The APPEA Journal 2017, **57**, 539–542
http://dx.doi.org/10.1071/AJ16192

Extended abstract

A step change in safety performance through critical control management

Roberta Selleck

Clough Limited, 34 Parliament Place, West Perth, 6005 WA, Australia. Email: aaron.ryder@clough.com.au

Abstract. The oil and gas construction industry experiences a high rate of unnecessary work-related fatalities. The International Association of Oil and Gas Producers (IOGP) reported 54 fatalities in 40 fatal incidents in 2015. When assessing this against the use of IOGP Life-Saving Rules (LSRs), which contractors are required to adopt, the IOGP found that of the 40 fatal incident descriptions in 2015, at least 73% related to the IOGP LSRs.

A program to apply a critical control management (CCM), or safety cased, approach to fatal hazards was trialled on construction sites in Australia and South Africa ranging from large power station constructions to offshore hook-up and commissioning to brownfields maintenance. The results demonstrated a step change in the safety performance occurred on projects where the CCM program was implemented. These projects have each demonstrated a significant improvement in recordable injuries, increases in hazard reporting and awareness, and almost complete elimination of high-potential incidents.

Further investigation of the reasons for these results is the subject of a PhD project and includes: (1) understanding how the CCM program improves hazard awareness and decision making of frontline supervisors; (2) determining the effects CCM has on the safety climate of the organisation as detailed focus is applied on the effectiveness of controls that drive leadership decisions; and (3) investigating how CCM improves leadership at all levels of the organisation due to better information that allows tangible action to be taken to improve control effectiveness.

This paper describes the progress of CCM program development, details present results and lessons learned, and provides a context for how CCM programs can be implemented in other organisations.

Keywords: awareness, change management, critical control management, hazard, prevention, risk, safety, safety case.

Accepted 6 April 2017, published online 29 May 2017

Introduction

The construction industry is one of the most hazardous in the world with statistically high injury and fatality rates (Health Safety Executive (HSE) UK 2015; SafeWork Australia 2015; US Department of Labor 2016). The Australian fatality trend has improved since 2003, but in 2015 26 construction-related fatalities occurred, with a further 16 occurring in the first 6 months of 2016 (SafeWork Australia 2016). Construction fatalities are typically single-fatality events with the mechanisms of the events relating to falls from height (28%), vehicle incidents, including trucks (16%), contact with electricity (15%), being hit by falling objects (12%) and being hit by moving objects (12%; SafeWork Australia 2015). These same mechanisms of injury have been causing worker deaths for the past 30 years (National Institute of Occupational Safety and Health (NIOSH) 1993). Over the past 30 years, the construction industry has been unable to eliminate fatal injuries occurring from these hazards through existing risk management practices. An alternative approach is required.

Compared with the construction industry, the Australian oil and gas industry from 2006 to 2015 had three fatalities (National Offshore Petroleum Safety and Environment Management Authority (NOPSEMA) 2016). One of the contributing factors in reducing fatalities in the oil and gas industry has been the introduction of the safety case regulatory regime following the Piper Alpha disaster in 1988 (Pate-Cornell 1993; Cox and Cheyne 2000; Brandsæter 2002; Khan *et al.* 2002; Vinnem 2010; SafeWork Australia 2012). The 'case for safety' was recommended by Lord Cullen (1990) to address failures identified in design, risk assessment, safety management systems and the organisational and cultural failures that contributed to the disaster. The 'safety case' approach applies a risk-based methodology to identify major accidents events, identify the critical control systems of the facility being assessed and define the safety management practices to monitor the effectiveness of the critical controls (NOPSEMA 2013).

