DEVELOPMENT OF SAFETY EFFECTIVENESS INDICATORS FOR USE IN THE CONSTRUCTION SECTOR

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ABSTRACT
This research outlines the development of a set of Safety Effectiveness Indicators (SEI’s) which are derived from previously mapped Safety Management Tasks (SMT’s) which in turn are constituents of a Construction Safety Competency Framework. Due to resource constraints, 13 only of the original 39 SMT’s were selected for detailed examination and development into effectiveness Indicators.

Initially six SMT’s were developed to collect both quantitative and qualitative data on the effectiveness of the undertaken process. A number of formats and data collection options were prepared. This pilot process was trialled at construction sites of three major Australian construction companies. Feedback via structured interview and focus groups enabled the development of an additional number of SEI’s to 13 in total.

This process resulted in the development of 13 SEI’s which included both qualitative and quantitative data collections and further developed the SEI’s as multi user instruments for ease of use on construction sites.

The initial development of this set of SEI’s is a positive step towards more clearly defining and measuring lead indicators. Further research is planned to explore the utility of these instruments with an additional number of construction companies.

Keywords: Lead indicators, Safety management tasks, safety effectiveness indicators

1. INTRODUCTION
Cohen (1977) reviewed the then current research on occupational safety, and stated that both strong company commitment to safety, and communication between all levels of a company are the most influential factors to improving safety. Other factors included careful selection of staff, and early and continuous training throughout the lifetime of the company. In 2009 these factors remain vital in Occupational Health and Safety (OHS).

Since Cohen’s review there has been a continued decrease in the injury rates within the Australian construction industry. However this sector suffers from far more injuries and ill-health than the Australian average, with one fatality occurring on average per week and pays one of the highest workers’ compensation premium rates in Australia. The fatality rate is three times higher than the national average, and 15% of all industry fatalities are in the building and construction sector. Notwithstanding some improvement in their rates, fatalities are too high. Other than lost time injuries (LTIs) or similar ‘negative’ ‘lag’ performance indicators, reliable, comparable and easily undertaken 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 clear 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 measurement have been addressed in part through a matrix of safety cultural competencies determined by identified safe behaviours and safety management tasks (SMTs) for the Australian construction industry (Biggs, Sheahan & Dingsdag, 2006; Dingsdag, Biggs, Sheahan & Cipolla, 2006).

1.1 Current methods of measurements
The main purpose of measuring safety is to develop strategies that will eliminate future incidents. Measurement and evaluation of OHS continues to be predominately by lag indicators, which include fatalities, compensation, Lost Time Indicators (LTIs). These measurements have the obvious inherent problem in that they can only be compiled after something has gone wrong, thus a negative measure – one of failure, rather than performance. Another contributing factor to poor OHS in the construction industry is the various State and Federal laws that govern OHS throughout Australia. These can be confusing and lead to inconsistencies between the safety regimes between states, and between and within construction companies.

Establishing a credible, accurate and timely standard for allowing industry-wide measurement of OHS performance remains the key to moving forward in improving OHS by the Australian Government (Federal Safety Commissioner's 2005-2006 Progress Report, 2006). Referred to as lead indicators, they aim to recognise signals before an incident happens. This would give a way to improve safety before an event occurs, thus reducing the lag indicator rates. At present the only tool actively used to measure lead indicators are Positive Performance Indicators (PPIs). PPIs measure the actions an organisation has taken to manage and improve OHS performance (Comcare 2004).

In 1999 the National Occupational Health & Safety Commission (NOHSC) gave the construction industry a guide to the development of performance indicators. From the areas identified, key indicators were designed, most focusing on the numbers of, for example, OHS audits, OHS training, OHS plans, etc. Views on the effectiveness of PPIs have varied, but there has been limited uptake by industry, which suggests they do not reliably measure OHS performance (Dingsdag, Biggs and Cipolla, 2008). A major problem with PPIs is they measure how often an event occurs, rather than how effectively it is undertaken. There has been a general lack of consistent uptake in the industry as a whole, and lack of convergence and guidance in the literature.

