IMPROVING SAFETY PERFORMANCE: USING DEVIATION REPORTING AS A SOURCE FOR CONTINUOUS IMPROVEMENT

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ABSTRACT

This paper focuses on how deviation reporting can be used as a source for continuous improvement of safety performance in construction projects. Deviation reporting here includes the reporting of accidents, near-accidents, and unsafe conditions into a database which, in turn, serves to summarize, analyze, and apply data and information in order to prevent future events.

The paper builds further on a contribution made to the 21st IGLC annual conference in Brazil, in which a model was proposed to integrate safety analyses as part of performing production planning and control (Aslesen et al. 2013). Since then, a survey has been conducted including nearly 600 employees in one of the leading construction companies in Norway, to investigate attitudes and awareness about deviation reporting and the Last Planner System (LPS). Findings from the survey reveal a generally positive attitude towards deviation reporting besides a widespread use of Last Planner. However, one major shortcoming exists in the form of lack of training in the use of deviation reports. Besides, the awareness of continuous improvement seems to be insufficient – whether it being related to safety or production planning.

KEYWORDS

Deviation reporting, last planner system, continuous improvement, safety performance.

INTRODUCTION

This paper is based on the idea that to really learn from incidents, near-accidents, and injuries, the knowledge and insights collected in deviation reports should be directly incorporated into the planning of production. The International Labor Organization (Geneva, 2003) estimates that, in most countries, less than 20 percent of construction incidents are reported. This major underreporting of incidents is partly due to the complex, fragmented, and volatile aspect of construction projects. Another

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explanation has probably to do with the lack of a proper reporting system to register and process such incidents. It is particularly against this background that we assume a close link between the quality of a deviation reporting system and the propensity to use it. We further anticipate that a more frequent use will contribute in raising the quality of the system itself. As much as the usability of the system is important, its relevance and applicability to real world situations is even more crucial, so that deviation reports can work proactively to prevent accidents rather than to react to them. A Deviation Reporting System is thereby introduced in the paper, to be coupled with the Last Planner System, in order to make safe and sound decisions about production progress in a regular and resilient way.

The paper presents results from a survey concerned with attitudes and awareness about deviation reporting and Last Planner. It includes nearly 600 employees from a construction company, where the respondents are mainly project personnel. The company under study is one of the leading construction companies in Norway. It uses a deviation reporting system called SYLVE (Systematic Learning in Veidekke Entrepreneur), which is made for the registering and handling of all deviations. The survey is conducted as part of a research and development work, including a PhD thesis, where the main aim is to develop insights on operative and strategic safety management within the industry as well as to produce knowledge about the factors that generate safe performance at the sharp end.

Safety performance is a top concern in the Norwegian construction industry. Although the construction site is a dangerous workplace, people should not get injured on the job. This is first and foremost a matter of caring for the individual worker. Every employer is responsible to make sure that every part of the business is following all the rules and regulations, so that no offenses are being made. However, in the matter of safety in the construction industry, coping with rules and regulations is sometimes not enough to avoid accidents from happening. This is due to the complex and nonstandard nature of construction production where it is difficult to dictate standard procedures. For the very same reason, one may think that safety in the construction industry is predominantly a matter of the individual worker taking care of his/her own health. However, the starting point of this paper is exactly the opposite; hence safety is predominantly perceived as a social and collective effort. Instead of workers being controlled, they should come together on a regular basis to interact in the process of preventing accidents from happening.

In fact, an unsafe work environment will undermine the quality of work thus incurring additional time and subsequent costs to cater for such conditions. Reduction of occupational hazards is, as such, not only valuable for the sake of preventing individuals from being injured on the job, although this is the primary motivation. Securing a safer working environment is also a matter of reducing non-value adding incidents in the production system. Not only does the Last Planner help in detecting potential disruptions and variations in planned activities, it seems plausible that it can also help workers better detect where hazards might be released and minimize the effects, if loss of control is reversible. However, rather than focusing merely on the productive outcome of using the Last Planner, we are even more interested in its inherent qualities based on the fundamental notion that humans are superior with respect to flexibility, adaptability, learning, communication, and negotiation. Our main question is not whether safety can be incorporated into production planning, but

rather how to make people being continuously on their toes to improve safety performance while learning from past experience.

