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GUIDELINE

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Glossary of Abbreviations and Acronyms

Abbreviation/Acronym	Description
ARTC	Australian Rail Track Corporation
ATSB	Australian Transport Safety Bureau
ATP	Automatic Train Protection
CORS	Confidential Observation of Rail Safety
CMS	Competence Management System
CRC	Cooperative Research Centre
ETCS	European Train Control System
HFESA	Human Factors and Ergonomics Society of Australia
ONRSR	Office of the National Rail Safety Regulator
PFA	Psychological First Aid
ISO	International Standards Organisation
ITSR	Independent Transport Safety Regulator (NSW)
NTC	National Transport Council
RIFOD	Returned In Face Of Driver
RSSB	Rail Safety Standards Board (UK)
RTO	Rail Transport Operator
SFAIRP	So Far As Is Reasonably Practicable
SPAD	Signal Passed at Danger
SMS	Safety Management System
TPWS	Train Protection Warning System

Contents

1. Introduction

The purpose of this Guideline is to provide examples of good practice in preventing and mitigating the risks arising from a Signal Passed at Danger (SPAD) and to improve the understanding of SPAD risk. Rail Transport Operators (RTOs), which includes both rolling stock operators and rail infrastructure managers, may benchmark themselves against the good practice presented within this Guideline. Good practices have been presented in a scaled maturity model style to separate what is basically a minimal approach from the more sophisticated approaches indicative of a mature safety management system.

It is recognised that SPAD risks will vary between networks and RTOs and hence this Guideline is not intended to mandate any particular practices to manage SPAD risk. It is intended to share good practice and solutions within the rail industry. Effective management of SPAD risks will also assist in managing a range of other rail safety risks. The same precursors to SPADs can be factors leading to many other risks and it follows that good SPAD performance is a sound indicator of good safety management generally.

This document identifies a range of resources that may be accessed for further information about SPADs and SPAD risk management. In particular, the Independent Transport Safety Regulator (ITSR), the New South Wales arm of the Office of the National Rail Safety Regulator (ONRSR) produced a SPAD Guideline that provides tools and detailed guidance which can supplement work in this Guideline[1].

Whist the guidance herein focuses on the management of SPAD risk specifically, RTOs must consider SPAD risk management as part of their broader operational and safety risk portfolio and risk management strategy. This approach supports the principles of So Far As Is Reasonably Practicable (SFAIRP), which ensures that the legislated duty of care obligations of RTOs do not require safety at any cost. This Guideline also responds directly to the items in RISSB's *Hazard Register* relating to SPADs, particularly hazards 5.9.1.1 through 5.9.1.42 as well as 5.7.1.26, 5.7.1.27, 6.11.1.13, 9.13.1.4, 9.52.1.1. Refer to the *Hazard Register* for further details (RISSB, December 2013).

1.1 Intended audience

This Guideline is designed for:

- Rolling stock operators, and
- Rail infrastructure managers, including:
  - Those involved in shaping strategic organisational response SPAD management
  - All staff involved in the development and implementation of SPAD management strategies and those affected by SPADs.

1.2 How to use this Guideline

The Guideline is designed to be used by railway professionals seeking to improve the way in which they manage and prevent SPAD occurrences. It provides illustrated examples of international best practice in relation to the management and prevention of SPADs.

The remainder of this Guideline is structured as follows:

- Chapter 2 – background information about SPADs: why they occur, associated risks, classification and costs;
- Chapter 3 – common contributing factors that lead to SPADs;
- Chapter 4 – the development of SPAD risk management strategies;
- Chapter 5 – measures to prevent SPADs occurring;
- Chapter 6 – the importance of post SPAD incident management and data capture;
- Chapter 7 – examples of joint initiatives that can enhance SPAD management;
- Chapter 8 – a brief discussion on managing the implementation of new technology; and,
- Chapter 9 – suggested further reading.

Footnote: [1]ITSR, 2011, Managing signals passed at danger.

2 Background to SPADs

2.1 What is a SPAD?

The definition of a SPAD under the current *Guideline for the Reporting of Notifiable Occurrences: (Occurrence Notification Standard One (ON-S1) (2008)* is: a train that passes without authority a signal displaying a stop indication or stop aspect. Instances of rolling stock not being properly secured resulting in a runaway and subsequent SPAD are not covered by this Guideline as the risks associated with these events must be managed differently.

There are differing views on whether to include or exclude the passing of stop boards or other limit indicators without authority within the definition of a SPAD. The national legislation *Guideline for the Top Event Classification of Notifiable Occurrences: Occurence Classification - Guideline One (OC-G1) (2008)*, excludes the following:

- Failure to comply with hand signal; and
- Proceed Authority Exceeded
- At locations such as stop boards, limit boards etc.

Nevertheless, these are still reportable events and, most importantly, if passed without authority can lead to the same harmful outcomes as the passing of a conventional signal. In other operations around the world, stop boards are treated as fixed signals and if they are passed without authority these incidents are recorded as SPADs. More detail on stop boards and other limit of authority indicator exceedances is provided in Section 2.7.

2.2 SPAD risk taxonomy

All SPAD events are significant but some have far more potential to cause harm than others. Consequently, SPADs are most appropriately recorded by category. The list below is a general example of the types of categories into which SPADs can be divided.

1. The signalling equipment was working properly, but the train passed the signal at danger even though there was adequate opportunity for it to stop;
2. The signal reverted to danger in front of the train due to an equipment failure or signaller error, and the train was unable to stop before passing the signal; and,
3. The signal reverted to danger in front of the train due to an emergency, and the train was unable to stop before passing the signal.

Points 2 and 3, above, are referred to by some RTOs as a Returned In The Face of Driver (RIFOD) event. In practice, RTOs will need to consider their own operations carefully as other categories may need to be introduced. RTOs should establish categories of SPAD that are relevant to their operations recognising any regulatory requirement that must be considered within the organisation.

This Guideline is primarily concerned with SPADs that have the potential to cause harm to crew, passengers or members of the public. However, all SPADs are a cause of concern and have the potential for adverse commercial impacts as well as personal injury. SPADs should therefore be properly investigated to establish the underlying causes and determine action to be taken to reduce them.

2.3 SPAD severity

Further categorisation can be applied to rank each SPAD according to its severity – from the most severe resulting in injury or fatality, through SPAD events that have the potential to lead to harm, to those that were contained before reaching a point of conflict (within the signalling overlap).

In ranking the severity of a SPAD the following factors may be considered:

- Train passes the overlap / distance travelled beyond the overlap;
- Infrastructure damage;
- Derailment; and,
- Personal injury.

SPADs with varying levels of risk are illustrated in the figure below. In order to categorise SPADs accurately it is important to understand the risks associated with these incidents, which are discussed in the following section.

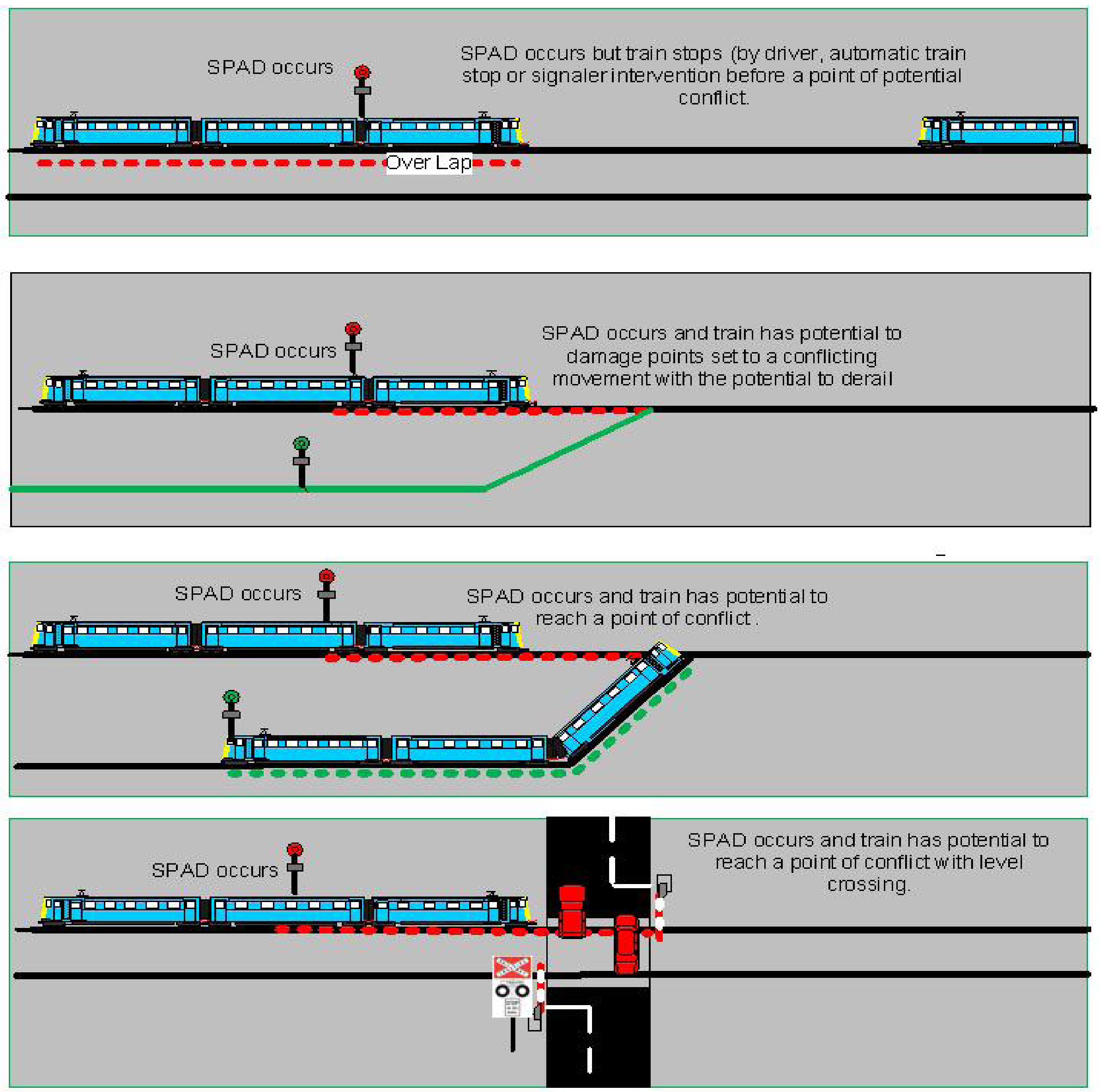

Figure 1: Examples of SPADs with varying degrees of severity

However, severity indices have the potential to overlook the relative levels of risk posed by the SPAD resulting in inappropriate categorisation. This is one of the reasons why a risk based categorisation system, such as that referenced in section 2.4, is a more effective means of categorising SPADs.

2.4 SPAD occurrences and classifications

Understanding SPAD risk is critical to applying effective control measures, because the precursors to a SPAD are many and varied, and the actual or potential severity of each SPAD can be vastly different. Train protection and SPAD consequence mitigation systems can be effective at managing the risk but they can also be circumvented or fail.

In Australia, the number of recorded SPAD occurrences is published in the Australian Transport and Safety Bureau (ATSB) report, *Australian Rail Safety Occurrence Data: 1 July 2002 to 30 June 2012* (ATSB, 2012). In 2011-12 there were 428 SPADs recorded across the country that were attributed to human error (including driver misjudged, completely missed and starting against signal events). In addition, there were 953 SPAD occurrences classified as “signal restored as train approaches”, also referred to as a technical error by ATSB.

In New Zealand quarterly SPAD statistics are published by the Ministry of Transport. The 2011-12 SPAD statistics recorded 154 operating occurrences, excluding any SPAD events that resulted in a derailment, collision or shunting occurrence. Further details, such as whether the SPAD was attributed to human error or a technical fault are not provided.

The aftermath of the Ladbroke Grove train accident

Tracking these data over time is useful to highlight trends. However, the numbers alone can be misleading and may not be very meaningful without supporting investigations and analysis. It should also be noted that the data is not normalised to allow for variability in train kilometres or other factors such as the number and density of signals on the network. This is particularly important when comparing data between geographical areas.

The Ladbroke Grove accident in the UK in October 1999 resulted in the loss of 31 lives with more than 520 people injured and highlights the point that SPAD frequency numbers alone can be misleading. The Train Operating Company (TOC) involved, until that date, had not recorded a single SPAD, yet this isolated SPAD event resulted in one of the UK’s worst train accidents in recent years.

However, most SPAD events do not result in such catastrophic consequences and a majority of SPADs are contained before real harm is encountered. The application of a structured SPAD risk management strategy is important when looking at not only SPAD frequency but also SPAD consequence. An RTO may consider using an iceberg model[2] when developing SPAD strategies, which considers SPAD events and other similar operational incidences that may indicate pre-curser events such as station overruns or speeding events, for example.

Footnote: [2] For an overview of the iceberg model concept see the following: http://www.ascd.org/ASCD/pdf/journals/ed_lead/el200910_kohm_iceberg.pdf.

The ITSR publication, *Managing Signals Passed at Danger* (June 2010, Section 2.2.4, pp21), makes reference to the SPAD severity/risk ranking categorisation scheme employed by a large Australian integrated RTO for the purpose of categorising their SPAD occurrences. The benefit of applying a SPAD categorisation system such as that referenced in the ITSR document is that the data provide a snapshot of SPAD frequency by severity/risk which enables the RTO to monitor trends and identify issues. Individual organisations should, however, consider their own risks in developing an appropriate categorisation system. The RTO should ensure that such a system is specific to their organisational risk profile and captures all relevant legislation, regulation and Safety Management System (SMS) requirements.

The national legislation *OC-G1,* provides guidance on the classification of notifiable railway occurrences more generally, including SPADs. However, this is designed to be a classification system rather than a ranking tool and is not aimed specifically at SPADs.

2.5 Historic accidents and their contributing factors

The majority of SPADs, or limit of authority exceedances, are managed safely, which may be a testament to the inherent safety in rail systems and the skills and training of rail operations personnel. However, the potential consequences of some SPADs can be catastrophic. The following pages provide a description and illustration of several severe accidents, highlighting the combination of factors that led to these events. Note that many of the factors that contributed to some of the more serious accidents could have occurred in isolation without such catastrophic outcomes.

Chatsworth 2008, California, US

In 2008 a freight train collided head-on with a commuter train in Chatsworth, California. Investigations into the cause of the accident found that the driver of the commuter train was distracted by sending text messages while on duty and failed to respond to a signal at stop at Chatsworth station. The incident highlights the dangers of train driver distraction, particularly involving mobile phone usage. Figure 2 provides an illustration of events leading up to and following this fatal SPAD. It also highlights the limitations of the location and design of infrastructure, which provided minimal opportunity to recover from the driver failing to sight and take action at the stop signal.

Recovery effort following the Chatsworth accident

The SPAD occurred as the train entered a single track section with restricted visibility and with no train protection system or even a means of providing feedback to the driver that a SPAD had occurred.

