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# Managing Safety Risks Associated with Nightshift in the New Zealand Electrical Distribution Industry

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**Abstract**

On a still winter's night in Dunedin, a car veered off the road and collided with a power pole, the impact leaving live wires on the vehicle's bonnet and roof. The occupants were trapped inside, injured and in need of urgent medical attention. It was up to electrical distribution workers to isolate the electricity and make the scene safe so that the first responders could provide life-saving support. This incident highlights the critical role of electrical distribution workers, who maintain the essential service of electricity to the community 7 days a week, 24 hours a day. In doing this, the workers are exposed to high-pressure situations which require heightened decision-making and acute situational awareness. This study examines how the New Zealand electrical distribution industry approaches the management of fatigue-related impairment associated with night shift work. Using a qualitative study design, and reflexive thematic analysis, it draws on both industry-submitted documents and focus groups with Network Control Operators and Fault Responders to explore current practices, perceptions, and gaps in fatigue risk management. The research exposes a heavy reliance on the self-management of fatigue, ambiguous policies, and insufficient training. Findings highlight the need for defensible fatigue risk management strategies to safeguard workers and the public.

**Key Words**: Night shift; Night work; Fatigue; Safety; Error; Electric

## Introduction

During an otherwise quiet winter's night in June in Dunedin, a car carrying four occupants veered off the road and collided head-on with a power pole. The impact brought down live streetlight conductors (electrical wires), which landed across the vehicle's roof and bonnet, remaining energised and trapping the occupants inside. Emergency services arrived quickly but could not approach the car or provide aid until the scene was made electrically safe.

The on-call Faults Responder, from the local electrical distribution business, was dispatched by the rostered-on shift Network Control Operator. Together, they began the urgent process of deenergising the site to allow for a safe rescue. However, errors were made during this isolation process, which was undertaken at night, under time pressure, and in a high-stakes environment. These mistakes, later identified as cognitive slips linked to fatigue, contributed to delays in safely resolving the incident and could have put the workers and others at risk of harm.

This incident is not an anomaly, but a stark illustration of the challenges faced by those who work through the night to keep the power on. The interplay of fatigue, decision-making, and safety in such scenarios sparked a personal quest to understand how night shift work impacts safety in New Zealand's electrical distribution industry.

## Background

Electricity is the lifeblood of modern society, yet meeting the public's expectation for uninterrupted supply demands constant, round-the-clock oversight. In New Zealand, twenty-seven Electrical Distribution Businesses (EDBs) ensure that the power flows seamlessly from the national grid through distribution networks to businesses and homes. Two pivotal roles in the upkeep of this supply are:

- Fault Responders: Line mechanics, technicians, cable jointers, and electricians who are on-call to address faults, often during night hours.
- Network Controllers: Professionals who monitor and manage the network, frequently working rotating shifts that include nights.

While the indispensability of these roles is clear, the toll of night shift work on workers' health and safety remains a topic for further research. Techera et al (2020) reported in a conference on their work – specifically how fatigue affects hazard recognition within Transmission and Distribution workers in a United States setting. The authors used psychomotor vigilance testing and the ability of participants to identify hazards in three different construction scenarios. Data was subject to Spearman correlation analyses and results emphasized the importance of improving fatigue management.

Research gaps and needs for preventing worker fatigue in transport and utilities industries were identified by Sieber et al (2022) who highlighted disparities in the approaches taken by individual parts of the sector and progress made by other sectors and the need for the development and implementation of fatigue mitigation tools and strategies.

Techera et al (2019) focused on the fatigue in electrical transmission and distribution workers using a standardised questionnaire to interview 143 power company workers. Results revealed that the perception of the participants was that extreme temperatures and long shifts were the principal causes of their fatigue. The results also suggesting that fatigue laboratory research may not directly apply to field conditions.

These studies, while all valuable and inclusive of electrical distribution sector information, were undertaken in the USA and not within a New Zealand context. None of them specifically focused on the safety risk associated with night shift work, nor did any of them capture the richness of data contained within the lived experiences of participants through focus groups and qualitative study (Braun, 2013).

