Culture Change Towards Construction Safety Risks, Incidences and Injuries: Best Practice Experiences

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Abstract: The construction industry has a reputation as one of the most dangerous industries because of its high rates of incidents, injuries and fatalities. Recently, many approaches have been adapted by construction companies but most of them were focused on physical working conditions and safety management system/procedure. An improvement to safety will only be achieved if all project stakeholders recognise the need to change their belief, attitude, commitment and behaviour to create a good safety culture. This paper presents a literature review to highlight the need for a culture change towards better construction safety. The paper then presents case studies on two construction management company - Bovis Lend Lease and Bechtel Corporation as strategies for developing good construction safety culture, which includes the objectives, strategies, context and implementation process as well as lessons learned. It is concluded that it is crucially important to develop a good construction safety culture through changing the employees' belief, attitude, commitment and behaviour. Therefore construction safety managers need to adapt more holistic strategies which focus on not only improving physical working environment and employees' safety knowledge, but also on shaping employees' beliefs and attitude which lead to safe behaviour and ultimately healthy safety culture.

Keywords: *construction, organization, occupational health and safety, culture, incidence, injury*

2) 1. INTRODUCTION

Construction industries around the world contribute significantly to national economic growth in terms of Gross Domestic Products (GDP) and offer substantial employment opportunities for workforce. For example in Malaysia, the construction industry contributed around 5.0% in national GDP and employed approximately 7.8% of total employment in the country in year 2003. Despite its important contribution to the nation's economy, the industry still saddled with serious problems such as low quality, low productivity, poor image, economic volatility, bureaucratic issues, shortage of manpower, lack of ethics conduct and lack of data and information (CIDB, 2005). However, the construction industry has high rates of incidences, injuries and fatalities. Out of total of 73,858 industrial accidents reported to SOCSO by year 2003, 4,654 were recorded in the construction industry. From this figure, almost 2.0% or 95 cases resulted in death, while 12.2% or 566 cases resulted in permanent disabilities. In comparison, the manufacturing industry and the agricultural, forestry and fisheries industry recorded 0.7% and 0.6% fatalities respectively out of the total accidents reported. Over the period of 1999-2003, the highest fatalities are in construction, followed by agriculture and manufacturing sector. Therefore, the construction industry has a reputation as being one of the most dangerous industries in Malaysia. Similar statistics was recorded in Australia where the incidence rate was 28.6 injuries per 1000 employees in 2003-04, which was almost twice the overall industry average of 16.4 per 1000 employees (ASCC 2006). Australian construction industry also experienced high fatalities of 6.5 fatalities per 100,000 employees in 2003-04, and this was almost three times the national average for all industries of 2.3 fatalities per 100,000 employees (ASCC 2005).

Many approaches have been adopted by construction companies, but most of them are focused on improving physical working conditions and safety management system/procedure which have led to some limited safety performance improvement. The construction companies nowadays are actively searching for the better approach to improve safety performance. This paper argues that integration between organisational systems/procedures and human-value systems will facilitate the development of good safety

culture and safety improvement will only be achieved if all involved recognise the need to change their belief, attitude and behaviour to create a good safety culture. This paper first presents a literature review to highlight the need for a cultural change towards construction safety risks, incidents and injuries and then presents case study on three construction management company's safety initiatives as a method for developing good construction safety culture, which includes the objectives, strategies, context and implementation process as well as lessons learned.

3) 2. RESEARCH METHODOLOGY

The research methodology adopted in this paper is relatively simple and straight forward which includes a critical review of current literature and a case study. Generally, case study is a method of conducting qualitative research. It is an ideal methodology when holistic and in-depth investigation is needed to understand a complex issue or object. Besides, with case study research, the real situation can be captured from inside the organization and not from outside. The case study will lead to understand the current practices of safety management and to provide details regarding the safety practices in three construction companies, which has explored the opportunities in enhancing safety by addressing safety cultural change in the organisation. The case study was conducted by reviewing company's profiles, implementation plan and lessons learnt from the initiatives.

4) 3. The need for a good construction safety culture in construction

Many researchers have studied construction safety and it appears that traditional approaches to safety management have been focused on the techniques and management tools and are related to identification of work hazards, minimizing the risks associated with these hazards, developing safety management systems, safety procedures and standards, improving physical working conditions such as design of plant and machinery and site access, training site workers, developing better planning and work methods and providing personal protective equipment (Holmes et al., 1998; Reese, 2003, Biggs et al., 2005). Furthermore, the construction industry relies heavily on traditional measures such as accident, and workers' compensation statistics (Mohamed, 2002). Study by Peckitt et al. (2004) described that the functionalist approaches to safety management systems focusing on techniques and mechanics of managing safety such as rules, policies and procedures will encourage safe actions, but they are only as effective as the consequences they predict and the extent to which they are implemented.

