SAFETY CULTURE RESEARCH, LEAD INDICATORS, AND THE DEVELOPMENT OF SAFETY EFFECTIVENESS INDICATORS IN THE CONSTRUCTION SECTOR

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Abstract - **Construction sector application of Lead Indicators generally and Positive Performance Indicators (PPIs) particularly, are largely seen by the sector as not providing generalizable indicators of safety effectiveness. Similarly, safety culture is often cited as an essential factor in improving safety performance, yet there is no known reliable way of measuring safety culture. This paper proposes that the accurate measurement of safety effectiveness and safety culture is a requirement for assessing safe behaviours, safety knowledge, effective communication and safety performance. Currently there are no standard national or international safety effectiveness indicators (SEIs) that are accepted by the construction industry. The challenge is that quantitative survey instruments developed for measuring safety culture and/ or safety climate are inherently flawed methodologically and do not produce reliable and representative data concerning attitudes to safety. Measures that combine quantitative and qualitative components are needed to provide a clear utility for safety effectiveness indicators.**

Keywords – safe behaviours, safety knowledge, effective communication, lead indicators, safety culture, safety climate

I. INTRODUCTION

Nationally the construction industry in Australia has far more injuries and ill-health impacts than the Australian average, and pays one of the highest workers' compensation premium rates in Australia. Similarly, notwithstanding improvement in their rates, fatalities are too high. Other than lost time injuries (LTIs) or similar 'negative' 'lag' performance indicators, reliable, comparable and standardised performance indicators are not available. An evaluation of Positive Performance Indicators (PPIs) as an OHS performance measuring tool, based on a brief overview of its limited uptake in Australian industry, suggests that it does not reliably measure OHS performance. There is a clearly demonstrable need to accurately measure safety performance on construction sites in order to improve industry performance. Likewise, in the pre-construction design and scoping phase, as well as in the post-construction facility management stage of completed projects, there is a need for reliable safety performance measurement. These issues of safety performance measurability have been addressed in part [2], [3], [4] through a matrix of safety cultural competencies determined by identified safe behaviours and safety management tasks (SMTs) for the Australian construction industry.

The current research is to examine how safety cultural competencies and their associated safe behaviours, as well as leadership attributes and effective communication can be pro-actively assessed predicated on the assumption that they have a measurable impact on safety performance. It is suggested that PPIs do not have the capacity to actually measure safety performance although some do recognise safe behaviours, leadership and communication as measurable characteristics of safety culture. PPIs tend to measure OHS processes, but not safety performance *per se.* Arguably one of the most practical guiding principles of the measurability of safety performance is given in the Australian/ New Zealand Standard, *AS/NZS 4804: 2001 Occupational health and safety management systems—General guidelines on principles, systems and supporting techniques* (AS/NZS 4804). This Standard which is approximately comparable with AS/NZS ISO 14004:1996 defines safety performance as,

> the measurable results of the occupational health and safety management system related to the organisation's control of health and safety risks, based on its OHS policy, objectives and targets. Performance measurement includes measurement of OHS management activities and results.

Perhaps ultimately, the most informative, yet simple, guidance for the efficacy of any performance indicator emanates from the UK HSE which prefaces one of the key sections of *A Guide to Measuring Safety Performance* by asking 'Why measure performance?' [5]

During the currency of the research project that produced *A Construction Safety Competency Framework*, [3] aside from identifying essential leadership attributes, communication and desired safe behaviours as necessary elements of safety culture, the

report identified the measurement of safety effectiveness as a requirement for measuring the influence of these elements of safety culture on safety performance. However, aside from suggesting that these have a positive influence on safety performance there is little validated evidence that the positive safety actions they generate actually influence safety performance positively.

An issue that militates against the uptake of PPIs is that for legislative purposes, such as recording and reporting injuries, mainly LTIs and the like are required under the nine disparate Australian OHS jurisdictions. Generally their format is guided by Australian Standard AS 1885.1-1990, known as the *Measurement of occupational health and safety performance - Describing and reporting occupational injuries and disease* or alternatively as the former NOHSC's *National Standard for workplace injury and disease recording*, which are both non-enforceable at law, but nationally and internationally recognized as an authoritative conformance document. Other than a cursory mention of PPIs in AS/NZS 4804: 2001 there is no equivalent Standard for PPIs. It is readily observable that those PPIs that merely measure a number of activities without follow up ('close out') actions, do not directly impact on safety performance. In fact, evidence gathered from industry focus groups held for the current SEI research strongly endorses what has been known for some time, *viz*, that, typically other than collecting and collating these indicators, no follow up action may occur at all. Hence it's entirely possible that historically there was no impact on safety performance at all, let alone that they may, '…only measure the number of events and do not provide any indication or measure of effectiveness of each measured event" [6], [7].

