crew Resource Management (CRM).

Today, CRM training is mandatory for flight crew in the civil aviation industry. It has

also been extended to other areas within aviation such as maintenance and dispatch, as well as to other industries such as defence, medicine, and shipping.

International and Australian accident investigation and research (e.g., McInerney, 2005) provides strong support for the view that CRM training could benefit the rail industry. While the concept of applying CRM training within rail is in its infancy (Morgan, Kyte, Olson & Roop, 2003), the international and Australian rail industries are exploring the opportunities to be had from the application of such training programs.

The Independent Transport Safety and Reliability Regulator (ITSRR) and Public Transport Safety Victoria (PTSV) have conducted, in partnership with the rail industry, and with the endorsement of the Rail Safety Regulators Panel (RSRP)[1], a national project to develop generic CRM training for the Australian rail industry.

This training package (called 'Rail Resource Management', or RRM)) draws on experience and learnings from other industries and adapts it to the Australian rail environment. To ensure the needs of the Australian rail industry are met, considerable research, analysis and consultation with stakeholders was undertaken.

The program is unique in terms of its comprehensiveness, the incorporation of risk-based Training Needs Analysis and its customisable format. The project deliverables included a best practice review, RRM Guidelines, and a generic training toolkit.

In this paper, we describe the development of the RRM package and discuss some of the opportunities and pitfalls associated with its introduction in order to provide insight into how future projects can be improved, and to identify some common misconceptions about CRM and Human Factors that need to be addressed.

2. Adapting the CRM concept to the Australian Rail industry

2.1 Objectives and application of CRM

CRM is one example of the application of Human Factors knowledge in operational settings and provides the structure through which non-technical skills can be developed. To date, the most successful non-technical skill development has been through CRM training programs.

CRM training aims to improve threat identification skills and the management of human error through the utilisation of all available resources (human, informational, procedural and equipment) in order to achieve safe and efficient operations.

CRM skills typically refer to specific competencies such as team communication and co-ordination, planning and contingency management, critical decision-making, situational awareness, workload management, leadership and assertiveness.

CRM program should be customised to meet the specific operational requirements and culture of the organisation concerned. However, regardless of the specific content of different programs, the common denominator of contemporary CRM programs is their focus on "threat and error management" at the individual and crew levels.

These programs are based on the principle that errors are ubiquitous and inevitable (Helmreich, Merritt & Wilhelm, 1999), and their consequences should be managed. CRM programs focus on training operators to develop error countermeasures such as error avoidance, error trapping and error mitigation.

To gain acceptance of the error management approach, organisations must

[1] Rail Safety Regulators Panel of Australia and New Zealand (RSRP)

communicate their formal understanding that errors will occur, and should adopt a non-punitive approach to error. In addition, a learning culture within the organisation should be reinforced from the use of positive examples of how errors are detected and managed.

2.2 From CRM to Rail Resource Management (RRM)

Rail safety workers face the same challenges as front-line operators in other high-risk industries. They have a key role to play in ensuring safety in a dynamic, demanding operational environment by managing threats and errors effectively. Just as other industries have recognised the need for specialised training to complement comprehensive technical knowledge and skills, the rail industry worldwide also now appreciates that CRM skills in the areas of communication, coordination, situational awareness, decision making and threat and error management are essential in preventing accidents and incidents.

There is strong support for the need to address Human Factors issues, in particular CRM, in the rail industry. For example, the US Federal Railroad Administration (FRA, 2002) reports that since 1985, Human Factors issues have accounted for approximately one-third of all rail accidents and half of all rail yard accidents in the United States. More specifically, human error has been identified as a causal factor in up to 37% of all train accidents not related to highway rail grade crossings (FRA, 1999). Further, ineffective CRM has been identified as a contributing factor in a number of major rail accidents (National Transportation Safety Board (NTSB), 1999a; 1999b, Office of Transport Safety Investigation (OTSI), 2004; Transportation Safety Board (TSB), 1998), confirming a direct link between CRM behaviours and safety within the industry. The NTSB investigation report into a 1998 train collision in the US state of Indiana (NTSB, 1999b) concluded that railroad safety would be enhanced if rail safety workers received 'Train Crew Resource Management' training (TCRM) and recommended that TCRM training be developed for all train crew members.

In the Australian context, the Special Commission of Inquiry report into the rail accident at Waterfall NSW in January 2003 included the recommendation that, "Train driver and guard training should encourage teamwork and discourage authority gradients" (McInerney, 2005a). A subsequent review of safety management systems within the operator was even more prescriptive, recommending "customised human factors training for rail safety workers and management/supervisory level staff based on contemporary Crew Resource Management principles" (McInerney, 2005b).