Research showed that majority of workplace accidents and injuries have been attributed to the unsafe work practices of employees rather than unsafe working conditions (Garavan & O'Brien, 2001; Hoyos, 1995 cited in Mullen, 2004). Sawacha et al. (1999) described that 'unsafe behaviour' is the most significant factor in the cause of site accidents. On the other hand, Clifford (1988) cited poor attitude towards safety and lack of interest towards safety issues as contributors to high accident rates on site. Attitude needs to be changed before behaviour change (Geller, 1998). Poriters (2000) also cited the 'macho image' among construction workers as the cause of poor safety performance and high accidents on site. Often, the workers believed that following all safety procedures including wearing safety equipment are not necessary for them. Review of the current practices of safety management reveals the major issue in safety is the lack of a sound safety culture within the organisation. In order to improve safety performance; one of the ways is to cultivate a sound organizational safety culture (Fung et al. 2005).

5) 4. Shaping a good construction safety culture

4.1 What is a good construction safety culture?

Definitions of safety culture abound. For example, the Advisory Committee on the Safety of Nuclear Installations (ACSNI) defined safety culture as: the product of individual and group values, attitudes, perceptions, competencies, and patterns of behaviour that determine the commitment to, and proficiency of, an organisation's health and safety management (Health and Safety Commission, 1993). Turner et al., 1989 cited in Cooper, 2002) defined safety culture as: the set of beliefs, norms, attitudes, roles, and social and technical practices that are concerned with minimizing the exposure of employees, managers, customers and members of the public to conditions considered dangerous or injuries. The Confederation of British Industry (CBI, 1990) defined it as: the ideas and beliefs that all members of the organisation

share about risk, accidents and ill-health. All these definitions are relatively similar in that they focused to varying degrees on the way people think and/or behave in relation to safety (Cooper, 2000). Safety culture is concerned with the attitudes, behaviours, systems and environmental factors that promote effective safety management. In relation to construction, the safety culture can be defined as: *an assembly of individual and group beliefs, norms, attitudes and technical practices that concerned on minimising the risks and exposure of workers and public to unsafe acts and conditions in construction environment.*

Good safety culture, according to Ostrom, et al. (1993), can be described as:

a) A culture where workers have particular patterns of attitudes and belief toward safety practices;
b) In the good safety culture, the workers might be alert for unexpected changes and ask for help when they encounter an unfamiliar hazard;
c) A culture that the workers seek and use available information that would improve safety performance;
d) A culture that the organization rewards individuals who call attention to safety problems and who are innovative in finding ways to locate and assess hazards, and
e) A culture that includes mechanisms to gather safety-related information, measure safety performance and bring people together to learn how to work more safely.

4.2 Changing workers' belief, attitude and behaviour towards construction safety

Fishbein and Ajzen (1975) described the theory of reasoned action as a construct for behaviour modification in organization. They suggested that in order to change the behaviour, we need to consider the role of behaviour intentions and behavioural beliefs in shaping attitudes. Besides attitudes toward the behaviour, they also explained the subjective norms which refer to person's beliefs that specific individuals or groups approve or disapprove of certain behaviour. This model gives an insight on two determinants - attitudes and subjective norms that shaped behavioural intention which lead to the actual behaviour of humans. The theory of planned behaviour, which is the extension of the theory of reasoned action, added perceived behavioural control as other determinants that shaped behavioural intention and actual behaviour. Lingard and Rowlinson (2005) described that past experiences and anticipated obstacles contribute to a person's perception about whether certain behaviours are within their control. Changing human behaviour requires changing their attitudes and belief.

To promote safety in the workplace it is important that workers have the right belief, attitude and behaviour towards good safety performance. Lingard and Yesilyurt (2003) contend that companies who manage occupational health and safety (OH&S) well typically have commonly held attitudes regarding the importance of OH&S, which are shared by employees at all levels and conveyed to sub-contractors. They added that the creation of a shared mental model of OH&S is the key to ensuring consistently good OH&S performance. In order to create a shared 'mental model' for OH&S in construction, it is important to understand the factors that affect workers attitudes towards safety. Therefore, it is essential to achieve human potential in safety by shaping a culture in which safety permeates all activities. An important element in shaping safety culture is to shape workers' perceptions and beliefs towards safety. Workers need to have optimum beliefs, and perceptions before attitudes and behaviour relative to safety can be changed. Tam and Fung (2001) maintained that the interactive relationships between how people behave, the attitudes and perceptions that people hold, and the situation or environment that people work in should be taken into account when developing the safety culture.

In order to understand safety culture, attention needs to be directed to understanding the concept of attitudes and behaviour change. Lingard and Rowlinson (2005) show how OH&S attitudes might shape OH&S behaviour in construction and their model consists of four elements namely belief about job, job attitudes, behavioural intentions and the actual behaviour towards safety. Belief represents the perspective a worker has relative to a subject. An example would be that a worker might believe that their job is inherently dangerous, exciting or probably dangerous. These descriptions represent beliefs the individual has about the job. These beliefs may or may not be factual and differ between individuals, which then influence attitudes. For example, a person who believes his/her job to be inherently dangerous may develop a negative attitude towards OH&S rules and regulations. This unfavourable attitude towards OH&S may lead workers to choose undesirable forms of behaviour. This conscious decision to behave unsafely is the behavioural intention. Fishbein and Ajzen (1975) explain that behavioural intentions will then transform into actual job behaviour, such as the occurrence of unsafe acts and

risk-taking behaviour among the workers. Lingard and Rowlinson's (2005) model also explains that individuals with negative OH&S attitudes will behave unsafely only if they make a decision to do so. Understanding the link between belief and attitudes to actual behaviour are crucial in the design of any attempts to improve OH&S performance through attitudinal change.