LITERATURE REVIEW

This paper focuses on the use of incident reporting and Last Planner to improve the safety system. Mitropoulos (2012) lays down a framework to integrate the safety system and production control system in a project. The safety outcomes of a project are then defined by these two organizational systems. As safety management dictates policies and practices that help reduce hazards on a project, the production control system establishes all the processes and decisions to ensure a safe work environment. Thus, enhancing safety is achieved through proper integration of safety management at the production level. Hinze (2002) discusses the importance of project planning and task planning for improving safety performance. Aslesen et al. (2013) explain how safety can be incorporated in production planning and control. A model integrating safety job analyses in the Last Planner System helps reduce hazardous situations by allowing the detection of these early on. Wehbe and Hamzeh (2013) also suggest the integration of Failure Mode and Effect Analysis at the look ahead planning level of LPS as a risk management practice that avoids the emergence of safety hazards.

In fact, safety management practices vary among different companies. Alarcon et al. (2011) identify seven safety practices that are statistically significant to reducing the accident rate in an organization. Among those are accident and incident reporting, management commitment, safety incentives, and others. The authors highlight the importance of choosing the right combination of prevention practices for better safety outcomes. In addition to this, a significant body of research has shown that management values, safety communication, safety training, and safety systems are all factors that are predictive of safety-related outcomes at works, such as accidents and injuries as well as safety compliance, motivation, and knowledge (Probst, 2004; Neal et al., 2000; Hoffmann and Stetzer, 1996; Dedobbeleer and Beland, 1991; Brown and Holmes, 1986). Hale (2003) describes both a formal and an informal aspect of safety management. The formal part is a structure rationally fulfilling a control function. To work effectively, it requires factors like commitment, involvement, care, trust, alertness, openness to learning and priority for safety; concepts cluster under the heading of the organizational culture influencing safety.

Kjellén (2000) claims that systematic feedback of experiences on accident risks is a cornerstone in any management system for the prevention of accidental losses. He states that the best HSE results can only be achieved when there are adequate production and maintenance planning and control system and an adequate HSE management system. He follows an underlying assumption that accidents are preventable through systematic experience feedback and introduces the concept of a HSE information system; a system that provides the information needed for decisions related to health, safety, and environment. Reporting accidents, near-misses and dangerous conditions are important means in experience-based safety management. These are unwanted events, but they do also represent a possibility to learn and thus avoid future accidents and improve safety performance (Kjellén, 2000).

Reason (1997) emphasizes the critical importance of an effective safety information system as a system that collects, analyses, and disseminates information

from incidents and near-misses as well as from regular proactive checks on the system's vital signs. Reason sees the safety information system as the principal basis of an *informed* culture, which he equates with the term of safety culture. He identifies four critical subcomponents to create this: a *reporting*, a *just*, a *flexible,* and a *learning culture*. Together they interact to create a safety culture as it applies to the limitation of organizational accidents. Though, a safety information system depends crucially on the willing participation of the workforce who is in direct contact with the hazard. To achieve this, it is necessary to engineer an organizational climate in which people are prepared to report their errors and near-misses, and a positive safety culture characterized by communication on mutual trust, by shared perceptions of the safety and by confidence in the efficacy of preventive measures. To ensure reliable reporting of incidents, Kjellén (2000) suggests the following: (1) criteria on what to report, (2) simple and well defined routines and responsibilities for reporting, (3) avoid focus on blame and guilt, (4) feedback after reporting and report treatment, and (5) avoid incentives that may counteract the reporting of accident. Probst and Estrada (2010) found that both positive safety climate and supervisor enforcement were significant moderators of the relationship between the reported and unreported accidents. Results from their research showed that underreporting was far more prevalent in organizations with low safety climate and low levels of supervisor enforcement compared to organizations with more positive organizational safety climate and higher supervisor enforcement of safety policies.

