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THE ROLE OF HUMAN FACTORS IN IDENTIFYING INCIDENT CAUSAL FACTORS IN NEW ZEALANDS ENERGY SECTOR.

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ABSTRACT

This paper documents the improvement of a safety management for a leading energy supplier. Transpower want to reduce the number of incidents and improve their risk management and safety culture in the technical space. To foster an impartial environment for objective investigation to take place, it was decided that a neutral party be contracted to do this job.

Igniter was contracted to investigate the severity of the problem, devise methods to help understand and implement measures to facilitate a change in organisational safety culture, and a reduction in technician related errors within sub-stations maintenance at Transpower. In order for the programme to be successful, it was essential to get buy-in from suppliers as well as the client organisation.

This paper demonstrates how developing a model of incident investigation adapted from Reasons' Swiss Cheese Model and HFACS was used to identify key strategic causal factors for the business. Igniter has also developed tools for improved risk assessment and complex simulation workshops to raise awareness of risk and communications in the workplace.

These efforts have resulted in a reduction of incidents, greater focus on risk assessment, and the development of corrective actions facilitating a cycle of continuous improvement within the workplace.

KEYWORDS

Safety, Reason, HFACS, Swiss cheese, Risk, Investigation, Risk Assessment, Safety Culture

INTRODUCTION

Transpower is the owner of New Zealand's high-voltage electricity transmission grid (the National Grid). The National Grid comprises over 12,000 kms of transmission lines, over 170 substations, and links electricity generators with lines companies and major electricity users. It now connects 5622 MW of renewable energy (about 67% of New Zealand's total electricity capacity) from many remote places around the country and transports it to towns and cities. Transpower is also the System Operator responsible for co-ordinating the real time transmission of electricity across the transmission network. Since the late 1980s all maintenance work has been outsourced to a number of companies. These companies employ a wide range of technicians and operators, who perform the role around the country of maintaining circuit breakers, transformers and other various assets at regional sub-stations.

Historically, it could be argued that there was not a need for continuity of supply and sustainable energy, and black outs were accepted by consumers. However, as energy needs have grown and the complexity of the equipment connected has increased - reliability and sustainability has become paramount. Also the environment has become more complex and more hazardous. As a result, Igniter was engaged to assist in the reduction of technician related incidents and near misses that resulted in a loss of service and damage to assets. Something, Transpower were very keen to reduce.

For the project to be successful it needed to ensure that their strategies created effective and sustainable improvements that were accepted by both management and field staff. Igniter had to show – using some of the foundation concepts of safety management, root cause analysis and investigation – how human factors play such a fundamental part in the reduction of incidents across the power system.

METHOD

A three stage approach was developed – evaluate the current mode of operation, develop and pilot new solutions, and implementation.

EVALUATION

Igniter undertook some initial analysis of the safety management in the technical space. Transpower had their own incident reporting system, incident investigation and job planning methodology. On further exploration, recommendations for improvements were quickly identified.

1. Concerning the incident management system – it was found to have originated from an asset management and grid operations platform. Information relevant to incidents, such as cause, type, injury, damage and lost time were bolted on as part of a roadmap of upgrades. Unfortunately the upgrades had only been partially completed resulting in a system that had limited reporting capability and anecdotal evidence indicated poor usability. The users (Transpower's employers and service providers) saw this system as just another piece of paperwork to file and forget. This attitude also had significant implications for Regional and Maintenance Managers as they met regularly to discuss how they were going to respond to major incidents. Sorting through incidents to discuss what was relevant became time consuming with meetings taking 4+ hours.

2. Concerning the incident investigation methodology – it was mostly conducted on events described as HEI's (Human Element Incident). These events usually had the active failure of a human performing an error or violation, and resulted in loss of service to the customer or loss of power (which drives up cost). Rarely did these investigations delve into root causes and often the technician at the point of failure was implicated severely.

3. Concerning job planning – it became apparent that jobs were being planned in the future (90+ days prior). The effort to complete the job, often, was dramatically underestimated. Inadequate risk assessment was being completed at the point of planning or execution of the job.

DEVISE AND PILOT SOLUTIONS

To respond to these three issues, a number of deliverables were achieved.

For incident reporting, a lengthy investigation into the user experience of their incident reporting system was conducted. This entailed a number of semi structured interviews with Transpower's power users and IT Support department. A business case was developed for Transpower recommending a replacement of their Incident Management System.

A data feed from Transpower's reporting system would be obtained. Incidents, on receipt were entered into a new database and reclassified. This was done to improve reporting capability, ability to tailor the database when required, and provide the ability to trawl through the incidents to identify common themes.

A review was also conducted on Transpower's Event Review Group (ERG) who met regularly to review major incidents. The key aim of the review was to improve the quality of the time spent discussing major incidents – root causes were communicated and corrective actions were implemented.