**Fatigue as a Safety Risk**

It is well established that night shift work disrupts the body's natural circadian rhythm, resulting in fatigue, a state of both physical and mental exhaustion. Furthermore, fatigue is known to impair critical cognitive functions such as decision-making, attention, and situational awareness, significantly increasing the risk of errors. High-risk industries, including healthcare, freight, nuclear power, the military, and aviation, have already documented the adverse effects of fatigue, linking it to heightened error rates and safety incidents. One study highlighted that the risks of fatigue-related impairment extend beyond the workers themselves, noting that long shifts, shift rotations, double shifts, and evening and night shifts pose short and long-term safety risks for nurses, as well as danger to their patients (Potera, 2018).

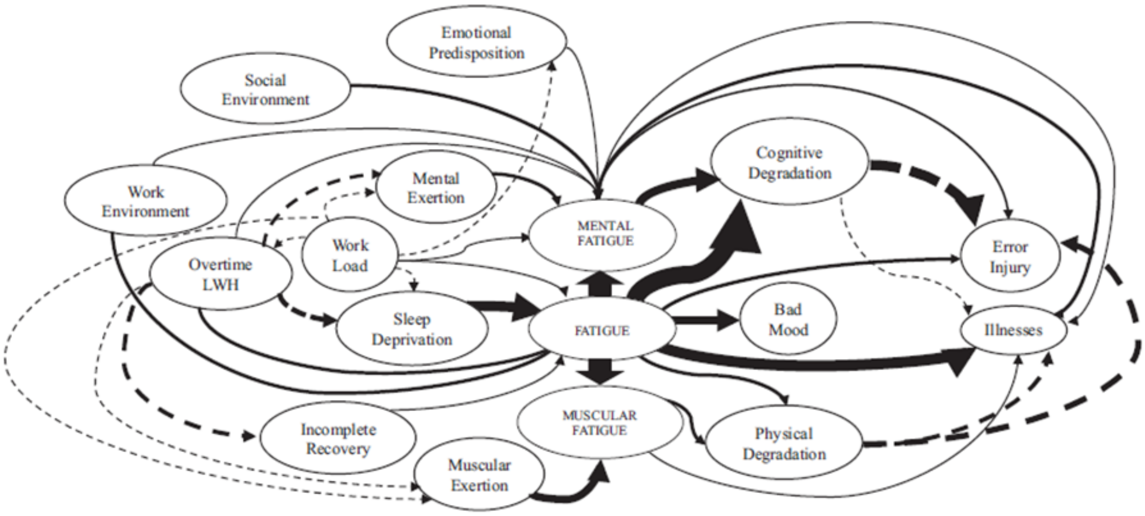
**Research Aim**

To qualitatively examine how fatigue related safety risks are experienced, understood and managed within the workforce that sustains society's round the clock access to electricity.

**Conceptual Framework**

Despite over a century of research, no widely accepted theory or comprehensive theoretical framework exists to underpin the study of fatigue as a contributing factor in safety risk management. The conceptual framework for this research was developed based on the available literature, acknowledging that the causative factors of fatigue and the relationship between cause and effect are complex. Diagram 1 is a visual system representation summarising a meta-analysis of existing research, highlighting this complexity. The model contains dashed lines representing the interrelationships among various causes and consequences of fatigue, highlighting these factors' complex, often reciprocal nature. Solid lines denote direct, immediate relationships between fatigue, its antecedents (such as shift work, sleep deprivation, and workload), and its consequences (such as cognitive impairment, performance decline, and safety incidents). The thickness of each line corresponds to the volume of empirical studies examining that specific relationship, providing a visual indication of where the research evidence is strongest or most lacking (Techera et al., 2016).

**Diagram 1: Systems Model**




Source: Techera, Hallowell,Stambaugh & Littlejohn (2016)

The conceptual model for this research was developed by the author. It is represented by the equation below and is framed throughout the research by the Plan-Do-Check-Act (PDCA) cycle, a well-known model for continuous improvement (Moen & Norman, 2010) based on (Bacon, 1620). This framework examines how fatigue-related risks are identified (Plan), addressed (Do), monitored (Check), and refined (Act) within the industry.

**Diagram 2. Conceptual framing**


**Overall Research Design / Methodology**

A qualitative research design was employed to explore the topic. A qualitative design was chosen because the goal was to examine the phenomenon of fatigue in the specific context of the electrical distribution industry. Therefore, the experiences of those working within the industry provide the richest and most reliable source of information and data (Braun & Clarke, 2006). The blend of spoken and written words was then converted into data, as this was in keeping with the basic definition of qualitative research

The research design aligns with a pragmatic worldview, prioritising real-world applicability (Creswell & Poth, 2024). Pragmatist research adopts methods and approaches tailored to the real-world conditions in which the inquiry occurs. Rather than strictly adhering to fixed theories or prescribed methodologies, it focuses on selecting the most suitable approach for addressing the specific research question. This flexibility allows researchers to respond to the complexities of practical contexts and generate directly relevant and applicable findings. Primarily, this is an attempt to interpret the world of knowledge and its progress with consistency through the effect of time (King, 1905).