The essential of all these is how the organization learns from the reported deviations and incidents. Reason (op.cit) claims that the organization must possess both the willingness and competence to draw the right conclusions from the safety information system, as well as the will to implement reforms when it is needed.

This study investigates individual and organizational behaviors that promote safety at the workplace. Incident reporting and deviation control are believed to play a role in avoiding future accidents. It represents a way of monitoring potential hazardous situations as well as the safety progress. This is similar to LPS and monitoring the Percent Plan Complete where PPC records are reported to control the progress of works and adjust for deviations in schedule. However, deviation reporting extends the spectrum of control as it allows for avoiding future accidents in the long term, rather than simple after-the-fact measures. Finally, both records promote learning and continuous improvement within the organization. Hence, combining proper safety practices such as incident reporting and deviation control with the correct use of LPS will render the safety system more resilient and robust.

RESEARCH METHODOLOGY

In order to assess the use of deviation reporting and LPS in enhancing the safety management practices across the company, a survey was conducted and distributed to 630 individuals by an electronic questionnaire, in addition to 61 individuals by regular paper response. 591 respondents completed the survey questions, which involves a response rate of 86% in total. The respondents are all employees working in the management and planning of construction projects, except for the team bosses who work at the sharp end. The respondents have different job positions such as site manager, work manager, supervisors, team boss, HSE managers, and safety officers.

None of the operative workforce is participating in this survey, except for their immediate supervisors and team boss.

As previously mentioned, the company has its own reporting system called SYLVE used for registration and treatment of all deviations. The company defines deviation as a condition or an incident that does not meet the requirements or expectations, something that is not the way it should be or should not have happened. Deviation reporting is mostly done through the writing of "green notes". All employees should carry their own pad of "green notes" where they can write down all kind of deviations they observe during the workday. Deviations can be written and delivered anonymously, then registered in SYLVE by an executive officer. The officer encodes all the deviations by recording them in different categories according to type and subtype abnormalities, injuries, and severity. The officer can then close the case or carry out one or several measures. All employees are, at least theoretically, supposed to have access to the system and be able to take out the reports they need. However, this is not achievable as neither the workforce nor their team boss has access to a computer on site.

RESULTS

DEVIATION REPORTING IN VEIDEKKE

In terms of deviation reporting in Veidekke, overall routines seem to be in place. One introductory question in the survey addressed whether the respondents wrote green notes as part of reporting unwanted incidents in the project. Almost all did (98%). Furthermore, nine out of ten worked in projects where the SYLVE database was used to register and handle deviations concerning either safety, health or the working environment.