1.2 Future methods of measurement
During the NOHSC (1999) safety culture was identified as a potential performance indicator, but not considered other than in a remote reference. Improving the safety culture has been the used the in the nuclear power industry, where there is an environment of planning for anticipated and unexpected events (Rochlin, 1999). There exists an ingrained culture of learning, communication, and locus of responsibility. These perceptions, attitudes and behaviours are created and maintained by management, and passed to employees in what actions will be rewarded, tolerated or punished (Aitken & Driscoll, 1998). Safety then must be personalized to the individual, and be allowed to challenge unsafe behaviour. It is at this level that safety could, and should, be measured, and used to as a lead indicator of effective safe behaviours. This as yet underdeveloped tool would be a means to assess an organisations sense of "how things are actually done around here", the direction in which Guldenmund (2000) concluded was the best way for measuring safety climate.

Recent research by Dingsdag, Biggs, Sheahan and Cipolla (2006) has developed a matrix of cultural competencies, developed through extensive consultation with industry, government and unions. 39 Safety Management Tasks (SMTs) were developed, which have definable activities, actions and processes associated. These activities, actions and processes need to be undertaken to manage workplace safety, and can be formatted into a tool to measure how effectively a task is being performed.
2. AIMS
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.

This paper looks at the pilot development of 6 effectiveness indicators drawn from 13 of the original 39 SMTs. It is further planned to extend the pilot investigation to an overall 13 of the original 39 measures which have been selected for their relative importance. Resource constraints have restricted both the pilot study and the follow on planned field trials to a total of 13 SMT’s.

The 6 SMTs were then trialed on various sites throughout Australia. It will then be discussed on how to refine the tool through the results, comments and suggestions from industry. This tool will then be developed into a workbook to be published and distributed to the construction sector.

3. METHODS
13 SMTs were developed to collect both quantitative and qualitative data on the effectiveness of the task on the investigated sites (See table 1). As discussed, 6 of these SMT’s were previously involved in a pilot (see table 1), were each tool was given to a construction site and over a period of 6 weeks the workforce was asked to complete each task when it arose on site. The results and feedback given from the pilot assisted in the development of the tool to be used in the field trial.

Table 1: List of all 13 SMT’s across Pilot and planned additional field trials.(*SMTs used in pilot)

<table>
<thead>
<tr>
<th>SMT Number</th>
<th>SMT Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1*</td>
<td>Carry out project risk assessment</td>
</tr>
<tr>
<td>6*</td>
<td>Carry out workplace and task hazard identification, risk assessments and control (JSAs/SWMSs)</td>
</tr>
<tr>
<td>13*</td>
<td>Plan and deliver toolbox talks</td>
</tr>
<tr>
<td>16</td>
<td>Consult on and resolve OHS issues</td>
</tr>
<tr>
<td>18*</td>
<td>Challenge unsafe behaviour/attitude at any level when encountered</td>
</tr>
<tr>
<td>20</td>
<td>Recognise and reward people who have positively impacted on OHS</td>
</tr>
<tr>
<td>21</td>
<td>Deliver OHS training in the workplace</td>
</tr>
<tr>
<td>22</td>
<td>Carry out formal incident investigations</td>
</tr>
<tr>
<td>24</td>
<td>Carry out formal inspections of workplace and work tasks</td>
</tr>
<tr>
<td>25</td>
<td>Evaluation research and prepare reports on OHS issues, performance and improvement strategies</td>
</tr>
<tr>
<td>26*</td>
<td>Monitor sub-contractors activities</td>
</tr>
<tr>
<td>28</td>
<td>Evaluate OHS performance of subcontractors</td>
</tr>
<tr>
<td>36*</td>
<td>Work with staff to solve safety problems</td>
</tr>
</tbody>
</table>

A Workbook was distributed for the Pilot. The first section contained information on the history of the project and instructions on how to use the Workbook, the final page was a feedback form that allowed users to return information on either the whole booklet, or an individual SMT in a structured format. The following pages were the 6 SMTs. Each SMT page was composed of the SMT title, spaces for name of evaluator, date and which status the evaluator considered him, or herself. This was followed by a description of the SMT and why it should be undertaken. Below
this was the measurement scale, which was broken into different elements. The number of elements used ranged from 2 to 5. Each element was constructed of 2 statements on the extremities of a 4 point Likert scale. A negative descriptor of the element was anchored to the lowest number on the Likert Scale (1), and a ‘best practice’ descriptor was anchored to the highest number (4). The 2 and 3 point scale had no descriptors associated with them. The user was instructed to read the element and then mark the scale that best reflected where the felt their site lay on the scale – either poor practice (1), best practice (4), or somewhere in between (2 or 3). Each SMT was to be done separately to the others, as and when they arose on site.