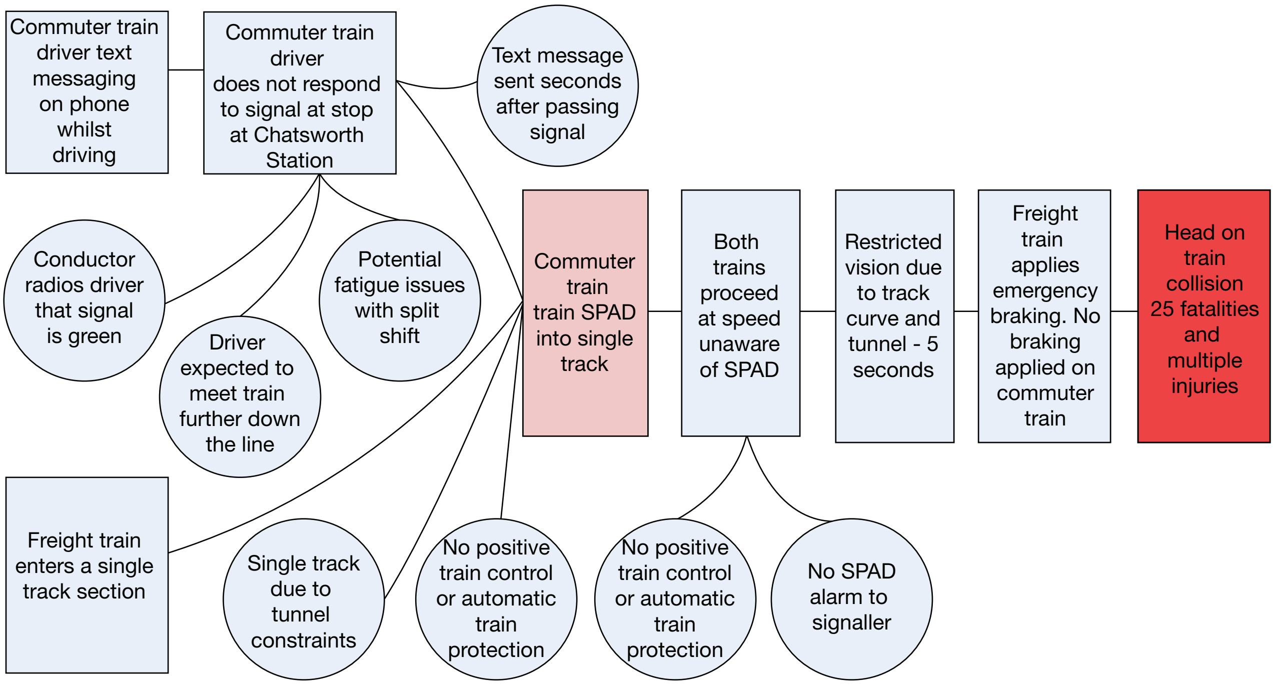

Figure 2: SPAD following driver distraction

Gunnedah 2012[3], NSW, Australia

In March 2012, a freight train passed a signal at stop on the outskirts of Gunnedah. The driver was alerted to the incident and responded by applying the brakes. At the same time, another freight train proceeding in the opposite direction was on a collision course and on becoming aware of the situation immediately brought his train to a stand. The trains stopped 715m apart.

The network controller attempted to make an emergency broadcast call over the network radio when he became aware of the SPAD. However, the call failed primarily due to the network controller's lack of understanding of the radio system's characteristic delay when placing this type of call.

The subsequent investigation considered a number of contributing factors including:

- Crew fitness for duty and crew affected by fatigue – the driver had misread two consecutive stop signals as one signal causing him to misinterpret where he should stop; and
- Communications failures immediately after the SPAD.

Footnote: [3]Office of Transport Safety Investigations (OTSI) 2012, Rail Safety Investigation Report: Signal Passed at Danger and Opposing Movement Between Two Freight Trains, Australia

Beresfield 1997, NSW, Australia

In 1997 a coal train passed a signal at danger and collided with the rear of another coal train on the Hunter Valley rail line. Investigations into the accident found that the crew of the second train had been working long hours and were probably suffering from fatigue. The collision highlights the vulnerability of rail operations to simple human error, particularly when fatigue is a contributing factor.

Both driver and co-driver failed to observe and react to the two cautionary and one stop signal indications prior to the collision, yet the train vigilance device had been routinely activated.

Beresfield coal to coal train collision

Significant overseas SPAD events

Other SPAD events in recent years that have led to multiple deaths and or injury as well as significant loss of asset are included in Table 1.

Table 1 Overseas SPAD events

Location	Year	Country
Ladbroke Grove	1999	UK
Åsta	2000	Norway
Pécrot	2001	Belgium
Norton Bridge	2003	UK
Qalyoub	2006	Egypt
Arnhem	2006	Netherlands
Chatsworth, California	2008	USA
Halle	2010	Belgium
Badarwas	2010	India
Saxony-Anhalt	2011	Germany
Sloterdijk	2012	Netherlands

2.6 Cost implications of SPADs

Accidents at work and work-related ill health cost Australia many billions of dollars each year[4]. Within a railway environment, SPADs also have the potential to incur significant costs. Whilst the majority of SPADs are classified as low severity, they still result in a loss to the RTO through train delays, drug and alcohol testing[5], manager's administration time, reporting, and the time and resources taken to investigate. In addition, corrective action may be required to control risk, such as changes to infrastructure, systems and re-training or monitoring of staff.

The financial cost of SPADs to RTO's varies widely and can run into hundreds of thousands of dollars and even more in the case of severe accidents. The nature of the costs incurred is also varied as highlighted above and accrue not only to the RTO but also to other rail industry participants and individuals. Costs increase significantly if the SPAD causes a delay to operations, for instance.

2.7 Stop boards, limits of shunts and other limit of authority indicator exceedances

OC-G1 includes the following as reportable incidents in the event that "a train exceeds the limits of authorised movements":

- Train order / authority;
- Token;
- Special authority order;
- Warrant; and,
- At locations such as stop boards, limit boards etc.

Stop boards may be used, for example, to protect a single line or in some instances simply to demarcate

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Footnote: [4] Safe Work Australia March 2012, The Cost of Work-Related Injury and Illness for Australian Employers and the Community: 2008-09, Australia
[5] This relates to the costs associated with staff members being stood from their position, generally for up to three days, whilst awaiting the results of the drug and alcohol tests, in addition to the cost of administering the test

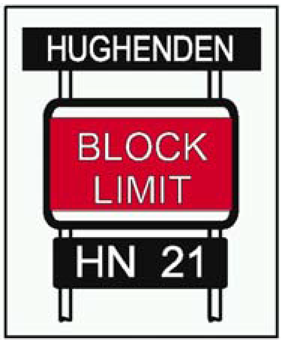
the point at which the infrastructure owner changes. However, the passing of a stop board without authority is still an incident that must be reported to an external organisation. RTOs should consider the risk profile of their own operation and the risks associated with passing a stop board, or other indicator, in much the same way as a signal. RTOs will need to consider the sighting and visibility of these indicators as well as the instructions that may be displayed upon them.

2.7.1 Limit of authority exceedance

The management of risk associated with a limit of authority exceedance has much in common with SPAD risk management. A point of difference is that the management of limit of authority exceedance risk often relies on the passing, understanding and compliance of safe working instructions and orders. The use of limit of authority boards necessitates the same consideration as stop signals. The design, sighting, visibility and the instruction found on that board must be carefully considered by the RTO.

Example track warrant intermediate board used in NSW - a notice board provided between stations or sidings to identify a location that may be used to designate a limit for a track warrant.

Example stop boards: clockwise from top left: 1) compulsory stop board that can only be passed on the authority of the person in charge, 2) is used where special authority is required e.g. permission required before entering a yard, and 3) stop sign used with specific operational instructions attached.



Example block board used in NSW - the design and sighting of limit boards like signals should be carefully considered. This is an example of a well designed block board.

3 Why do SPADs occur?

3.1 Overview

It is often the case that a chain or sequence of events combine to lead to an undesired outcome such as a SPAD, or worse an accident following on from a SPAD event. It is breaking the chain of events that will prevent an accident from occurring. It is therefore vital to understand why SPADs occur and why a SPAD can lead to a disaster.

SPADs have a principal cause and other contributing factors. Investigations must identify first the principal cause and subsequently the contributory factors. This can be an interactive process as sequential underlying factors are identified. In general, a SPAD can occur because an individual (a train driver, signaller, train controller, or infrastructure worker) made an error or violation, or because of a technical deficiency associated with rolling stock, and infrastructure. These are sometimes referred to as immediate causes because they are the trigger for the SPAD. Numerous SPAD investigation reports find the cause of incidents to be the result of the driver misjudging the braking distance or the driver somehow being distracted. This does little to get to the bottom of what really happened, that is, to identify the true underlying causes.

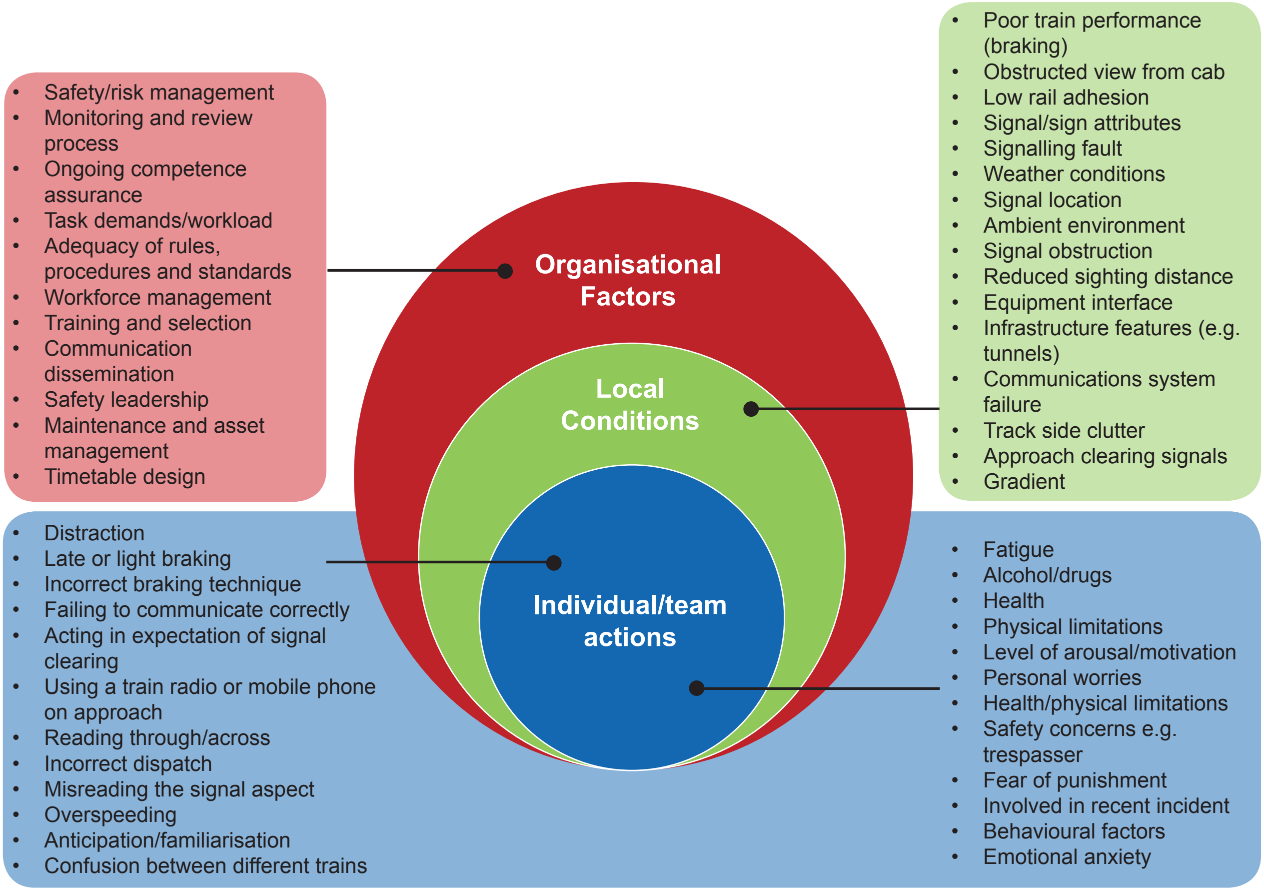
In many cases, the immediate causes provide a description of what happened but do not provide an explanation for why it happened. Also, any investigation that stops at the level of immediate cause will generally fail to identify appropriate corrective or preventative measures that can be taken to try to reduce the likelihood of further incidents. To do this, it is necessary to look at a broad range of contributing factors to determine the underlying factor or factors.

In Australia, ITSR developed a range of tools and documents concerning SPAD management. This information is now available through the ONRSR website <http://www.onrsr.com.au>. ONRSR also provides a range of other useful resources that may be accessed via the website. The following discussion has drawn on the ITSR document, *Managing signals passed at danger*.

3.2 Contributing factors

Figure 3 provides an overview of the potential combinations of factors contributing to a SPAD, which can be categorised by:

1. Individual / team actions;
2. Local conditions; and
3. Organisational factors.



- Safety/risk management
- Monitoring and review process
- Ongoing competence assurance
- Task demands/workload
- Adequacy of rules, procedures and standards
- Workforce management
- Training and selection
- Communication dissemination
- Safety leadership
- Maintenance and asset management
- Timetable design

- Poor train performance (braking)
- Obstructed view from cab
- Low rail adhesion
- Signal/sign attributes
- Signalling fault
- Weather conditions
- Signal location
- Ambient environment
- Signal obstruction
- Reduced sighting distance
- Equipment interface
- Infrastructure features (e.g. tunnels)
- Communications system failure
- Track side clutter
- Approach clearing signals
- Gradient

- Distraction
- Late or light braking
- Incorrect braking technique
- Failing to communicate correctly
- Acting in expectation of signal clearing
- Using a train radio or mobile phone on approach
- Reading through/across
- Incorrect dispatch
- Misreading the signal aspect
- Overspeeding
- Anticipation/familiarisation
- Confusion between different trains

- Fatigue
- Alcohol/drugs
- Health
- Physical limitations
- Level of arousal/motivation
- Personal worries
- Health/physical limitations
- Safety concerns e.g. trespasser
- Fear of punishment
- Involved in recent incident
- Behavioural factors
- Emotional anxiety

Figure 3 SPAD contributing factors

3.2.1 Individual/team actions

Individual/teams actions refers to errors and violations as well as other personal factors that can have an impact on safe rail operations. Personal factors in this instance means non-work related issues and considerations, for instance, a worker may not be sleeping well as a result of non-work related concerns. Errors and violations are examples of unsafe behaviours that can lead directly or indirectly to a SPAD.

Personal factors can increase the likelihood of errors or violations. Although many personal factors cannot be avoided, it is important for individuals to be able to recognise their significance and to manage them, with the support of the organisation. Training and awareness in non-technical skills provides important mitigations for these factors.

Procedures used by some RTOs to investigate SPADs may conclude once the primary error or violation has been identified. This can have the effect of focusing any corrective action - such as counselling, disciplinary procedures, endorsing of records/drivers licence, retraining - predominantly on the train driver. Such procedures are unlikely to identify any system issues or precursor events that may have contributed to the error or violation.

Most errors, such as misreading a signal, are unintentional, so disciplinary action against those responsible may not be effective at preventing the same error in future. Also, violations are often made with positive intentions and are routinely accepted, or even encouraged under different circumstances, such as aggressive driving to maintain on time running.

Other violations, however, are not the result of positive intentions. For investigations it is important to understand the balance. Having an appreciation of the reasons that underlie errors and violations is core to promoting a just culture. It is also the role of managers to set the standard for their staff and to challenge and enforce appropriate behaviours.

3.2.2 Human factors

The knowledge and application of human factors has matured significantly in the past ten years, having been applied widely in the aviation industry. The most significant SPAD incidents are attributed to a person making an error, therefore a better understanding of why people make errors can lead to more effective SPAD risk mitigation.

Operational staff members do not go to work with the intention of making a mistake, which in turn leads to a SPAD, or worse, an accident. Understanding the chain of events, the precursors and influences that lead a person to react or decide to act in a certain way is fundamental to the investigation of why SPADs occur. These behaviours themselves will tend to have underlying reasons: what caused the loss of concentration; what distracted the driver; why did the person anticipate; are the types of questions that must be asked.

The example in section 3.3 provides some useful information in understanding how the frame of mind of a safety critical staff member can lead to an action or in-action with the potential to cause a harmful event.

As well as the working environment, external factors can also have a considerable affect on that person's behaviour. An increasing issue today is the proliferation of personal communications devices and the popularity of social media, such as Facebook. The use of personal devices to communicate with others outside of work has the effect of taking the individual out of their professional space during the communication and afterwards whilst they continue to think about the exchange. For instance, a driver takes a call from their partner that develops into a brief argument. The driver's mind is now in a different place resulting in a mistake being made. Some RTOs have reported a growing concern with staff members being distracted by using social media. Although both can be considered as a violation it is now a fact of life that people are using such communications as a matter of course.

In regards to the use of train radios and mobile phones, RTOs often have a policy that prohibits the use of these communication devices on approach to a stop signal. However, it should be noted that some organisations completely prohibit the use of mobile phones by train crew. An exception to this may be the use of company issued mobiles phones for the purpose of receiving incoming calls only.

