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The Role of Information Systems in Preventing Railway Suicide: A Service Value Co-creation Perspective

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Abstract

Suicide prevention is a major concern for railway operators internationally. This paper reports research in progress examining how information systems can facilitate passenger/organisational co-created value in terms of reducing the incidence of railway suicide. Thus, the objectives of this research are to: (1) explore and evaluate the effectiveness of using information systems interventions in a passenger railway servicescape, and (2) explore the relationship between these servicescape interventions and customer experience, and assess their impact on railway suicide prevention from a value co-creation perspective. While the focus of this research is preventing railway suicide, the information systems developed would also lend themselves to a wide range of additional railway security issues such as the detection and prevention of crime, terrorism, and potential misadventure incidents.

Keywords: Railway suicide, detection and prevention, value co-creation, action design research

1 Introduction

Suicides on railway and metro transportation systems is a major worldwide concern (Mishara and Bardon 2016). According to Naomi Frauenfelder, Executive Director of the TrackSAFE Foundation (TrackSAFE 2016), there are around 150 fatalities in Australia resulting from rail suicide annually. These events have a profound and lasting impact on train drivers, other rail employees and the wider community. While absolute numbers are still small by comparison to other means of suicide, the violent and public nature of railway suicide incidents has far-reaching impact. Because of the public nature of railway and subway suicides, a single incident has the potential to affect the psychological well-being of many others including rail staff and passengers who witness the incident or its aftermath (Chung et al. 2016; Cothureau et al. 2004; Farmer et al. 1992; Kim et al. 2013; Krysinska and De Leo 2008; Limosin et al. 2006; Weiss and Farrell 2006; Yum et al. 2006). Prior research also highlights the significant financial and organizational costs of railway suicide, including delays to services and driver absenteeism (Dinkel et al. 2011; Erazo et al. 2005; Krysinska and De Leo 2008; Ladwig and Baumert 2004; Law et al. 2009).

Given the extent of damage and costs, it is not surprising to find that the issue of railway suicide has attracted significant research interest since the first reported incident in England in 1852 (Clarke 1994). From our review of prior research, literature on the topic is classified into two broad categories. The first is concerned with the epidemiology of those who would choose railway suicide as the means of death (Krysinska and De Leo, 2008). The studies in this group are useful as they provide clues regarding the different types of interventions that could be employed to reduce the incident of railway suicide for people suffering with different types of mental illness.

The second category of papers specifically examines the different suicide prevention strategies and interventions that have been employed. The papers in this second group can be further classified into three sub-groups based on the nature and focus of the intervention. Behavioural interventions relate to training provided to railway staff to reduce the incidence of suicide, and training to ameliorate the impact of suicide on railway staff and bystanders. An example of a behavioural intervention is to train customer facing staff in mental health first aid to enable them to better identify suicide warning signs (Debbaut et al. 2014). Servicescape interventions relate to those changes to the service environment that can inhibit or influence suicidal intentions. An example of a servicescape intervention is the use of platform barriers or changes to other environmental conditions such as lighting or sound (Havârneanu et al. 2015; Ichikawa et al. 2014; Matsubayashi et al. 2013). Communication interventions are similar to behavioural interventions in that they aim to influence ideation and the incidence of suicide, however, the target of such interventions is the commuter rather than railway staff. An example of a communication intervention is the award winning “Dumb Ways to Die” social media campaign by Metro Trains in Melbourne (Salm and Hommers 2013). It is important to note that these are not typical health interventions, as staff are not trying to understand or modify an underlying health issue. The objective of these interventions is to improve the existing operational responses to suicide, with at-risk persons directed to appropriate external support services if needed.

Notwithstanding the many contributions of previous research, there are, nevertheless, some very specific gaps in our understanding of railway suicide. For instance, the nature of railway suicide presents some challenges as the effectiveness of the method means that we only have limited understanding of the psychopathology of those selecting this method of suicide (Krysinska and De Leo, 2008), particularly if they have no prior history of psychiatric illness. The intervention focused literature is also problematic as the vast majority of the literature tends to focus on single interventions, ignoring the possible interdependencies among intervention types, and the contingent effects of the various situational factors related to the form of suicide. Our review of prior research also found that much of the existing literature is descriptive in nature, with very little focus on theory building or theory testing, and very little by way of guidance for operations management. Finally, the nature of railway suicide also presents some methodological challenges due to the binary nature of suicide. As with all variance-constrained dependent variable models, there are some statistical challenges when trying to identify sensitive direct and interaction effects.

