

LAST PLANNER™ AND ZERO ACCIDENTS PROGRAM INTEGRATION - WORKFORCE INVOLVEMENT PERSPECTIVE

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ABSTRACT

Construction is one of the most dangerous industries. In the European Union around 1300 workers are killed each year (EASHW, 2004). Additionally, the economic costs of all injuries, ill health and fatalities are vast. This questions the whole construction sector from both social and economical perspective of sustainable development.

Construction organisation Skanska Finland has applied zero accidents program since 2004. Implementation of Last Planner™ System to the organisation, as a part of the lean construction production management initiative, started in 2006.

There is a variety of lean construction (LC) learning approaches described (Hirota, E. H., Formoso, C. T., 1998). Also benefits in the use of Last Planner™ System on safety performance have been reported (Thomassen M. K. et al, 2002). The literature does not, however, report integrated implementation of LC and zero accidents program.

Decision on introducing shared actions to implement Last Planner™ system (LP) and zero accidents program were made. This was based on two hypotheses. H1: LP will offer a framework and structure to health and safety (H&S) management and zero accidents program will offer stepping stones to educate and train lean thinking. H2: LP and zero accidents program implementation require workforce engagement. Better workforce involvement will increase weekly work plan reliability, thus increasing productivity.

Both qualitative and quantitative research methods were used during 2007-2010. Meetings, discussions and personnel surveys were used to collect data from personnel.

Study shows shared value-base between the two initiatives, e.g. valuing, respecting people, zero waste and prevention policy. Integrated use of tools such as go-see, visualisation, constraints removal and workforce engagement is not only beneficial but often necessary to achieve improvement, e.g. to create mutual trust to the change process. Workforce involvement also seems to increase weekly work plan reliability.

KEY WORDS

Involvement, Safety, Accident, Lean, Construction, Last Planner™, Workforce

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INTRODUCTION

Construction is one of the biggest industries in the world. In Europe it provides jobs for nearly 13 million people, which is nearly 8 % of the working population (EFILWC, 2002).

Construction is also one of the most dangerous industries. In Europe more construction workers are killed, injured or suffer ill health than in any other industry. Every year more than a thousand workers are killed and over 800 000 workers are injured (Eurostat, 2004). In addition, workers suffer from occupationally acquired diseases, among others musculoskeletal disorders, noise induced hearing loss and skin diseases. The economic costs of all injuries, ill health and fatalities are vast. They may account for up to 8.5 % of a construction project's costs (HSE, 1993).

Use of lean construction and Last Planner™ tools presumably reduce waste and incident rates in the construction process (Thomassen M. K. et al, 2002). This is no surprise because errors in the design, communication and risk management constitute root causes that generate breakdowns in the process, e.g. interruption in work flow, material losses or incidents.

On the other hand implementing lean production system is challenging. Most observations on the failures concern poor management of the social part (Liker, J. 2004). The tools, that represent the technical piece, are easier to be put into practise, but they form only “25%” of the package (Hafey, B. 2010). Last Planner™ system has been introduced to help adaptation in the construction industry (Ballard, G. 2000). Variety of lean construction (LC) learning approaches have been reported (Hirota, E. H., Formoso, C. T., 1998). The literature does not report integrated implementation of LC and zero accidents program.

This study elaborates the possibilities of Last Planner™ (LP) and zero accidents program integration from workforce involvement perspective. Workforce involvement is essential to tackle the social challenge in the change. Positive is, that construction sector is populated by workers with a high need for independence (Coffey, M. 2000). Workforce possesses needs to participate in making decisions in their jobs. At the same time, construction workforce generally suffers poor H&S performance. This creates an interesting driver for change – both from economical and workforce point of view.

Integration of LP and zero accidents program implementation may turn to be beneficial for the implementation of both initiatives. Both of them, in order to be successful, require intense workforce involvement.

Construction organisation Skanska Finland has carried out zero accidents program since 2004. Implementation of LP System, as a part of the lean construction production management initiative, started in 2006.