In Australia and New Zealand RTOs engage with and employ human factors specialists in a wide range of subjects including:
- Human factors driven design requirements;
- Human factors integration plans for major projects;
- Accident investigation;
- Task analysis;
- Ergonomic assessment;
- Human Machine Interface suitability; and,
- Workload assessment.

The study of human factors is now well established in the railway industry and has followed the airline industry's approach of establishing human factor representation in operational and human performance optimisation.

Some examples of human factors that have a direct link to SPAD causation are:

- Distraction and loss of concentration;
- Conditioning;
- Anticipation;
- Reaction (muscle memory);
- Fatigue;
- Confusion; and,
- Awareness.

Managing human factors related risk must therefore be a key aspect in the RTO overall SPAD risk management strategy.

3.2.2.1 SPAD human factors models

Examples of human factors models can be found in the Human Factors and Ergonomics Society of Australia (HFESA) research article *Hurry Up and Wait: Danger Signals in the Rail Environment* (Naweed, 2013a), and in the Accident Analysis and *Prevention article psychological factors for driver distraction and inattention in the Australian and New Zealand rail industry* (Naweed, 2013b).

These models illustrate how different aspects of the driving task are key determinants for SPAD-risk. These include time pressure, interactions with the controller, and the feeling that the train is dwelling at the station longer than necessary. Under certain conditions, these issues encourage inattention to safe working, and intensify the experience of distraction. For example, time pressure can distort the perception of service delivery by increasing the emphasis on time keeping performance. This can disconnect the driver from their awareness of the signal too.

Figure 4 provides an overview of main determinants for SPAD-risk identified from an international SPAD-risk mitigation project undertaken by the Cooperative Research Centre (CRC) for Rail Innovation. It categorises the three risks associated with the task, but also makes a point of illustrating how sighting restrictions impact upon safety. Signal and railway sighting issues are a norm of the rail environment, so much so that train drivers are taught to address them through route knowledge. While sighting restrictions are key risks for a SPAD, the other factors such as time pressure and station dwells can interact with them, and produce SPADs such as signal misreads and starting away against a station starting signal incidents.

SPAD causation is also multi-causal, and SPAD-risk models try to illustrate the impact of attentional shifts. Figure 4 illustrates two primary effects on attention associated with signal dynamics (disconnection, dislocation) and two effects on service delivery (disruption, distortion). The models also show how a task-related or un-related ‘novel event’ can arise opportunistically and intensify the overall experience, for example a door fault during a station dwell that elevates time pressure and encourages disconnection and/or dislocation of the signal awareness.

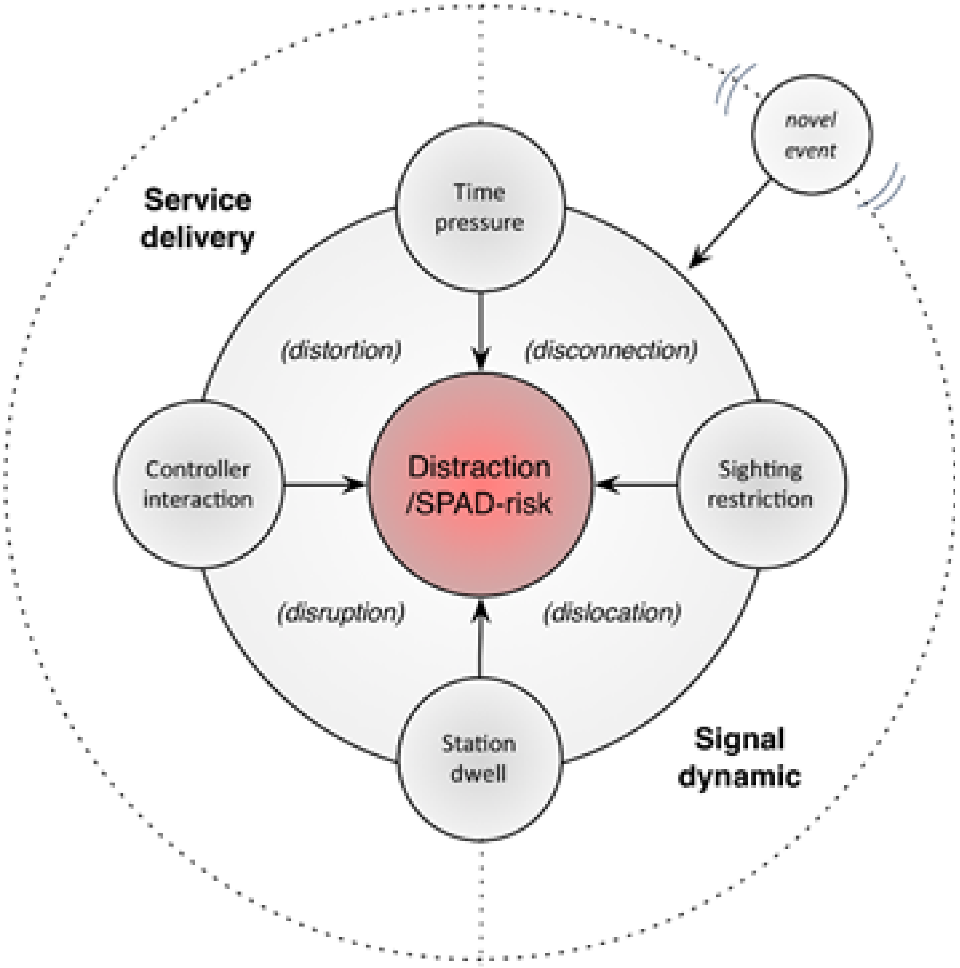


Figure 4: Human factors model showing key determinants for SPAD-risk (Naweed, 2013)

3.2.3 Local conditions

Design of infrastructure and trains can have a significant impact on human performance and therefore may be a major contributor to SPAD incidents.

For example, signal sighting decisions taken by an infrastructure manager can contribute to a more hazardous work environment for an RTO. For instance, if the infrastructure manager does not engage the users in making decisions about signal sighting they make inadvertently overlook driver related issues. Similarly, the design of driver cabs may assist or impede signal visibility and/or driver fatigue. Such design factors are typically controlled through proactive risk management and system safety processes. Similarly, human factors should be systematically considered and integrated into engineering design of infrastructure and rollingstock.

As explained elsewhere in this document, there are many different railway operating environments, with no two being exactly the same, thus the risk factors for each RTO can differ greatly. Table 2 below lists some typical of railway operating environments alongside some examples of associated SPAD related risks.

Table 2: Example railway environments and associated risk factors

Rail environment	Typical risk factors
Metro railway	• High number of signals; • Short distances between signals; • Uneven signal spacing; • High number of cautionary signals; • Complex infrastructure, junctions etc; • High potential to find signal at stop; and, • High degree of task and environment distraction.
Suburban railway	• Mixed operation and operating environment; • Mixed speed profiles; • Uneven signal spacing; and, • Potential for high number of stop signals in areas of high traffic density.
Inter-city/state long distance	• Higher speeds; • Increased time in cab leading to fatigue; • Changes to environs along the route; • Mixed operating practices; and • Changes in operating methods or infrastructure encountered along the route.
Freight railway	• Fatigue (night work/long distances or increased time in cabs); • Increased risk of SPAD during shunting operations; • More verbal communications result in communication failure; • Heavy trains with increased braking distance requirements; and, • Changes in operating infrastructure and practices along the route.
Mixed operations	• Non standard SPAD consequence mitigation measures applied (train stops, Train Protection Warning System (TPWS)); and, • Differing rules, practice, jargon and knowledge/risk awareness between operators.
Operation in dark territory	• Verbal communications for receiving train orders (etc) result in communication failure/misinterpretation; and, • Long distances between signals or markers.

The SMS needs to effectively manage many areas of operational risk including the factors listed in Table 2.

The design of the infrastructure can also dictate the number of stop signals a driver is likely to encounter, thus affecting SPAD risk. Examples include driver approaching junctions or level crossings with the protecting signal at the end of a station platform where the train is booked to stop.

3.2.4 Organisational factors

Organisational factors are conditions associated with business and operational systems that may impact on working conditions and workforce performance. Impractical procedures, which lead to frustration and, probably, non-observance, may contribute to violations. Organisational factors generally occur sometime before the actual SPAD event, and are usually only identified in systemic investigations.

Organisational factors are typically controlled through the implementation of an effective SMS. One organisational factor that should be carefully considered is the effect that timetable design and associated performance targets can have on staff performance and SPAD risk. If the timetable has a high degree of conflict associated with it, and drivers are continually encountering stop signals, then SPAD risk will be greater. If turnaround times at terminal stations or driver relieving times are too short then there can be a greater chance of a driver rushing to meet performance targets (right time starts), thus the risk of a SPAD can be greater.

The contributing factors presented in Figure 3, and their relationship to SPAD performance, are discussed further on the UK Opsweb site under *SPAD management tools - Common factors in SPADs*. These tools may be accessed from the website <http://www.opsweb.co.uk/tools/common-factors/PAGES/QA.aspx>.

3.3 An example SPAD and its causal factors

The following describes a real SPAD incident and illustrates the chain of events and circumstances that led to a SPAD. The driver, who was newly qualified, had returned to work on a Sunday late shift after taking leave to attend the funeral of a close friend:

- Poor weather over the previous few days had led to substantial autumn leaf fall, which had contaminated the rails;
- The driver booked on duty but before leaving the mess room had been involved in an altercation with another driver;
- There was engineering work on the route and trains were terminating short of the normal destination so that passengers could transfer to buses;
- The approach to the target signal (the station starter) was on a steep downhill gradient in a cutting and was a notorious area of poor wheel/rail adhesion;
- The driver was distracted by their own thoughts and did not react to the first of two cautionary signals;
- The driver reacted to the second cautionary signal but the heavier than normal brake application caused the train to skid on the contaminated rail; and,
- The train failed to stop at the target signal and past it by 10 metres without causing harm.

The incident was investigated and it was determined that the driver was at fault. At the time no other action was taken other than to reprimand the driver and the investigation failed to record any of the above contributing factors.

One might consider the outcome had the incident caused a train accident. It is possible that the resulting scrutiny, including press coverage, may have produced a different investigation outcome - one that identified the underlying factors, and prompted the affected organisations to implement measures to reduce the risk of such incidents occurring again. Just because a SPAD event has little impact in terms of property damage or personal injury does not mean the subsequent investigation should be any less rigorous than had an accident occurred.

Often with SPADs, as illustrated by this example, a number of factors occur and combine to cause the incident. In trying to understand why a SPAD has occurred an RTO should not stop at the first obvious cause but rather try to establish the contributing factors and underlying causes. This approach is important in the development of a robust SPAD risk reduction strategy.

3.4 Potential SPAD traps

Poorly designed infrastructure and/or operating procedures that significantly increase the risk of a SPAD event are known more commonly as SPAD traps. The driver, through explainable human behaviour, may be led into making an error as the result of inadequate design, operating procedures or a combination of the two.

In essence, SPAD traps embody the issues attributed to individual/team actions, local conditions and organisational factors. Combining one or more local condition, such as dark territory and organisational factors, such as a communications failure, can create a SPAD trap and entice a human error or violation that results in a SPAD.

The following are examples of SPAD traps that increase the likelihood of driver error, which may in turn lead to a SPAD.

1) Driving in anticipation of approach cleared/conditionally cleared signals

Based on repeated previous experience, a driver may anticipate that a signal will clear after they have maintained their speed below a certain limit. For example, on some areas of the railway, to control the speed of a train, the signal aspect is maintained at danger before changing to a less restrictive aspect as the train approaches. Some drivers may even begin accelerating in expectation of the signal aspect changing as they approach. This can lead to a SPAD if the signal does not clear.

2) Driving on successive caution signals

The presentation of repeated caution aspects may cause the driver to become desensitised to the cautionary message of the signal. It will increase the expectation of the driver that the next signal will also be at caution and may reduce their responsiveness/reaction times if the signal is on red.

3) Signal normally encountered at proceed aspect

Drivers build up knowledge and experience of the route and handling of the train and as a result they develop mental models - what should happen, where signals should be and what signal aspects they are likely to encounter.

In this instance, mental models are representations of the route environment constructed in the mind of the driver based on their experience of travelling that route. These models vary depending on the perception, knowledge and understanding of the individual and are used to help guide thoughts and actions. They reduce the driver’s mental workload but if relied on too much may cause the driver to anticipate a signal aspect and thereby miss changes from the norm. If a proceed aspect is normally encountered, but unusual traffic regulation or a change in timetabling means that a red aspect is encountered, then the driver may fail to react properly. This hazard is particularly relevant for regional drivers where a large percentage of signals are encountered at a proceed aspect. This issue may prove to be even more hazardous since drivers who normally encounter a signal at a proceed aspect are not practised at stopping at that signal and misjudge the braking when required to do so.

4) Driver assumes can pass signal at stop due to special working

In degraded operations, drivers can be given authority to pass one or more signals at stop. During these degraded operations there is an increased likelihood of human error and the system may not prevent signals being passed without authority.

5) Driver is distracted by a significant task between cautionary aspect and target signal

In instances where a driver is required to undertake other tasks between cautionary and target signals there is an increased likelihood that the driver will forget the previous signal was at caution. For example, if a driver receives a cautionary signal before reaching a station they may be distracted by station duties such as operating doors and ensuring passenger safety.

This image illustrates how a driver may read across to a non-target signal.

If the driver is unable to see a target stop signal ahead, and having been distracted by station duties, the driver may forget the cautionary signal as they accelerate from the station and will be less prepared to stop. Other distractions might include:

- Slowing train for a speed restriction and subsequent acceleration afterwards;
- Driving through tunnels; and
- Radio operation

6) Reacting to the wrong signal

Some SPADs have been attributed to the driver reacting to the wrong signal by either reading through the target signal or reading across to a non-target signal. This risk is especially salient where the non-target signal comes into view before the target signal or is more prevalent than the target signal.

This error can also occur at stations and at junctions where a train has stopped at a target signal correctly but the driver (perhaps after being distracted by station duties or other requirements of service delivery e.g. making a PA call) has responded to a change of aspect on a non-target signal that is also in view.

For example the effect of performing other service delivery tasks, such as making public address announcements, passenger door operation and other passenger interface duties must be carefully considered. These tasks can be distracing and have contributed to SPAD occurrences.

3.5 What are the barriers to good SPAD management?

Introducing measures to reduce SPAD events can meet with resistance. The barriers to better SPAD management, illustrated in Figure 5, should be fully considered when designing a SPAD risk management strategy.

Figure 5 Barriers to good SPAD management

The barriers to good SPAD management illustrated in the figure above are summarised as follows:

- Failure to fully understand the risk posed by SPADs - perhaps the greatest barrier to good SPAD management since a lack of understanding will often result in a SPAD reduction strategy that is ineffective in mitigating actual risk, if a strategy is produced at all. For instance, a belief that SPADs are not a problem if the train stops before the conflict zone[6] demonstrates a lack of understanding of SPAD risk. It is often the case that poor SPAD performance can be a precursor to other events with undesirable outcomes;
- Failure to robustly report SPADs - the actual risk posed by the SPAD in these cases can be much greater than the perceived and the RTO may not understand all of the contributing factors. Without this understanding RTOs have difficulty in developing an effective SPAD risk management strategy;
- Overreliance upon robust SPAD consequence mitigation measures – some RTOs have in place a robust SPAD consequence mitigation system, which may include, for example, the use of train stops. However, an adverse consequence of using such mitigation systems is the occurrence of accidents owing to the train continuing without proper authority. This occurs following a SPAD as a result of the resetting of the system;
- Perceived high cost of implementing a SPAD management strategy – this is a common misconception. Good SPAD performance can be achieved through a number of low cost solutions. For example, an Irish SPAD reduction strategy focused on low cost management initiatives to establish good practice and achieved significant reductions in SPADs (see Figure 6);
- Employee relations may create resistance – the close relationship between managers of train driver competence[7] and drivers (often driver managers are former drivers), for example, can lead to reluctance on the part of driver managers to challenge established behaviours, to suggest alternatives or to instruct drivers to do things differently. Historically trade unions have demonstrated caution with regard to SPAD risk management strategies since the perception is that their implementation will increase pressure on drivers or other staff groups. Working with staff representatives and properly considering human factors or human performance limitations is vital if the SPAD reduction plan is to be achievable.
- Lack of national industry cooperation – the sharing of lessons learned, good practice, and general information in relation to SPADs allows individual RTOs to develop more comprehensive and mature SPAD risk management strategies. Industry cooperation can also speed up the development and adoption of effective strategies for managing SPAD risk;
- Lack of awareness of good practice - many railways around the world have spent thousands of hours debating how SPAD risk is best managed. Understanding what others are doing or have done is a positive and logical step in determining a robust and achievable strategy for a safer railway; and
- Organisational cultural impediments – the culture within an RTO may act as an impediment to good SPAD management. This could be due a lack of risk understanding, insufficient allocation of resources, employees not wanting to get into trouble and/or employees otherwise not being prepared or organised to manage SPADs.