5. CASE STUDY I -- BOVIS LEND LEASE'S INCIDENT AND INJURY FREE INITIATIVE

5.1 Company's Background in Relation to Safety Performance

Bovis Lend Lease (BLL) is one of the largest construction companies in the world. With over 7,500 employees in 93 offices around the world, BLL constantly seek to improve management techniques and practices that enhance client returns (Lend Lease, 2006). The company is committed to fostering a culture in which individual employees seek to achieve a workplace free of incidents/injury. The safety programs aim to provide employees from worksites through to the Managing Director with the skills and empowerment necessary to maintain the highest health and safety standards (Lend Lease, 2006). However, the company noticed that despite the implementation of a safety management system, people were still injured or fatally dead. This phenomenon lead BLL to extensively explore the human side of safety - how to change workers' mind-set and behaviour towards safety and what the motivators are that will lead to better safety performance. Therefore the incident and injury free (IIF) process is a process that focuses on the current safety program, improves performance and addresses what is missing on the human and cultural side of the equation for the company to sustain an incident and injury free workplace. BLL has employed a consultant JMJ – whose roles are to provide independent advice on how to develop a safety culture and the Environmental Resources Management, audit the safety performances and provide recommendations.

5.2 The Incident and Injury Free (IIF) Concepts

BLL's safety initiative known as IIF was launched in November 2002. The vision of IIF initiatives is to realise incident and injury-free projects and BLL is committed to realising this vision wherever they have a presence. This vision requires a mind-set intolerant of any injury or incident regardless of frequency or severity. BLL has invested in IIF initiatives and empowered employee to make this vision real. BLL has worked proactively with all stakeholders including clients, designers, contractors and the workforce and is prepared to forgo a project rather than compromise their commitment to safety.

The IIF subscribes the principles of a value-based approach and not in competition with personal and organisational priorities. BLL believe that working safely is an integral component of 'doing it right'. IIF is not about systems or procedures, but is about changing beliefs relative to safety. Everyone needs to have a strong belief regarding the importance of safety and the consequences of failing to behave safely. Furthermore, the IIF is not about reducing the number of incidents and injuries amongst the workers, but a journey embarked on by BLL to improve safety performance on their construction sites. It is the way the company is building a culture to eliminate all safety risks. The IIF is focused on the human side of safety, making it personnel - It's about creating a mindset intolerant of any level of incident or injury. This initiative was developed to not only change workers' mindsets towards safety but also that of their management. BLL believed that implementing IIF is a choice and a basic human right and therefore the IIF was the heart of the BLL's long term approach to managing safety. BLL recognised that the goals of IIF are achievable and this commitment requires making a personal commitment, great courage, and trust and commitment, both personal and organisational.

The IIF initiatives also provide a platform for workers to approach management if something is wrong without been blamed therefore. The IIF has a positive impact in terms of increased safety awareness among construction workers, and also provides opportunities for continuous improvement. This philosophy reaches every part of its operations and extends to clients, suppliers, subcontractors and other stakeholders (Lend Lease, 2006). The success map for IIF is depicted in Figure 1.

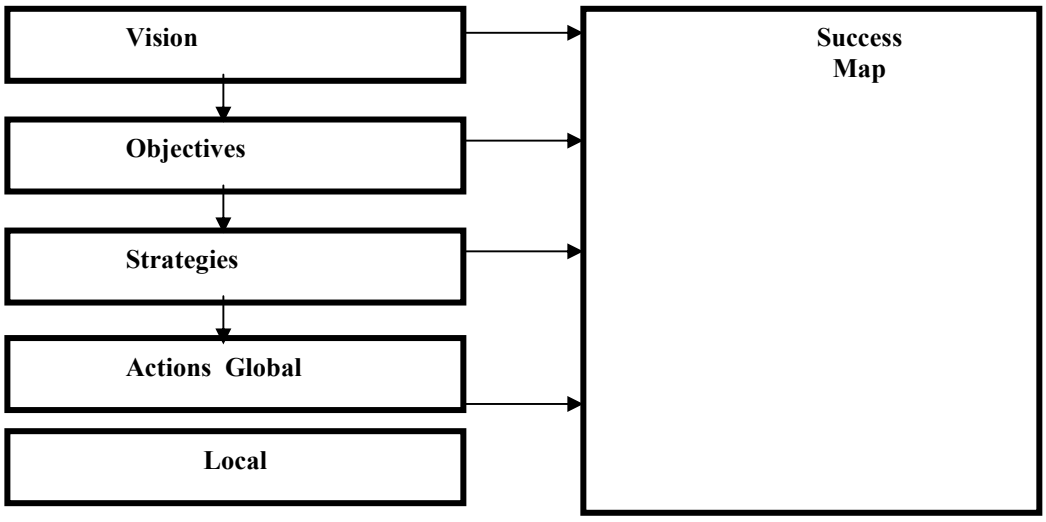

Figure 1: IIF Success Map (Lend Lease, 2002 and 2006)

5.3 The IIF Implementation Objectives and Strategies

The IIF implementation plan is defined by three objectives -- *Owning, Enabling and Sustaining*, for which there are a series of sub-objectives. These objectives are supported by strategies as shown in
Figure 2. The strategies are to support the objectives and include leadership and commitment, structure of the organisation, communications, systems alignment, and skilling of workers.

a) Owning

BLL believed for this initiative to succeed, the commitment and involvement from all parties from all levels is important. It is essential to create an environment where the workers believe:

- All injuries are preventable;
- No injury is acceptable, and
- We will not rank schedule, cost or production ahead of an injury-free workplace.