Decision on introducing shared actions to implement LP system and zero accidents program were made. This was based on two hypotheses (H) which are now elaborated. H1: LP will offer a framework and structure to health and safety (H&S) management and zero accidents program will offer stepping stones to educate and train lean thinking. H2: LP and zero accidents program implementation require workforce engagement. Better workforce involvement will increase weekly work plan reliability, thus increasing productivity.

DATA AND METHODS

RESEARCH AT COMPANY AND PILOT SITE LEVEL

Action research method was used during the three years period. Research follows three construction sites that apply LP system. Several meetings and discussion sessions were organised with personnel. Methods to involve workforce in the usage of LP tools for accident prevention were identified and tested. These included reverse phase scheduling sessions, tool box talks, safe job analyses and incident investigation. Lean construction and LP Systems were also compared with organisation's zero accidents program. The overlaps and implications in workforce involvement were identified. Results are presented in tables 2 to 7.

In addition, personnel surveys were used to collect data.

PERSONNEL SURVEY

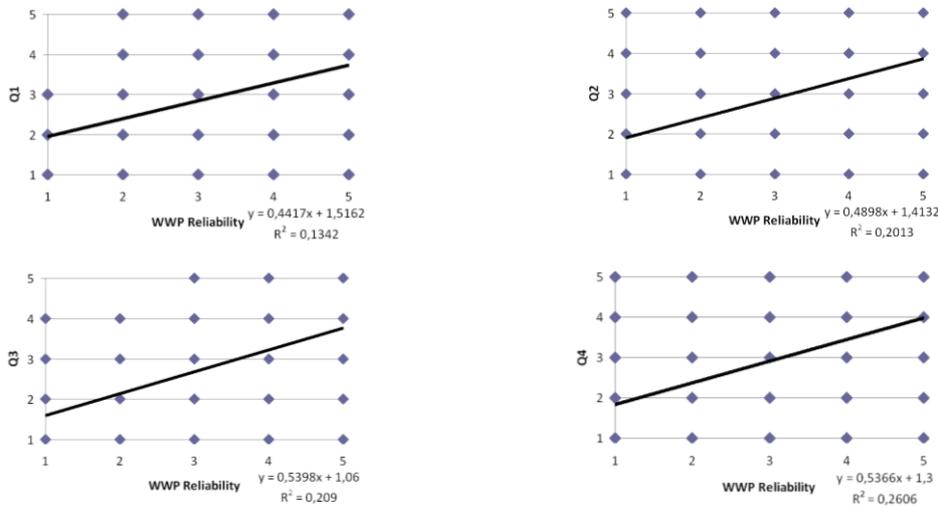
Organisation conducts yearly personnel surveys. The aim is to chart the employer image, organisation's functionality, work atmosphere, superior work and respondent's own tasks. Over the years the response rate has been approximately 70 %. For the study purposes some new questions were introduced (Q3 and Q4). Extract from the surveys results are collected in table 1.

Table 1. Results of the BU Skanska Finland personnel survey from 2005-2009

	Questions on the yearly personnel survey Scale: 1= I disagree ... 5=I agree	2008 N=2382	2009 N=1952	2010 N=2268
Q1.	Co-operation at the site and in my work group works well.	4,02	4,00	3,93
Q2.	Whenever there is a hazard observed there is intervention and safety observation is collected.	3,78	3,83	3,86
Q3.	My supervisor understands the importance of health and safety and it is visible in his actions.	4,14	4,13	4,07
Q4.	My supervisor makes continuously good use of my expertise in pre-task planning	N/A	3,70	3,67
QWWP Reliab.	Weekly work plans are so reliable that I can carry out my job without disturbances	N/A	3,29	3,24

Correlation analysis is calculated against questions 1-4 (Q1, Q2, Q3, Q4) and question on the weekly work plan reliability (QWWP Reliability). To do that, answers are grouped accordingly as to the scale from 1 (= I disagree) to 5 (= I agree).