Innovations in services have made significant contributions to the growth and management of service industries and increased economic influence (Su 2011), yet not so much on improving public health and solving social issues such as suicide. Further, there is some evidence that information systems can provide effective interventions for suicide prevention in different settings (Kreuzer et al., 2016). As the ultimate goal of this study is to prevent railway suicide behaviours, we focus on railway-centric servicescape given that it is an important determinant of customers’ behavioural intentions (i.e., suicide attempts) when customers spend moderate to long periods of time in the servicescape (i.e., waiting

trains on a platform). To sum up, there is potential in exploring how information systems based servicescape interventions help to prevent railway suicide and, in particular, the co-creation role that humans (e.g., train staff and passengers) might play in this servicescape environment. Thus the purpose of this research is twofold: (1) explore and evaluate the effectiveness of using information systems interventions in a passenger railway servicescape, and (2) explore the relationship between these servicescape interventions and customer experience, and assess their impact on railway suicide prevention from a value co-creation perspective.

2 Literature Review

In order to understand the role of servicescape intervention, regarding how it helps to prevent railway suicide, and the effect of customer experience in developing effective servicescape, it is planned to figure out the types of servicescape and the role of customer experience from a value co-creation theoretical perspective.

2.1 Servicescape

Bitner (1992) identified three dimensions that influence customers' holistic perceptions of servicescape: (1) ambient conditions: for example, temperature, air quality, noise, music, etc. ; (2) spatial layout and functionality: for example, the way in which equipment is arranged, and the ability of it to facilitate consumers' feelings; and (3) signs, symbols and artefacts: for example, signage and decoration used to communicate and enhance a certain image or mood, or to direct customers to desired destinations. Similarly, when applied to suicide prevention context, these elements are kept to influence customers' perceptions or behaviours by creating the conditions or changing the physical environments.

Interventions that help to prevent suicides can be classified into four general approaches (Pirkis et al. 2015): (1) restricting access to means, (2) encouraging help-seeking, (3) increasing the likelihood of intervention by a third party, and (4) encouraging responsible media reporting of suicide (p.994). The most commonly used approach is restricting access to means, which refers to the implementation of servicescape interventions. This type of interventions are mostly physical barriers, such as platform screen doors (PSDs), which are installed on train platforms to deter passengers from jumping. It is considered to be one of the most effective measures to prevent railway suicide (Ladwig et al. 2009; Law and Yip 2011; Mishara 2007). However, it can be costly. Another approach is the installation of blue light-emitting-diode (LED) lamps on railway platforms to prevent people from diving to a running train (Ichikawa et al. 2014; Matsubayashi et al. 2013). This type of servicescape is used to change the ambient conditions of platforms by calming passengers' mental states.

Servicescape interventions used to direct customers to desired destinations can be the installation of signs directing troubled individuals to call the local 24-h psychiatric emergency service. This type of intervention is influential, social, enforcement or psychological in nature and is dedicated to influence the person's knowledge and attitudes (Havârneanu et al. 2015).

The installation of CCTV cameras helps suicide prevention by increasing the likelihood of intervention by a third party. Railway staff can identify people on station platforms who are at risk of attempting suicide on the basis of observed behaviours, by observing video recordings from the metro closed circuit TV security surveillance system (CCTV) in stations, preceding their attempts.

2.2 Value Co-creation

Our research model has the value co-creation as its underlying theoretical foundation. A general concept of value co-creation is that companies interact and collaborate with customers to generate value (Vargo and Lusch 2008). From the service science perspective, instead of products, companies should focus on the services they can offer their customers (Vargo and Lusch 2004). The ultimate value of the offered services are generated through customer collaboration. Based on this definition, to maximum the value of services that customers receive, an effective system should be developed to accommodate customers' own needs. When customers are involved in producing and delivering the services offered to them, not only does it reduce labour costs and enables a service provider to market the offering at a lower cost, but customers also play a more active role in terms of making the outcome more satisfying. Thus resulting in a win-win situation (Fitzsimmons 1985; Fitzsimmons et al. 2014; Wind and Rangaswamy 2001). In the other words, value co-creation is the process during which customers take an active role and co-create value together with the service provider (Prahalad and Ramaswamy 2004), and the ultimate goal is to improve service performance.

