



The role of Human Factors in optimising the operation, management and design of the Platform Train Interface

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SUMMARY

In December 2013 cross-industry Platform Train Interface Strategy Group (PTI SG) was set up responsible for the creation of a national PTI Strategy. The strategy was published in January 2015 [1].

To develop the strategy a risk-based approach was adopted which triangulated methodologies (workshops, quantitative and qualitative analysis, literature review and external research), combining the disciplines of Human Factors, Operations, Engineering, and Data Analysis. This paper is focused on the role Human Factors played in the development of the strategy.

INTRODUCTION

In 2013 to 2014 1.6 billion passenger journeys took place on the GB network equating to 3 billion movements across the Platform Train Interface (PTI) [1]. Although a significant majority of these occurred safely, over the last 10 years 32 fatalities were recorded at the PTI, while 21% of the overall passenger fatality and weighted injury (FWI) risk and 48% of the passenger fatality risk occurs at the PTI. Indeed the amount of harm while boarding or alighting, taking into account a rise in passenger journeys, has increased since 2007/08 [2].

PTI incidents involve passengers or members of the public crossing the boundary between the platform and track or the platform and train and break down into those that occur during boarding and alighting and those that occur when an individual is on the platform but not boarding and alighting.

Tackling the risk posed by the PTI is a significant challenge, compounded by a range of variables including significant variations in station, platform and train design; passenger attitudes and behaviours; differing dispatch methods and staffing requirements for platforms and maintaining access for mixed traffic operations (different rolling stock, freight operations, and on-track machine for example).

In recognition of this, the GB PTI Strategy has been developed, underpinned by cross-industry collaboration, providing a vision and roadmap to improve safety, performance and capacity through optimising the operation, management and design of the PTI over the next 50 years.



The strategy is a collaboration between Engineering, Operations, Human Factors and Data Analysis. To support its development each domain completed a set of research activities to help determine the factors contributing to PTI risk and the work streams that should be developed and implemented to help tackle these factors and facilitate improvements in safety, performance, accessibility and capacity, so far as is reasonable practicable. The research programme focused on a specific set of hazardous events and contributory factors, based on analysis of PTI incidents contained in the Safety Management Information System (SMIS) (Table 1).

Hazardous events	Factors to be considered
Person trapped in train doors Slip, trip, or fall across the platform train interface Contact with train exterior while on platform Person falling between train and platform Fall from platform onto track	Injured party factors – the injured party’s actions, or personal characteristics Third party factors – the actions of a 3rd party, but not the actions of train or station staff Station design – the design of the station, including the platforms Station operation – the operation of the station, including the actions of platform staff and the impact of events such as delays on station operation Train design – the design of the train, including doors, handrails and alarms Train operation – the operation of the train, including the actions of on-board staff, and dispatch procedures

Table 1 Hazardous events and factors studied

This paper describes the Human Factors element of the research programme, describing the Human Factors research activities that were undertaken, the key Human Factors issues identified and the strategic work streams generated.

HUMAN FACTORS RESEARCH ACTIVITY

Human Factors Literature Review

The aim of the Human Factors literature review was to:

1. Collate evidence from published literature to support or challenge the conclusions of the Human Factors workshop.
2. Determine what factors make behaviours more likely, taking into account factors relating to the person, the train environment, the train operation, the station environment and the station operation (see Table 1)
3. Collect evidence from published literature regarding methods to influence behaviour at the PTI, summarise the methods and if possible, draw conclusions about how effective they are.
4. Identify mitigations in use internationally and summarise any evidence relating to their effectiveness.

The following information sources were used:

1. Keyword search of relevant national and international publications and research including relevant conference proceedings, using Google, Google Scholar, SPARK and the RSSB HF library
2. All previous relevant RSSB R&D projects, RSSB special topic report on PTI, RAIB and ORR publications
3. Other relevant safety information and data generated nationally and international as well as information on mitigations utilised by international rail operators.



As part of this, an RSSB questionnaire was sent to a range of international rail operators requesting information on the mitigations used to tackle PTI incidents. One response was received from the East Japan Railway Company.

Human Factors Subject Matter Workshops

Two workshops were completed, with 25 industry attendees from 17 different organisations. Attendee roles varied and included heads of safety, heads of customer service, station managers and engineers.

In the first workshop attendees identified the behaviours that they felt contributed to the hazardous events described in **Erreur ! Source du renvoi introuvable.** Attendees then rated each behaviour by a) frequency (how often), b) distribution (how widely) and c) likelihood; using a 1 to 5 scale, where 1 = very low frequency, distribution and likelihood and 5 = very high frequency, distribution and likelihood. Ratings were multiplied with each other to produce a priority score for each identified behaviour.