The approach to the research used multiple methods to enable triangulation of information sources and ensure validity and maintain standards of scientific inquiry. The methods used included literature review, two structured focus group discussions and document analysis. The literature search did not identify any research relating to the impact of night shift related fatigue on safety risk in electrical distribution. Participants for the focus groups and sample size were selected through purposeful and convenience sampling, resulting in a key informant sample. All participants were screened to ensure they had at least five years' experience in their respective roles. This approach aimed to ensure participants had in-depth knowledge and relevant expertise, minimise potential bias or uninformed opinions, and enhance the overall data quality, contributing to more meaningful and credible findings (Braun, 2013). The participants contributed two hundred and sixty-five years of industry experience to the research. The sample size was ten percent for network controllers and just over three percent for fault responders. This is considered a representative size that provides confidence in the information gathered to answer the research question (Marshall, 1996).

**Data Collection**

Focus group sessions were held on successive days, 26th and 27th July 2022, and lasted one and a half hours each. The initial plan was to achieve heterogeneity in the focus groups through an even split between network controllers and fault response personnel. However, upon further reflection, a decision was made to form homogeneous groups. This approach fostered a familiar and socially comfortable environment, which encouraged open dialogue, facilitated shared understanding, and supported more natural and uninhibited discussion. The focus groups were guided by pre-defined questions designed to elicit insights directly relevant to the research question, ensuring that participant contributions remained aligned with the study's core aims. This approach enabled participants to express and share their experiences and opinions, with the conversation and discussion leading to rich information and insights as the participants interacted (Braun, 2013). Most (eight out of ten) of the preliminary questions asked in the focus groups were the same as the tried and tested questions in the Massey University Sleep/Wake Research Centre study of fatigue in the aviation industry (Van Den Berg et al., 2020). This gave the primary question set more validity because it was used successfully in previous research on the same topic in another sector. Ethical considerations included risk of harm, consent, confidentiality, and anonymity. As the research involved human participants, standard ethics approval was required, application ID #30379. During the focus groups the rights, needs and values of the participants was at the forefront and considered (Merriam, 1988). Transcriptions were made available to the participants. The research did not require commercially sensitive information, and no names or industry affiliations can be connected to the responses and narratives collected.

To help with triangulation, eight electrical distribution businesses submitted thirteen fatigue-focused documents to be analysed, which included.

- four policies

- four standards
- two procedures
- one plan
- one checklist
- one guideline

## Analysis

Documents, and the transcripts from the focus groups, were analysed using reflexive thematic analysis, beginning with a period of familiarisation—an immersive phase of "reading the data as data" (Braun, 2013) to develop an intuitive and grounded understanding of the content before formal coding commenced (Braun & Clarke, 2006). Manual coding was then backed up with auto-coding facilitated by NVivo software. This identified and confirmed eleven key themes related to fatigue risk management.

The Plan-Do-Check-Act (PDCA) framework was applied to the themes. Although PDCA was traditionally used for quality management, it provides a useful structure for evaluating safety risk management by framing the themes within a continuous cycle of planning, implementation, monitoring, and improvement (Taylor et al., 2014; Toy, 2019).

## Findings

Eleven key themes were identified from the data analysis:

## Plan: Identifying & Understanding Fatigue Risks

### Theme 1: Insufficient Induction and Training

Participants across both focus groups consistently highlighted a lack of structured induction or formal training related to fatigue management. Rather than being supported through orientation or mentoring, individuals described a "sink or swim" environment in which they were expected to learn about fatigue and nightshift demands through personal experience. Fatigue awareness was characterised as self-taught, emerging informally over time, with no organisational systems to support early learning or preparedness for managing shift work's physiological and cognitive impacts.