This remainder of this Guideline is intended to provide the information necessary to help your organisation overcome these barriers.

Footnote:

[6] *The term conflict zone can be defined as the point at which a train passes a signal at danger and reaches a point of physical conflict.*

[7] *The term manager of train driver performance is used here to refer to those who manage the ongoing competence and train driving performance of drivers, including compliance to rules, instruction and standards.*

Figure 6 provides an example of the results of a SPAD improvement program. The program targeted 550 drivers and had the effect of reducing the frequency of SPAD occurrences from 50 to 5 given effective management of softer issues as highlighted in the chart.

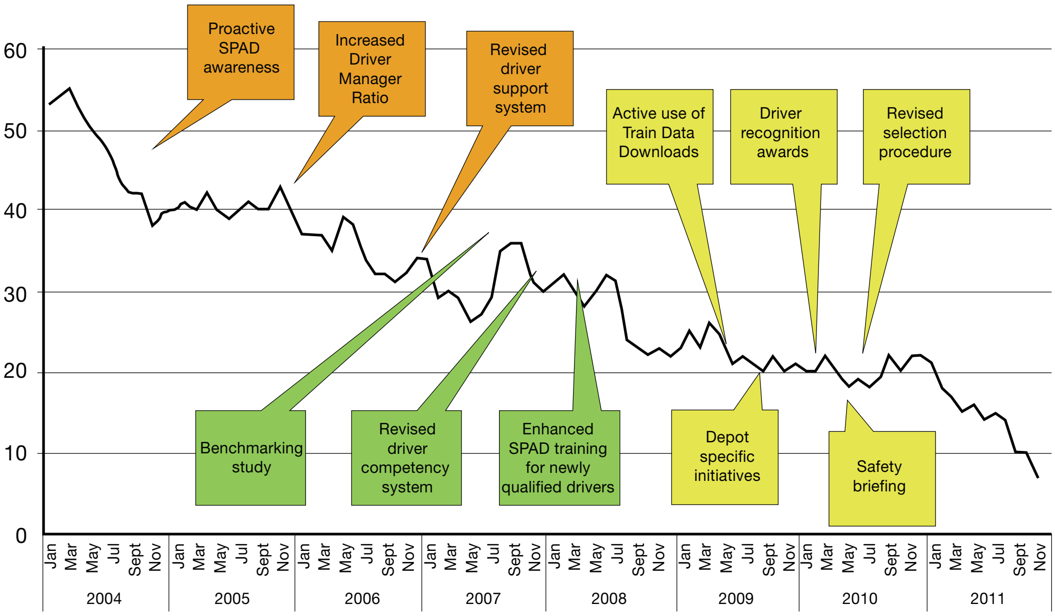


Figure 6: SPAD improvement program 2004-11, Ireland

This shows that cost effective measures can be taken to reduce overall SPAD numbers through:

- Increased risk awareness;
- Increased driver management and support;
- More robust selection, training and competency management; and;
- Increased monitoring.

4 Developing a SPAD risk management strategy

4.1 Introduction

There are four fundamental questions that any RTO should ask itself with respect to SPADs:

1. Do we know how many and type of SPADs occur on our network?
2. Do we know the risk this poses to our organisation?
3. Do we have a plan to manage this risk to an acceptable level?
4. Do we have the resources to deliver the plan?

These fundamental questions are the starting point in introducing a SPAD risk management strategy. The SPAD risk management journey therefore starts with understanding the nature and size of SPAD risk before managing and reducing that risk.

The role of SPAD risk management must be set within the broader context of operational risk management in general, and should be integrated within the RTO's SMS. An effective risk-based SMS will enable the RTO to identify risks, establish a process for safety data collection and reporting, develop a standard approach for assessing risks and implementing controls, and allow for performance measurement and continuous improvement.

It should be remembered that a balance between a quantitative and qualitative risk approach is required. Even the most sophisticated risk assessment tool will need professional judgement from subject matter experts, especially when considering high consequence, rare events. The key is to take on board the concerns of those with operational experience.

The purpose of the following sections is to describe the most common causes and control measures to effectively manage the risks posed by SPADs. This is followed by guidance on SPAD prevention (Chapter 5) and post-SPAD incident management (Chapter 6).

4.1.1 Steps in developing an effective strategy

Figure 7 presents the key steps in developing an effective SPAD risk management strategy.

Figure 7: Steps in developing an effective SPAD risk management strategy

As with any risk management strategy it is vital to truly understand the specific risks that SPADs pose to your organisation. SPAD risk is not the same for every RTO and in many cases SPAD risk will differ on parts of the network under the same organisation. The most significant risks that affect your operation should be prioritised to identify the steps that can be implemented early on to make early gains. SPAD consequence mitigation measures are in place in many organisations. Although they can drastically reduce the adverse consequences of SPADs, and thus the overall risk, they must not be over relied upon. The cause of a SPAD event, even when mitigated by a measure such as TPWS or train stops, can point to underlying safety issues that, if left unchecked, could lead to other undesirable outcomes.

As a first step to develop a strategy it is vital for an organisation to establish whether all SPAD occurrences are being captured and reported.

SPADs may not be reported by operational staff members or may not be recorded by supervisory/ management staff. RTOs should consider the barriers that prevent the reporting of SPADs, for example:

- Cultural barriers (staff not wanting to get into trouble or report colleagues);
- Supervisors/managers not recording SPAD occurrences; and,
- Technical barriers (dark territory, areas of the network where there is no tracking of the train location by the signalling system, and a lack of SPAD monitoring equipment).

4.1.2 Factors to consider in understanding SPAD risk

Understanding why a SPAD occurred, how often that type of SPAD occurs, and any other trend analysis is vital if the SPAD strategy is to focus on actual risk. Factors for consideration in establishing SPAD risk are shown in Figure 8. Developing a strategy for SPAD risk management should not be considered in isolation. There are other operational incidents that can be considered as potential precursor events such as station over-runs, speeding events, and failure to call at stations.

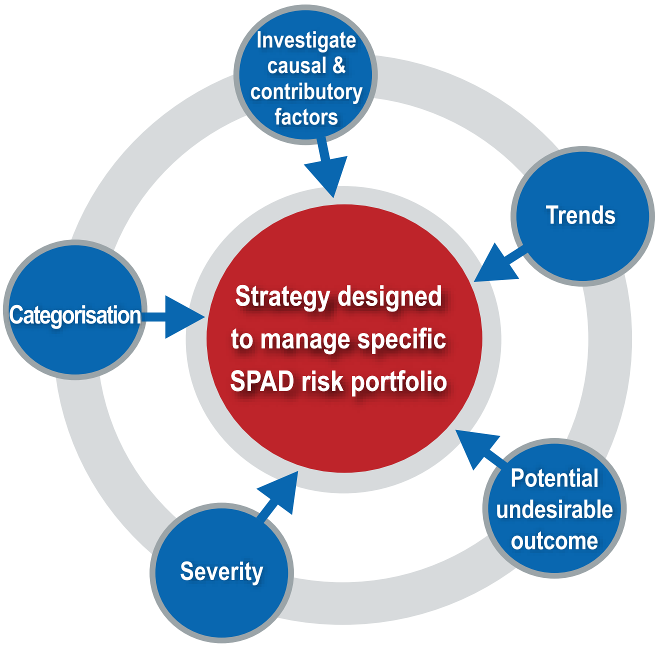


Figure 8: Factors to consider in establishing actual SPAD risk

The operators of on-track plant and maintenance vehicles will need to consider the specific risks associated with operating rail vehicles on lines that are under the control of engineering staff (lines under possession). Quite often these rail vehicles are required to operate under special instructions and not under the normal protection offered by the signalling system that may be suspended either fully or in part. Historically there is a higher frequency of incidents at the point where on-track plant returns to the railway operating in a normal state.

There is a requirement for operators of on-track plant to mitigate SPAD risk by developing and complying with operating instructions that take into account the degraded operating modes in which they may operate.

The following sections provide insight into the core components of a SPAD strategy. Where appropriate these components have been structured as follows:

- Issues – provides a summary of the key issues associated with the SPAD strategy component being discussed; and,
- Benchmarking – documents basic and good practices associated with that component of the SPAD strategy.

Note: the activities listed under Benchmarking are an illustration and their appropriateness for application to an operation must be assessed on a case by case basis.

The standard practices documented within the benchmarking sections are categorised as follows:

Indicates the minimum level of activity to be undertaken

Indicates good practice, which may vary by RTO

4.2 Establishing trends for SPAD risk

Issues

The starting point in developing a SPAD strategy is to gain an accurate picture of safety performance. This may include the actual number of SPADs as well as precursor trends, such as failure to react to caution signals, starting against a signal, miscommunication, driver inexperience, driver involved in repeat incidents, repeat SPAD signal etc.

Understanding the risk associated with SPADs is critical in order to determine the type of investigation to be carried out, the priorities for safety expenditure and to assist the development of SPAD reduction initiatives and train protection systems.

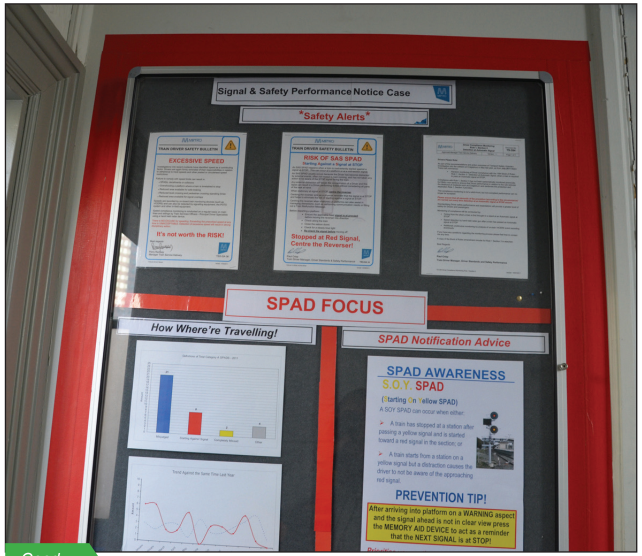
Even if an RTO is experiencing low numbers of SPADs or has a train protection system fitted, there still exists the potential for a one off catastrophic accident through either a SPAD itself, or through the unauthorised movement of the train following an incident. This is illustrated through a UK RTO that had an exemplary SPAD record but in 1999 experienced a SPAD that resulted in the Ladbroke Grove accident with 31 fatalities.


3 position automatic signal. In Victoria the above signal shows proceed at normal speed but in NSW this is a cautionary signal

Benchmarking

BASIC PRACTICE

- Policies and procedures are in place to ensure that SPAD events are systematically recorded; and,
- SPAD trends are monitored and discussed by the RTO.



Good Practice

A SPAD notice board

- Effective reporting regime in place to record SPADs supported by a strong safety culture amongst staff;
- Process in place to assess the risk of SPADs in terms of severity, for example, distance the train travelled passed the signal and whether the overlap/ conflict point was breached;
- Detailed analysis of SPAD trends undertaken to gain an informed understanding of error categories; and,
- RTO progressively reviews and monitors performance trends at safety meetings and uses data analysis to assist with implementing a SPAD reduction strategy.

GOOD PRACTICE

- Procedures for reporting SPADs are clearly specified and followed;
- Safety culture within the RTO that encourages self-reporting of incidents/near misses and train protection interventions that may not always be detected by signalling systems;
- Systematic risk ranking of SPADs against a structured process using a risk ranking tool. The process, for example, assesses initial collision potential, SPAD accident vulnerability ranking and risk ranks the incident. The process takes into account factors such as: train protection, crash worthiness of rollingstock, passenger loading, length of overrun etc;
- Systematic trend analysis conducted of all SPADs to establish common factors across the RTO and the specific factors and trends that may apply to certain groups of staff, work locations such as train crew depots or signals which become multi-SPAD locations;
- Results of trend analyses are used to set KPI’s;
- SPAD trends are communicated to staff in driver safety interventions/briefings to raise awareness and highlight trends; and,
- The RTO’s SPAD risk management strategy clearly relates to trend and risk analysis and also takes account of other precursor incident data which can lead to SPADs.

4.3 SPAD reduction strategies, SPAD groups and engagement of staff

Issues

A key part of effective SPAD management is the implementation of a strategy or SPAD action plan to deliver and monitor initiatives to improve performance. The type and content of the strategy can be influenced by many factors such as the size and nature of the organisation's operations, the number of incidents that are occurring, the level of risk, the responsibilities and interfaces with infrastructure owners, and resources available to deliver successful implementation. Engagement of staff in delivery of the strategy is important.

Even when SPAD performance can be benchmarked against good practice and performance targets are nearing the limitations of human performance, successful organisations never become complacent and continue to explore new initiatives to ensure the focus is maintained.


A mirror used for driver only operation - RTO's need to consider specific risks in relation to SPAD management

Benchmarking

BASIC PRACTICE

- SPADs are analysed and recommendations/ transferable lessons are actioned with the objective of preventing further incidents;
- The RTO has developed a SPAD risk management strategy; and,
- The SPAD risk management strategy is reviewed at regular intervals.

- A SPAD strategy is in place which has been strategically developed and monitored with active support throughout the organisation;
- SPAD KPIs are set within the strategy based on annual moving averages and take into account the limitations of human performance and the protection afforded by train safety and protection systems;
- All key levels of management are actively involved in the delivery of the strategy;
- Objectives and actions are prioritised and systematically tracked through to completion;
- Depending on the size of the RTO, SPAD working groups are set up to actively review trends, monitor strategy implementation and develop new initiatives. In larger organisations a SPAD project manager is appointed;
- Key outputs and initiatives are communicated to frontline staff through methods such as DVDs, safety

GOOD PRACTICE

- A SPAD strategy is in place, which has been strategically developed and includes actions to address operational incidents and precursor events that lead to SPADs;
- SPAD and operational risk KPIs are set, taking into account annual moving averages and limitations of human performance and the protection afforded by train safety and protection systems. These KPIs should be based on an in-depth understanding of the organisation's risk profile;
- The strategy clearly defines prioritised actions according to risk, with associated responsibilities and timescales for closure, including success measures to monitor the effectiveness of the initiative;
- At all levels of the organisation, employees are aware of the strategy and their role in implementing initiatives and initiatives are discussed during safety encounters with staff;

BASIC PRACTICE		GOOD PRACTICE
	newsletters etc; and, • RTO managers attend workshops/conferences with other organisations with a view of understanding the experiences of other organisations and to learn examples of good practice.	• SPAD reduction includes active engagement of frontline staff. Their views are sought through workshops and working groups with regard to the actions required to achieve performance improvements; • For larger RTOs, individual depots conduct risk assessments for their location and routes. These fully assess, both reactively and proactively, the risks and the control measures needed to ensure depot performance meets targets, with an ongoing objective of continued improvement. This includes the development of depot specific strategies; • The process of communicating key output and initiatives to frontline staff (through methods such as DVDs and safety newsletters etc) is extended to include staff contributions and active engagement, and provide tips for colleagues; • Recognition of SPAD improvement is provided through awards for depots and individuals based on safety performance targets being met; • The RTO presents at workshops/conferences with other organisations, outlining their experiences of SPAD and operational risk management and giving examples of initiatives they have implemented which provide examples of good practice; • The RTO supplies information and initiatives to an industry specific website for the sharing and promotion of good practice in terms of SPAD and operational risk management; and, • Even when achieving industry leading SPAD performance targets, there is no complacency and the organisation continues to explore dynamic initiatives to ensure focus is maintained.