The need for CRM training within the Australian rail industry had, however, been identified before the Waterfall accident. The investigation of a collision between a passenger train and a derailed ballast train near Bargo NSW in 2002 (Transport NSW, 2000) identified deficiencies in post-accident communication and emergency management, and attributed these to inadequate resource management. A recommendation for corrective action was made that "all Rail Safety Workers undertake Crew Resource Management training to increase their competence in the use of all resources".

Some CRM-related activities have been undertaken in Europe, for example training in communication skills and teamwork in the UK (Mills, 2003; Rail Safety and Standards Board (RSSB), 2004). However, it appears that CRM has to date only been formally adapted to significant components of the rail industry in North America. Even there, the adoption of CRM training principles has been sporadic and fragmented. For example, the NTSB reports that in 1996 they became aware of a CRM program implemented by the former Southern Pacific Railroad (now Union Pacific) that was apparently based on the training provided to flight crew at American Airlines (NTSB, 1999b). This program was reportedly established in the late 1980s

(FRA, 2004b) and the NTSB reports that Union Pacific has required all new employees to undertake this training since 1998. Further NTSB (1999b) enquiries into this program have not yielded additional details. Canadian Pacific Railway (CPR) has conducted a two-day CRM training program for new-hire conductors and trainmen since 1999 (Ackerman, 2005). About five years ago the FRA Railroad Safety Advisory Committee (FRA, 2000) reported that a combined project between the Association of American Railroads (AAR) and Canadian Pacific had commenced to develop a generic CRM program based on existing CPR materials that could be customised for each individual railroad.

In 2003 the Texas Transportation Institute (TTI) conducted a study to collect information about the extent of CRM activities in the North American rail industry (Morgan et al., 2003). The major current CRM activities in rail appear to be those conducted by Canadian Pacific and the Texas Transportation Institute. The Transportation Safety Board of Canada (TSBC) reports that the AAR has adapted the Canadian Pacific CRM program for generic use by all North American railroads (TSBC, 1998). Finally, the Texas Transportation Institute, working with the FRA's Office of Railroad Development, Office of Safety, and Burlington Northern Santa Fe Railway (BNSF) have developed a pilot CRM training program for the rail industry (FRA, 2004a).

3. The National Rail Resource Management Project

3.1 Background, Objectives and Approach

The National Rail Resource Management project was commissioned in June 2005 with the purpose of providing guidance to the Australian rail industry on implementing training based on CRM principles. The project's vision was to provide a resource that would improve understanding of CRM benefits and provide practical guidance and tools.

Objectives for the project were to:

- Establish a best practice model for the application of CRM for the rail industry, drawing on the experience and contemporary practices of other high-risk industries;
- Develop a strategy to facilitate a successful implementation of CRM in the rail industry;
- Develop Guidelines for competency-based CRM using behavioural markers tailored to the specific needs of the rail industry and rail safety workers; and
- Develop generic resources that provide a starting point for rail organisations wishing to implement a CRM program.

One of the major challenges in developing an RRM program is that any 'off-the-shelf CRM' training is unlikely to be successful since customisation to the particular needs of an operator and its occupational groups is crucial. As a consequence, an RRM program that would be suitable for all operators (e.g., large passenger and freight, small tourist and heritage) and a range of occupational groups (e.g., drivers, track workers, network controllers, etc.) would have to be comprehensive and highly flexible.

The project was divided into the following three main stages with corresponding products.

(a) A best practice review. This included a review of contemporary CRM programs and their characteristics in a range of industries such as aviation (flight

operation and maintenance), air traffic control, nuclear industry, maritime, defense, health care, etc. Best practice principles were derived and documented in an Interim report (Dédale Asia Pacific, 2006).

(b) The identification of implementation issues. This was based on extensive consultation with industry stakeholders and comprised a sample of 130 people from 24 rail organisations across Australia. Industry briefings were conducted in each state and interviews were conducted with subject matter experts including urban and regional drivers, freight drivers, guards, train controllers, signallers and shunters. Implementation issues and potential solutions raised were incorporated into the best practice report and adopted during the development of the guidelines - the second stage of the project.

(c) The development of a rail safety behavioural marker framework. The purpose of this activity was to provide a method through which RRM training needs could be determined for different organisations and rail occupations. Since the scope of the project neither allowed nor required a formal comprehensive task analysis, an approach was taken to focus on the identification of generic safety activities that underpin safe and efficient operation in terms of non-technical skills. Data sources included existing behavioural marker systems, task descriptions for rail safety workers, accident and incident reports, and data from local rail industry projects as well as research reports. A hierarchical taxonomy similar to that used in the NOTECHS system (Flin et al, 2003) was developed to generate a set of behaviours that could be addressed through CRM training. The process by which specific RRM training needs are identified is further explained in the Guidelines for RRM.