### Theme 2: Ambiguous and contradictory fatigue documents

Both focus groups acknowledged the existence of fatigue policies within their organisations, noting that most included provisions such as 10-hour rest breaks, 24-hour stand-down periods, and capped work hours. This represented progress compared to past practices they had observed. However, participants also highlighted that these policies were often confusing and open to interpretation, with their application varying according to organisational needs rather than being consistently guided by what was best for the individuals performing critical roles. Document analysis revealed the use of vague terminology (e.g., "shall," "should," "might," "may") leading to various manipulations due to inconsistent application. None of the documents provided mentioned specifically that fatigue had safety implications. However, all focus group participants unanimously identified their mental, physical, and emotional state as "highly important" to safe outcomes.

### Theme 3: Over-Reliance on Work Hour Restrictions

Fatigue policies were narrowly focused on limiting work hours, without comprehensively addressing fatigue risk. They often lacked enforcement mechanisms and, in some cases, participants indicated that there weren't even basic systems to track hours worked accurately. Support such as employee assistance programs, access to specialists, standing desks, or rest facilities was mentioned by a few participants, but this was inconsistent. These measures were often perceived as superficial or symbolic, rather than part of a meaningful, systematic and embedded approach to fatigue risk management.

#### Theme 4: Self-Management of Fatigue

Workers were expected to monitor their fatigue levels and those of their colleagues, despite having no practical tools, systems, or training to do so effectively. Across nearly all industry documents reviewed in this study, self-assessment and self-reporting of fatigue were presented as primary controls. This reliance persists despite well-established research demonstrating that self-recognition of fatigue is often unreliable, particularly in high-pressure, high-risk environments. The expectation placed on workers to manage fatigue without adequate support highlights a disconnect between policy and evidence-based practice. Both groups indicated that reporting fatigue was now more accepted, especially compared to the past, and workers felt more supported in saying they are too tired, with some supervisors actively encouraging standing down when unfit.

### Do: Implementing Fatigue Management Controls

#### Theme 5: Inconsistent Shift Patterns & Workloads

Participants noted the absence of any industry-wide standard governing night shift schedules or workload expectations. There was also limited guidance provided by industry representative bodies, such as the Electricity Engineers' Association (EEA). Although the EEA had established online forums within its knowledge network—specifically the Control Network Operations Group (CNOG) and the National Industry Network Operators (NINO) groups—these appeared to lack formal coordination and governance. Moreover, whether these forums were actively used or had any practical influence on shift design was unclear. As a result, participants perceived a gap in sector-level leadership, with nightshift practices evolving independently across organisations rather than being guided by a consistent, evidence-informed approach.

#### Theme 6: Work-Family Conflict & Sleep Deprivation

Both focus groups spoke of long shifts, typically fifteen to eighteen hours, with disrupted sleep and its side effects on home life. Descriptive phrasing in both focus groups for sleep quality included terms "terrible," "deprived" and even "rat shit." Participants in both focus groups reported average sleep durations of as little as four to six hours due to family expectations and environmental disruptions. Participants openly shared experiences of sleep deprivation, acknowledging microsleeps, particularly when driving home after a shift or during nighttime callouts. These stories were accompanied with numerous accounts of impaired cognitive function, including memory lapses, reduced concentration, and diminished situational awareness. Participants commonly shared stories about leaving tools onsite and not remembering driving home, underscoring the serious impact of fatigue on both safety and performance.

#### Theme 7: Experience-Driven Awareness of Fatigue

It was evident across both focus groups that workers developed knowledge of fatigue primarily through personal experience, rather than through structured training or education. While reporting fatigue had become more common and generally more accepted by managers over time, organisational responses remained inconsistent. As a result, participants described relying on improvised, self-directed strategies to manage fatigue, such as using old couches or mattresses, installing blackout curtains, taking "NASA naps" with caffeine, or timing naps between 2:00 and 4:00 a.m. Despite the widespread use of these informal fatigue-proofing behaviours, they were largely absent from organisational policies or formal documentation, indicating a disconnect between practice and official systems.

### Check: Evaluating Fatigue Management Effectiveness

#### Theme 8: Lack of Monitoring & Fatigue Detection

Across all documents reviewed, there was an absence of systematic fatigue detection mechanisms such as biometric monitoring or alertness testing. Instead, organisations relied heavily on self-reporting, despite well-documented evidence that individuals often underreport fatigue symptoms due to cultural norms, fear of stigma, organisational pressures, and reduced self-awareness. As fatigue increases, our ability to accurately assess our level of impairment diminishes; this is sometimes called “fatigue-induced self-awareness deficit”. This reliance on self-disclosure mirrors findings from other high-profile incidents, such as the Fiordland Navigator grounding (Dann, 2025), where fatigue guidelines were in place but poorly implemented, and no effective mechanisms existed to identify or respond to fatigue in real time. This highlights a critical gap between policy intent and operational execution, with fatigue management remaining reactive and individualised rather than proactive and system driven.