A major concern is linked to the lack of training in the use of SYLVE. In particular, since all employees in Veidekke have access to SYLVE, it should be the case that everybody can register deviations directly into the database and order reports from it. As Figure 2 shows the problem is specifically related to certain groups. Indeed, according to the guidance for using SYLVE, every project should assign a person or an officer with the responsibility for registering and updating the database. It seems reasonable that this person is rarely a team boss, since only very few have received any kind of training in the use of SYLVE. At the same time, lack of training is relatively widespread among all groups, including those expected to have a dedicated health and safety responsibility in the project. Furthermore, the problem with lack of training is likely intensified for some as one out of four of the respondents consider SYLVE as a low user-friendly system.
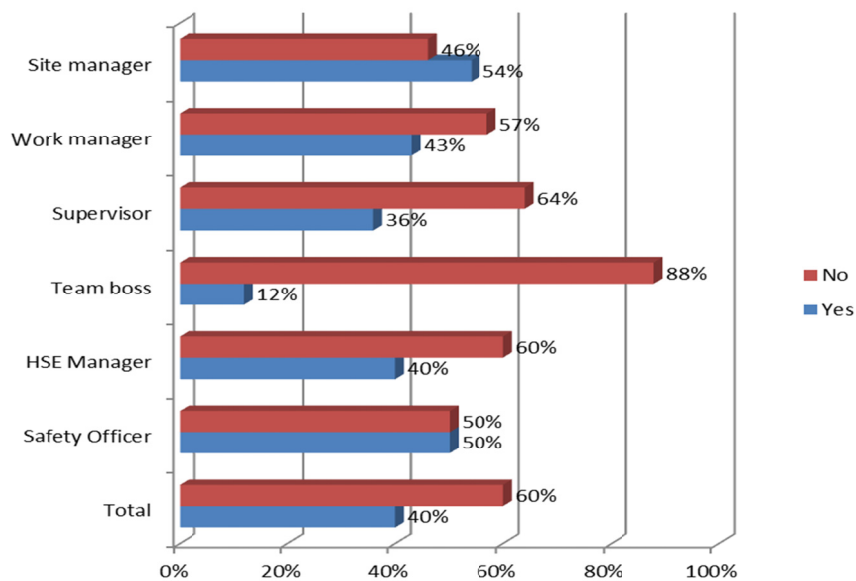
Figure 2: Have you received any kind of training in the use of SYLVE?

When it comes to who is responsible for the registering of green notes in SYLVE, the practice seems moreover to differ among construction and heavy construction projects. In heavy construction projects, the registering of green notes seems predominantly to be done by the HSE manager, whereas in construction projects the responsibility for registering is more evenly spread among several functions. Above all, this might indicate that in heavy construction the HSE responsibility is normally more centralized and associated to specific functions than in construction projects.

DEVIATION REPORTING – WHAT IS IT GOOD FOR?

The respondents were exposed to a number of statements regarding deviation reporting in order to get an overview of their attitudes towards it. From their replies, one may conclude that deviation reporting seems to be well incorporated into the organization especially when it is viewed as a source to continuous safety improvement. Figure 3 shows that nine out of ten find the reporting of incidents as important for preventing undesirable incidents, regardless of how serious they are. Furthermore, four out of five think that reporting deviation has helped improving safety on the project. It is alarming though that as much as 62 per cent work in projects where underreporting of incidents occur. On one hand, the nature and aspect of construction projects makes it hard, maybe even impossible, to maintain a full overview of all incidents at all times. On the other hand, lack of training in the use of SYLVE as well as low usability of the system may explain this underreporting. User instructions and comprehensive guidance are probably decisive to reduce the amount of unrecorded incidents in the future.
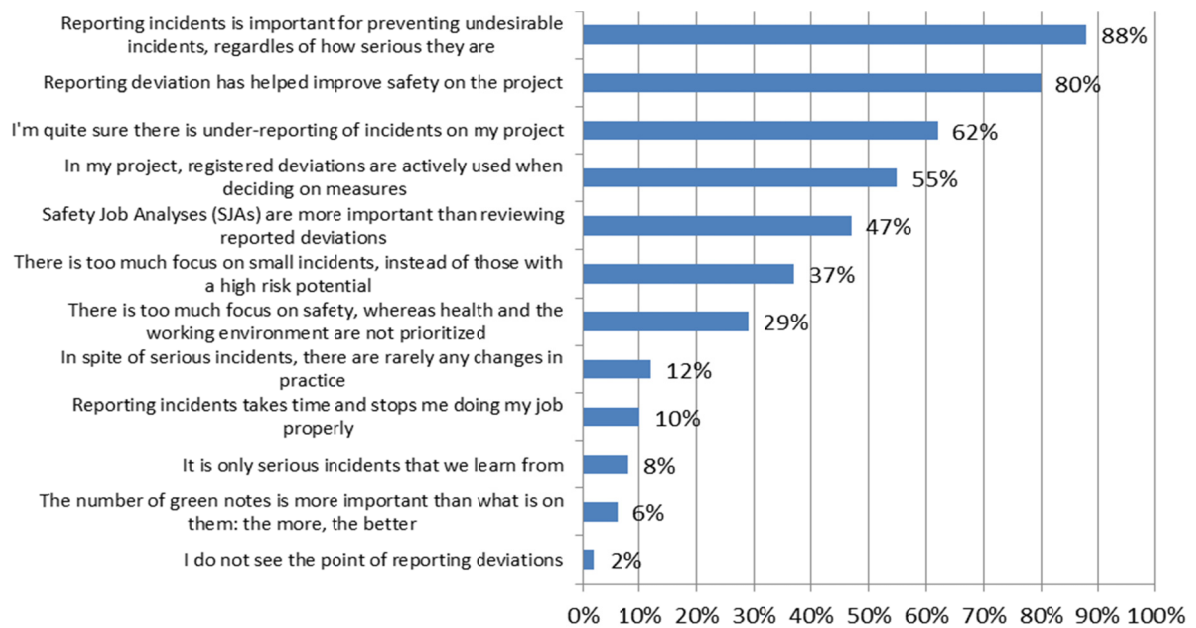
Figure 3: Statements about deviation reporting