Figure 1: Linear correlations between the respondents' answers to the Questions 1, 2, 3, 4 and Question on the Weekly Work Plan reliability, 2009



Linear correlation analysis shows significant correlation between the individuals' answers to the Questions 1, 2, 3, 4 and Question on the Weekly Work Plan reliability. Strongest correlation is with the answers between Q4 ("My supervisor makes continuously good use of my expertise in pre-task planning" and QWWP ("Weekly plans are so reliable that I can carry out my job without disturbances"). The coefficient correlation is 0.5105 and significant p value is <0.0001. P value is less than 0.05 which reveals significant correlation. This can be seen also from figure 1 scatter plots.

RESULTS

Research findings from the meetings, discussions and testing are grouped into six categories. They are values (table 2), leadership role (3), planning (4), doing (5), checking (6) and acting (7). Categories cover areas in which integration and implications in workforce involvement were most obvious. Plan, do, check and act also follows four-step problem solving loop on which continuous improvement is based (Kjellén, U. 2000).

Table 2: Values; LP, zero accidents program integration and workforce involvement

Values in lean & Last Planner™	Zero Accidents Program Integration	Implications in Workforce Involvement
Value and respect people	Confirm by Safety Policy Statement employees that the company will respect and care for their safety at all times.	Communicate Lean policy, including zero accidents, and following actions to workforce.
Develop mutual trust through stakeholder collaboration	Engage with stakeholders through an open dialog about the safety impacts of the activities to continuously improve safety performance.	Involve workforce, safety representatives and trade unions in the dialog.

Commitment and reliability. Share values and processes between all project stakeholders	Manage the whole supply chain also from H&S point of view.	Sub-contractor safety performance is key performance indicator for general supply chain compliance.
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Table 3: Leadership Role; LP, zero accidents program integration and workforce involvement

Leadership Role in lean & Last Planner™	Zero Accidents Program Integration	Implications in Workforce Involvement
Customer Focus: Add value to customer by reducing waste. Use logic and fact-based decision making to manage uncertainty, thus increasing production reliability.	Consider unwanted situations such incidents as waste. Manage H&S risks, similarly as other process risks that may interrupt work flow, to implement preventative measures.	Involve workforce in continuous process development.
Set zero waste policy and action plans, e.g. 5S.	Set zero accidents policy and H&S action plans. Keep constant attention to order and tidiness.	Involve workforce to the process.
Create corporate culture in which the social and technical pieces of Last Planner™ may be applied. Encourage proactive zero waste thinking across the organisation and supply chain.	Promote proactive and preventative behaviour to reduce risks. Integrate zero accidents program into lean thinking, communication and implementation.	Start educating lean thinking to workforce by examples that are concrete, close and which make task easier, safer and more productive.
Be an agent for change. Build alliances with all stakeholders in the production process.	Disseminate zero accidents thinking to improve safety in the whole supply chain. Share good practice.	Highlight and give opportunity to individuals to demonstrate the gains that zero accidents and waste policy offers. Strengthen internal message through public communication.
Demonstrate visible leadership by applying the go-see –principle.	Integrate H&S into site visits and reviews.	Invite worker's safety representative to join the site tour and feedback discussions.
Manage Competencies. Focus on competencies that are critical in the process to achieve the production targets.	Include safety competencies in the job descriptions, training matrix and evaluation of the whole staff. Train H&S and Last Planner combined.	Use bottom-up approach in selecting the critical H&S competencies. Use peer-to-peer approach in H&S training.
Award good practice and the best performers.	Integrate or give equal emphasis in the award/bonus schemes to H&S performance.	Always include workers or their representatives in the award schemes.
Set standard leader roles and	Include H&S in the standard.	Include workforce

tasks	consultation in the standard.
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Table 4: Planning; LP, zero accidents program integration and workforce involvement