#### Theme 9: Absence of Incident Analysis for Fatigue

Both focus groups observed that fatigue was rarely identified as a contributing factor in safety investigations, potentially due to the inherent difficulty in proving impairment after the fact. Post-incident reviews focused almost exclusively on technical failures, with limited attention given to human performance factors such as fatigue. This was despite unanimous agreement among participants that fatigue, and the cognitive and physical impairments it causes, pose a significant safety risk. The lack of consideration given to fatigue in investigations reflects a broader cultural and systemic gap in recognising and addressing human factors within incident analysis processes.

### Act: Continuous Improvement & Organisational Learning

#### Theme 10: Weak Organisational Learning & Policy Evolution

Across both focus groups, participants noted a distinct absence of formal mechanisms within their organisations for translating fatigue-related insights into policy or practice improvements. Fatigue was consistently managed reactively, typically addressed only after an incident or near miss, rather than being systematically considered part of proactive risk management or continuous improvement processes. Participants described instances where fatigue was acknowledged as contributing to operational errors yet reported that these learnings rarely led to organisational change. There was little evidence of structured debriefing, cross-team learning, or integration of fatigue-related findings into system-wide reviews, training, or policy development. Fatigue remained largely siloed as an individual issue, rather than being treated as a system-level risk requiring strategic oversight. This reactive stance indicated a broader cultural and procedural gap where fatigue was recognised anecdotally but not embedded within organisational safety or operational frameworks.

#### Theme 11: Limited Cross-Sector Learning

Participants highlighted the contrast between the electrical industry and other high-risk sectors such as aviation and healthcare, where structured fatigue risk management frameworks are well established and known. These industries were seen as more advanced in recognising fatigue as a systemic risk and embedding practices to mitigate it.

In contrast, the electrical sector lacked formal sharing opportunities, with limited external collaboration or reference to best practice models from other industries. Participants noted that without these mechanisms, fatigue risk management remained underdeveloped and inconsistent across organisations. There was a clear appetite for learning from sectors with more mature approaches, but no structured pathway to do so currently existed. This theme reflects the need for cross-industry engagement and knowledge transfer to raise standards and promote evidence-based fatigue management within the electrical industry.

## Discussion

This research confirmed what the Dunedin incident first hinted at: nightshift-related fatigue is a silent but significant safety risk within the electrical distribution industry. The findings revealed inconsistencies in how fatigue is defined, recognised, and managed across the sector.

What stood out most was the widespread reliance on self-management, which placed the responsibility for recognising and mitigating fatigue squarely on individual workers. This expectation was evident in participants' perceptions, as captured in the focus group data, and in organisational procedures, which lacked formal controls or mechanisms to support fatigue management. As a result, fatigue was treated less as an organisational risk and more as a personal burden. This was true from a perception standpoint (focus group data) and within defined controls (procedural data). Without tools like the Karolinska Sleepiness Scale or structured assessment protocols (Dawson et al., 2012), fatigue remains invisible until it causes harm. Given the hazardous nature of this work, often conducted at night, in the dark, near live wires, there is an urgent need to improve. Fatigue should not be the invisible risk that workers are expected to carry alone.

It became clear that while companies had policies and procedures, they often lacked clarity, consistency, and enforceability. Fatigue was not deliberately ignored; it simply was not being well understood or addressed proactively or systematically. It was evident from the focus groups and the document analysis that fatigue meant different things for different companies and individuals. Inside the submitted documents from the eight participating companies, there were six different definitions of fatigue, with two companies having no definition at all. The finding recognises the difficulties in managing a complex phenomenon like fatigue.

Fatigue risk management practices in the sector had heavy reliance on limiting work hours, which, while easy to apply, is ultimately a blunt instrument (Bérastégui et al., 2018). Often modelled on road transport regulations, these limits fail to account for the biological and cognitive impacts of night work, nor do they reflect individual differences in fatigue tolerance. In contrast, other high-risk sectors have evolved beyond hours-based systems, incorporating fatigue science with biometrics, alertness testing, and targeted education. This shift reflects a growing recognition that actual hours worked, especially when factoring in callouts, planned overtime, and emergency responses, often exceed what is formally recorded or intended. The sector's continued reliance on rigid hours-based limits may stem from its operational focus and strong adherence to technical norms. However, unlike mechanical faults, fatigue is a human factor, less visible and more complex, but equally capable of contributing to serious harm. This underscores the need to move beyond procedural compliance and adopt more holistic, evidence-based approaches to managing fatigue.