2.3 Customer Experience

Experience is usually caused by direct observation or participation in the incident and it occurs when a person responds to specific incidents or some stimulus (Schmitt 1999). We found customer experience highly relevant for the current research as preventing suicide incidents requires passengers (as customers) to share their experience in direct participation (i.e., commuting by train and waiting on the platforms). This kind of information is very useful for developing a more effective integrated prevention and response system with a servicescape design based on customers' actual experiences and behaviours.

Schmitt's (1999) Strategic Experiential Modules (SEMs) include five elements: sense, feel, think, act and relate:

- **Sense:** it refers to customers' sensory experiences. It provides them with pleasure or excitement through consciousness stimulus.
- **Feel:** it refers to customers' affective experiences, such as inner feelings and emotions.
- **Think:** it refers to customers' creative cognitive experiences. Companies can appeal their customers to think deeply via surprise or provocation.
- **Act:** it refers to customers' physical experiences, behaviours and lifestyles. Companies can enrich or change customers' lives by providing them with alternative options or ways in doing things.
- **Relate:** it refers to customers' social-identity experiences that relate to a reference group or culture. Companies can appeal to customers' need to be identified by others in a social group by reflecting them in a broader community or cultural environment.

By applying these five elements to our research model, passengers/customers are treated as emotional human beings with experiences reached by service providers through servicescape or communication devices. According to value co-creation theory, customers as co-creator for generating the ultimate value of services and play active role in contributing their own experiences which can serve as input to make the service outcome more satisfying and realistic. This process is reciprocal because the service innovation can influence customers' experiences, which in turn serve as input for improving servicescape. Our research framework is illustrated as shown in Figure 1.

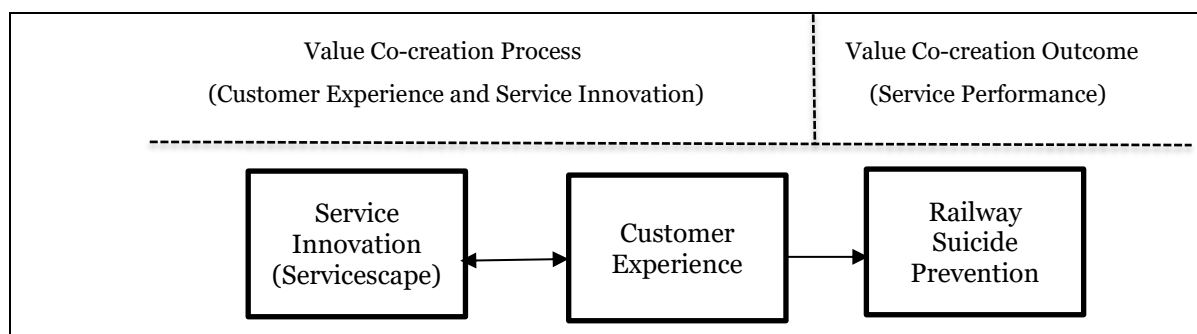


Figure 1: Research Framework

3 Methodology

After examining the goals of this research in terms of rigour and relevance, suitability to type of research questions as well as practical research goals (Venable and Baskerville 2012), we found Action Design Research (ADR) method suitable for our research because it allows prescriptive design knowledge to be generated during the process of building and evaluating IT artefacts in an organizational setting (Sein et al. 2011). Because of the dynamic and specific organizational setting of this research, the design knowledge is prescriptive in nature which should be generated during the value co-creation process involving customers' experiences and interactions.

3.1 Action Design Research (ADR)

ADR is ideal in dealing with research problems encountered in a specific organizational setting by intervening and evaluating IT artefacts that addressing these problems (Sein et al. 2011). The ADR method includes four stages as follows.