The strategies to support *Owning* include the leadership supports and commitment of stakeholder to the IIF vision. The stakeholders need to be explained on the important of the vision and how the vision can help improve safety performance. The IIF also works as a driver of BLL's Business and Industry strategy and become a core value of the company.

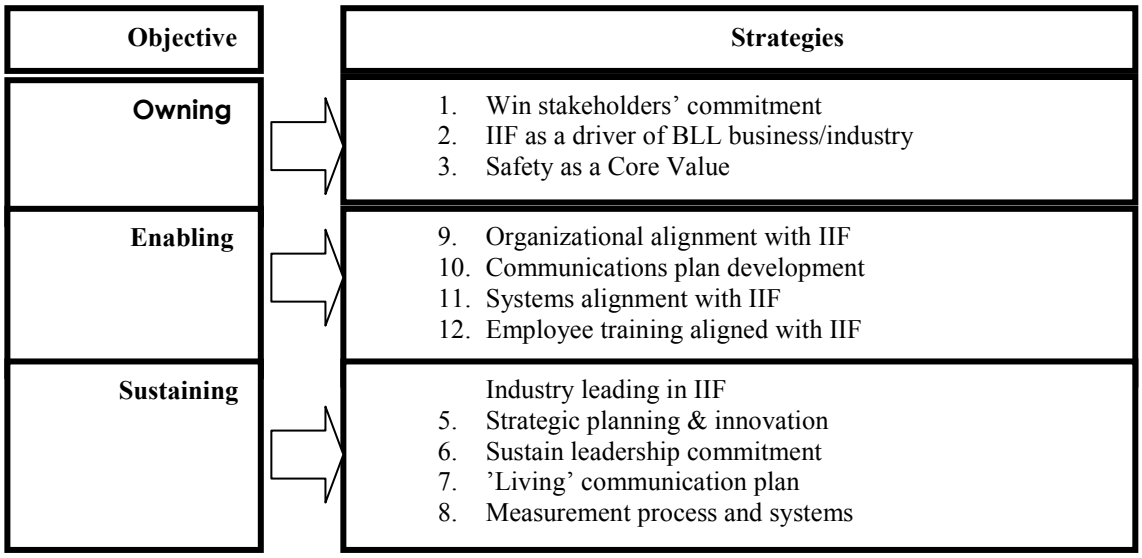

Figure 2: IIF Objectives and Strategies (Lend Lease, 2002 and 2006)

b) Enabling

BLL operates the IIF initiatives as a core action towards improving safety performance in construction projects. The strategies to support *Enabling* include the organizational alignment with IIF where all the policies, management structure and roles are restructure, redesign and clarify with IIF vision. Furthermore, the communication plan is developed and implemented to support the communication programme that will drive the culture and behaviours of the organisation and employees to the IIF Vision. All key business systems and processes are also aligning with the IIF Vision. Training sessions will be provided to workers to gain special skills and knowledge.

c) Sustaining

To sustain the IIF initiatives, BLL has tried to lead the industry by sharing the benefits of transformation with their external stakeholders. The company invests in research, innovation and benchmarking to redefine the vision. The organization also sustains leadership commitment by reviewing, recognising and rewarding behaviour of leaders for achieving the IIF Vision. The 'Living' communication plan was used to utilise feedback from all stakeholders to update message and align with the vision. Lastly, the IIF system was reviewed to facilitate the transformation towards the vision.

5.4 The IIF implementation process

The IIF implementation processes consist of four areas: management, schedule, business planning process and communications. What BLL have done is described as below:

a) Introduction of IIF to employees, owner and supply chain

In order to gain support, the IIF initiatives, have been introduced to the employees, owners and supply chain members. This is important to enable understanding of the IIF concept and how the IIF process improves safety performance.

b) Create a focus on the human side of safety

The IIF is an initiative to improve safety performance and to spread the concept of intolerance to incidences and injuries. The main focus is to concentrate on the human side of safety, shaping worker's beliefs and perceptions towards sound safety and their importance to make the vision a success. The initiative was not only focused on the organisation's safety system but more

importantly to make sure all workers, internal or external to the organisation understand the importance of having the right belief relative to safety, working in a safe environment and working together to achieve the vision and mission of an incident and injury free workplace.

c) Accountability and Authority

Transformation management can be divided into two key aspects which are the Accountability & Authority and Management & Reporting. Figure 3 presents the Lines of Accountability and Authority used in IIF implementation plan. The ultimate accountability for the success of IIF program lies with the ExCo, but will be managed and implemented by operations at the business unit and project level.