<i>Planning</i> in lean & Last Planner™	Zero Accidents Program Integration	Implications in Workforce Involvement
Right action at right time. System must tell us what we should do and what we can do, so that we can decide what we will do, then compare with what we did to improve our planning. Use Master schedule, look-ahead plans, weekly work plans.	Create planning system that enables identifying boundaries and limitations that H&S risks set. Incorporate hazard identification and risk management to reduce H&S risks that may interrupt work flow.	Involve workers representative in phase scheduling sessions. Plan and approve look-ahead and weekly work plan with the workgroup.
First Run Studies. Planning by a cross functional team to do the first operation, followed by methodical study, redesign of the operation, and retrial until a standard is established.	Use First Run Study to identify and mitigate H&S risks.	Involve in the study individuals who are lean thinkers and competent in H&S risk management.
“Kaizen Blitz” for rapid improvement.	Use “Safe Job Analysis (SJA)” as Kaizen Blitz tool to improve H&S.	SJA, by its nature, is a vehicle to engage workforce in safety improvement.
Remove constraints that stand in the way of a task being executable or sound.	Include H&S always in the constraints removal process. Do not start a task that has H&S constraints.	Use workforce both in identification and finding ways to remove H&S constraints.
Standardisation. Continuous improvement activities can only be measured against standards that set the baseline.	Incorporate H&S standards into the baseline, such as personal protective equipment, work methods, etc.	Workforce piloting and opinions are essential in finding sustainable standards. Preferably they need to ease the job and make it safer at the same time.

Table 5: Doing; LP, zero accidents program integration and workforce involvement

<i>Doing</i> in lean & Last Planner™	Zero Accidents Program Integration	Implications in Workforce Involvement
Ensure through communication and visualisation that expectations are understood by the involved parties.	Incorporate into task orientation or induction H&S instructions. Use visual methods to communicate hazards at work and respective action.	Use skilled workers in the induction process and tool-box talks to convey the H&S message.
Pre-start meetings and daily Job briefings.	Integrate productivity and H&S in the task briefing. Use stretch’n’flex training to warm up muscles, sharpen H&S	Challenge workforce to contribute in the briefing. Use skilled workers in to conduct the stretch’n’flex

	focus and improve workplace culture in which safety is a shared value.	training.
Be aware of the system and workflow status.	Establish and encourage two-way communication on H&S performance. Create mechanism and culture for immediate response.	Involve and engage workforce in continuous H&S performance monitoring.

Table 6: Checking; LP, zero accidents program integration and workforce involvement

Checking in lean & Last Planner™	Zero Accidents Program Integration	Implications in Workforce Involvement
Measure production performance. Learn from deviations through 5-Whys	Consider H&S breakdowns similarly as other breakdowns. Use 5-Whys in incident investigation	Involve workforce safety representative in the investigation.
Audits and compliance reviews	Integrate H&S issues in the audit and review process.	Involve workforce safety representative in the auditing process, e.g. weekly safety inspection.

Table 7: Acting; LP, zero accidents program integration and workforce involvement

Acting in lean & Last Planner™	Zero Accidents Program Integration	Implications in Workforce Involvement
In case of monitored non-compliance or production breakdown use Practical Problem Solving (PPS). Analyse the problem, find root cause, plan and implement corrective, preventative measures and ensure follow-up.	Use PPS also for problems associated with poor H&S performance.	Always include in the PPS team workers' safety representative.
Learning Organisation. Study and communicate both good and bad experiences to improve total organisational performance.	From safety point of view learning is needed always in case of an accident or near-miss incident. Dependant on the scale of the problem learning cycle may be on 1) individual, 2) site, 3) regional, 4) company level. Use also for H&S success stories.	Modify the learning/message to be relevant to the audience. Include chapters that promote personal motivation and zero accident thinking.

DISCUSSION ON H1

Hypothesis 1 (H1) stated that LP system will offer a framework and structure to health and safety (H&S) management and zero accidents program will offer stepping stones to educate and train lean thinking.

According to the results from the study period 2007-2010 this proves to be true. Main findings include:

Values in the two approaches are shared. Lean direction and zero accidents goal may be communicated together. Accident reduction may be integrated and communicated as one of the goals that LP system strives to achieve. On the other hand, to create mutual trust open dialog with workforce is needed. Health and safety (H&S) improvement is a shared theme to start to involve and educate workforce into lean thinking.