The pilot trial began mid 2008 and was conducted on a number of sites suggested by the Industry members of the research group. The three companies are large 1st tier construction companies in Australasia.

Following completion of the pilot trial, debriefing meetings took place to receive any comments users had on the ease of use of the workbook. During the meetings and focus groups different scales were presented to the groups to see which scale would most relevant and easily used by sites. The scales presented were:

1. 4 point likert scale (as used in field trial and pilot).
2. 0 Point Likert scale.
3. Yes/No/Not Applicable boxes for each whole element.
4. Yes/No/Not Applicable boxes for each element description sentence.

4. RESULTS

Feedback was provided to the team by the forms contained in the workbook, which were collated. Focus groups were conducted to receive feedback from all participants in the pilot trials.

Of the comments received back via the feedback from, the changes requested were:
- Language/wording too complicated make simpler
- Repetition between elements
- Scale confusing

Of the focus groups held the major changes requested were:
- Language made more comprehensible
- More room for comments
- Ensure users of the workbook realize that each SMT is filled out separately from the rest

Other factors discussed in the focus groups that could potentially impede the uptake of the workbook are that it could simply add, or be seen to add, another layer of complexity to safety requirements.

Of the six SMT’s used in the Pilot to develop SEI’s, two are reproduced here (Figures 1 &2). The six SEI’s developed in the Pilot take into account the comments and feedback described above. Once the follow on field trials are completed, it is anticipated that all thirteen SEI’s will be developed and produced in a similar manner.
SAFETY EFFECTIVENESS INDICATOR FOR SAFETY MANAGEMENT

**TASK 13: PLAN AND DELIVER TOOLBOX TALKS**

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
<th>Descriptors</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Element 1</strong> Facilitator/leader encourages and gets participation, listens, and provides opportunities for input from all participants.</td>
<td></td>
<td>• Participants are actively encouraged to participate and to provide input.</td>
<td>Yes [ ] No [ ] Not applicable [ ]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Facilitator is open to feedback, encouraging discussion that increases the level of risk awareness relevant to the team and site.</td>
<td>Yes [ ] No [ ] Not applicable [ ]</td>
</tr>
<tr>
<td><strong>Element 2</strong> Facilitator/leader organizes actions arising from toolbox talk and allocates responsibilities.</td>
<td></td>
<td>• Action owners are consulted by facilitator/leader before task allocation.</td>
<td>Yes [ ] No [ ] Not applicable [ ]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Facilitator/leader confirms understanding of individual responsibilities, milestones and timeframes, and any other action owners involved.</td>
<td>Yes [ ] No [ ] Not applicable [ ]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Action owners recognize and support the need for change and the outcomes wanted from the actions.</td>
<td>Yes [ ] No [ ] Not applicable [ ]</td>
</tr>
<tr>
<td><strong>Element 3</strong> Facilitator/leader records relevant toolbox meeting discussion, awareness points, actions and action owners.</td>
<td></td>
<td>• Toolbox talk is accurately documented and distribution process agreed.</td>
<td>Yes [ ] No [ ] Not applicable [ ]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Awareness strategies, opportunities and any improvements or requests raised or identified are accurately captured.</td>
<td>Yes [ ] No [ ] Not applicable [ ]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Agreed action owners, activities and timeframes are recorded and allocated.</td>
<td>Yes [ ] No [ ] Not applicable [ ]</td>
</tr>
</tbody>
</table>

Figure 1. Plan and deliver toolbox talks
Figure 2. Work with people to solve safety problems

5. CONCLUSIONS
The initial reaction by participant organizations was favourable to the use of the SEI process. The pilot SEI workbook was considered by all participants as an excellent tool as it "offers consistency across the industry", and they would like to see it "applied across industry". The researchers intend to expand the study from pilot to field trial and include a number of organisations both at 1st and 2nd tier level across several States and develop a further 7 SEI's to a total of 13. This trial is expected to complete in late 2009. The final SEI measures are anticipated to be simple to use and robust in their applicability across the sector. The overall aim is to meet Cole's (2003) proposition of a uniform series of measures across Australia and across construction environments.
6. REFERENCES AND CITATIONS