4.4 SPAD consequence mitigation

Issues

SPAD consequence mitigation should form part of your overall SPAD risk management strategy. Reducing the SPAD consequence can dramatically reduce overall risk and largely involves the use of technical solutions, such as Automatic Train Protection (ATP), positive train control or other enhanced train separation. Ultimately, these are the most effective means of reducing SPAD risk, however, it is recognised that they may not provide the optimum solution because:

- Technical solutions often come at a high cost – the balance of costs and benefits need to be considered to determine the best use of resources;
- Problems with interoperability – systems may not be compatible or standardised between RTOs or across the rolling stock fleet. Many networks carry mixed traffic including metropolitan passenger trains, regional passenger trains and freight trains, each with their own type of rolling stock and train protection systems. There are additional problems of interoperability given the variation in network rules across state boundaries;
- Compatibility with legacy systems – rail infrastructure can vary greatly even across the same network. This may be due to variance in asset age and/or variability in adopted standards;
- Potential for de-skilling – some technical solutions may reduce the efficiency of route knowledge or inadvertently impact the manner in which routes are navigated.

These systems are often still vulnerable to human error under degraded operating conditions.

The approach of some RTOs is to focus SPAD consequence mitigation at high SPAD risk areas, perhaps at junctions or where signal spacing is reduced. A method of assessing high risk signals which examines both the likelihood and the consequence of a SPAD occurring at a specific location is therefore desirable. Sydney Trains (formerly RailCorp) is finalising an assessment model for all signals on their network which will assess the likelihood and potential outcome of a SPAD at that location.

Benchmarking

Train protection systems offer varying levels of automation and the systems available include:
- Alarms;
- Automatic application of emergency braking;
- Automatic train speed supervision; and,
- Full automatic train operation.

Consequence mitigation can be provided by:
- Automatic Train Warning;
- Train Protection and Warning System;
- European Train Control System (ETCS);
- Positive train control;
- Adequate signal overlaps;
- Speed restrictions;
- Double blocking;

- Approach clearing (however take note the need to balance the risk as presented in section 3.4 Potential SPAD traps); and,
- Catch points - catch points are typically applied to prevent runaway or inadvertent entry to main/running lines.

Although some RTOs employ such train protection systems there are cases where the trains of other RTOs are not fitted to interface with them. Where this occurs, RTOs should work together to ensure that risks are managed to an acceptable level.

Due to the significant differences and levels of risk found across the industry, the appropriateness of SPAD consequence mitigation measures can differ greatly depending on many factors. For this reason an attempt has not been made to provide ranking guidance in regards to the benchmarking of SPAD consequence mitigation.

2 position lower quadrant signal commonly used at a junction location. Both signals displaying stop.

5 SPAD prevention

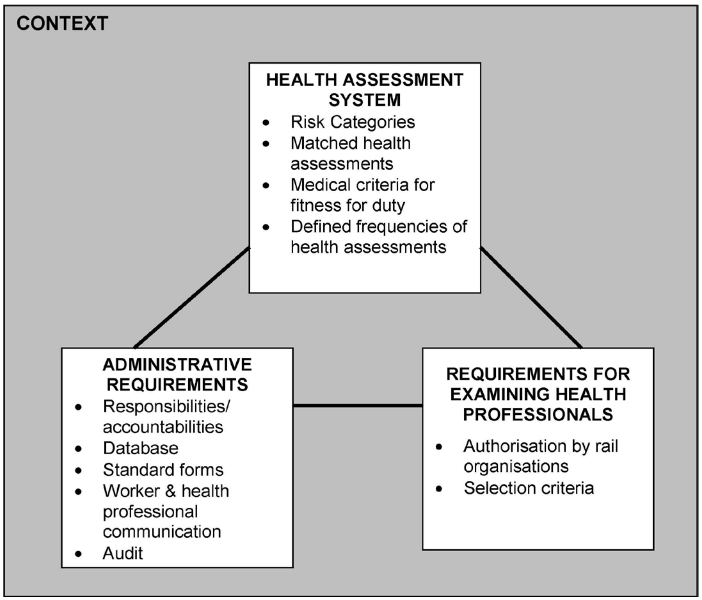
5.1 Behaviour and performance management of safety critical staff

Initiatives that help shape behaviour and support performance of staff involved with train driving are key to reducing SPADs. Staff involved in train driving, signalling and train control can be considered safety critical due to the risks associated with SPADs.

In the context of SPADs, safety critical staff includes:
- Train drivers/guards/second persons;
- Track machine drivers;
- Signallers/train controllers;
- Shunters;
- Platform staff;
- Worksite protection officers; and,
- Signal technicians.

Management of health and fitness and drug and alcohol are significant topics in themselves and are covered extensively in other publications.

The following sections highlight the key areas on which to focus regarding the behaviour and performance management of safety critical staff.



Features of the Health Assessment Standard

5.1.1 Recruitment and selection

Issues

If systems associated with recruitment and selection of candidates do not systematically evaluate the applicant's suitability for the role, including their propensity for taking risk, it can significantly increase the likelihood of the person being involved in an operating incident such as a SPAD.

Benchmarking

BASIC PRACTICE		GOOD PRACTICE
• Selection processes are used to assess the most significant medical and physical demands placed on staff by their operations in line with the requirements of the National Health Standard for Rail Safety Workers; and, • Selection assessment tests are used to assess the applicant's propensity for risk.	• Selection processes are used which assess the suitability of staff from a medical, physical and psychological perspective; • The RTO should only accept those candidates that meet a predetermined minimum benchmark set by the operator. The benchmark must be developed to ensure the individuals have the qualities, such as an appropriate propensity for risk, considered necessary for a train driver on their operations; • Tests should be validated by a capable, competent and authorised body and used as a proactive tool for determining the individual's risk profile; • Tests should map to the results from a rigorous job analysis; and • Systems are in place to audit the testing process and verify that it is being conducted correctly.	• Selection processes assess the physical demands placed on staff by their operations which are not reasonably practicable to eliminate or change through system design; • Pre-selection tests assess the previous safety performance of the applicant to determine their risk profile. The process is conducted for internal and external applicants from other RTOs and includes an assessment of the safety performance of the candidate in any previous safety critical railway role, for example, a shunter applying for a train driver role; • Previous assessment and training records of the applicant are obtained and are evaluated as part of a training needs analysis and used to assist with the formation of personal development plans; • The selection process includes a robust set of selection tests according to the nature of the role. For example, for train drivers, assessments may cover: personality, attention, concentration, vigilance, train handling aptitude, decision making, trainability, verbal and written communication skills, conscientiousness, rule compliance, multi-skilled under pressure, emotional stability etc; • Psychometric assessments used are supported by robust validation processes related to their application within rail operations covering key areas of risk such as SPADs;

BASIC PRACTICE

GOOD PRACTICE

- Results of psychometric assessments are communicated to those involved in training and developing the trainee. This should include the provision of information to the trainee and trainer to highlight areas of development during the training period; and,
- Robust controls are in place to manage the process of psychometric assessments. This may include, for example:
  - Preventing applicants re-sitting tests within pre-determined timeframes, if applicable; and,
  - Limiting the amount of times an applicant re-sits an assessment.

5.1.2 Managing the risk arising from inexperience

Issues

Inexperience is a key risk factor in managing SPADs. Newly qualified employees may have crossed the dividing line between a trainee and a competent employee, but they lack experience and normally need time to fully develop their decision making skills and confidence.

If controls are not in place, newly qualified train drivers are considered to be twice as likely to have a SPAD in their first two years of driving[9]. Immediate causes are often related to inadequate training, assessment, monitoring or additional support post initial qualification. From an individual perspective, issues such as over confidence and complacency often feature in incidents.

Benchmarking

BASIC PRACTICE		GOOD PRACTICE
• Reactive SPAD awareness training is provided; and, • Newly qualified drivers are subject to an increased level of assessment during the first 1 to 2 years post qualification.	• Specific SPAD awareness training is allowed for in the driver training course; • Specific modules associated with 'Safety versus performance in service delivery' are allowed for in driver-learning, with particular focus on how to mediate performance to balance these effectively. • Limited training is provided in human performance related issues such as fatigue awareness; • The training programme is structured and competence based with regard to known company risk, and provides some training in qualitative risk and error prevention techniques; • A trainee is assessed on their knowledge of relevant routes as part of their final competency assessment; and, • Post-qualification controls are in place including covert monitoring.	• Proactive SPAD awareness training is embedded throughout initial training, progressively building up a trainee's knowledge and understanding of SPAD and operational risk and the techniques used to minimise the likelihood of error; • Human factors and non-technical skills are embedded throughout initial training, progressively developing a trainee's understanding of risk management; • Professional driving/signalling/shunting/dispatch policies clearly identify techniques to be applied to support professionalism and error prevention. Supporting training sessions focus on trainees researching information and applying good practice; • Initial training programmes: - Are robustly designed, risk-based and aimed at minimising the risks associated with inexperience; - Minimise potential delay between the delivery of core modules;

Footnote: [8]BRB and RSSB safety data, 1991 to 2006

BASIC PRACTICE

GOOD PRACTICE

  - Ensure practical train handling includes a driver signing core route knowledge upon qualification;
  - Ensure trainees are mentored by trainers/instructors who themselves have had sufficient training and fully understand how the risks of inexperience can be managed. This includes detailed knowledge of route and SPAD risk that need to be communicated to trainees including setting the highest standards of professionalism;
  - Ensure the train handling module is competence based with clearly defined objectives in terms of developing skills associated with train handling, professional driving, route knowledge and decision making skills;
  - Provide at least weekly feedback by mentors on trainee performance;
  - Ensure workplace experience provides an understanding of other safety critical roles and associated risk of error with that activity; and,
  - Include allowances for annual leave within the main body of the training programme rather than programming this once the trainee is qualified.
- On initially qualifying, ensuring workplace experience is gained unsupervised to enable the newly qualified member of staff to develop confidence and competence;
- Where practical, restricting the level of route knowledge once qualified;
- Newly qualified staff maintain a log book of their experience, for example their driving experience (hours) post initial qualification, including any significant events or out-of-course situations that they may experience; and,
- Implementing a post qualifying support programme during the first 12 months to 2 years post initial qualification. The level of support will be dependent on the type of safety critical work the employee is involved in, but should consist of:

BASIC PRACTICE

GOOD PRACTICE

- Support interviews - these aim to provide an opportunity to give guidance and support, to build up a working relationship and to enable the employee to have confidence in approaching their line manager/ supervisor with personal/welfare issues or any other areas of concern or uncertainty;
- Additional monitoring and assessment e.g. cab rides, train data recorder analysis, unannounced monitoring. These should be systematically structured to provide an initial high level of support with timeframes being progressively extended over the course of the assessment cycle;
- Additional development days or workshops, providing an opportunity for newly qualified staff to discuss their experiences and to further develop understanding and competence in human factors, non-technical skills and operational risk avoidance techniques;
- A full assessment of competence after a period of 12 months to ensure key underpinning knowledge and competence in degraded and emergency working has been retained;
- At the end of the post qualifying support period, conducting a simple risk assessment to determine whether the candidate can progress to the ongoing assessment/re-accreditation process. If there are concerns, the employee should remain on a higher level of support and monitoring; and,
- Systems for managing inexperience also assess the additional support needed to monitor and support employees who transfer from another RTO. This takes account of issues such as confidence (over-confidence or a lack of confidence).

5.1.3 Developing and maintaining staff competence

Issues

Competence plays a very important role in controlling safety risks on the operational railway. The role of employees in controlling risks is essential in both normal operations and during degraded operations and emergencies where rules and procedures infrequently applied are encountered. Where competent performance is not maintained for normal and degraded working, accidents and incidents such as a SPAD may occur.

Benchmarking

BASIC PRACTICE

- Ongoing recertification/reaccreditation processes are in place, aimed at meeting the minimum requirements;
- The ongoing recertification/reaccreditation system is primarily focused on periodic refresher training;
- A professional policy (e.g. driving/signalling) is issued; and,
- A standard approach is applied to any monitoring/assessment conducted.

- Generic industry risk based competence standards have been developed based on known company risk;
- An ongoing recertification/reaccreditation process is in place with a focus on practical workplace observations with limited levels of unannounced covert monitoring are included. For example, analysis of driver performance through the use of train data recorders is only conducted post an incident rather than proactively;
- Persons involved in assessing employees are subject to robust selection and training procedures;
- Consider use of risk triggered commentary driving techniques;
- Technical Assessment records are maintained; and;
- A professional (driving/signalling etc) policy exists providing advisory and mandatory guidelines to be applied.

GOOD PRACTICE

- Competence standards have been further developed so they are specific to the risk and nature of the organisation’s operations;
- Competence standards include competencies associated with non-technical skills (e.g. rail resource management);
- Staff are issued with competence standards associated with their role and understand the method by which competence will be assessed;
- The process for assessing the competence of staff upon initial qualification is holistic, recognising the risk associated with inexperience. This includes a systematic assessment of all training and assessment records prior to initial certification;
- Ongoing systems for managing staff competence (recertification/reaccreditation):
    - Are risk-based providing high levels of support, according to the risk profile of the employee e.g. newly qualified employees, or employees that have been involved in incidents and accidents are provided with a higher level of support;

BASIC PRACTICE		GOOD PRACTICE

  - Include, within the assessment cycle, programmed assessment events such as practical rides, unannounced monitoring through, for example, on-train data recorder analysis, random monitoring of safety critical communications, monitoring from stations and yards, monitoring using CCTV etc; and,
  - Ensure that, over the duration of the assessment cycle, competence is re-assessed in all activities with a focus on key areas such as practical work place observations safety critical communications and rules and emergency procedures infrequently applied.
- Practical workplace assessments proactively address and record areas of development and these are systematically followed up to minimise the likelihood of the employee being involved in an operational incident;
- Methods for recording assessments grade the assessment findings on a scale, for example, 1 to 4 to ensure more than the minimum standards of competence are achieved;
- A professional (driving/signalling etc) policy is issued providing advisory and mandatory guidelines to be applied. It includes supporting information on the management of precursor incidents to SPADs, and associated information on errors and techniques to avoid an operating incident;
- Persons involved in assessing and monitoring employees:
  - Are occupationally competent in the role;
  - Have received suitable training and have core

BASIC PRACTICE

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  management and people skills to coach, develop and manage sub-standard performance; and,
  - Are periodically assessed in their competence to be able to undertake the task being assessed and also in their core management skills, including their ability to conduct assessments.
- Quality (rather than quantity) records of assessments are maintained providing an effective audit trail. The summary of the assessment highlights the softer human factor skills of the candidate in terms of their professionalism, situational awareness and general application of non-technical skills;
- The assessment process is risk-based and targets changes in risk profile due to, for example, new traction, additional routes, new methods of work, new signalling etc;
- The assessment process is subject to regular verification and audit;
- Periodic reviews are conducted to ensure that the competence management system (CMS) remains effective;
- Competence management systems include further development of staff as part of continued professional development; and,
- Safety briefing and development days are provided to periodically develop the employee’s understanding of SPAD and operational risk. Topics include reviewing lessons learned from previous incidents and new techniques to further reduce the likelihood of error are actively promoted.

5.1.4 Managing sub-standard competence

Issues

If an employee is carrying out an activity below an acceptable standard of performance (for example, the employee is involved in an operating incident such as a SPAD where an error or a violation was the primary cause), an effective procedure to manage sub-standard performance is needed. The system needs to establish the reason for sub-standard performance and ensure suitable procedures are in place to restore competence. If necessary, individuals who are not performing competently may need to be removed from that type of work and certificates/licences of competence temporarily or permanently withdrawn.

Benchmarking

BASIC PRACTICE

- Organisational standards indicate that additional support and monitoring must be provided to employees involved in operating incidents. Criteria may or may not be defined as to how this should be managed; and,
- Sub-standard competence in more significant events is managed through a standard process.

- A system is in place to manage sub-standard competence and additional levels of support are provided and documented;
- Underlying human factor issues are considered as part of the process;
- The system is operated independently of the competence management system;
- Systems exist to remove employees from safety critical tasks if their safety performance presents a significant risk; and,
- Sub-standard competence is managed differently depending on whether an error or violation has occurred. Disciplinary proceedings are conducted separately and outside of the investigation.