3.1.1 Stage 1: Problem Formulation

The purpose of this stage is to identify problems in practice or to find potential problems that researchers may anticipate. There are multiple sources to contribute input in this stage, including review of previous studies, industry practitioners, end-users, researchers, current systems/technologies in use.

In addition to identifying research questions based on existing theories and technologies, as well as those input from different sources, another critical aim of this stage is to secure long-term commitment from the participating organizations. The input for this formulation stage of this study comes from literature reviews, industry practitioners, field customers (passengers), researchers and current systems/technologies in use. The participating organizations include a major transport trains in NSW and Lifeline Australia.

In this stage, we follow the two principles proposed by Sein et al. (2011) by focusing on field problems and evaluating IT artefacts that are informed by theories.

3.1.2 Stage 2: Building, Intervention, and Evaluation

The research problems framed and identified in Stage one are used in this stage to provide a platform for the initial design of the IT artefacts. A sequence of design cycles and organizational use is employed to modify the initial design. Therefore, this stage is intertwined with *building* (the IT artefacts), *intervention* (in the organization) and *evaluation* (through organizational use).

Three principles are highlighted in this stage: reciprocal shaping, mutually influential roles and authentic and concurrent evaluation. To realize these three principles, we organize quarterly meetings and workshops with participating organizations and industry practitioners to engage in the recursive design cycles. In addition, we learn from each other by bringing our knowledge of theory and technology while the practitioners share their practical experiences and knowledge of work practices with me. Finally, through working with our industry partners, we ensure that our evaluation is authentic. Informed by a review of relevant literature and concurrent, which should not be separated from the building and intervention processes in organizational settings.

3.1.3 Stage 3: Reflection and Learning

This stage aims to move from finding solutions for particular problems to applying the learning to a broader body of knowledge. This stage draws on only one principle: guided emergence, which emphasizes that the designed artefacts which are framed in Stage one and shaped through a series of recursive cycles of organizational use and authentic evaluations in Stage two may not reflect all possible consequences. Therefore, the ADR team should be sensitive to anticipate changes or locate any signals that can be used for further refinement.

3.1.4 Stage 4: Formalization of Learning

The solo objective of this stage is to formalize the learning. The principle highlighted in this stage is generalized outcomes. To carry out this principle, we have to generalize both the problems identified in Stage one and the solutions/IT artefacts designed and shaped through evaluations in Stage two. Finally, the most challenging part will be to derive principles and learning outcomes from previous processes.

In the following section, the current status and primary findings will be described in more details.

4 Current Status and Primary Findings

4.1 Stage 1: Problem Formulation

The input for this formulation stage of the study comes from a review of the literature, industry practitioners, field customers (passengers), researchers and current systems/technologies in use.

- Literature review: a comprehensive meta-analysis of prior academic and practitioner research on suicide prevention and railway suicide was undertaken as part of the pilot work. Table 1 provides a brief summary of the key interventions identified from the literature review.
- Industry practitioners: a focus group workshop provided useful feedback in terms of the feasibility and challenges of potential interventions identified in the literature review. In addition, these key stakeholders also provided their annual summary report from 2016 identifying the practical problems encountered in train stations and other operational contexts.

Suicide Interventions		
Organizational	Servicescape	Communication
<ul style="list-style-type: none"> - Help points - Cooperation with public health and not-for-profits - Education programs for staff - Increased human presence - Quick response emergency services - Community 	<ul style="list-style-type: none"> - Fences and barriers - Limit/prevent access - Change ambient conditions (e.g., lighting, music) - Surveillance devices - Installation of pits 	<ul style="list-style-type: none"> - Signage - Advertising - Public announcements

Table 1. Summarized Suicide Interventions from the literature

Technology to Support Suicide Interventions		
Interventions/Feasibility Assessed by the ADR Team	Current Technology	New Solutions Proposed during the ADR Meeting
<ul style="list-style-type: none"> - Fences and barriers (High) - Limit/prevent access (Low) - Change ambient conditions (e.g., lighting, music) (Medium-High) - Surveillance devices (High) - Installation of pits (Low) - Signage (High) - Advertising (High) - Public announcements (High) 	<ul style="list-style-type: none"> - Sensors - Platform screen doors (PSDs) - Blue Lights - Surveillance devices - Sensors - LCDs - Social media - TV walls 	<ul style="list-style-type: none"> - Sensory Manipulation - VR Technology (Ambient Conditions) - Robot Presence (Interaction and Communication) - Interactive LCDs - Social Media with Big Data - Wi-Fi Technology - Community Stations