Igniter developed an improved investigation methodology based on Reason's Swiss Cheese Model (Reason, 1990) and the HFACS Model (Weigmann and Shapppell, 2003). HFACS is widely accepted as the principle human factors classification index which builds on the Reason's model of accident causation and provides a strong foundation to develop an investigation methodology. Like the HFACS and Reason's Swiss cheese model, investigations were driven by relentlessly questioning to establish the latent conditions contributing to the incident's occurrence. The result would be a chain of events leading up to the accident, incident or near miss and the root causes were used for further analysis. To help achieve this, two documents were developed to help investigations take place. One documentprovided an overview of the framework to help facilitate a discussion when an interview was conducted, the other to document the outcome of the investigation. Root causes were categorised using a categorisation list based on HFACS (see Figure 1 below).

	Number key		Human Factors Causation List
External influences	0	1	Political
	0	2	Economic
	0	3	Social
	0	4	Technological
	0	5	Legal
	0	6	Environmental
Organisational Influences TP&SP	0	7	Organisational climate
	0	8	Resource Management
	0	9	Operational Process
Supervision Influences TP&SP	0	10	Supervision Quality
	0	11	Correction of Problem
	0	12	Allocation of Work
Pre-Conditions	0	13	Off Duty activities
	0	14	Coordination and
	0	15	Physiological
	0	16	Psychological
	0	17	Technology and Assets
	0	18	Physical Environment
Local actions	0	19	Breaking rules - Excep.
	0	20	Breaking rules - routine
	0	21	Error - Decision
	0	22	Error - Skill-based
	0	23	Error - Perceptual

Figure 1 Investigation root cause categorisation table

For Job Planning – it was identified that there were issues surrounding planning of jobs in advance. One of the concerns was the level of risk assessment that took place for each job. To address this, Igniter developed two "Risk Sliders" – a Planning and Mobile Risk Slider. The Planning Slider (see Figure 2 below left) completed by the job planners, to be applied 90 and 30 days prior to the job, and a Mobile Risk Slider to be completed by field staff before the job at the beginning of the day. Users would respond to each question by making selections on a sliding scale. Their scores would be combined to create a final score and a red/amber/green risk profile.

The purposes of these tools were to identify trends and mitigate risk; e.g. this tool enabled Igniter to identify trends of fatigue. For the technicians, self reporting was shown to improve their risk awareness, and has also allowed them to engage in a personal risk assessment to make informed decisions on their ability to succeed on a job.

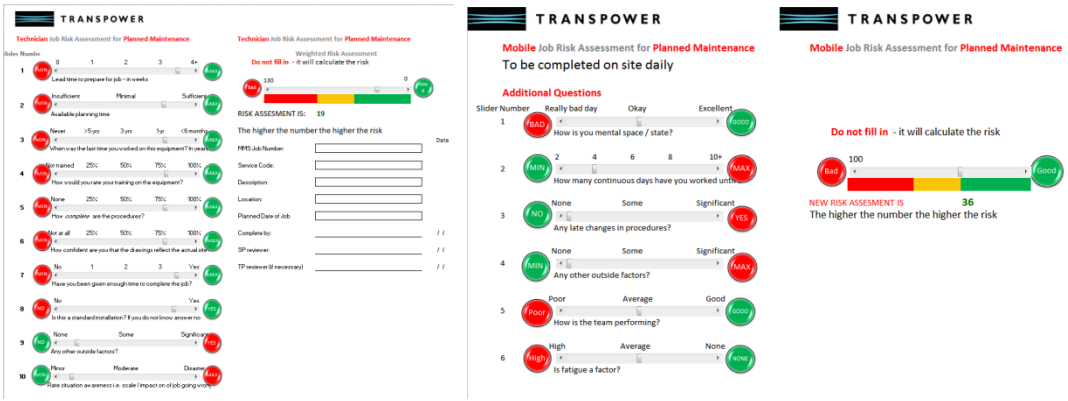

Figure 2 Planning (left) and Mobile (right) Risk Slider

To facilitate the adoption of risk sliders and increase the general awareness of human factors in the workplace, a series of "Bomb Workshops" were devised and delivered across the country. The purpose of these workshops was to engage field staff and have a conversation about human factors without using complex terminology and highlight the dangers of not planning. This entailed an exercise where small groups had to follow complex instructions to defuse a timed bomb. The workshop exercise was designed to challenge communication, teamwork skills, human factors and draw parallels with everyday working practice. This hands-on session was followed by a feedback session which involved communicating the importance of on-going risk management in the workplace. This workshop then led to a conversation about the accident and near miss causation using the experience they went through.

IMPLEMENTATION

Following a period of piloting these solutions, three work streams were set up to facilitate their implementation nationally.