GOOD PRACTICE

- A documented system is in place to provide a mechanism for managing employee competence by providing additional development and support “proactively” (prior to) and “reactively” (post an incident);
- The proactive section of the system:
    - Clearly identifies influencing factors which can lead to a potential incident - for example aggressive driving techniques or not using self-checking skills; and,
    - Permits the employee to proactively self-report a deficiency in competence.
- The system is integrated into the CMS to:
    - Reduce duplication of assessments and monitoring; and
    - Ensure ongoing assessments are more holistic and place greater emphasis on the improvement of driver competence.

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GOOD PRACTICE

- The process clearly determines levels of support according to the nature of the incident. It also takes into account the weighting of incidents and the number of incidents the employee has been involved in to determine the content and duration of support plans;
- All safety of the line incidents according to the role such as excess speed, station overruns, poor train preparation, collisions, derailments etc. are considered when determining the level and duration of support of the employee;
- Development plans:
  - Are robust and specific to the individual;
  - Form a commitment between the manager and the employee on the action required to improve and restore competence and as such should be SMART (Specific, Measurable, Achievable, Realistic and Time Bound);
  - Include a range of support and development initiatives which are wider then monitoring and are aimed at addressing the underlying causes of sub-standard competence or behavioural issues;
  - Recognise improved performance and reduce the timeframe the employee is within the system when evidence indicates the risks have been controlled;
  - Are subject to regular and systematic review to ensure objectives are being met; and,
  - Are systematically closed out when evidence exists that competence has been restored.
- The system distinguishes between personal/welfare issues and other factors that can influence safety performance such as attitude, approach, motivation, commitment, rule violation etc;

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GOOD PRACTICE

- The system clearly defines the criteria, and associated processes for managing safety performance reviews, including associated appeal processes in accordance with employment law;
- The processes for determining whether an employee remains on safety critical duties following an incident takes a holistic view of the individual’s overall competence and safety performance;
- Transition arrangements from current to new systems evaluate and document the processes followed and justifications for decisions if the risk profile of the employee has changed; and,
- In the event of serious violations, in instances where an employee remains on safety critical duties, a supporting development plan is implemented to ensure risks are being controlled.

5.1.5 Managing driver route knowledge

Issues

Route knowledge is a key part of train driver competence. Whilst signal sighting standards and train protection systems are used to minimise SPAD risk, proactive SPAD management involves drivers being systematically briefed on route risks and the locations of multi-SPAD signals, critical junctions and SPAD traps as part of route learning. Historically, trainee drivers learned the route by observation and by informal advice regarding the risk encountered on the route given by experienced drivers. This informal approach, of course, led to inconstancies in driver learning. In more recent times RTOs have set about recording the risks associated with each route and training the driver accordingly.

Many RTOs have systems in place to maintain records of a driver's experience in driving a particular route. A route may have a minimum learning requirement (based on trips or hours) given its complexity determined by the lines route risk assessment. Drivers may also need to self manage this area of competence and request training/re-training before they are required to travel along a route with which they are not familiar or have not travelled recently.

There are some suggestions that drivers can become over familiar with a route with the effect that they are able to "switch off" and drive on "auto pilot". While on the other hand, some drivers report that on unfamiliar routes they have a heightened sense of alertness due to the lack of familiarity compared with routes they have driven many times. RTOs should consider these factors when designing driver working patterns and rosters to try and get the correct balance. Techniques such as the calling out of signals may also be used by the driver as a memory aid and to assist in maintaining alertness.

View from the driver's cab

The effect of temporary changes to the infrastructure (thus the drivers route knowledge) can have an impact on SPAD risk and also more general operational risk. For example, a temporary speed restriction may lead the driver to be distracted from a cautionary or stop signal as they focus on reducing the speed for the restriction. Conversely, the driver might forget the speed restriction after braking for the stop signal, which subsequently clears. The driver may then accelerate above the temporary speed restriction limit. How the temporary change and potential risks are communicated to the driver should be considered to ensure the driver is fully prepared.

Benchmarking

BASIC PRACTICE		GOOD PRACTICE
• Core information is provided to drivers when learning routes, including supporting route maps, gradient profiles and key location information; and, • Competence assessments are conducted of driver route knowledge measuring underpinning knowledge of key route features.	• Route risk assessments are carried out to identify route features and route risks. This includes identifying the location of multi-SPAD signals and signals that present a SPAD risk; • The outputs of the risk assessment are used to develop supporting route learning aids;	• Route risk assessments identify generic and specific risks associated with each route and outputs form the basis of route training; • Route learning aids include route DVDs, supporting maps with route and SPAD risks indicated, including information on multi-SPAD signals;

BASIC PRACTICE

GOOD PRACTICE

- Where a route risk assessment has identified a signal as having high SPAD risk (e.g. read across/ through potential), consideration should be given to highlighting the risk other than through formal training alone. Even if a signal is not multi-SPAD engineering mitigation may be considered to highlight the signal as high risk. This might include the use of countdown markers, fitting larger back plates of moving the signal;
- Include lessons learned on route maps;
- New qualified drivers are given time to consolidate and practice newly learned skills over more basic routes before learning more complex routes;
- Drivers are briefed on route risks as part of route learning; and,
- Route information on multi-SPAD signals is posted at depots.

- Route assessments are focused on measuring a driver's understanding of route risks and techniques to prevent error;
- When a signal is no longer classified as multi-SPAD, a risk assessment is undertaken to establish the residual risk and whether drivers should still be briefed on the signal as part of route briefing;
- Briefing information is communicated to drivers on any changes to signals that experience multiple SPADs. This includes the reason for the change and any techniques to minimise the likelihood of a further SPAD;
- Driver mentors and assessors have an informed understanding and can discuss, with confidence, route and SPAD risks;
- The route risk assessment process determines the method of route learning and the criteria for route retention;
- Ongoing assessment of competence and safety briefings communicate information on route risks and shunting movements infrequently encountered;
- Controls are in place to manage the risk associated with route conducting and route learning of other organisations' trains where this method of working is authorised;
- Following timetable changes in methods of working, such as new traction, an assessment is undertaken to establish potential changes to SPAD risk;
- Provision of advance warning signs for multi-SPAD signals, commonly referred to as "alert" signs;
- Post incident briefings are communicated to drivers to raise awareness of any changed risk following a SPAD or operational incident; and,
- In the event of hands-on driving experience not being obtained during route learning, controls are in place to minimise the risk.

Example of a multi-SPAD signal alert sign as used in NSW

5.1.6 Fatigue management

An employee who is fatigued will be less alert, less able to process information, will take longer to react and make decisions, and will have less interest in working compared to a person who is not fatigued. Fatigue increases the likelihood of errors and adversely affects performance especially in tasks requiring vigilance and monitoring, decision making, awareness, fast reaction time and tracking ability.

Fatigued staff may not adequately perceive risk and may tolerate risks they would usually find unacceptable, e.g. accepting lower standards of performance and safety. People can often be completely unaware of the extent to which their performance is being reduced by fatigue, and may also be unaware of lapses in attention or even briefly "nodding off". Fatigue can be hard to detect in staff – unlike other causes of temporary mental impairment such as drugs and alcohol, there is no "blood test" for fatigue.

It is important that RTOs raise awareness amongst their staff about fatigue and, more importantly, how to identify and management fatigue. For example, Kiwi Rail runs a brief instructor led training session for its rail operation staff called Alertness Management. The training is designed to inform employees of the potential for performance impairment as a result of fatigue, sleep loss, sleep deprivation, inadequate sleep quality, and working odd hours.

> If YOU remember nothing else
> - Fatigue symptoms have physiological causes
> - Sleepiness and fatigue can have severe consequences
> - People are different – tailor this information to *your own* needs
> - Fatigue can be managed but not eliminated
> - The best person to manage your fatigue is you

Kiwi Rail Alertness Management concluding remarks

Benchmarking

BASIC PRACTICE

- RTOs have standards defined for managers and staff on expected maximum working hours and minimum breaks, and arrangements are in place for checking that these are being followed;
- Instructions issued on what employees should do if they feel too tired to work safely; and,
- Instructions issued on what supervisors or managers should do if they believe a member of staff is too tired to work safely.

- The RTO has a fatigue risk management plan in place clearly defining limitations and procedures for managing fatigue;
- Fatigue is included in the organisation's safety training (e.g. during staff induction and periodically thereafter);
- RTO's instructions and guidance are issued to staff to manage fatigue and lifestyle;
- Roster design is subject to a fatigue management risk assessment/indexing; and,
- Incident and accident investigation procedures consider whether fatigue may have contributed.

GOOD PRACTICE

- Implementation of a structured fatigue risk management plan based upon on a comprehensive understanding of fatigue, and manages fatigue in a flexible way appropriate to the risk and nature of the operation. As far as possible it should:
  - Be based on sound fatigue control principles rather than custom and practice;
  - Take account of fatigue information collected about the organisation's own operations and feedback from staff, tailoring fatigue controls accordingly;
  - Be integrated with the organisation's safety management system; and,

BASIC PRACTICE

GOOD PRACTICE

Drivers of long distance freight trains have their own specific risks to consider

  - Be a continuous and adaptive process, continuously monitoring and managing fatigue risk, whatever its causes.
- Employees fully understand the risk and signs of fatigue, the actions to take to reduce fatigue and their own responsibilities for managing fatigue and coming to work properly rested;
- Employees inform their manager as soon as possible if they believe that they or a colleague are, or are likely to become, too tired to carry out their duties safely;
- Trade unions have an active role in ensuring that negotiated terms and conditions and resulting working patterns do not give rise to excessive fatigue;
- Standards and limits, so far as is reasonably practicable, take into account foreseeable causes of fatigue covering issues such as job design; the workload and the working environment; the shift system in operation; shift exchange; control of overtime; on-call working; the frequency of breaks; recovery time during periods of duty; and the nature and duration of any time travelling;
- Limits for hours worked and working patterns are clearly defined;
- In addition to fatigue index rosters, systems are in place to manage changes to rosters on an individual basis – shift exchange, actual work against planned work;
- Staff openly declare a second job or other factors that may influence fatigue;
- A fatigue assessment tool is used as part of roster risk assessments, and on samples of actual hours worked;
- Sickness absence rates are monitored to establish whether fatigue is an influencing factor; and,
- Staff who design rosters patterns are adequately aware of good fatigue management practice.

5.1.7 Safety critical communications

Issues

Research indicates poor communication has been a contributory factor in a significant percentage of all railway incidents/accidents, particularly SPADs. Influencing factors include: not communicating at all, failure to reach a clear understanding, not using safety critical communication protocols, not using the phonetic alphabet, communicating nonessential information at critical times resulting in distraction and the use of unauthorised methods of communicating such as a personal mobile phones.

Simulation tools are used by many RTO to allow staff to practice safety critical communication skills. This is important as safety critical communication between drivers and those controlling the network (signallers and controllers) is often by exception. Practicing safety communication skills to deal with a degraded or emergency situation in a simulated environment has many benefits and can reduce the risk of drivers becoming anxious and making mistakes when facing a real event.

IT'S HARD TO CONCENTRATE
ALWAYS
ON TWO THINGS AT THE
REMAIN
SAME TIME. ALL MOBILE
FOCUSSED
PHONES MUST BE SWITCHED
ON THE
OFF WHEN IN CHARGE
RED AHEAD.
OF A RAILCORP TRAIN.

NoSPADvember

Where is Your focus now?

Sydney Trains (formerly RailCorp) SPAD awareness advertisement

Benchmarking

BASIC PRACTICE

- Rules mandate safety critical communication protocols, the use of the phonetic alphabet, standard terms and phases and the protocol to use when reporting an emergency;
- Initial training includes the basics of communicating effectively and associated protocols; and,
- The RTO has a policy in place detailing the restrictions and protocols regarding the use of mobile phones in the work place.

- Rules and procedures mandate safety critical communication protocols, the use of the phonetic alphabet, standard terms and phrases and the protocol to use when reporting an emergency;
- Initial and on-going training includes the importance of effective communication and techniques to do so;
- The RTO clearly communicates and enforces their policy regarding the use of mobile phones in the work place;
- Clear guidance as to when and when not to communicate and task prioritisation advice is given when approaching a stop signal or when required to carry out any other safety critical tasks. This should include guidance to those initiating calls to drivers to ask if is safe to talk and to avoid calling the train if it is known that are approaching stop signals;
- Periodic monitoring of safety critical communications carried out;

GOOD PRACTICE

- The RTO's (SMS) and associated rules clearly define the standards and associated rules and procedures for managing safety critical communications;
- Initial and on-going refresher training in safety critical communications is provided and where appropriate, incorporates the use of simulation to develop the competence of the employee to communicate safety critical messages effectively;
- Employees consistently apply a systematic and disciplined approach to safety critical communications at all time and when working unsupervised;
- Employees challenge their colleagues in the event of safety critical communication protocol not being followed;
- In an emergency situation, employees are able to critically assess the situation and communicate

BASIC PRACTICE

GOOD PRACTICE

- Cue cards and standard scripts for key safety critical activities are used to ensure that a precise order of words is used to pass certain messages; and,
- On-going assessment processes assess safety critical communication protocols.

effectively and calmly the nature of the incident, the location of the train and the action to take to control the risk;

- Proactive monitoring of safety critical communications is conducted as part of the competence management system. Where deficiencies are identified, suitable development plans are implemented;
- The organisation continues to explore initiatives to improve standards in safety critical communications to enable benchmarking against best practice; and,
- Testing of new recruits to safety critical posts in spoken English.

A	*= Alpha*	*H*	*= Hotel*	*O*	*= Oscar*	*V*	*= Victor*
B	*= Bravo*	*I*	*= India*	*P*	*= Papa*	*W*	*= Whiskey*
C	*= Charlie*	*J*	*= Juliet*	*Q*	*= Quebec*	*X*	*= X-Ray*
D	*= Delta*	*K*	*= Kilo*	*R*	*= Romeo*	*Y*	*= Yankee*
E	*= Echo*	*L*	*= Lima*	*S*	*= Sierra*	*Z*	*= Zulu*
F	*= Foxtrot*	*M*	*= Mike*	*T*	*= Tango*		
G	*= Golf*	*N*	*= November*	*U*	*= Uniform*		

Phonetic alphabet – used to ensure the accurate communication of safety critical messages

Good Practice

Effective communication between staff

5.2 Managing human factors and safety in engineering design

Ensuring that human factors are systematically considered and are properly integrated into the design and procurement process will reduce the risk of SPADs due to work environment, infrastructure or train design factors. Driving performance can be impaired by factors such as extremes in temperature, poor ventilation, noise, lighting and glare. Both train crew and signallers can be affected by poor equipment design or layout.

An appropriate management of change process must also be implemented to ensure that changes that have the potential to impact on the safety of railway operations are managed effectively. More details about management of change processes are provided in the ONRSR guidance for the preparation of rail SMS.

5.2.1 Signal sighting/route design for new infrastructure

Issues

Route design that does not proactively consider human performance issues can increase the risk of a driver not detecting or incorrectly perceiving a signal aspect with the result that they pass a signal at stop. Alternatively, poor design of in-cab signalling, sub-optimal location of stop boards and poorly communicated or difficult to remember limits of authority can also increase the risk of a SPAD.

SPADs can also occur as a result of crew expectation. A driver may be expecting a signal to clear up because it usually does or approaches a signal at stop that is normally clear. Despite route knowledge, drivers may expect signals only on the left hand side. SPADs may occur if a route design includes signals that conform with signal sighting principles but depart from convention, such as right side signals, signals that are not clearly visible or not clearly associated with the respective track.

Signalling design for new infrastructure and changes to existing infrastructure should follow standards that adequately consider the needs of signal visibility and readability and competing requirements of signal hazards. The standards for signal visibility should provide for adequate time to identify signals, read the aspect information and determine the required actions. The time for this must also consider the context of other decision making and short term memory constraints of the driver. Human factors issues should be considered in developing signal sighting standards and determining the hazards to signal visibility and readability. RTOs should consider training crew for signal sighting, with due consideration to the signal standards, so that their expectations will be consistent with the actual design of signalling.