Although the safety case management approach has been effective in controlling 'process'-related major accident events in the oil and gas industry, fatalities still occur relating to occupational health and safety hazards. The oil and gas construction industry experiences a high rate of unnecessary work-related fatalities. The International Association of Oil and Gas Producers (IOGP) reported 54 fatalities in 2015 (IOGP 2016). When assessing this against the use of IOGP Life-Saving Rules (LSRs), which contractors are required to adopt, the IOGP stated:

> Analysis of the 40 fatal incident descriptions in which there were 54 fatalities has shown that at least 73% of the fatal incidents reported in 2015 related to the IOGP Life-Saving Rules. (IOGP 2016)

The Major Accident Prevention (MAP) program was developed by Clough in response to a fatality event in Papua New Guinea in 2013 experienced by a construction company. The MAP program applies the principles of the safety case to define the mechanisms of energy release (hazards) for the range of construction and maintenance activities conducted, and details the critical controls that directly prevent the energy from being released using a bow-tie risk analysis method.

During 2016, the MAP program was implemented across construction projects and brownfields maintenance contracts across Australia and Africa. The implementation included training in the MAP critical control and verification processes, together with organisational alignment to the core principles of the program, discussed in *Lessons learned* below.

Results and discussion

Results demonstrate that a step change has occurred in the safety performance of projects where the MAP program has been implemented. Specifically, these projects have each demonstrated a significant improvement in recordable injuries, hazard reporting and awareness, and all but eliminated high-potential incidents.

Case studies

Power station, South Africa

The MAP program was implemented during May and June 2016 across a workforce of 6000 personnel (including subcontractors) on a mega power station construction project in South Africa. This project had previously experienced serious injuries relating to working at heights, stored energy and lifting operations. An immediate effect of the MAP program on incident performance was identified and has been sustained since implementation, resulting in the lowest all-incident frequency ever achieved on the project and zero high-potential incidents. The MAP program has reduced all types of incidents across the project and performance on the project is still improving (Figs 1, 2).

Based on the early results on this project, and other projects where the program is being implemented, the MAP program appears to be effective. Further research is required to understand how the MAP program interacts with existing risk management programs and organisational decision making in the field, as well as at senior management levels. Anecdotally, supervisors indicate that the MAP program is providing a practical checklist that improves compliance to critical controls and enables workplace planning for high-risk tasks.

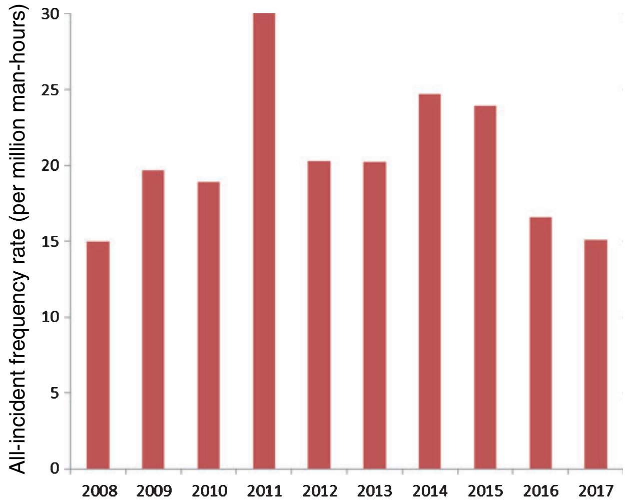

Fig. 1. Project incident performance showing the annual frequency rate for all incidents (NM, near miss; FAC, first aid case; MTC, medical treatment case; LTI, lost time injury; PD, property damage; ENV, environmental). Note, data for 2017 are up to 23 March 2017.