In spite of obvious training needs in the work force, courses in the use of SYLVE are not considered a crucial measure to achieve the target of removing four out of five injuries within a time frame of five years (2010-2015). Instead, as Figure 4 indicates, a great majority emphasizes on the importance of looking more closely into the underlying causes of incidents and near-accidents. For relatively many, this seems to include focusing less on people and more on the reasons why things happen. Besides, many respondents prioritize efforts to improve feedback from reported deviations. Findings support that, in many cases, this will involve using deviation reports more actively in the daily work.
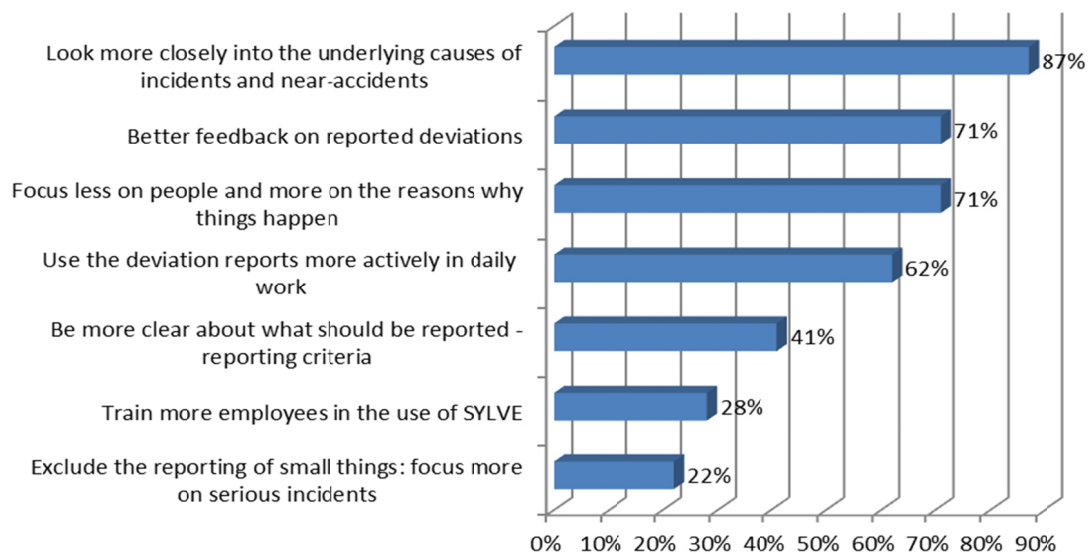

Figure 4: Respondents views to measures that can help Veidekke to reduce injuries by 80 per cent in the course of 2015

