



## Safety outcomes for engineering asset management organizations: Old problem with new solutions?



Jeremy Novak<sup>a</sup>, Ben Farr-Wharton<sup>b</sup>, Yvonne Brunetto<sup>a,\*</sup>, Kate Shacklock<sup>c</sup>, Kerry Brown<sup>d</sup>

<sup>a</sup> School of Business and Tourism, Southern Cross University, Queensland, Australia

<sup>b</sup> School of Business, University technology, Sydney, NSW, Australia

<sup>c</sup> Griffith Business School, Griffith University, Queensland, Australia

<sup>d</sup> Edith Cowan University, Western Australia, Australia

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### ABSTRACT

The issue of safety and longevity of engineering assets is of increasing importance because of their impact when disasters happen. This paper addresses a literature gap by examining the role of workplace relationships in employees' safety behaviour, and builds on the Resilience Engineering (RE) framework by examining some organisational culture factors affecting how employees behave. A Social Exchange framework is used to examine the impact of supervisor-employee relationships, employee commitment to safety practices, and the type of maintenance culture upon employees' commitment to safety and safety outcomes. Survey data from 284 technical and engineering employees in engineering asset management organisations within Australia were analyzed using Structural Equation Modelling (SEM). Effective employee relationships with management and a proactive maintenance culture were associated with employee commitment to safety culture and safety outcomes. The findings provide empirical support for embedding an effective organisational culture focused on a proactive maintenance approach, along with ensuring employees are committed to safety processes, to ensure safety outcomes and also asset longevity. One study contribution is that good safety outcomes do not develop in a vacuum; instead they are built on effective workplace relationships. Therefore, SET helps to explain the forming of effective safety culture.

## 1. Introduction

Safety outcomes are a concern for all organisations, but especially those considered to be Critical Infrastructure and Engineering Asset Management Organisations (CIEOs). CIEOs include many of the engineering asset management organisations delivering essential services (such as power, water, sewerage, transport) to the public. CIEOs can be defined as those organisations that are concerned with “engineering objects, the things that are managed by engineering asset managers, such as inventories, equipment, land and buildings” [1, p. 120]. A conservative estimate by the Australian Government in 2012 is that they hold over \$150 billion of commercial infrastructure assets, let alone private interests, and Australia is NOT in the G8 and therefore these estimates form a small fraction of the number and impact of CIEOs in other countries. Consequently, effective management of these organisations is essential.

### 1.1. The research gap and justification

If safety protocols are breached and an accident occurs in an CIEO, the consequences include not only the withdrawal of an essential service required for society to function, the collateral damage on employee life and health, and plant equipment, but also in some cases, the negative short and longer term fallout on the quality of the communal air, water and natural habitat [2]. For this reason, Furniss et al. [3] argued that it is important to undertake research so that organisations have the tools to detect and put in place systems that can either avoid or at least reduce the impact of safety breaches and this requires a better understanding of the antecedents that lead to good safety organisational outcomes. However to date, De Bruijne and Van Eeten [2] argue that this areas has not received nearly as much attention as is required. Additionally, public and private shareholders are increasingly aware of the significant investment and development in the critical infrastructure and essential asset organisations such as dams, power stations, sewage works, roads, gas and water pipe lines,

\* Corresponding author.

E-mail addresses: [Jeremy.novak@scu.edu.au](mailto:Jeremy.novak@scu.edu.au) (J. Novak), [benjamin.farr-wharton@uts.edu.au](mailto:benjamin.farr-wharton@uts.edu.au) (B. Farr-Wharton), [yvonne.brunetto@scu.edu.au](mailto:yvonne.brunetto@scu.edu.au) (Y. Brunetto), [k.shacklock@griffith.edu.au](mailto:k.shacklock@griffith.edu.au) (K. Shacklock), [k.brown@ecu.edu.au](mailto:k.brown@ecu.edu.au) (K. Brown).

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offshore oil rigs, oil and gas refineries, naval ships, submarines, hospitals, schools and other infrastructure (such as the national broadband network currently implemented in Australia). One mistake can have a large financial, human and natural environment impact. Additionally, many infrastructures are interconnected; hence, for example, if power is affected, then other organisations are also affected. This increase in complexity intensifies the likelihood of multiple infrastructural breakdowns which results in a crisis or disaster occurring that reaches beyond functional and geographical borders, sectors and boundaries [4,5]. However, to date, the research outcomes are unclear as to what is the impact of workplace relationships, employee commitment to safety practices and the type of maintenance culture on employee commitment to safety and safety outcomes.