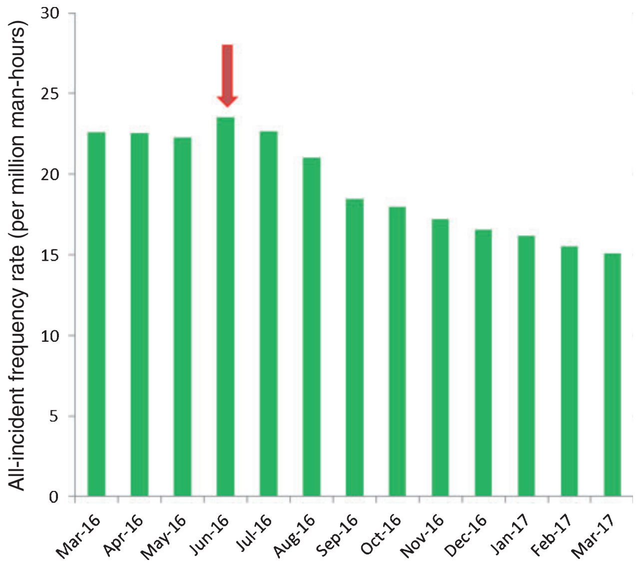

Fig. 2. Project incident performance after implementation of the Major Accident Prevention (MAP) program (arrow) showing the frequency rate for all incidents (NM, FAC, MTC, LTI, PD and ENV, see Fig. 1 for definitions).

Oil and gas infrastructure refurbishment project, Australia

Undertaking work to support the refurbishment of loadout facilities, the project team performed a series of work scopes that included high-risk tasks (heavy lifts on water, diving, marine operations, working at height, rope access, scaffolding) with 10 months in the field; the project team achieved ‘zero harm’. Specifically, there were no injuries throughout the project (no first aid, medical or any other injury), no high-potential

Table 1. Clough Global and Australia safety performance

LTIF, long term incident frequency; TRIF, total recordable incident frequency; FY16, financial year 2016; CY2016, calendar year 2016; FYTD17, financial year to date 2017; FY, financial year

	LTIF				TRIF			
	FY16	CY2016	FYTD17[A]	Change (FY)	FY16	CY2016	FYTD17[A]	Change (FY)
Global performance	0.18	0.00	0.00	–0.18	3.36	2.22	0.48	–2.88
Australia performance	0.22	0.00	0.00	–0.22	4.09	2.70	0.00	–4.09

[A]January 2017.

incidents, one spill of 15 mL oily water, two minor property damage incidents (less than AU$100) and no motor vehicle incidents.

Company performance

Clough has now implemented the MAP program on all construction projects and brownfield maintenance contracts it manages in both onshore and offshore work environments. The data show a higher incident rate in Australia, due largely to the majority of field-based construction projects occurring in Australia over the past 2 years. A step change in safety performance was achieved in 2016 (Table 1).

Lessons learned

During the development and implementation of the MAP program, the following principles were defined and are critical to the effectiveness of the MAP program: (1) MAP critical controls are mandatory; (2) if an MAP program critical control has not been implemented, the task(s) is stopped immediately; (3) every critical control applicable to a project shall be validated in the field on a monthly basis and 100% compliance is the only acceptable result; (4) supervisors are directly responsible for validating the critical controls and stopping work, without reference to line management; and (5) managers and executives actively support stop-work decisions, holding line managers accountable for ensuring the program is implemented and effective.

The MAP program fundamentally hands back operational control to supervisors by providing them with clearly defined operational limits for critical controls, which empowers supervisors to stop work when critical controls are not implemented and effective.

Conclusion

The construction industry is one of the most hazardous in the world, with statistically high injury and fatality rates. Current risk management practices within the construction industry are proven ineffective in preventing serious and fatality incidents. An alternative risk management approach has been developed and applied within the oil and gas industry based on a ‘safety case’, which includes an assessment of major accident events, the critical controls that directly prevent the accidents and a safety management system applied to ensure critical controls are consistently implemented. The MAP program has been used to apply the principles of the ‘safety case’ in the form of critical control management to existing construction and brownfield maintenance projects in Australia and South Africa, demonstrating step changes in safety performance.

Understanding the underlying reasons why the MAP project has been so effective is subject to further investigation and is being explored through a PhD project, which aims to understand: (1) how the MAP program improves hazard awareness and decision making of frontline supervisors; (2) the effect the MAP program has on the safety climate of the organisation as detailed focus is applied on the effectiveness of controls that drive leadership decisions; and (3) how the MAP program improves leadership at all levels of the organisation as a result of better information that allows tangible action to be taken to improve control effectiveness.