COLLABORATIVE PLANNING IN VEIDEKKE

The use of Last Planner System, or Collaborative planning, seems to be widespread in Veidekke. Four out of five respondents claim they work in projects using it. Nevertheless, when those involved in projects applying collaborative planning are addressed specifically, their answers reveal – as Figure 5 shows – that some of the system practices are more incorporated than others. Whereas it seems widely common to plan in collaboration and that everyone has the ability to influence their own work, only 60 per cent plan all operations based on the seven prerequisites (materials, information, preceding activities, crew, surroundings, equipment and external conditions) and only half remove obstacles systematically.
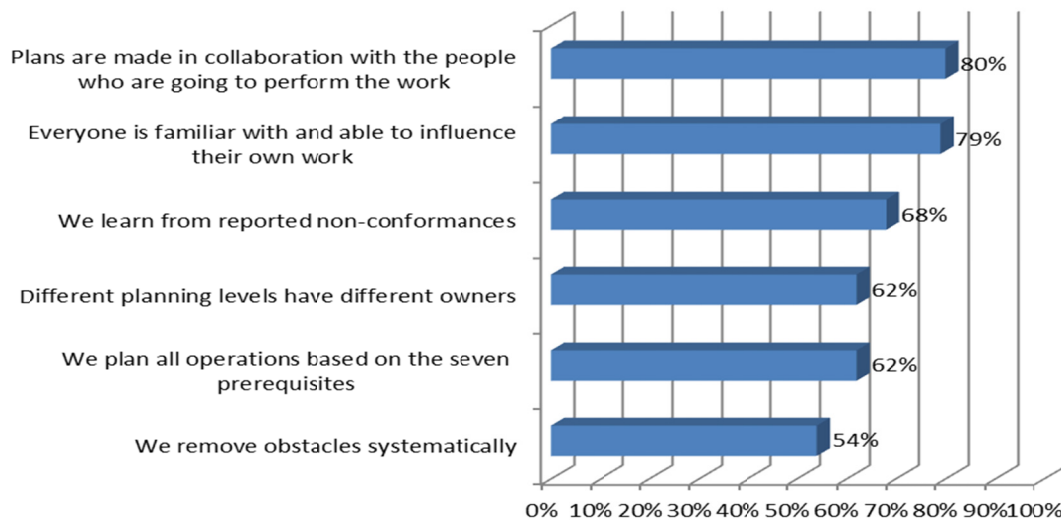

Figure 5: Respondents views on collaborative planning

On a major level, one may question whether it is right even to state that a system is applied when in fact only some of its practices are actually in use. For the company's concern, it is important to note that failure to use the system properly is directly related to the principles of handling deviations in a systematic manner.

DISCUSSION AND ANALYSIS

Generally, the results in terms of attitudes towards deviation reporting and the use of LPS seem to be positive in the company. One main concern is related to the lack of training in SYLVE; another concern has to do with how to use the system for Safety Job Analyses (SJA) and a third concern is due to some sort of resistance that seems to exist in the workforce towards systematic, continuous improvement. Our three concerns are interrelated.

Although many in the company have no training in the use of SYLVE, everybody uses it the way green notes are written and put into the system. This is exactly in line with one of the main purposes of the system, which is to make people more aware of hazards. At the same time, observing and reporting something is not necessarily the same as understanding what the hazard is all about. The point to be made here is that the quality of SYLVE is very much depending on the information put into it. While

the total number of reported deviations can work as an indication of the safety situation, the value of this information will significantly increase if it also includes some sort of categorization, and maybe even some explanation. When only 40% have been trained to use SYLVE, there is the risk that on many occasions green notes are written and put into the system including only limited information about the incident. Not necessarily because the one who writes the note has no opinion, but because he or she has little or no knowledge about how the system works. It may thus seem as a bit of a paradox that, when questioned about how to reach the target of reducing 4 out of 5 injuries, more training in the use of SYLVE is not amongst the prioritized measures. One reason might be that SYLVE as a system is linked to particular functions i.e. not all personnel are involved. Especially in heavy construction, the registering and handling of deviation reports is particularly done by the HSE manager whereas in construction, this seems to be more evenly spread among several functions.