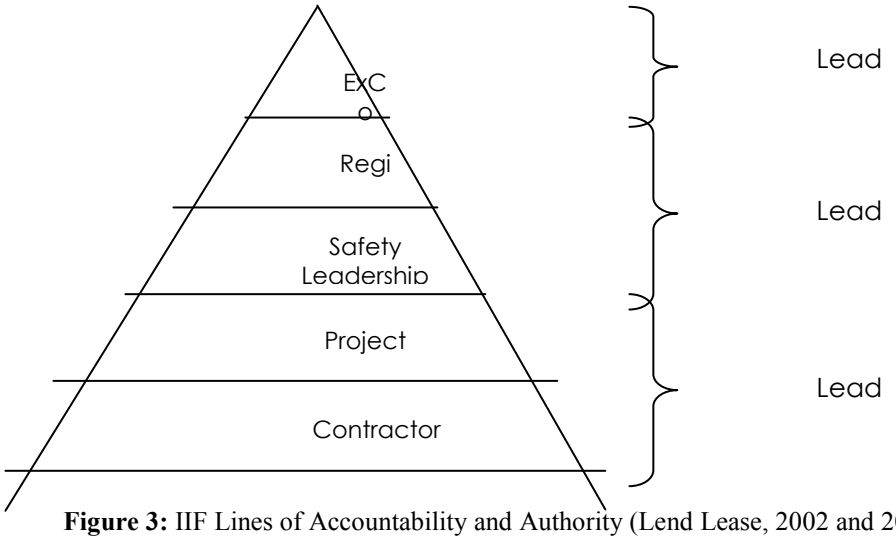

Figure 3: IIF Lines of Accountability and Authority (Lend Lease, 2002 and 2006)

d) Management and Reporting

A Management & Reporting system is an operation led program with operations taking the lead at all levels of the business. The Health & Safety (H&S) Director or ExCo lead on the implementation of this business plan and corresponding transformation. The high-level executives will assist the H&S Director at the Business Unit level. Together with the high-level executives are the H&S Executive Team that functions to report to both Business Unit CEO and H&S Director. In addition, each Business Unit will establish a Safety Leadership Team (SLT). The H&S Leadership Team are responsible to plan, marshall the necessary resources (both internal and external) and ongoing facilitating/coaching all the way down to the project level. Figure 4 shows the management and reporting system for IIF. To provide a smooth management and reporting system, the initiative required resources, including a platform for communication, human resources management to manage the workers, information technology to spread the information and store databases, and local health and safety officers.

e) Communications

The communication plan for the IIF concentrates on two keys areas - to win worker's hearts and minds, and the use of traditional methods of communications such as internet, intranet and newsletters to spread the safety issues and plan. BLL has developed global communication objectives (Lend Lease, 2002):

- To help create a significant shift in mindset and attitude towards the whole H&S issue;
- To do so by bringing fresh impetus and innovation to communication;
- To ensure that every communication opportunity is maximised, consistent with the H&S strategy with appropriate and relevant to the needs of the recipient or audience;

- Supports, guides and illuminates the debate, informs the progress of the journey and ensures that the transformation is enshrined and constantly enlivened.
- Positively manage the reputation as a world-class leader.
- Maintain the topic as a 'conscious consideration' through profiling people, progress, insights, and innovations.

The principles of the IIF communication program include:

- The communications program must be prepared as an integral part of the IIF business plan;
- It must appropriately lever and guide broader BLL communications;
- It must be relevant, engage and be interactive if possible;
- It must be consistent worldwide
- It must evidence leadership, innovation, buy-in and engender progress of the program, and
- It must be a vehicle to recognize teams and individuals who are engaged with the program and making significant changes.

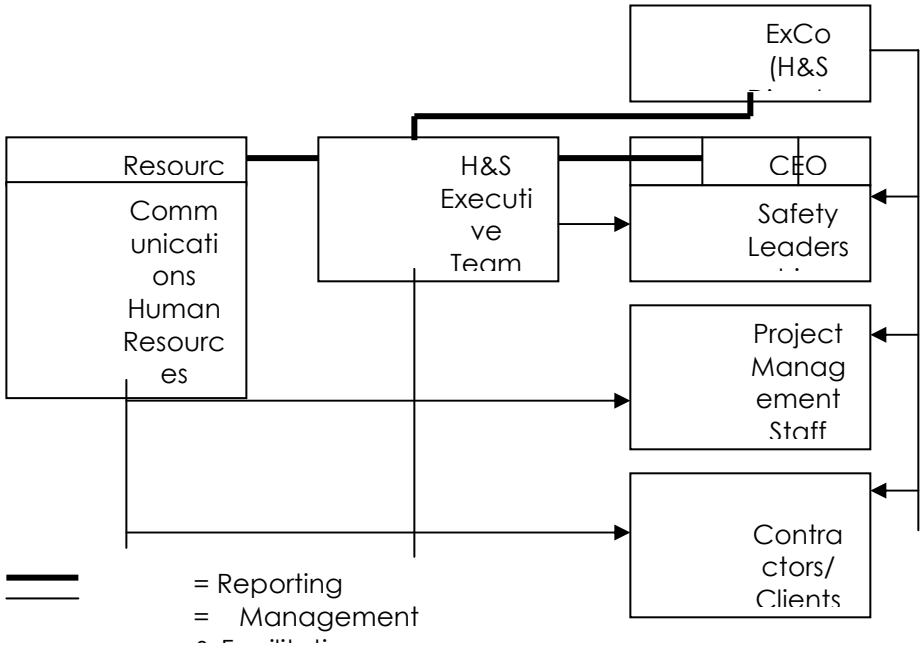

Figure 4: Management & Reporting Systems (Lend Lease, 2002 and 2006)

f) Orientation Program

BLL staff and employees have all completed on Orientation on IIF allowing each individual to explore, establish and nurture their relationship to daily and long-term issues, which help create a basis for success in achieving an incident and injury free culture. The target of the Orientation program is to address the human side of safety. It attempts to engage workers and managers on a personal level. This improvement process involves aligning their entire business around safe work. As part of the training process on safety, all Bovis Lend Lease employees worldwide need to attend either two day IIF leadership commitment workshops or 4 hour IIF orientation.