Table 2. Identified IT Solutions and Initial Evaluation

- Field customers: ongoing field observations and interviews are planned going forward.
- Researchers: through weekly meetings and input from literature reviews and industry practitioners, we were able to identify potential problems in practice: (1) evaluate the effectiveness of servicescape and explore how they interplay with each other (2) the relationship between servicescape and customer experience and how can it contribute to the value-co-creation process.
- Current systems/technologies in use: the current control systems and barriers in use are limited. So far our industry partners only have a few sites with sensor equipment installed.

Table 2 shows the current intervention technologies deployed in different jurisdictions and identifies potential new technologies that can be harnessed and utilised in new information systems. The use of interactive social media technologies, in particular, provide opportunity for value co-creation in terms of suicide prevention.

4.2 Stage 2: Building, Intervention, and Evaluation

We identified the research problems in practice and new solutions to improve those technologies currently in use in Stage one. In Stage 2, we used those findings for the initial design of the IT artefacts.

Informed by the theories and findings from literature reviews and discussions among the ADR team, two complementary information systems were proposed for initial design. The first system focuses on the detection of commuters who are deemed to be at-risk of suicide. While the exact criteria will be based on later organizational use, it is anticipated that this system will focus on commuters who exhibit unusual or suspicious behaviour, or show physiological signs of emotional distress consistent with suicide intent. The second system will use the information generated by the video detection system, along with information from an analysis of situational data to facilitate a quick-response capability.

Both systems will be evaluated with at least two design cycles. The design process will begin with interviews and focus groups with a mix of stakeholders and passengers at the metropolitan rail authority head office and selected stations.

4.2.1 Video detection system

Michalak et al. (2009) provide a methodology for adapting Troje (2008) framework for human movement to automatically capture, decompose and analyse raw motion data to successfully predict mood and emotion. Our research extends this work through the application of insights from prior studies on computer vision (e.g., person tracking, face and gesture recognition), affective sensing (e.g., emotion detection), and pattern recognition (e.g., techniques for dealing with sparse data). We plan to tag each commuter with an initial suicide risk rating as they enter a station, and then monitor them and dynamically update their rating based on subsequent changes to behaviour or physiology.

The use of tagging will assist security staff monitoring the video feeds to focus their attention on potential problems, and will aid railway staff to more quickly locate at-risk persons if required. Tracking the activities of at-risk persons will also improve our understanding of the railway suicide phenomenon, with these insights used to enhance the accuracy of detection over time.

4.2.2 Quick-response system

The quick-response system will have two purposes. The first is to provide monitoring data to staff on a range of suicide risk indicators with the goal to raise awareness and to encourage vigilance. This information will be presented in a user-friendly mobile application that will be installed on the devices of railway service personnel, management and drivers. The second purpose is to turn the mobile devices into a broadcast device that will bring information on at-risk commuters to the attention of staff, or in the event of an incident, to provide a quick-response and triage capability.

A follow-up sequence of design cycles and organizational use will be employed to modify the initial design.

5 Conclusion

There are significant gaps in our understanding of railway suicide and of effective interventions for prevention. The extant literature is deficient in this area. Studies that do exist are descriptive in nature, and tend to focus on single interventions while ignoring possible interdependencies and contingent effects from other factors. We contend that information systems can facilitate effective interventions for railway suicide prevention by altering the servicescape environment and providing tools to augment existing operational procedures. This program of research will examine how information systems facilitate passenger/organisational co-created value in terms of reducing the incidence of railway suicide. Thus, the objectives of this research are to: (1) explore and evaluate the effectiveness of using information systems interventions in a passenger railway servicescape, and (2) explore the relationship between these servicescape interventions and customer experience, and assess their impact on railway suicide prevention from a value co-creation perspective. While the main focus of this research is addressing railway suicide, the information systems developed would also lend themselves to a wide range of additional railway security issues including the detection and prevention of crime, terrorism, and trespass.

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