In the second workshop attendees identified mitigations that they felt could reduce or prevent the behaviours identified and prioritised in the previous workshop. Mitigations were confined to those that were already in use on the GB network or could foreseeably be used without making major changes to the way the railway operates. Attendees provided a rating of confidence for each mitigation, using a 1 to 5 scale, where 1 = “Never works to prevent this behaviour or to prevent the hazardous event” and 5 = “Always works to prevent this behaviour or to prevent this hazardous event”.

Qualitative study of PTI incidents

A qualitative study of passenger behaviours was commissioned [3].

The project aimed to:

1. Identify passenger behaviours leading to increased risk of PTI incidents and explore the factors that underpin these behaviours
2. Explore passengers' perceptions and attitudes towards risk at the PTI and strategies they adopt to mitigate risk
3. Make conclusions and recommendations on the priorities and methods for mitigating risk at the PTI.

To achieve the aims, five different work streams were undertaken:

1. A review of previous programme outputs and previous research to set the context for the study
2. Observations of passenger behaviour to identify behaviours that lead to increased risk from incidents at the PTI
3. Audits of station environments to provide an insight into whether particular features of stations contribute to PTI incidents
4. Focus groups with rail users to establish to understand views and opinions regarding PTI behaviours and risks, station environments and other factors that may be associated with risk at the PTI
5. A survey of passengers to probe attitudes, behaviours and perceptions of risk at the PTI.

Findings from the research

The findings from the Human Factors workshops, literature review and qualitative study [3,4] led to the identification and prioritisation of passenger behaviours that contribute to the occurrence of the PTI hazardous events described in **Erreur ! Source du renvoi introuvable.** and mitigations which can, so far as is reasonably practicable, help reduce the occurrence of these behaviours and/or mitigate the impact of such behaviours. The



research also identified other contributory factors that can increase the potential occurrence of PTI hazardous events. Table 2 provides the prioritised set of passenger behaviours and characteristics identified.

Prioritised behaviours	Example evidence
Accidental slips, trips and falls, for example, making a physical mistake or misjudging the step.	Literature reported that incidents of falling are highly likely to result in a hazardous event, with loss of balance cited as the common reason, while this factor received the highest priority rating within the Human Factors workshops.
Rushing, for example, attempting to board too late and/or running while boarding.	Rushing, was commonly mentioned in the literature and often associated with being trapped in train doors. Moreover, Hustle alarms, staff behaviour and layout of entrances to platforms were all identified as factors that can potential affect rushing behaviours.
Too near the edge when a train is departing, arriving or not at the platform.	Observations of the PTI revealed that standing too close to the platform edge and/or walking the wrong side of the yellow lines were associated with the potential occurrence of all the hazardous events described in Table 1
Lack of awareness, for example not seeing or realising the size of the step/gap, leaning on the train.	Lack of awareness was identified as key behaviour in the Human Factors workshops, while the passenger attitudinal survey revealed that PTI activities that present a genuine risk of severe injury are not recognised as such by passengers, while PTI activity is not collectively considered to present a high level of danger.
Crowding on the platform, in relation to unplanned service disruptions	Being forced to the platform edge due to lack of available space was the second highest prioritised factor within the Human Factors workshops.
Intoxication	Literature suggests that intoxication was associated with a small percentage of events. However, this is not surprising as intoxication is often associated with low frequency, high consequence events. For example, the Office of Rail and Road [5] reports that intoxication was a factor in 21 of the 32 deaths at the PTI in the past 10 years.
Encumbered travel, for example passengers with luggage or pushchairs	Evidence from the literature review and the qualitative study suggests the PTI is a common place for passengers to be encumbered and can contribute to hazardous events such as falls between train and platform; slips, trips and falls and being trapped in doors. Moreover, “multiple trips on and off train to load luggage” was identified as a priority behaviour in the Human Factors workshop.
Sensory impairment, for example visual impairments	Both the literature review and the qualitative study indicated sensory impaired passengers, especially visual impaired, to be a high risk group.
Technology use, for example mobile phones and tablets.	The literature review and the qualitative study suggests using a device while walking or waiting for a train can result in distraction. Distraction was associated most commonly with falls from platform onto track and contact with the train exterior.

Table 2 Prioritised passenger behaviours

A number of operational, rolling stock and infrastructure factors were also identified. These are provided in Table 3. The most notable was the height and width of the gap between the platform and the train. This was mentioned a number of times during the passenger workshops [3] and was identified as a key contributor factor in potential hazardous events involving passengers falling between the platform and the train.



Infrastructure	Operational	Rolling stock
Platform (slippery, uneven, obstructions)	Service issues (delays, frequency, changes, cancellations, inaccurate announcements, staff errors)	Hustle alarm Exits (number, location)
Height and width of the gap between platform and train	Maintenance on platform	Train fittings
Wayfinding	Dwell time	Footsteps/plates
	Presence of staff	On-board space

Table 3 Infrastructure, operational and rolling stock contributory factors

Generation of work streams to help tackle the Human Factors issues

The Human Factors workshops, literature review and qualitative study [3,4] revealed a similar set of mitigations that allowed a prioritised set to be generated and assigned to five of the six work streams described in the strategy.