There was no consistent national strategy for fatigue risk management across New Zealand's EDBs. Some companies showed glimpses of good practice, but there was no shared language or framework. Where other high-risk industries like aviation, healthcare, or transport have embraced structured fatigue risk management systems, the electrical distribution sector remains reactive. Lessons from post-incident reviews rarely make their way into improved procedures or training. There's also little effort to benchmark against or borrow from more mature industries in this space. Drawing from existing models like those in the aviation or maritime sectors could offer an immediate uplift in practice (Dawson et al., 2017).

Yet signs of progress are emerging. In response to the research, a working group was established to address fatigue risk, and the Electrical Engineers Association published guidance informed by the study's findings. Encouragingly, the research also prompted reviews in other industries, indicating a growing recognition of the need for systemic change. This ripple effect suggests momentum is growing for systemic, coordinated, and initiative-taking approaches to fatigue risk management.

As Shakespeare once wrote in Macbeth, "Sleep…chief nourisher in life's feast." That wisdom, long buried beneath the hum of 24/7 industry, is beginning to resurface.

## Recommendations

This study led to five key recommendations to improve fatigue management in the electrical distribution sector.

**Recommendation 1: Introduce standardised induction & training**

Build fatigue capability and awareness from front line to board level by developing inductions, training, and information material about fatigue and how to manage it for separate roles and even for the families of workers.

**Recommendation 2: Develop and implement fatigue monitoring systems**

Implement tools like psychomotor vigilance tests (PVTS) or subjective rating scales (e.g., Karolinska Sleepiness Scale) to detect fatigue in real time.

Explore biometric or wearable tech options for fatigue detection in high-risk tasks. This approach is in line with health and safety legislation and the hierarchy of control.

**Recommendation 3: Adopt industry-wide shift design standards**

Use and support the industry advocacy bodies to lead industry guidance that supports member organisations to align shift scheduling with circadian science, minimising long night shifts and ensuring adequate rest periods. Using the industry bodies to lead this will to avoid duplicated efforts and drive national consistency.

Encourage rostering practices that reduce work-family conflict and cumulative fatigue, thinking more broadly about the impacts of fatigue into the community and home.

**Recommendation 4: Enhance organisational learning capability**

Build people’s competence and capability and the maturity of organisational learning processes to ensure that fatigue is considered in incident investigations, debriefs following work activity, and safety audits.

Establish clear accountability for fatigue risk at all organisational levels from the frontline to leadership and align and build competence to fulfil the roles and accountabilities identified.

**Recommendation 5: Develop and mature cross-sector learning**

Leverage learnings from more advanced fatigue risk-managed industries (e.g., aviation, mining, transport) and share these across the sector.

## Conclusion

This study set out to explore a question born from experience: To what extent are the safety risks of nightshift work being managed in New Zealand’s electrical distribution industry? Based on interviews, focus groups, and document analysis, the answer is that they are not being managed as well as they could or should be.

The PDCA framework revealed weaknesses across all four stages:

- Plan: Fatigue risks were poorly defined and inconsistently assessed.
- Do: Controls relied heavily on individual strategies rather than systemic supports.
- Check: There was little monitoring or meaningful evaluation.
- Act: Organisational learning was limited, and cross-sector collaboration was rare.

Fatigue does not look like a hazard. It is quiet, invisible, and slow burning but its effects are no less dangerous than a frayed cable or faulty transformer. This research showed that in the New Zealand electrical distribution industry, nightshift fatigue has long flown under the radar, underestimated and under managed.

But things are shifting. What began as a personal observation at the site of a car-versus-pole event became a sector-wide conversation. Since this research was undertaken, new guidance has been issued, working groups have been formed, and other industries have begun to reflect on their own fatigue management practices.

### Further research

There is more to do but this is a start. And as with all systems improvement, the first step is recognising that the problem exists.

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### Conflicts of interest

Declarations of interest: none.

### Disclaimers

The opinions are my own and do not represent the views of my employer.

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