Leaders in the organisation set action plans to improve production efficiency. Workplace order and tidiness improve both productivity and reduce incident rates. Consequently, application of 5S needs to get priority. Prevention, a shared principle, is a key for both more reliable production and incident reduction. Leaders must lead the change: visible leadership uses go-see –technique that involves workforce into discussions on H&S and productivity improvement. Zero accidents and lean principles are appropriate to be jointly communicated in the workforce training sessions. Good performance either on productivity-wise or H&S-wise is always evaluated and awarded jointly, not independently. LP system does not disconnect H&S from the production process.

Use of peer-to-peer H&S training has proved to be effective. Lean messages may be integrated into site induction, stretch'n'flex-sessions and tool box talks and may be conveyed by skilled workers.

Compliance checks that involve workforce have proved to be been beneficial. That serves not only as a learning opportunity for individuals, but also organisation is also offered with first-hand expertise on the task improvement (e.g. value added in practical problem solving sessions).

5-whys has proved to be successful investigation tool for near-miss incidents and accidents. It reveals both immediate and root causes, such as lack of competencies, preplanning and works co-ordination. Investigation is an educational process both to workforce and site management. Better understanding in the underlying reasons and factors justifies LP system application.

DISCUSSION ON H2

Hypothesis 2 (H2) stated that LP and zero accidents program implementation require workforce engagement. Better workforce involvement will increase weekly work plan reliability, thus increasing productivity.

According to the findings this appears to be true. Main findings include:

In order to ensure quality hazard identification and respective action at the right time workforce involvement is needed. For example weekly work plans and safe job analyses need workgroup review to increase trust and commitment. First run studies and standardisation cannot, obviously, be carried out without workforce involvement.

Workforce involvement seems to have a key role also in weekly work plan reliability. H&S hazards constitute a major risk area in construction. Control over the construction process increases through workforce involvement in pre-start meetings, pre-planning, daily job briefings and continuous performance monitoring.

In personnel surveys workforce describe their perceptions on several issues. Linear correlation analyses reveal correlations in the positioning of the answers. The strongest correlation is found between answers to “my supervisor makes continuously

good use of my expertise in pre-task planning” and “weekly plans are so reliable that I can carry out my job without disturbances”.

CONCLUSIONS

Employees in construction industry suffer from poor health and safety (H&S) performance. This creates also a vast economical problem. This questions the whole construction sector from both social and economical perspective of sustainable development.

Implementation of Last Planner™ (LP) and zero accidents program in the construction organisation Skanska Finland has resulted in better employee satisfaction and H&S performance (Leino, A., Elfving, J., Ballard, G., 2010). Lost time accident rate dropped over 80 % between 2004 and 2009.

This study shows that LP system has potential in offering framework and structure for H&S management. On the other hand, lean implementation often fails in managing the social side. Study shows that shared action plan with zero accidents program offers stepping stones to educate and train lean thinking to the organisation.

The common factor in the successful implementation is workforce involvement. Both initiatives require it. According to lean philosophy, all waste, including misuse of expertise in the organisation needs to be minimised. Worker has the first hand knowledge on the task risks and obstacles. Considering the experience that workers have dealing with the every-day construction work risks, they also have knowledge in hazard identification and respective preventative action. Eventually, systematic workforce involvement serves as an educational process; it creates mutual trust, understanding, commitment and response that will lead to fewer disturbances in the weekly work plans. Better reliability means less disturbances, less unexpected situations, less making do, less constraints for efficient work flow and less improvised working methods. At the same time H&S risks are reduced.

In the supply chain H&S performance is a key performance indicator for general supply chain compliance. If a subcontractor worker understands site safety rules and acts accordingly probability for general compliance in other areas is also high.

It is suggested that in the LP system implementation zero accidents program is tightly coupled into the implementation plan. It will require that leaders are educated to the subject, procedures that integrate workforce involvement are standardised. Workforce involvement will need to have a key role. Study shows that LP system offers a fertile platform for workforce involvement - from early involvement of safety representatives, to Safe Job Analyses (SJA) and daily job briefings. Through careful integration, H&S risks will be better managed resulting in fewer occupational accidents.

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