References

Brandsæter, A. (2002). Risk assessment in the offshore industry. *Safety Science* **40**, 231–269.2. doi:10.1016/S0925-7535(01)00048-0

Cox, S. J., and Cheyne, A. J. T. (2000). Assessing safety culture in offshore environments. *Safety Science* **34**, 111–129. doi:10.1016/S0925-7535(00)00009-6

Cullen, W. C. (1990). ‘The Public Inquiry into the Piper Alpha Disaster.’ Vol. 2. (HMSO: London.)

Health Safety Executive (HSE) UK (2015). Statistics on fatal injuries in the workplace in Great Britain 2015. Full-year details and technical notes. Available at: http://www.hse.gov.uk/statistics/pdf/fatalinjuries.pdf [verified 28 April 2017].

International Association of Oil and Gas Producers (IOGP) (2016). Safety performance indicators – 2015 data. (IOGP: London.) Available at: http://www.iogp.org/pubs/2015s.pdf [verified 15 September 2016].

Khan, F. I., Sadiq, R., and Husain, T. (2002). Risk-based process safety assessment and control measures design for offshore process facilities. *Journal of Hazardous Materials* **94**, 1–36. doi:10.1016/S0304-3894(02)00004-3

National Institute for Occupational Safety and Health (NIOS) 1993. Fatal injuries to workers in the United States, 1980–1989: a decade of surveillance. (US Department of Health and Human Services, Centers for Disease Control and Prevention: Atlanta, GA.) Available at: https://www.cdc.gov/niosh/docs/93-108/pdfs/93-108s.pdf [verified 28 April 2017].

National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) (2013). The safety case in context: an overview of the safety case regime. (NOPSEMA: Melbourne.) Available at: https://www.nopsema.gov.au/assets/Guidance-notes/A86480.pdf [verified 28 April 2016].

National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) (2016). Annual data tables – Q2-2016. (NOPSEMA: Melbourne.) Available at: https://www.nopsema.gov.au/assets/Data-and-statistics/A493074-Annual-Data-Tables-Q2-2016.pdf [verified 15 September 2016].

Pate-Cornell, E. (1993). Learning from the Piper Alpha accident: a postmortem analysis of technical and organizational factors. *Risk Analysis* **13**, 215–232. doi:10.1111/j.1539-6924.1993.tb01071.x

SafeWork Australia (2012). How to manage work health and safety risks – code of practice. (SafeWork Australia: Canberra.)

SafeWork Australia (2015). Construction industry profile. Available at: http://www.safeworkaustralia.gov.au/sites/swa/about/publications/pages/construction-industry-profile [verified 5 September 2016].

SafeWork Australia (2016). Work-related fatalities. Available at: http://www.safeworkaustralia.gov.au/sites/swa/statistics/work-related-fatalities/pages/worker-fatalities [verified 15 September 2016].

US Department of Labor (2016). 2014 Census of fatal occupational injuries (revised data). Available at: https://www.bls.gov/news.release/archives/cfoi_09172015.pdf [verified 18 September 2016].

Vinnem, J. E. (2010). Risk indicators for major hazards on offshore installations. *Safety Science* **48**, 770–787. doi:10.1016/j.ssci.2010.02.015

The author

Roberta Selleck has a BSc and graduate diplomas in environmental impact assessment, education and occupational health and safety. Roberta is a Health, Safety, Security and Environment (HSSE) professional with over 20 years' experience in senior HSSE manager roles across the resource sector, and has held site and corporate-based roles in the oil and gas and mining industries. Roberta joined Clough in August 2013 in her current role to support the design, development and implementation of Clough's HSSE improvement strategy. Significantly, this has included developing the Clough Major Accident Prevention Program to address high-risk construction activities undertaken by Clough. Prior to joining Clough, Roberta was the HSE Manager for the FMG Solomon Operational Readiness team, which included the introduction of autonomous hauling strategy for mining at Solomon.