This study uses Social Exchange Theory (SET) to better understand how workplace relationships affect safety outcomes. SET is based on the principle of reciprocity, arguing that if employees experience positive encounters with management, they feel committed to return high performance to the organisation [6]. Employees work practices are very much a reflection of the goals and rewarding practices of management [7]. Therefore, we argue employees will only show commitment to safety in the workplace if it is synergistic with the organisational goals, and management clearly articulates the message in detailing work orders and rewarding employees' performance. Further, we argue those organisations that promote a focus on proactive maintenance of engineering assets (fixing it before it breaks), rather than a reactive organisational culture (fixing only what breaks) have the foundations in place to ensure safe outcomes. Many of those who manage engineers and technical staff share similar values and belief because they themselves are also engineers and therefore have been through the same socialization process ensuring they share similar values and beliefs [8], and consequently, we argue high supervisor-employee relationships (captured by the Leader-member Exchange (LMX) concept) will be associated with a proactive maintenance organisational culture and high employee commitment to safety. In particular, Shirali, Mohammadfam, & Ebrahimipour [9] argued that unless managers embrace safety as a priority and manage accordingly, organisations are exposed to high risk. They argue the supervisor acts as the linchpin to ensuring safe outcomes. Hence, we expect that effective workplace relationships with management provide the platform on which a proactive maintenance organisational culture that values safety practices develops.

Previous research has tended to ignore the importance of human impact in achieving safety outcomes. In recent times, the rising cost of safety failures on employees to both society and business has led to a strong emphasis on achieving personal safety using the Occupational Health and Safety legislation. However, examining the drivers of process safety outcomes within organisations and ensuring effective safety processes are embedded into high performing work cultures, have been somewhat ignored [3,10]. More recently, research [9,11–16] (to name a few) has identified the important role of effective maintenance routines to ensure safe outcomes. We extend previous research, especially by researchers such as Shirali, et al. [9] who identified the importance of 'top management's commitment' to safety and examine one factor (informed by SET), the supervisor-employee relationship on employees' commitment to safety, the resultant type of proactive safety culture adopted in the organisation and perceived process safety outcomes in CEOs. The research question guiding this study is:

What is the impact of workplace relationships with supervisors on employees' commitment to safety, the adoption of a proactive organisational culture and finally, perceived process safety outcomes?

The remaining paper provides a detailed literature review identifying the voids in the literature and relevant hypotheses.

## 2. Theory

### 2.1. Social Exchange Theory

The concept of Social Exchange Theory (SET) has been used to explain numerous workplace exchange relationships [17] and has provided an influential framework for organisational researchers for explaining workplace behaviour [6,18,19]. As stated, the premise of SET is that mutual reciprocity develops over time if employees experience positive interactions with management. The process involves management providing a "helping hand" attitude along with resources and respect to employees, which then generates a perception of obligation on the part of employees, such that they in turn must return something positive back to their managers [6,7,20–22]. In particular, when employees are given adequate information, resources and support, SET argues that management can expect that employees will support management decisions and work productively, in turn increasing work performance [23]. This means if management prioritizes safety goals and provides adequate resources and support (both physical and moral support when needed) to employees delivering utilities (such as power, sewerage and water), then SET argues that employees are likely to work harder to deliver the utilities safely to the public. In contrast, SET argues that under poor workplace relationship conditions, managers communicate ambiguous goal priorities. On the one hand, SET states safety is a priority. Whilst in practice, on the other hand, SET provides inadequate physical and moral support to employees and instigates performance management for cost cutting purposes, rather than safe working practices to achieve maximum profits.

When SET has been applied to the safety agenda, SET variables such as, Leader-Member Exchange (LMX) (which measures the quality of the supervisor-employee relationship), has been found to significantly predict safety outcomes [24]. Further, another SET variable – affective commitment, which measures employees' emotional attachment to the organisation, and is often used as a proxy for job performance, has also been shown to affect safety outcomes. In particular, Hofmann and Morgeson [27] found that LMX was associated with safety commitment and Brunetto et al. [7] found that LMX was associated with affective commitment. However, to date, no research has used a SET framework to examine how workplace relationships in combination with proactive safety maintenance culture impacts safety outcomes.

### 2.2. SET variable: Leader–Member Exchange

This study examines the impact of Leader–Member Exchange (LMX) upon employees' commitment to safety. Shirali et al. [9] argued that commitment to safety begins with senior management because they then ensure that the important building block of achieving safety outcomes such as a 'just and learning culture' and a prepared workforce are embedded in an organisation. We argue that if senior management is focused on safety, then this should be evident in the decision-making of supervisors. However, much research shows that supervisors do not always have the skills required to develop effective workplace relationships with employees. Unless there is an effective LMX relationship (which are based on a social exchange between the subordinate and supervisor), employees are unlikely to perceive an obligation to reciprocate high-quality relationships [20,26–28]. Often undertaking work routines to achieve safety outcomes takes more time, resources and effort [11,12] and therefore an effective relationship is required to support employees to be proactive in undertaking maintenance tasks. Also Oedewald and Gotcheva [16] identified from their research on subcontractors in a nuclear power plant in Finland that management must focus on safety outcomes in order to ensure employee adopt a similar focus of learning and adapting in the workplace. Past literature has highlighted that LMX has been associated positively with several desirable outcomes such as job satisfaction, subordinate performance,

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