As opposed to more training in the use of SYLVE, efforts addressing the need to investigate the underlying causes of incidents and near-accidents are highlighted by most as a very important measure to reach the 2015-target of removing four out of five injuries. If we associate the lack of training in SYLVE to the fact that many are likely short of competence in how to use the system, there are reasons to believe that in many instances, the analyses of underlying causes will suffer from being less systematic than they should. This is not to say that the analyses need to be simple as such. Rather, it may very well be that they are loaded with thick information. However, when all the collected information from SYLVE is left out of the equation, the loss of opportunity to compare from similar situations is drastically reduced.

To reach the 2015-target, most people list better feedback on reported deviations as well as using deviation reports more actively in the daily work among the highly prioritized measures. So why don't they do it? SYLVE has existed for several years already and all projects in the company are required to use it. Lack of training is likely to be part of the explanation, although this is not what respondents put on top of their wish list. Other findings in the survey indicate that improving the usability of the system might motivate a more active use. One last possible reason is related to the people's culture. All respondents come from an industry where people think in practical ways about what they do. Much knowledge is collected in people's minds, being tacit rather than written down or codified. Using SYLVE is about applying codified knowledge in order to understand more of a problem. For many construction workers, this is totally the opposite of what they are used to.

When it comes to LPS and collaborative planning, the results shown in Figure 5 indicate that the planning process involves teams who are doing the work and engages them in planning their own work and gives them enough power to impact the outcomes. Furthermore, the attitudes towards examining tasks for the availability of prerequisites before proceeding with the work and analyzing the reasons for planning failures after executing the work seem conducive to effective look ahead planning and receptive to the importance of deviation reporting in process improvement. However, a more comprehensive application of LPS needs to be implemented in the company.

On one hand, proper collaborative planning using the LPS is expected to contribute to better understanding of the work process and accordingly to better SJA. A more inclusive SJA is expected to result in a better planning for job hazards and ultimately in lower safety accidents. On the other hand, reporting deviations from the

plan in the LPS and from proper safety procedures in the form of green notes is the first step to future improvement. This should be followed by proper investigation such as the five whys in the LPS and incident/accident investigation for safety. Learning from failure is the basis for continuous improvement and this basis seems present in the survey results. In this sense, deviation reporting is crucial part of the check step in "plan, do, check, act" continuous improvement process.

However, proper and systematic failure analysis should be performed, reported, shared, and saved for a better future performance. Changing the culture has started and future improvements rely on the increased involvement and contribution of the workforce and management to meet the desired goal of 80% reduction in accidents by 2015.

CONCLUSIONS AND FUTURE WORK

Looking at the survey results, the attitudes towards deviation reporting are positive for most of the employees. The majority acknowledge the importance in both reporting and use of the deviation reports in decision making and preventing undesirable incidents.

The survey is just a screening on attitudes and knowledge towards the deviation reporting system and use of SYLVE, as well as use of the Last Planner. Several of the questions are quite general and not specific; further research is needed for a better explanation of results and for suggesting mitigation measures.

To reduce injuries by 80 percent in the course of 2015 there is a need to improve both on the methods and tools in use, as well as changing practice and culture through promoting a safety culture within the company in a social and collective effort (Aslesen et al., 2013).

There is a need for further research on how to improve systems for incident reporting and deviation control, not only on the administrative level, but rather on the construction site among the workforce that do the daily performance. The study will elaborate on what data need to be collected in an experience-based safety management system and how practical reporting can be made reliable. All the mentioned efforts will help enhancing the safety management system within the company, along with its integration in the production planning through proper safety routines and safe practices at the sharp end.

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