Benchmarking

BASIC PRACTICE		GOOD PRACTICE
• Signal sighting standards are used to support the signal sighting process and new route design and changes to existing signalling. They ensure consistency in signal design and placement; • Signal sighting committees shall include representatives from train crews, rail infrastructure managers, signals and rail operations. These representatives shall be experienced and able to identify the issues that will affect signal visibility and readability. It is desirable that they are knowledgeable of the signals sighting procedures of the rail infrastructure manager; and, • Signal sighting standards for new routes should be developed by the rail infrastructure manager considering the SPAD Hazards.	• Signal sighting standards support the signal sighting process and incorporate human factors considerations to ensure that adequate signal sighting time is achieved and that possible obstructions, interruptions or distractions are minimised; • Signal sighting committees shall include representatives from train RTOs, train crew, rail infrastructure managers, signals construction, signals design, signal maintenance and rail operations. These representatives shall be competent in their various roles and able to identify the issues that will affect signal visibility and readability. They should be knowledgeable of the signals sighting standards and procedures of the rail infrastructure manager. The infrastructure manager has a structured process to review all issues and this includes human factors issues. Facilitation encourages all members to observe the situation of each signal and identify issues in terms of hazards or human factors issues and have these recorded and not unsupported opinions. Processes exist for review of the situation where consensus is not achieved; • Signal sighting standards provide some guidance on route design to ensure consistency; and, • Tools, such as the overrun risk assessment and drivability assessment tools are used to support the design of new routes.	• Proactive signal sighting tools[9] are in use to support the signal sighting process. These tools incorporate signal sighting standards and require the user to systematically consider possible SPAD risks when sighting. SPAD hazards could include distractions, signal visibility factors, signal perception hazards, association with line issues, etc. The tools provide guidance to signal sighting committees on what to do when human factors issues arise and how to prioritise conflicting requirements. They also provide an audit trail that captures the reasoning behind key sighting decisions; • Signal sighting tools are used systematically by sighting committees to support the sighting process; • Detailed guidance is available to support signal design engineers and this ensures that route design considers crew expectations and is consistent with straightforward, clear rules for signal placement. Potential SPAD traps are minimised. Clear rules are developed to minimise read-through and station departure risks and support the placement of right hand signals; • For instance, train crew should have a good understanding of when right hand signals will be used and when to expect right hand signals, such as: - On sections of double track used for bi-directional working; - On crossing loops or passing lanes in single line territory; or

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Footnote: [9] RSSB, 2003, Railway Group Standard GE/RT8037 Signal Positioning and Visibility, Issue 01, UK

BASIC PRACTICE **GOOD PRACTICE**

  - In exceptional situations where signal sighting working group review indicates that right hand placement is the best solution for reducing risks so far as is reasonably practicable.
- Design of in-cab signalling systems and train order systems are developed based on a detailed understanding of user requirements and take into account performance limits associated with driver attention and workload to minimise the cognitive overhead required.

5.2.2 Procurement or design of new equipment/ upgrading existing equipment

Issues

When designing or procuring new equipment, such as train cabs, or when upgrading existing equipment/working environments there is an opportunity to ensure that factors impacting on human performance are considered.

Optimising interactions between operational staff, processes and equipment in a particular working environment, such as a train cab or a signalling control centre, can improve human performance and reduce the likelihood of SPADs. For example, by ensuring maximum visibility out of cab windscreens or designing controls and displays to minimise confusion, distraction or driver physical/mental fatigue.

Human factors should be incorporated systematically into the appropriate stages of the engineering process when designing new equipment or upgrading existing equipment. It is desirable to ensure that functional and design requirements are clearly identified and recorded. The inclusion of human factors, ergonomics and human machine interface with any system must be fully considered when creating what can be termed “end user requirements”. This will help ensure that the system can be used safely as intended and deliver optimal design that reduces the risk of expensive re-engineering, operational workarounds or a legacy of sub-operability. The design process may include consultation in pursuit of user centred design principles, the creation of a human factors issues register (HFIR), the development of user specifications, and the provision for user testing/ acceptance (e.g. mock-ups, prototypes, etc).

In designing cabs, designers should consider the anthropometry of drivers (rather than simply the physical characteristics of the median person) and the adjustability of the seat, to assure site lines are optimised. Consideration must be given to the sighting lines from the cab with regard to the type of signals that will be viewed by the driver. The location of in cab equiment that may interfere with the view of the signals must also be considered. Reflection from in cab light sources, CCTV screens and train management system should be minimal. The positioning and operation of sun screens should not overly impair the view from the cab. Not only should the intended use of equipment be considered but also the potential informal use of the equipment, which may affect the ability to view signals or could lead to distraction.

A systems engineering approach can be taken to ensure that end user and human factors needs are considered early on in the project. Operational concepts can be developed to test these requirements in terms of how the system will function in its environment.

In terms of SPAD reduction, understanding what tasks are being completed and what other systems might cause a distraction on the approach to the target signal are all considerations that affect how a human will perform.

Benchmarking

BASIC PRACTICE		GOOD PRACTICE
• Consultation with users, for example, the train crew to discuss user issues and ensure that user requirements are taken into account during the design process; • Human factors design standards (e.g. RISSB cab design standard AS 7533) are used to derive some requirements for the new design or to support procurement; • Some user testing takes place in the later stages for the design/procurement process; • Change management processes are used to support upgrades of working environments or equipment; • Risk assessments involving stakeholder representatives to develop a risk register/hazard log; • Maintaining risk register/hazard log through the project including verifying proposed controls are implemented and formal handover of residual risks to operations personnel prior to commissioning; • Approvals involving operations representatives at defined project milestones (“project gates”) to proceed with concept, design development and commissioning; and, • Change management process followed in compliance with legislative requirements.	• User consultation is part of the design process with user representatives involved regularly as part of a Human Factors Working Group, coordinated through a human factors specialist; • Human factors design standards are referenced to demonstrate compliance with good practice; • User testing is more extensive, takes place earlier in the design process and more systematic in terms of validating requirements; • Significant changes do consider human factors as part of the change management/safety assurance processes; • Formal requirements management process documenting operational requirements and assessing the impact of any changes. Requirements are then verified in testing and commissioning; and, • Separate approval of safety assurance documents to demonstrate safety targets have been met.	• There is a Human Factors Integration (HFI) standard that is followed in all major design and procurement projects. The HFI standard allocates responsibility and describes the process for systematic consideration of human factors through all stages of the project from requirements development through to validation and testing. It outlines the type of human factors activities that should be considered at each stage and the coordination of these activities through a human factors integration plan and a human factors issues register. Human factors activities are an integrated part of the systems engineering process; • When upgrading equipment or work environments, change management processes require the systematic consideration of human factors risks and implementation of suitable mitigation measures to address the hazards including risk based training needs analysis; and, • Formal safety and/or systems assurance processes in place in line with a recognised standard (e.g. EN 50126) to demonstrate that safety requirements and targets were met.

5.2.3 Management of human factors risks associated with existing infrastructure and rolling stock

Issues

Poor design of existing infrastructure and rolling stock cabs can influence the performance of safety critical staff, which can increase the risk of a SPAD. Factors that can affect performance include:

- Noise;
- Temperature;
- Distractions;
- Equipment design and layout; and,
- Operational demands.

It can be difficult to modify some of the features of existing work equipment or signalling infrastructure but it is important that these performance shaping factors are identified so that the related human factors risks can be managed. For instance, SPAD investigations should systematically consider possible factors that can affect driver performance.

Benchmarking

BASIC PRACTICE		GOOD PRACTICE
• SPAD investigations consider the sighting of the signal that is passed at danger if a sighting issue has been stated. Any changes that are suggested to improve signal sighting are passed on to the infrastructure owner; • Data sharing with the infrastructure owner/other RTOs is undertaken; and, • Training for train crew may highlight the most significant risks associated with existing train design.	• SPAD investigations identify SPAD hazards that can influence train driving performance. When a signal is passed at danger the investigation considers the signals in the rear as well as the approach to the signal passed in the SPAD; • There is some proactive identification of SPAD traps and at-risk routes; • SPAD data is shared with other RTOs and the infrastructure owner. Multi SPAD signals are identified; • Mitigations identified as a result of SPAD investigations are managed with the infrastructure owner using a clearly defined process; • A proactive program is in place to identify possible hazards associated with existing rolling stock and working environments; and, • Just Culture policies support SPAD reporting.	• A SPAD hazard tool is used to support SPAD investigations and ensure systematic consideration of possible human factors issues. SPAD investigations consider broader organisational factors that may influence SPAD likelihood; • Mitigations that require modifications to existing signalling infrastructure are prioritised according to risk gains; • Multi-SPAD data is collated and at-risk routes are identified. This is part of driver briefings, and depots provide clear up to date information to drivers, highlighting particular route risks for the routes relevant to each depot; • Driver routes and crew rostering are designed to minimise SPAD risks such as fatigue and inexperience;

BASIC PRACTICE

GOOD PRACTICE

- Risk based training needs analyses are developed for operational staff to support competence management and prioritise training effort. These are also used to identify training requirements for significant modifications to the work environment;
- Where appropriate, a Rail Resource Management training program is implemented to provide operational staff with the knowledge, skills and attitudes to manage themselves and available resources more safely and effectively;
- On the job observations of operational staff, such as the Confidential Observations of Rail Safety (CORS), are used to collect data on threats and errors. This data supports training development and identifies other opportunities to mitigate risks to human error from existing equipment or work environments;
- The Just Culture program is widely adopted and integrated into operations. Staff report near misses and other safety information; and,
- A seperate and accessible budget is available for SPAD mitigation to respond to identified infrastructure/system risks.

6 Post SPAD incident management

6.1 Overview

When a SPAD occurs it is important to have plans and procedures in place to:

- Limit the affect of the SPAD;
- Gather information (evidence) that may be lost with the passage of time;
- Take immediate steps to prevent further SPAD events if an immediate cause is identified, for example, poor rail head conditions, train braking issue or signal obscured by foliage; and,
- Recover the service.

Your organisation should be ready to deal with a SPAD if one occurs. The organisational response is critical to the overall management of SPAD risk. Good SPAD investigation is critical to our understanding of SPADs and a failure to investigate SPADs fully can act as a barrier to good SPAD management since a lack of understanding often results in a SPAD reduction strategy that is ineffective in mitigating actual risk.

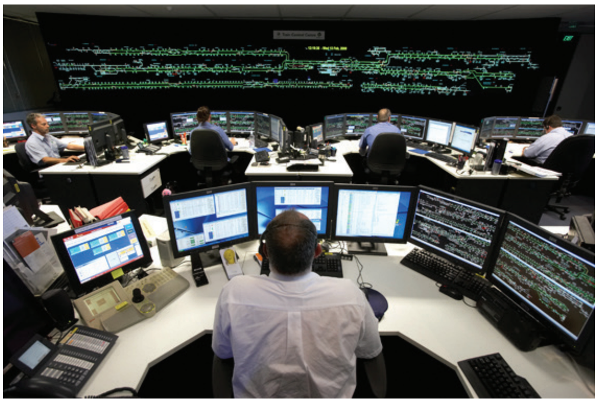
The requirements of post incident response, interface agreements between rail operators and network managers, and investigation, are also requirements of legislation and are contained in other RISSB documents. For more detailed guidance in the area of SPAD investigation please refer to the *Railway Safety Investigation Code of Practice* (RISSB, 2008) and the *Railway Accident Investigation Guidelines for Railway Network Owners, Railway Operators and Emergency Services Personnel* (ATSB, 2009).

6.2 Immediate actions

Issue

In the moments immediately following a SPAD there is potential for a poor response to escalate from a safely managed event to a rail safety accident. At the very least an effective response minimises the operational disruption. Operational pressures can be conducive to inadequate communications and errors or violations. Having plans and procedures in place to deal with the SPAD event will often need to be agreed between different railway undertakings especially where the trains and infrastructure are controlled by separate organisations.

The most obvious example is a ‘reset and go’ which effectively circumvents the train protection in place to mitigate SPADs in the first instance. However, more and more organisations are starting to use verbal driver inspection checks to verify if they are ‘fit to continue’ post-SPAD incident. In most cases, this is motivated by operational pressures and can lead to risk-blindness within organisations. Whilst there may be good reasons why the train driver should keep moving to a safe point of relief, it is important to recognise that their driving performance will almost certainly be impaired.



Control room staff controlling operations

Any plan or procedure must be designed to further prevent damage or loss by:

- Having systems in place to be alert to SPAD events;
- Stopping the train that has had the SPAD;
- Stopping trains that are approach a conflict point with the SPAD train;
- Stopping other trains that could become involved;
- Preventing the SPAD train from continuing until it is established that it is safe to do so;

Footnote: [10] *Public Transport Authority of Western Australia, 2007, Annual Report, WA.*

- Managing the safe and efficient recovery of a train to a place of safety (noting that the train may not be fully protected or managing the risk of detrainment of passengers between stations);
- Providing other relevant staff with basic trauma response training, including station staff (often the staff required to check welfare) and crew supervisors/first responders;
- Improve crew resourcing to aid the driver immediately post-SPAD; and,
- Consider providing train guards (if used in network) with basic trauma response skills to assist the driver and increase confidence in the ‘fit to continue’ check.

Benchmarking

BASIC PRACTICE

- SPAD alarm raised only by the observation of track circuit activation or other automated measures;
- Rules or railway signalling instruction to stop a SPAD train after SPAD event in place but not worked into specific instruction for the location;
- Rules or railway signalling instruction to manually contact and stop the SPAD train and other trains after SPAD event but not worked into specific instruction for the location;
- Rules or railway signalling instruction in place to stop the SPAD and other trains that have not been assessed jointly with the RTO of the infrastructure and the RTO of the trains; and,
- Rules in place that instruct the driver on the action to take after the SPAD event prioritising the protection of obstructed (by the SPAD train) lines.

- SPAD alarms in place at key locations only;
- Clear location specific instruction on the immediate action that a signaller or controller is to take post SPAD event;
- Group emergency replacement switches to place signals to danger on any other affected line;
- System to send group radio/text stop message to all trains in the location;
- Agreed emergency plan between all organisations on the action to take post SPAD event to prevent further consequence;
- Regular joint review of SPAD action plan;
- Driver receives specific instruction on post SPAD event management as part of the organisation driver competence management system. Information included in the organisations professional drivers policy and ongoing training and re-assessment program;
- Post SPAD recovery checklists for signallers and train drivers that are included in training and drills; and,
- Trains apply speed governors following a train trip.

GOOD PRACTICE

- SPAD alarms at all signals;
- Automated system to stop all affected trains post SPAD event;
- Technological solutions, such as ETCMS, designed to prevent most SPAD incidents and mitigate residual incidents;
- Driver initiated alert that warns other trains to stop (emergency broadcast system); and,
- Joint working party (all route users) to produce post SPAD management plan which is updated at regular intervals and post SPAD events.

6.3 Analysis and investigation

Issue

Capturing data or evidence post a SPAD event is vital if the cause of the SPAD is to be properly determined. Most evidence is time sensitive and even electronically stored data can be over written or corrupted. An organisation should be prepared and have systems in place to capture data immediately before, during and post a SPAD event to facilitate thorough analysis and investigation. An organisation's SPAD management response plan should detail how (and by whom) SPAD data is collected and analysed.

RTOs may consider the application of a root cause approach to the investigation and analysis of a SPAD event. This will assist in identifying what, how and why the event happened, thus preventing recurrence. At a high level, the root cause methodology would involve the following steps:

1. Data collection – generally through documenting the details of the incident and through interview with relevant staff members;
2. Causal factor analysis – establishing the sequence of events that led to the occurrence including through the development of diagrams. This may require an iterative approach as sequential underlying factors are identified;
3. Identify root cause – this can be achieved through the use of decision diagrams that assist in structuring the reasoning process and help answer questions about why particular factors occurred; and,
4. Generate recommendations – once the root cause has been identified recommendations can be developed to help prevent reoccurrence.