g) Regular Updates

Updates on the IIF programme are regularly communicated throughout the BLL Group. Improvements in health and safety demonstrate that extra planning and extra care makes a difference. Sharing information about the incident and injury free programme helps to embed a culture of safety at all levels of the organisation.

5.5 Lessons learned

The IIF has given positives impacts to company's safety performance and the followings are some of the lessons learned:

- **The importance of human side of safety --** The most importance lesson learnt from IIF is that the organisation believed on human side of safety as an important aspect towards safety improvement. The major focus on safety in a construction company cannot solely depend on improving the work system, development of new equipment, but shaping workers' beliefs and perceptions towards good safety - get the attitude right then the behaviour will be right.
- **Increased safety awareness among workers --** The IIF implementation plan provides an effective method to increase awareness regarding safety by the workers. The implementation plan addresses from the top management level to lower level of workers focusing on how to change workers' mindsets and beliefs towards safety. The safety orientation process and regular safety meetings enhance workers' beliefs and attitudes regarding the importance of safety.
- **Improved safety management process --** The IIF initiative provides a company an opportunity to improve their safety management systems. The company believes that by developing an effective safety management system the integration of both the human and management side of safety can help maintain good safety performance.
- **Creating a safe working environment and culture –** the workers from top level to lower level are exposed to complete safety systems that can help them to create a safe working environment. By providing appropriate training on safety, provides a good safety equipment and regular meeting and checking helped the company creates a safe working environment and culture.
- **Opportunity to workers to raise and discuss safety concerns and issues -** The IIF initiatives provide an opportunity to the workers to raise issues, concerns and ideas on how to perform safety effectively. It is also a platform to discuss improvements, and the IIF removes the barriers between management and workers.
- **Engagement with supply chain members -** The IIF initiative has engaged all supply chain members and BLL together to achieve the vision and mission of IIF. The IIF succeeds in creating an environment that results in all parties working together, sharing the same belief regarding sound safety and providing feedback on improving safety performance.
- **Establishment of a Safety Leadership Team -** the establishment of a safety leadership team had a significant impact on safety performance. The safety leadership team leads the organisation in terms of following the IIF's vision and mission, work together with the workers and disseminates information about safety within the entire organisation.

6. CASE STUDY II – BECHTEL CORPORATION 'ZERO ACCIDENT' PROGRAM

6.1 Company's Background in Relation to Safety Performance

Bechtel Group was founded in USA in 1898. The company concentrates into Engineering, Procurement and Construction (EPC) with more than 50,000 employees worldwide. The company's projects are located in more than 50 countries in the world. Currently, the company has more than 1,000 ES&H personnel worldwide and continuously improving their safety performance. Bechtel Corporation also play and important lead as a global leader in developing, managing, and constructing civil infrastructure. From airport, rail, and highway systems to regional development programs, from office buildings to theme parks and resorts, Bechtel builds the infrastructure necessary to improve quality of life and sustain economic growth. Year by year, the company has developed some of the best processes and technologies in the industry, saving customers millions of dollars and assuring quality results while meeting tight schedules on the most challenging projects. In addition, Bechtel Corporation is experienced in helping to form public-private partnerships that bring together the resources of government and the private sector for new projects. In term of safety, Bechtel Corporation holds the motto "*Zero accidents are our unwavering goal—people's lives depend on it."* to make sure that they are always on top in term of safety performance.

6.2 The "Zero Accident" Concepts

Safety is always Bechtel's top priority and it develops as a value that is fundamental to their culture. Bechtel has earned an industry-leading record of achieving zero lost-time incidents on 90 percent of their projects worldwide. Year after year, our zero accidents policy helps put their safety performance right at the top of the industry. Bechtel believe that every accident, and therefore every injury, is preventable, and they embed that philosophy into every Bechtel project through a combination of technical field procedures and ongoing training programs. Every employee has stop-work authority—if it's not safe, don't do it. They also ask their subcontractors and partners to adopt a commitment to safety and health. The result is exceptional safety performance, even in hazardous work environments, severe weather, and remote location. Their dedication to safety helps keep workers safe, and it also pays off for our customers. Their operating costs go down and productivity goes up because less time is lost to accidents. They also frequently pay less for insurance. Management leadership and commitment is crucial to improve safety performance in Bechtel. All parties need to work together to achieve "zero" and not just "lowest average" in the industry. They believe that any number greater than zero means that someone still got killed, someone still got injured and harm to environmental resources. Therefore, any number which is greater than 'zero' is unacceptable. Riley Bechtel, CEO of Bechtel Group once said, *"I sincerely believe all accidents and all injuries are preventable. Accidents don't just happen. They occur primarily because of someone's unsafe behaviour. Correcting that behaviour is the only way we'll get to Zero Accidents. Zero Accidents means exactly that-zero. When it comes to preventing accidents, nothing less that perfection will do."* This statement shows the commitment from top management of the company to support safety improvement.