As a consequence of the vagueness and broadness of PPIs and their measurement, what this research seeks is the investigation of the development of a guidance framework for performance measurement that can be applied by individual organizations based on an industry standardized set of performance indicators suited to their particular organizational objectives and environment. At this stage of the research process we propose to develop a mechanism which may incorporate lead indicators that have demonstrated capacity to measure their impact on safety performance and combine those with measures of safe behaviours and safety cultural competencies. Simply stated, this research project seeks to create a mechanism to standardize and customize the measurement of safety effectiveness with valid and user-friendly industry supported indicators that measures the effectiveness of specific proactive safety activities each company undertakes.

Even though lag indicators have been repeatedly criticised in some academic literature and government reports as being negative and reactive [7] [8] and merely measuring failure; it may well be that LTIs, LTIFRs and a raft of other lag indicators give the most accurate measurement of performance or, in some instances, the lack of performance (see Table 1, Table of suggested lag indicators, below). At this stage of our current research it is envisaged to examine a range of lag indicators as dependent variables with proposed lead indicators (which have not yet been fully definitively identified) as independent variables. The proposed methodology, based on a range of suggested lag indicators and lead indicators will be industry trialed and modified according to industry feedback.

Table 1 Table of suggested lag indicators

Acronym	Rates
FAIFR	(first aid injury frequency rate)
FIFR	(fatality incidence frequency rate)
LTIFR	(lost time injury frequency rate)
MTIR	(medically treated injury rate)
NMTIR	(non-medically treated injury rate)
NDOR	(notifiable dangerous occurrence rate)
NII	(non injury incident) or near miss/ near hit
RTWR	(return to work rate)
WCCR	(workers' compensation claim rate)
WCPR	(workers' compensation premium rate)

II. METHODOLOGY

Data from the two year national research project [3] that investigated the motivators of safety culture and safety behaviours in the construction industry has provided a data base which identifies measurable safety behaviours informing the future formulation of SEIs. Based on approximately 70 interviews with managing directors, other senior management, construction site managers, union officials and semi-structured focus groups consisting of line and senior management of Australia's eleven largest principal contractors the research identified 39 Safety Management Tasks (SMT's) that are considered critical to enhancing safety performance by the industry. Two survey instruments consisting of a management and worker questionnaire were administered nationally to the participating construction companies [9]. All of the findings were validated through interviews with senior officials of the ACTU

(the peak union body in Australia), the principal construction sector union, the CFMEU, and senior managers of each of the OHS regulators in every State and Territory. After the qualitative and quantitative data were collated and analysed, the results were taken back to each participating organisation for comment, suggestions for change and or validation. To create SEIs was outside the scope of the original research project, but the standardised measurement of safety actions and associated safety behaviours is seen by industry as a necessary complement to the 39 SMTs, Further the research project's investigation of the motivators of safety culture and safety behaviours in the construction industry data suggested that measurable safety behaviours have the capacity to formulate SEIs. Other recently conducted research [10] strongly endorse the measurability of safety culture elements

However, the success of measuring safety culture/ safety climate is complex notwithstanding its strong endorsement in the literature. Safety culture/ safety climate may not be able to be measured accurately at all [1]. Further, other than the reasons examined above and below, at an industry level measurability of safety performance and safety culture is negated by the fragmented nature of the Australian construction industry which in the private sector consists of fewer than 30 very large principal contractor organizations and a similar number of 'second tier' large principal contractors. Typically these organizations rely on a substantial component of large contractors employing up to 100 or more employees who in turn employ subcontractors which may consist of two or three to less than 20 employees. It is also common to engage subcontractors who are the proprietor/ only employee. Conversely, in some construction trades, such as in formwork there are very large subcontractors employing 100 employees or more. Perhaps, the distinction between contractor and subcontractor is notional other than in the contractual basis under which they are engaged. Additionally, construction workers may also be recruited from labour hire companies. In this manner the Australian construction industry employs approximately 900,000 people of which, according to industry informants, in NSW, up to 98 percent of the workforce is employed making principal contractors very small employers indeed relative to the total numbers in the industry. (More accurately, the Australian construction industry:

- generates 6.9% of GDP or $A 61 billion (ABS 2007)
- Employs approximately 876 000 people (9% of the Australian workforce) (ASCC - 2005–06)
- Injures approximately 1 in every 33 people (10% of all worker's compensation claims)
- Kills approximately 40-50 people a year)