Benchmarking

BASIC PRACTICE

- Rules in place for signallers and controllers to take note of the circumstance immediately before, during and after the SPAD event. Standard or rules in place to gather basic data on a SPAD data collection form;
- Signal/controller is interviewed and statement is recorded;
- Inspection of the SPAD signal, local environs is completed;
- Inspection of rolling stock is made where an allegation of poor braking has been made;
- Arrangements are in place for the driver to be interviewed within three days of the SPAD;
- All voice communications recorded and made available for review;

- Joint process agreed to capture base data;
- Detailed capture forms in place for RTOs;
- Process for joint investigation in place with strong just culture regardless of blame;
- Signalling system records events automatically (data log). Data is shared with all parties involved;
- Ease of access to signal log data and other relevant communications records (such as dialogue between the signaller and the driver) during an investigation;
- Train data recorder analysed. Data is shared with infrastructure operator;

GOOD PRACTICE

- Train borne recorder captures train performance/ condition information;
- Forward facing cab CCTV records signal aspects;
- Train operator and infrastructure operator share SPAD investigation process each contributing to the data capture process;
- Incident/investigation personnel from either organisation agreed by both parties and free to investigate; and,
- Infrastructure and train tested routinely following a SPAD event.

BASIC PRACTICE

GOOD PRACTICE

- Basic driver interview form is completed ensure base information gathered;
- Disciplinary interview is held separately to the SPAD investigation (where required);
- Data of SPAD event is shared with Infrastructure RTO and other RTOs of the route; and,
- Staff assessed for effects of drugs and alcohol.

- Driver and signaller interviewed as soon as possible after the event and before the end of the shift;
- Agreement with trade unions in place to extend staff hours to complete required interviews;
- Route cause analysis techniques used to determine underlying cause and contributing factors; and,
- Staff tested for effects of drugs and alcohol by third party.

6.4 Post SPAD recovery

Issue

Once a SPAD event has been contained and all measures to prevent loss/further loss have been taken, there will be a need to restore and recover the service as soon as possible. The severity of the SPAD will determine the priority for returning to normal operations. Therefore the SPAD data collection process will need to be practical in its execution. Importantly the driver of the SPAD train might be required to continue to a point where he/she can be relieved. If this is the case a robust process of determining the driver's fitness to continue will need to be in place to ensure that the driver is not at risk of contributing to other safety of the line events. The driver may not need to be relieved immediately and whilst the signaller or controller may be able to ascertain through a phone conversation if the driver is fit to continue, this may only be reliable if they know the driver well. Either way it should be cautioned that actions taken post-SPAD do not focus on SPAD recovery without giving due consideration to the risks created by the SPAD recovery actions.

Consideration to isolating equipment that may have led or contributed to the SPAD and the effect this will have on the train service will have to be made.

A further point to make is that drivers do not go to work intending to pass a signal at danger. It should be recognised as part of the post-SPAD recovery process that, depending on the nature of the incident, a high level of emotional distress could have been caused to the driver and other affected staff. A SPAD can create symptoms of an acute stress reaction in the driver, which includes the release of adrenaline, increased heart rate, constricted blood vessels, change in blood pressure, and so on. This is typically accompanied by emotional irregularities such as disbelief, fear, and panic anxiety, which reduce the performing capacity of the driver. Often they can be dazed, confused, distracted, disoriented, and they may also have impaired judgement, narrowed attention, and partial amnesia, all of which is often accompanied with shaking, muscular agitation, delayed response. Understanding the issues for post-SPAD recovery is contingent on recognising that a SPAD has psychophysiological effects on the driver, and this happens regardless of whether it is technical in origin, or caused by human error

In addition to checking on the driver's ability to continue to a point where they can be relieved, there should also be follow-up actions and enquiries on the part of the RTO as a responsible employer to support drivers post incident. In particular, extending support consistent with international best practice in delivering Psychological First Aid (PFA) could be considered.

After experiencing a SPAD the actions that follow must be carefully considered and safely executed. It is important to use safety critical communications post-SPAD event and to put into action degraded operations plans.

In some instances, the driver may not be aware that they have experienced a SPAD. For example, a driver may not realise that a train stop has been activated as a result of a SPAD and instead attributes the train stop activation to some other cause, such as the presence of a foreign object on the track. In these instances the driver will tend to reset the train stop and continue, also referred to as a "reset and go". RTOs must place the onus on the driver to fully investigate these occurrences so as to avoid a reset and go situation. This post-SPAD recovery guidance does not necessarily apply to Return In Face Of Driver, or RIFOD, events, which are managed differently and, whilst still being significant events, generally require less effort in recovery.

Benchmarking

BASIC PRACTICE		GOOD PRACTICE
• Once the SPAD has been contained rules are in place for the driver to continue to a point where he can be met by a supervisor manager and relieved of duty provided the driver is deemed fit to continue; • Rules are in place for the train to be removed from service; • Signalling staff are interviewed and relieved if any claim is made; and, • Staff are available to assess/test infrastructure.	• Signalling control or management staff have agreed process to follow to assess initial fitness to move the train to a suitable location be relieved; and, • SPAD recovery plan agreed with all parties which includes a plan to deploy staff to assist with service recovery.	• The driver's fitness to continue to a point where the can be relieved safely is determined by staff (controllers or guards for example) that have been trained in basic trauma response skills[11]; and, • Condition monitoring equipment able to give near instant and robust report to enable equipment to be brought back into use.

Footnote: [11] Naweed. A. (2013). Psychological factors for driver distraction and inattention in the Australian and New Zealand rail industry. Accident Analysis and Prevention, 60(0), 193-204.

6.5 Lessons learned

Issues

Once SPAD recovery is complete the business of understanding what caused the SPAD should begin as soon as possible. SPADs are often investigated internally between the infrastructure operator and/or train operator. However if a more serious undesirable outcome has resulted then it is likely that the SPAD will also be subject to an external formal investigation.

If the cause of a SPAD is properly understood then steps can be taken to prevent reoccurrences. As previously mentioned, capturing, analysing and reporting SPAD events, ties in directly to a SPAD reduction strategy ensuring that a RTO is focusing on the highest risk issues. It is also important to the process of learning from SPADs that lessons learned are published and disseminated to those in a position to benefit from the sharing of this information.

Benchmarking

BASIC PRACTICE		GOOD PRACTICE
• SPAD are investigated to understand cause; • SPAD severity and causation are recorded and reported; • Trend analyses is completed; • Trend data is shared with other route users to assist them with their own SPAD reduction strategy; • Route risk groups meet to discuss trend analysis and agree on joint SPAD reduction initiatives; and, • Just culture supported reducing the link between SPAD occurrence and disciplinary action for SPAD events where a member of staff was responsible.	• SPADs are investigated to understand root cause using principles of route cause analyses; • Investigation staff trained in evidence collection and root cause analysis techniques; • Full consideration to human factors issues are considered by the investigation; • A robust method of SPAD severity and causation capture is developed based on the specific risk of the RTO; • Cause and severity data is recorded and reported and shared with route users; • Investigation reports are made available to route users and infrastructure operator; • Trend analyses is completed with full consideration to human factor issues; • Trend data is shared with other route users to assist them with their own SPAD reduction strategy; • Route risk groups meet to discuss trend analysis and agree on joint SPAD reduction strategies; and, • Just culture with regard to proportioning responsibility linked to joint SPAD reduction strategy.	• All data collated is made available to the wider industry; • Open forums attended to discus SPAD reduction strategies; and, • Route committees formed to manage joint SPAD reduction strategies.

7 Interfaces and joint initiatives with other operators

7.1 Overview

This section discusses the importance of information sharing and joint initiatives between RTOs and infrastructure managers. We also consider the importance of information sharing between organisations operating on the same line as well as those who are physically separated.

In the UK, and indeed across Europe, much work and effort has been put into industry-wide initiatives, SPAD reduction and other operational risk reduction strategies. This is despite the sometimes commercially competitive nature of train operating companies running on the same routes. Although the legal obligation will always remain with the individual railway undertaking, there is great benefit in working together to drive down operational and SPAD risk. The work in Europe has culminated in the production of international standards designed to ensure minimum safety standards across borders, paving the way for greater European interoperability.

National focus, sharing of best practice and other safety “lessons learned” has been very successful in the UK. UK national SPAD workshops and conferences have been at the foundation of better cross organisation relationships. Delegates from around the world have attended and presented their own SPAD management strategies and explained key success factors.

Within Australia there a number of industry events and initiatives that provide a platform for the sharing of information regarding SPAD risk management including AusRAIL and the annual Rail Safety Conference.

7.2 Australian forums for knowledge sharing

AusRAIL

AusRail is an industry wide event held annually. It provides a forum for the sharing of knowledge and experience within the rail indutry and offers the opportunity for rail industry practitioners to network. The event attracts delegates from across Australia and around the world. As such it can act as an effective platform for the sharing of information regarding the management of SPAD related risk.

Rail Safety Conference

The Australian Rail Safety Conference is an annual event that targets decision-makers within the rail industry with the aim of developing and implementing new and progressive ideas in rail safety. Unlike AusRAIL, this event is focussed specifically on matters relating to rail safety. The conference includes presentations and workshops.

ARA SPADS Working Group

This is a cross industry group that meets approximately every 2 months to share good practice.Their aspirational agenda is to better understand the causal factors relating to SPADs but as a first step towards that, they are putting energy into coming up with a nationally consistent categorisation system for Australia and New Zealand passengers and freight rail operators. Establishing a consistent SPAD classification system to be used by all Australasian rail operators and the Regulator will allow operators to benchmark, share information and learn from each other. Aligning the SPAD classification and data with what is provided to the Regulator will also help reduce regulatory burden on operators.

7.3 Examples of UK initiatives

National Operational Risk Conference

The National Operational Risk Conference is a UK event that takes place annually and provides a senior industry focus on operational safety and SPAD management. Targeted at chief executives, directors and senior managers from within the rail industry, in terms of rail operational safety management it is probably the most important occasion during the year as it provides an opportunity for senior managers to come together to learn about and discuss how to address significant operational safety risks. Presentations are provided on UK and international industry good practice in rail operational safety and risk control.

National Operational Risk Workshop

The UK National Operational Risk Workshops are organised each year and are aimed at people directly involved in the management, supervision and monitoring of the people involved in carrying out operational activities - drivers, signallers, shunters, train conductors, train dispatchers. Delegates include drivers, signallers, shunters, train conductors/dispatchers and the managers responsible for these activities.

7.4 Promoting knowledge sharing

To manage cross industry policy, strategy, standards, risk information and the sharing of good practice, a nationally recognised institution and organisation is well placed to facilitate a national focus.

A central organisation can bring economic benefit as a combined industry approach brings economies of scale and minimises duplication of effort.

The role of such an organisation may be to:
- Deliver functions that the industry has collectively decided on;
- Manage and take ownership of national railway industry standards;
- Manage the collection and dissemination of safety intelligence and risk information; and,
- Make provision for cross industry research programme.

In the Australian context such an organisation might focus on:
- Sharing SPAD event information;
- Creating a vessel to share safety performance history of railway workers between organisations;
- Sharing of route risk information and creating a national database;
- Creating a data base of good practice; and,
- Facilitating SPAD management workshops and events.

Benchmarking

BASIC PRACTICE		GOOD PRACTICE
• Consultation with other RTOs at a local level.	• National level consultation with other RTOs through informal channels.	• Regular national level consultation between RTOs through formally established channels or workgroups.

8. Managing future risk

The railway has seen remarkable changes in the past two decades. Modern innovations applied to train control, command and communication systems have revolutionised the way the industry operates and has done much to reduce safety risk. Such technologies vary from the complex to the relatively simple and have different cost implications. When considering technology based risk mitigation measures as part of a SPAD reduction strategy an RTO should use the guiding principles of SFAIRP whilst considering other risks to safety and the operation holistically.

It is important that an RTO considers the risk that such technologies may introduce to the organisation; the potential for over reliance on the technology, the ability of staff to develop workarounds and change in the operational risk profile can lead to unexpected and undesired outcomes.

Historically, the introduction of TPWS in the UK, whilst drastically reducing SPAD related incidents, introduced the reset and go risk, which also poses a risk to Australian RTOs operating similar devices including train stops.

The implementation of new technologies may result in the introduction of mixed safe working systems. For example, ATP and operating systems may be applied to a high capacity central core only, whilst traditional line side signalling is employed across the rest of a network. RTOs must consider the risk associated with this as well as the risk involved in transitioning to a new system.

RTOs should have established management of change processes in places and employ subject matter experts in assessing the risk associated with new technology.

9. Suggested further reading

A list of suggested further reading is provided below. This is not an exhaustive list and many of the organisations and authors represented below have produced additional material which the reader may wish to review.

		Establish trends and SPAD risk	SPAD reduction strategies, SPAD groups and engagement of staff	SPAD consequence mitigation	Recruitment and selection	Managing the risk arising from inexperience	Developing and maintaining staff competence	Managing sub-standard competence	Managing driver route knowledge	Fatigue management	Safety critical communications	Signal sighting/route design for new infra-structure	Procurement or design of new equipment/ upgrading existing equipment	Management of human factors risks associated with existing infrastructure and rolling stock	Post SPAD Incident Management - Lessons Learned	Interfaces and joint initiatives
		4.2	4.3	4.4	5.1.1	5.1.2	5.1.3	5.1.4	5.1.5	5.1.6	5.1.7	5.2.1	5.2.2	5.2.3	S6	S7
1.	Reference: Link: Guideline Section:	International Union of Railways, 2002, UIC 651 2002: *Layout of Driver's cabs in Locomotives, Railcars, Multiple Unit Trains and Driving Trailers (4th ed)*, France. http://www.uic.org/														
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2.	Reference: Link: Guideline Section:	International Union of Railways, 2010, UIC and Unife 2010: Technical Recommendation Driver Machine Interfaces in the scope of TSI High Speed and Conventional Rail, TecRec 100_002 Issue 1, France. http://www.uic.org/														
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3.	Reference: Link: Guideline Section:	Ministry of Defence, 2008, Defence Standard 00-250 2008: Human Factors for Designers of Systems Part 4: HFI Method, Tools and Techniques, UK. www.hfes.org														
													✓			
4.	Reference: Link: Guideline Section:	Annual Rail Safety Conference, Australia. http://www.railsafetyconference.com.au/														
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Suggested Further Reading			4.2	4.3	4.4	5.1.1	5.1.2	5.1.3	5.1.4	5.1.5	5.1.6	5.1.7	5.2.1	5.2.2	5.2.3	S6	S7
5.	Reference: Link: Guideline Section:	Annual AusRAIL Conference, Australia. http://www.ausrail.com/															✓
6.	Reference: Link: Guideline Section:	ARTC, 2010, Spoken and Written Communication, Australia. http://www.artc.com.au/library/ANPR%20721%20Spoken%20and%20written%20communication%20%20I%201%20Rev%202.pdf										✓					
7.	Reference: Link: Guideline Section:	ARTC, 2010, Hunter Bulk Terminals Radio Communication, Australia http://www.artc.com.au/library/OWP-01-05.pdf										✓					
8.	Reference: Link: Guideline Section:	Association of Train Operating Companies (ATOC) , 2009, ATOCACOP006 Audit of Selection Processes, UK www.rgsonline.co.uk				✓											
9.	Reference: Link: Guideline Section:	ATOC, 2007, ATOC/GPG016 Good Practice Guide – Management of Sub-Standard Performance by Train Drivers, UK www.rgsonline.co.uk						✓									
10.	Reference: Link: Guideline Section:	Australian Rail Track Corporation (ARTC), 2008, ANGE 204 Network Communication, Australia http://www.artc.com.au/library/ANGE%20204%20Network%20Communication%20I%201%20Rev%202.pdf										✓					
11.	Reference: Link: Guideline Section:	Australian Safety and Compensation Council, 2006, Guidance on the Principles for Safe Design for Work, Australia http://www.safeworkaustralia.gov.au/sites/swa/about/publications/Documents/154/GuidanceOnThePrinciplesOf-SafeDesign_2006_PDF.pdf												✓			

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<tr><td rowspan="2">12.</td><td rowspan="2">Reference:
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Guideline Section:</td><td colspan="15">Federal Railroad Administration, 1998, Human Factors Guidelines for Locomotive Cabs, USA
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Guideline Section:</td><td colspan="15">International Standard Organisation (ISO) , 2007, ISO 3411: 2007 Earth-moving machinery – Human physical dimensions of operators and minimum operator space envelope, Switzerland
http://www.iso.org</td></tr>
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