6.3 The 'Zero Accidents' Implementation Strategies

An Integrated Safety Management System for Bechtel Corporation was developed with four objectives (Berg, 2006):

i) Identifies areas of strength within ES&H systems and processes.
ii) Identifies areas were improvements are necessary for continued growth of ES&H initiatives.
iii) Fosters ownership of ES&H process from all level of workers.
iv) Assures success in ES&H program implementation.

Bechtel ES&H Safety Management System consists of ten elements as Figure 5 below:

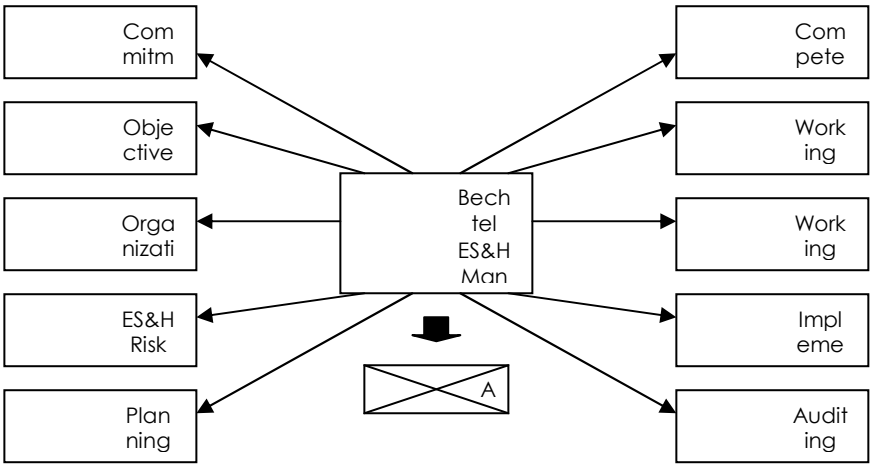

Figure 5: The 10 Elements of Bechtel ES&H Management System (Berg, 2006)

6.4 The IIF implementation process

a) Management commitment and support

Success to safety requires a strong support and commitment from the management in the company which covers all level of management. Leadership and commitment to ES&H must be visible, sincere, consistent, believeable, genuine and constant. In Bechtel, safety is a core value in all thet they do and cannot be compromised. Safety cannot be places behind cost, schedule or quality.

b) Standardised ES&H Procedures

The company had developed a standardised ES&H Procedures that need to be followed by all projects in all countries. This procedure established minimum acceptable ES&H requirements and based upon known Global Best Practices. The procedures are reviewed periodically (annually) and updated as required. It formally assessed to measure and ensures the compliance at any time. This procedure also allow for consideration of other specific requirements such as country-specific regulations and standards.

c) Employee-Owned ES&H Processes

Employees were important entities in this company. Safety improvement can only be made if all the strategies get the support from the employeee from the bottom workers to the top management. Regular ES&H inspection were conducted to all work areas, tools and equipment, condition, etc. Pre-work and post-work requirements on housekeeping need to be followed. Job Hazards Analysis and pre-tasks safety talks are conducted to recognize and eliminate or control hazardous conditions. On the other hands, observations of fellow workers at work were also conducted with an aims to identify and eliminate risk-behaviours.

d) ES&H Risk Management

Rish management activities in Bechtel are critical to minimize incidents and liabilities to the company. ES&H hazards are identified and all the risk associated with the hazards is managed properly. Risk Matrix approach were applied to assess project risks. Later, hazards and their mitigation are communicated and risk assessments were also updated frequently.

e) ES&H Planning

Proper planning for safety is essential for Bechtel. Plan to achieve ES&H excellence were developed and considered the external and internal ES&H requirements that were needed. ES&H procedures and work practices were developed and critical ES&H assets are identified and assured.

f) Competency and Behaviour Management

In order to maintain the competency and manage worker's behaviour at work, Bechtel developed the ES&H competency program and procedures including job-specific training and people-based safety process.

g) ES&H Monitoring, Auditing and Reviewing

In Bechtel, regular assessments of overall safety performance were conducted. ES&H performance were monitored and documented to assure the compliance with the standards set by the company. Auditing process were also conducted in order to maintain the safety requirements and to find ways for future improvements. All auditing results were reported to the management team and documented.