Projects may last from a few months to a few years after which the project team moves on to another project and the safety culture and its safety performance dissipates. In addition, the industry is further fragmented, by the nature of the work undertaken, which includes the erection of commercial and residential high rise buildings, the cottage industry, building refurbishment and maintenance, facility management, road and bridge work, tunneling, rail infrastructure, energy infrastructure including electricity transmission lines, pipelines of various types as well as the development of open-cut mines. Quite clearly, the industry is not uniform in terms of the work performed and organizational size, and hence organizational resources: In addition, each part of construction work has its own particularized context relative to OHS risk, safety performance and performance measurement. Notwithstanding this variability, indicators should be based on the particular OHS risk exposure generated by the types of work and projects undertaken, yet they must be uniformly applicable and comparable across industry.

Currently the research team is examining the scope and nature of the SEI (s) that may be able capture these steps quantitatively, or indeed whether it will be a quantitative measure. The current stage of development is to develop a set of qualitative values for each SEI based on a sliding (quantitative) scale. However, some form of readily accessible and easily applicable enumeration may have to inform the qualitative aspects of the SEIs: This approach is appealing for several reasons: The application of metrics is common practice in the industry so that the construction process itself is accurate and the product is not defective, as is the reliance on scoring/ measuring safety performance quantitatively: It is also well understood: The reason for the ease of use is predicated on the industry principle that immediacy of measuring safety effectiveness on site is imperative and must be usable by all on site; otherwise the impetus will be lost and its essential linkage to measuring safety performance based on lag indicators will lose its significance too. Another way of characterising the on site measurement of safety effectiveness may be that it represents the microcosm of the macro/ global co-ordinating functions of capturing site data and correlating it with other site data and linking it to the appropriate global organisational lag indicators.

III. RESULTS

Industry respondents claimed they 'knew' that their site safety culture had a positive, but immeasurable, impact on safety performance. When prompted to articulate what the visible attributes of a vibrant safety culture might be the most consistent elicited response was 'good housekeeping.' The rationale proffered being that if housekeeping was regularly attended to that the

more essential safe behaviours and related actions such as conducting regular pro-active risk assessments would also be more likely to be conducted properly. So far, other constant safety culture attributes indicated were; 'good' toolbox talks, i.e., those that were planned and based on two way communication rather than a diatribe delivered without meaningful input: What was seen as essential in this regard was that participants' suggestions or concerns were listened to and, more importantly, 'closed out.'

Another suggested element of safety culture was the planned alignment of the disparate phases of the construction process; for example, ensuring that the steel fabrication phase was completed in tradesman like fashion and on time before the concrete pour began: The rationale being that when each construction phase is systematically completed, contractors and subcontractors start on time without having to rush their task and more importantly without cutting corners because that is when essential OHS procedures are likely to suffer. Another recurrent safety culture attribute was predicated on holding pre-construction/ design phase meetings with contractors and subcontractors where site/ task specific safety management plans and Safe Work Method Statements (SWMSs) were prepared based on meaningful input because of the positive impact these have on safety performance during the construction phase. A 'lessons learnt' overview of safety culture and the related task and safety performance, undertaken either at the 'close out' stage of the project or about sixty per cent through the project, were also seen as having positive impact on the safety of current and subsequent projects. The latter suggestions were premised on the 'hard' or functional aspects of safety culture; the 'softer' attributes suggested were under the rubrics of visible and engaged leadership and collaboration; for example;

- Regular site walk-arounds by senior management and/ or board members
- All management regularly seen on site (wearing the correct PPE)
- Work done collaboratively (based on consultation)
- Listening to each other
- The need to treat people as people and to have respect for the individual
- Commitment from workers and from management built on mutual trust
- Explanations given of why actions suggested at toolbox talks/ pre-start meetings were undertaken or not

V. CONCLUSION

The challenge for the current project is to develop reliable, comparable and constant indicators that measure safety performance without the drawbacks commonly attributed to PPIs: The indicators must be easily measured, comparable for benchmarking purposes within sections of an organization and across industries without being subject to random variation. For the construction industry specifically, they must be able to be implemented uniformly from project site to project site notwithstanding the disparate sectors of the industry, the variability of the work undertaken and the diverse risk contexts these generate. Further, they must be simple to implement so that they are not capital and human resource intensive: They must not be so complex that they are time-consuming to administer and collate and they must measure effectiveness instead of simply measuring a number of events which have no demonstrated effect on safety performance.

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