The Investigation and Safety Analysis Centre (ISAC) work stream was designed to analyse all incoming incident and near miss events to identify – using a prescribed criteria list – good candidates for Human Factors root cause investigation. ISAC was responsible for overseeing the investigations to completion, trawling all available data for common themes, common root causes and providing regular or ad hoc reporting. ISAC was also responsible for providing a quality audit service to all investigations ensuring adequate depth of root cause and appropriate classification on Igniter's Human Factors Causation list.

The Investigations Support work stream was responsible for conducting human factors investigations, help implement corrective actions, facilitating the bomb workshops, encourage cultural change and foster a no blame culture. The work stream also had a regional representative at any meetings focusing on incidents or near misses.

The ERG work stream was responsible for facilitating change within the Event Review Groups. Their role was to make the most of the time available ensuring that more time was being spent driving corrective actions to completion, feeding back to the key personnel within Transpower the safety risks and issues occurring within their region.

Programme management was put in place to communicate regularly with the business owner within Transpower and provide on-going progress reports.

RESULTS

There was a dramatic reduction in human induced loss of service – termed HEI (Human Element Incident) Trippings. The financial year for Transpower occurs July to June – so the drop experienced in Q1 – 2011 (figure 3 below) was a consequence of reduced work during the 2011 Rugby World Cup. As reflected in the chart below there have been no HEI Trippings since end of March 2012 (Q3-2011). The pilot and implementation phase started around Q2-2011.

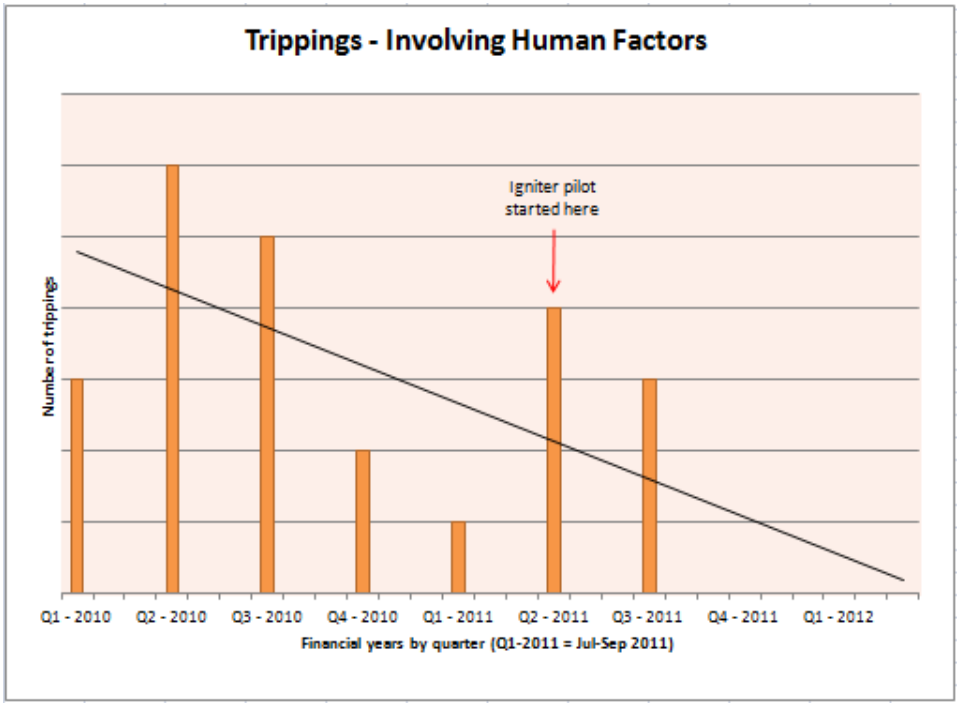

Figure 3 Trippings by Quarter – Involving Human Factors

Reason's Swiss cheese model was customised to provide improved understanding by heat mapping root causes based on prevalence – affectionately known as "the cheese-map" (see figure 4 below). This enabled Igniter and Transpower to work together to understand and identify some of the top issues on each layer of the cheese which were contributing to the prevalence of incidents.

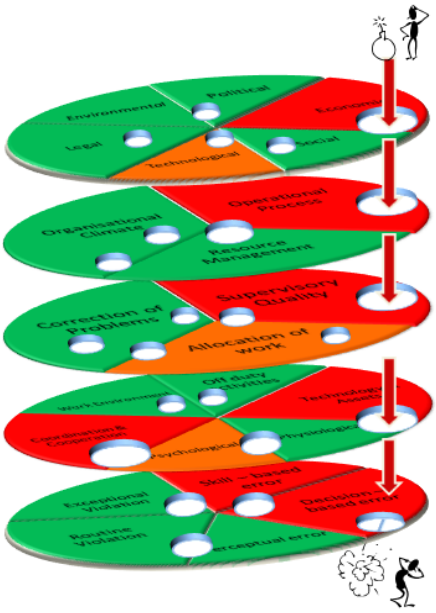

Figure 4 the Cheese-map showing the most prevalent root causes for approx 150 investigations – red = most prevalent

Risk Sliders have proven to be particularly effective. Numerous jobs were stopped which were deemed too risky based on factors such as poor planning, low situational awareness, change of designs and training issues. The consequence of which could have been quite severe. This information was tabulated and presented to Transpower enabling them to target specific issues.