6.5 Lessons learned

Implementation of Zero Accident initiatives in Bechtel gave a significant impact on company's safety performance. Some of the lessons learnt are as follows:

- **Leadership and commitment** - The success of safety initiatives not only depends into top management and supervisor but also includes general workers, clients, contractors and others in the supply chain. Without strong support from all parties involved in the project, and effective leadership from the management team, the aims for Zero Accident cannot be achieved. A key element of success in safety is by obtaining agreement or 'buy-in' from every employee at every level of the company. In Bechtel, the synergy in construction safety focuses on the 'process' rather than 'results' (Berg, 2006). When the process is successfully implemented and managed, the desired results are more probable.
- **The importance of perception of workers about safety risks** – The perception of all workers regarding safety risks is important for them to understand and adopt the Zero Accident philosophy. Workers on the other hands need to have the right mindset and belief on the important of safety and the effect the safety risks can bring to them by not following the safety standards and procedures. Understanding factors that influence this perception is paramount to develop strategies for continuous improvements on safety.
- **Safety as a 'value'** – In Bechtel, safety is regarded as a core value in any process and work place. Every projects in all locations need to adopt safety as the core requirements before planning and performing the tasks. Bechtel also differentiate between 'priority' and 'value'. Priority can change from hour to hour, day to day depending upon other aspects such as Cost, Quality or Schedule but value does not change. It is a belief that is strongly embedded in worker's hearts and minds that cannot be compromised with any other aspect of business (Berg, 2006).
- **Realization of cultural differences drive worker's behaviour** – Cultural barriers in Bechtel involve language barriers, specific skills requirements, behavioral norms, social differences, economic differences, religious differences, political differences and education differences. The management team studied the impact of each of these barriers and provides strategies that will overcome these barriers. For example. to overcome language barriers, the company identify the language requirements prior to arrival of their multi-national workers and provided them with the translated version of work documents and procedures. In the same time, the company also provides training in language to ensure they understand and in the same time provided a multi-language safety signs or 'pictograms' on site (Berg, 2006).
- **Performance Based Leadership (PBL)** – Bechtel believes in the concepts of Performance Based Leadership. This is the process of improving business that started with understanding and application of behavioral science. The concept described that before attempting to change at-risk behaviors; they must first understand and analyze the reasons people behave in certain ways. Adjustments to improve human performance using behavioral modification techniques can only be achieved after understand these reasons. According to Berg (2006), leadership at every level involves creating business success by guiding and motivating others to *want* to do the right things and then to *do* those things the right way.
- **Documents lesson learnt** – Lesson learnt from previous drawbacks in the past projects are documented and reviewed for the next project. This is very important for the company to analyze previous mistakes to set new strategies for the next project. The lesson learnt might also influence future policy changes in the company. Review on the past mistakes gave the opportunity to workers to discuss possible problems, suggest possible solutions and prepare for the worst.

7. DISCUSSIONS

Safety initiatives put by construction organization were aim to improve safety performance. As a good safety performance meaning continuous business for the company, any attempt to improve safety became paramount. Nowadays, besides rigorous safety management policies and systems are developed, the human factor is vital to ensure a safe working environment and performance. All cases emphasized the importance of human factors, including their beliefs, values, attitudes and mind-sets about safety. In the same time, all cases highlighted the need for engagement of the

entire supply chain from client to sub-contractor and supplier towards safety. This is because each member in the chain is linked with the others and the strength of the chain is a strong as the weakest link in the chain (Zou, et al. 2007).

Case study on Bovis Lend Lease shows the important of the workers to have right belief and mindset regarding safety risks and incidences in order to maintain and improve safety performance. Besides improving safety management systems and procedures, BLL also looking into the human side of safety as another strategy to significantly improve safety performance.

Bechtel adopt safety as a value approach as their philosophy. Putting safety as a core value in all processes gave a significant impact into workers both in the process and psychology of workers. Company's past experience and mistakes lead the company to improve their safety performance. In order to deal with the psychological aspects of workers, the company regularly asks the workers what is important for them and how fulfilment of the workers' needs can help improving safety.

Ultimately, the success of any system depends as much on people changing their attitude and behaviour as it does on a well-designed system and one must remember that while it is easy to bring about behavioural change, it is extremely difficult to keep it changed. (Loosemore and Zou 2006). Furthermore, developing a safety construction culture is something which cannot occur overnight. It is a journey rather than a destination which takes time and commitment over an extended period (Loosemore and Zou 2006). To this end, it is essential that any organisation that has adopted a new approach to construction safety management continues to champion its new philosophy and monitor its performance on a continual basis, learning lessons, feeding them back into business processes and refining management practices. This must be supported by an effective training, motivation and performance appraisal system to reinforce appropriate behaviour (Loosemore and Zou 2006).

6) 8. conclusions

Safety is a fundamental psychological need of a human being and construction is no exception. Workers are the main assets of any construction company. As a labour intensive industry, the management needs to focus on maximising the productivity of workers without sacrificing their health and safety. Workers on the other hand need to have the right mindsets, beliefs and attitude towards safety and work together with the management team to perform work safely. A successful safety culture requires both effective management systems and appreciation of human factors within an organisation. A good construction safety culture relates to the humanitarian aspects of safety as an integral safety management system component and shaping safety culture requires a collaborative effort between management and workers.

This paper has argued the need for a culture change towards the development of a construction safety culture where the human side of safety is emphasised to help the industry and companies to continuously improve safety performance. The case studies were good examples on how construction companies can promote and develop an innovative and healthy safety culture within and external to the company. It is concluded that besides concentrating on the safety management system and new technologies, focus on the human side of safety is an important aspect and the vision of incident and injury free construction sites is achievable when the management and workers have the right beliefs, attitudes and adopt appropriate behaviour and the organisation has an integrated safety management systems that focus on not only policies, regulations, and site conditions, but also the human factors.

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