3.2 The Guidelines for Rail Resource Management

The RRM Guidelines were the key deliverable of the project. They are based on the outcomes of the best practice review, including implementation issues and the framework for the RRM Training Needs Analysis. As such, they represent what is considered ’best practice‘ for the implementation of RRM.

The following aspects describe the main characteristics of the Guidelines:

(a) Step-by-step approach. The Guidelines are structured in a step-by step format. They take into account the unique characteristics associated with the implementation of RRM programs (i.e. preparing for RRM, developing a learning strategy and the training content, selecting facilitators, delivering training, integrating and extending RRM and evaluating the training). Information is also provided on how an RRM training program can be supported to ensure long-term effectiveness.

(b) Question and answer format. Each section is written in a ‘Question & Answer’ format aimed at anticipating the kind of questions that typically arise for each step during the implementation process.

(c) Best practice foundations with alternatives. The Guidelines are based on a best practice approach. However, it is acknowledged that achievement of best practice in the short term may be aspirational rather than realistic for many rail operators. Therefore, a number of alternatives for the design and implementation of RRM features is offered.

(d) Customisation. It is essential that RRM programs and materials are tailored to suit the needs of the specific rail organisation and different occupational roles. Risk-based Training Needs Analysis represents the centre-point of this process. The behavioural marker framework, based on a Safety Task Analysis developed during the first stage of the project, provides a set of generic task descriptors and behavioural markers that can be used to generate a profile of task requirements for

any rail safety worker role. The RRM program works on the premise that only a subset of behavioural markers will be relevant for a particular work role and need to be addressed in training. The Guidelines provide a process, which not only supports the selection and prioritisation of RRM training aspects, but also allows for organisations that already have a program in place to identify and address any existing gaps.

(e) Tools. The Annex of the Guidelines contains practical tools to assist operators with preparation, implementation and evaluation. These include the rail safety behavioural marker framework, a proforma for a risk-based RRM Training Needs Analysis, a safety culture self-assessment, an RRM attitudes questionnaire and a sample participant evaluation questionnaire.

(f) Training Toolkit. The training toolkit (provided via CD) was developed in the third phase of the project. It contains a training syllabus, course materials for facilitators and participants, case studies, exercises and some additional resources. In general, training materials are built around categories and elements of the behavioural marker framework in a way that allows operators to select materials according to their RRM Training Needs Analysis and customise the training program to their requirements.

4. The RRM Pilot

The initial scope for the project was to provide guidelines and training materials for the rail industry. However, during the phases of the RRM project dedicated to the development and review of the guidelines and training materials, the view that a pilot would be desirable grew stronger in both the Steering Committee and Reference Group. In particular, industry representatives felt that a pilot would enhance the uptake of the RRM program in providing a practical experience-based starting point. The RRM program is the first of its type in terms of its comprehensiveness and risk-based Training Needs Analysis, and that it can be customised to the needs of the individual operator. While the steps are described in detail in the guidelines, it is essential that the practical use of the materials is captured and lessons learned are communicated.

An Australian rail operator has agreed to conduct a pilot of the RRM guidelines and training toolkit with its staff. The aim is to implement a best-practice approach, following the RRM Guideline as closely as possible, which will allow for proper evaluation and feedback of the materials. This offers a unique opportunity to gather ‘lessons learned’ from the pilot and make them available to the wider industry.

An important piece of work during the preparation phase of the pilot has been the conduction of a Cost-Benefit Analysis for an RRM program. The model used for the Business Case was based on a recent report by the Federal Railroad Administration (FRA, 2007), which incorporated utility analysis[2]. It provided a monetary reflection of the savings anticipated if North American railroads were to introduce RRM.

The outcome of the Utility Analysis from the Australian pilot operator showed positive expected estimates and the RRM pilot program was subsequently endorsed by the executive management and is expected to start in the first quarter of 2009.

2 Utility analysis has been used in organisational psychology to estimate the net financial effects of resource management training interventions, and has been found to be a valid predictor of resource management training effects.

5. Lessons learned (to date)

The RRM project has generated significant interest in CRM type training and Human Factors in the Australian rail industry and from further afield in Europe and the United Kingdom. The size and scope of the project inevitably led to many insights and opportunities to improve on our approach for future large-scale Human Factors programs and the better integration of RRM into the Australian rail industry.