These strategic work streams are:

1. Passenger movement through the station and across the PTI.
2. Train stopping positions, dispatch, monitoring the dispatch corridor and stopping once dispatched.
3. Optimising the step and gap.
4. Accessibility.
5. Data intelligence and gathering, and
6. Performance and capacity.

Table 4 presents the prioritised mitigations and work streams they were assigned to. No mitigations were assigned to the data intelligence and gathering work stream. However, the prioritised behaviours identified, helped to inform the type of data that should be collected in the future to enhance PTI data intelligence and gathering.

Relevant strategic work stream	Mitigation
Passenger movement through the station and across	Raising passenger awareness of PTI risks and



Relevant strategic work stream	Mitigation
the PTI	facilitating behavioural change
	Providing staff with the skills, time, and equipment to better engage with passengers and support reductions in PTI risk
	Enhancing the management of intoxicated passengers
	Demarcating the position of platform markings to designate zones where passengers should not wait, walk, or stand too close to the edge of the platform
	Improving the provision, location and content of information for customers
	Improving platform management
Accessibility	Supporting and empowering vulnerable passengers or those requiring assistance. This includes suitable assistance, way finding, travel information and tactile information.
	Rolling stock design
Optimising the step and gap	Optimising infrastructure and design of the physical environment.
Train stopping positions, dispatch, monitoring the dispatch corridor and stopping once dispatched	Use of technologies to support the safe arrival, departure and dispatch of trains.
	Provision of standardised train stop markings.
Performance and capacity	Provision of adequate and flexible dwell times for boarding and alighting and increased capacity of rolling stock and platforms

Table 4 Prioritised mitigations and assigned work streams

CONCLUSIONS

The platform train interface strategy

The Human Factors workshops, literature review and qualitative study [3,4], combined with research undertaken by operations, engineering and data analysis has led to a strategy that:

1. Focuses on safety, performance, capacity and access issues that impact on the PTI.
2. Aims to reduce, so far as is reasonably practicable (SFAIRP), fatalities, major injuries and minor injuries at the PTI.

3. Reflects the wide range of Human Factors, operation, performance, capacity, engineering and data generation issues surrounding the PTI, and
4. Sets out evidence based immediate, short, medium and long term goals for the industry to optimise the operation, management and design of the PTI.

Moreover, the development of the strategy is an illustration of how industry as well as different research domains (Human Factors, Engineering, Operations and Data Analysis) can work collaboratively to undertake risk based research and develop an evidence based strategic approach to tackling a significant industry wide issue. This is illustrated by the following endorsement from the Office of Rail and Road:

“This marks a point in time where the rail industry’s vision and resolve has brought them together to work collaboratively, to optimise the management of the PTI in terms of safety, operational performance, and availability of access.” [1]

Deliverables to date

The PTI Strategy Implementation Group (PTISIG), made up of industry stakeholders and partners, is responsible for coordinating the implementation of strategy. To date the following deliverables have been completed:

1. National media campaign entitled “lend a helping hand” to help raise passenger awareness of PTI risk
2. On-line PTI good practice guide located on Opsweb
3. PTI strategy technical research report and strategic action plan [4]
4. Staff communication on PTI risks, covering identifying and supporting vulnerable passengers [6]
5. Promotion of good practice to support the management of intoxicated passengers [7]
6. PTI Risk assessment tool [8]
7. Evaluation of platform gap fillers [9]
8. Investigation into platform edge positions [10,11]
9. Guidance of managing the impact of luggage [12]
10. Improving the methods used to provide access to and from trains for wheelchair users [13]
11. Industry training resource including a re-enactment of a trap and drag incident [14]

Ongoing work includes:

1. Development of a risk based training needs analysis and non-technical skills training for staff responsible for dispatch [15]
2. Development of research proposals to investigate platform markings, stop car markers and step/gap arrangements.
3. Adaptation of the RSSB fair culture good practice guide [16] for dispatch staff.
4. Development of a guide on risk triggered commentary for dispatch staff.
5. Update to RIS-3703-TOM Rail Industry Standard for Passenger Train Dispatch and Platform Safety Measures [17]

Further details of strategic deliverables are contained within the PTI strategy [1]

Finally, the strategy will be updated as further information and knowledge becomes available, with links to other relevant areas of work such as suicide and trespass for example, being developed to achieve the core aim of the PTI strategy:

“For industry to work together to reduce safety risk and optimise operational performance, capacity and availability of access in a manner that promotes the long term best interests of the mainline railway system and those who use it” [1]



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