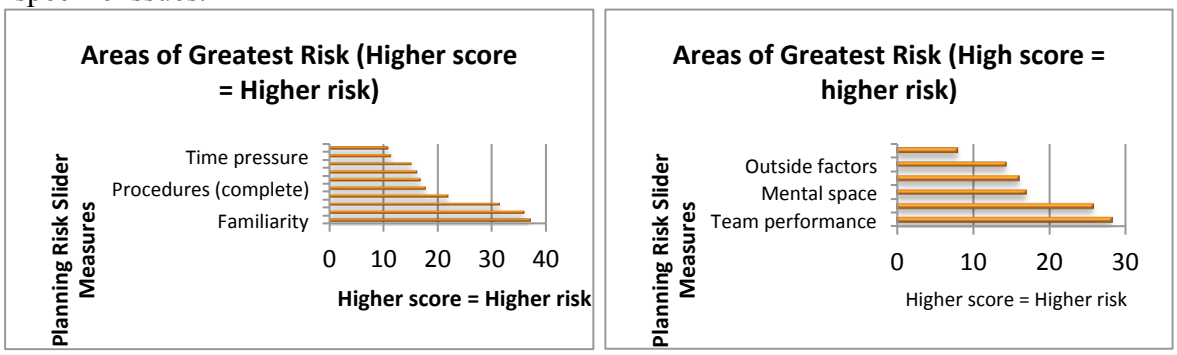

Figure 5 – Areas of greatest risk for the Planning (left) and Mobile (right) Sliders

The Investigations Support work stream has helped facilitate cultural change in the work force. Since Transpower does not directly manage that workforce, all maintenance work is outsourced to a number of companies and as a result, the change management proved more challenging. Through the development of risk slider tools and a constant presence by the support team, service providers became more engaged enabling them to make better, more calculated decisions before they started their work.

All this information gathered during this process proved vital to enable Regional and Maintenance Managers to make informed decisions during their Event Review Groups (ERG). As for the ERGs, they encountered a dramatic change of their agenda, and their time is much better spent looking at what is most important.

CONCLUSIONS

The success of this work has been due to driving change from the field with approval from senior management from day one. Some of the improvements made include more accurate reporting of incidents and near misses, a regime that addresses corrective actions that have dealt with root causes, built a no blame culture where reporting incidents have become accepted and have gained insights across the country. This has enabled Transpower to direct resources to develop the best preventative measures.

It is easy to ask, what all this has to do with sustainability, and on the face of it, easy to jump to the conclusion that there is no link. Sustainability is about the capacity to endure against economic, social and environmental change. Moving towards sustainability is a challenge to all organisations. For Transpower, it is reliant on a secure resilient service provider community. Therefore it is motivated to ensure that business for its contractors remains sustainable, and this is improved by ensuring that the outcomes of the work is more effective, more accurate, with less errors.

Safety management systems are a way to ensure sustainable business and service to the customer within an environment of continual change. They are an important and pervasive part of organisations which serve to protect the workforce, protect the assets and ensure business continuity to the customer. In fact safety management by its own nature needs to be sustainable to ensure organisational sustainability works.

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BIOGRAPHY

Karl Bridges works as a Human Factors Expert and Consultant for Igniter. He has a Bachelor of Science with Honours in Psychology and a Master of Science in Human Factors studied at Cranfield University, UK.

Sean Burns works as a Principle Consultant for Igniter. He has a Masters Degree in Information Management & Systems and a Masters Degree in International Relations. Sean has a wealth of experience in large scale programme and change management.

Geoff Dawson works as a Consultant for Igniter. Geoff has a background of asset management, solutions implementation, solution design and implementation of quality management systems.

Nick Douglas works as an Analyst for Igniter. Nick has a Bachelor of Commerce and Administration (Hons) in Business and Economics, and has obtained experience in e-commerce and design industries.

Martin Foster works as a Senior Consultant for Igniter. Martin has held a variety of major positions within New Zealand industry focusing on change management, business process re-engineering and applied technology.

Daniel Lord works as a Principle Consultant for Igniter. Daniel has many years of management consulting focusing on strategy and transformation obtained from working within consumer goods, financial services, telecommunications and government sectors.

William Young works as a consultant at Igniter. William has a background at HR and has recently been enjoying the complexities of root cause accident investigation within the energy sector.