5.1 The role of the Regulator

The proposal to launch the RRM project led to some debate about the role of the regulator under the Australian co-regulatory regime. It is not considered modern regulatory practice to prescribe regimes for industry stakeholders. Rules still apply, but industry is given the responsibility of determining how they comply with the rules. The regulator still has a significant role in compliance and auditing and to raise awareness and where necessary challenge industry to raise the bar. As such, the RRM program is not mandatory and all materials are available to members of the Australian and New Zealand rail industries to be customised to meet their own specific needs. The regulator has a role in terms of awareness raising and educating the industry. This sometimes requires a significant amount of work in order to make the case sufficiently compelling.

An additional aspect that requires consideration is the work across jurisdictions in Australia as any National project needs to be agreed to by seven state regulators which work on different levels in terms of size and resources. Ongoing consultation and information is crucial to gain buy-in and support from all regulators.

5.2 RRM Champions

An important factor contributing to the success of this project was the commitment of members of the RRM Reference Group. Made up of union representatives, operational staff, safety managers, trainers and industry Human Factors people, the group had a key role to provide insight on industry issues and access to other stakeholders to the project consultants. However, over the life of the project, the group's guidance role grew extensively and we came to see this group as RRM champions. Future projects would benefit from development of champions from their earliest stages, as they have a significant role to play in winning over other industry stakeholders.

With projects of this size and scope, it is easy to underestimate the extent of the consultation required both for the purposes of information gathering and awareness raising. The benefit of the RRM Reference Group was that it was flexible, able to include stakeholders with a range of expertise as required, to meet as deemed necessary and could be focussed on specific problems as they arose. Of course, the challenge of such a group is to focus members on the areas of most importance in order to achieve the required outcomes within the set timeframes.

For RRM to take root and flourish in the industry it needs to be taken up and championed by rail operators themselves. The RRM Reference Groups' role as RRM champions is regarded as essential for its success in industry. As the project came to a close, the RRM Reference Group decided to continue the group as an industry RRM working group. Its aim is to foster awareness and providing a forum for sharing their RRM experiences.

5.3 Lack of knowledge about CRM and Human Factors

Whenever a discipline such as Human Factors is newly introduced to an industry, there is inevitably confusion about how it works, why it is important and its benefits. The application of Human Factors in the Australian rail industry is relatively new. While there has been some work over 10 or so years, this tends to have been limited to the larger companies. The RRM project highlighted a lack of knowledge about Human Factors and its various applications in the industry and often provided the first introduction to Human Factors for many of the industry stakeholders consulted.

While in general the initial reactions towards the project were positive, some resistance has been observed in two forms. The first argues that the industry has been doing Human Factors all along, and therefore, there is no need for this more formal approach. The second (contradictory) argument is that the industry has gotten along just fine without it – so why change anything. It is important to note that this perception might be stronger with any "regulatory initiative" – even if non-mandatory. While the majority of industry stakeholders are fully supportive of the RRM program and its objectives, others remain to be convinced. This issue has been in part addressed through the planned introduction of the RRM Reference Group.

These issues illustrate the need for good quality information about the benefits of Human Factors approaches and methods. While some marketing was always planned, future projects would benefit from explicit planning and funding for marketing and awareness raising. Activities that introduce and reinforce the benefits of CRM/RRM programs include a series of articles in industry magazines, regular briefing sessions as industry events and opportunities to see CRM/RRM in practice through other related industries. Also, ongoing marketing and awareness raising of the benefits of Human Factors applications in general is essential for the long term success of integration of Human Factors into rail.

5.4 Confusion between CRM/RRM and Human Factors training

The project also highlighted a common confusion amongst some industry stakeholders that CRM/RRM and Human Factors are the same thing. This is in part exacerbated by the habit within CRM circles of calling CRM programs, human factors training. It not only was important to constantly emphasise that the CRM/RRM programs were only one application of Human Factors in the area of training but also to distinguish between CRM programs and training focused on general awareness of Human Factors issues in the work place. In addition, there is a need to reinforce the traditional Human Factors approach of managing human error through good design and the application of Human Factors methods in the design process. It is also important to emphasise that CRM/RRM programs should be seen as a further defence against hazards and human error, not as a replacement for good design.

6. The future of RRM

This project has raised the profile of the need to address Human Factors issues in the rail industry and has provided operators with a relatively low cost opportunity to address hazard and error management at the individual and crew levels. In Australia a number of the larger rail companies such as Queensland Rail, RailCorp and recently V/Line have had Human Factors programs for some time including CRM style training components. Those operators have been actively involved in the RRM project and continue to develop their programs.

The RRM project continues in 2009 with the pilot of the RRM guidelines and training materials. Following the pilot, a report will be prepared for industry outlining implementation issues and lessons learned during the pilot.

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