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Quality Quandaries*: Personal Injuries: A Case Study

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INTRODUCTION

In an economy that is driven more and more by services rather than industry (Snee and Hoerl 2005), employee safety is not often considered an issue. Where improvement projects in an organization often aim to reduce cost or increase revenue, projects considering employee safety are relatively rare.

Lean Six Sigma is a tried and tested improvement methodology focused on improving any kind of process in an organization. Lean Six Sigma projects in The Netherlands are being applied mostly in services and engineering, which are relatively employee-friendly environments in terms of physical demand. Employees in the construction sector, however, are involved in physically demanding work. This brings about new types of challenges for an organization, clearly brought to light by occurrences of work-related injuries or, even more tragic, deaths. In a world where Lean Six Sigma projects are dominated by increasing efficiency of personnel, increasing revenue, or reducing throughput times (De Koning et al. 2008; Niemeijer et al. 2011), safety-related problems invoke a new dimension to Lean Six Sigma projects.

Burgers Ergon is a subsidiary company of Heijmans N.V., one of the largest construction companies in The Netherlands, involved in the development of applicable installation techniques for construction and renovation as well as service and maintenance. Without the proper safety measures, working circumstances on construction sites can be dangerous.

Comparison with a peer group revealed that Burgers Ergon performed slightly worse than its peers in terms of number of incidents at work leading to personal injury. In addition, a recent project for a Dutch oil firm demanding very high safety standards at the construction site highlighted the fact that a proactive attitude towards safety can have a big impact on the number of injuries. From an improvement project stance, safety is an important aspect as it not only relates to health and therefore availability of employees but also to more efficient production and less property damage.

Burgers Ergon decided to take safety seriously and start a Lean Six Sigma project to improve employee safety on construction sites. The Define–Measure–Analyze–Improve–Control (DMAIC) methodology (De Mast et al. 2011) was used as a framework while executing this improvement project.

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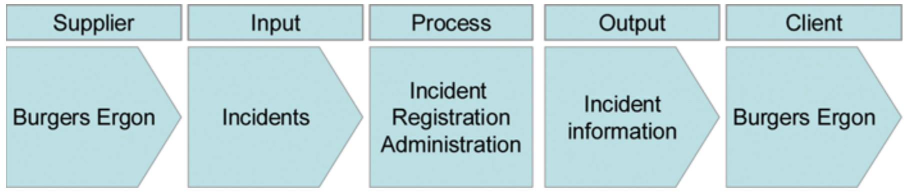

FIGURE 1 SIPOC. (Color figure available online.)

DEFINE PHASE

The project started with a clear definition of the process. Because safety is something that involves every employee involved in physical activities, the process best capturing this part of the organization was the incident registration administration. The first step was to capture this in the so-called SIPOC (Supplier–Input–Process–Output–Client; De Mast et al. 2011); see Figure 1.

The next step was to translate the purpose of the project to create ideal work and production circumstances into specific and quantifiable measures (called *critical-to-quality measures*, or CTQs, in the Lean Six Sigma terminology; De Mast et al. 2011). One of these measures was straightforward, namely, the number of work-related injuries. Because it was expected that incidents have their economic impact on the organization, a measure called *damage* was selected as the second CTQ. Damage included all forthcoming financial losses such as material damage, cost of replacing personnel, claims, etc.

Defining these two CTQs allowed the project team to objectively measure the current situation and work from there.

MEASURE PHASE

After defining the CTQs, the first step was to collect data in order to determine the current behavior and therefore to establish clarity regarding the size of the problem. Since the incident registration administration had been gathering information on incidents for years, data were readily available. Data were present in the form of incident reports, forms filled in after an incident indicating detailed information on location, date, time of the day, part of the body injured, material damage, etc. Documented incident reports went back as far as 10 years. Closer inspection by the project team indicated that the quality of the data on the first 3 years was unacceptable, leaving the project team with nearly 600 reported incidents over the last 7 years. Checks were made on the validity of these data—for example, by cross-checking with the database on sick leave—which deemed the quality of these 7 years sufficient.

In addition to the incident reports, data on claims by third parties were available. The fact that this information was thought of as being important enough to gather in previous years left the project team in the fortunate position of not having to gather data by hand. At the same time, one could wonder why this information was not used before in order to substantially reduce the impact of incidents. With this kind of data available, realizing a substantial improvement seems within reach.

ANALYZE PHASE

These data led to the establishment of the baseline of the situation at hand. The current number of work-related injuries was 12 per month. Figure 2 shows the development of the number of incidents over time, split up between two different activities within Burgers Ergon.

Damage in terms of sick leave accounted for about 50,000 euros per year in the form of hiring replacing personnel. Material damage caused by incidents on the work site was deemed negligible. Furthermore,

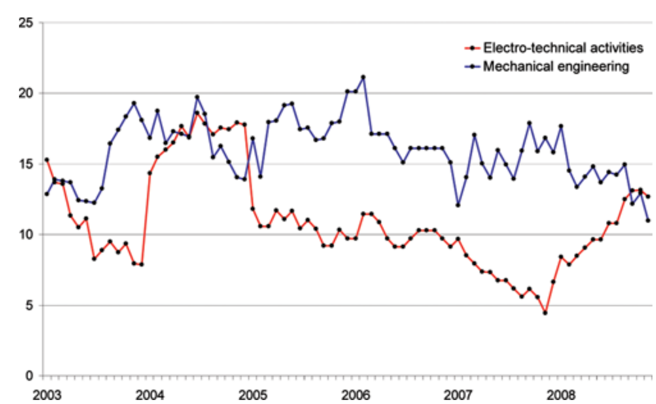

FIGURE 2 Number of incidents between 2003 and 2009. (Color figure available online.)

the few claims that had been made to compensate for financial damage did not lead to a higher insurance fee.

This information on the baseline led the project team to decide to focus the remainder of the project on the number of work-related injuries. There were several reasons for letting go of the CTQ damage. First of all, the financial impact was small, not justifying the necessary time investment. But most of all, the project team wanted to prevent giving the signal that the project started with the aim to improve safety was actually inspired by reducing cost. In addition, reducing the number of incidents seemed to have several positive side effects, in terms of employee availability, employee satisfaction, no delays on the construction site caused by incidents, etc.

Reducing the scope to only one of the original two CTQs allowed the project team to work with more focus. All efforts could be put into investigating what factors were causing the number of incidents. Mapping these so-called influence factors is the purpose of the remainder of the Analyze phase.

The incident reports contained detailed information on every incident and were therefore an important source of mapping possible influence factors. The project leader also facilitated a brainstorming session to generate more ideas. These brainstorming sessions led to the idea that employee behavior was an important cause of incidents, either in the form of ignorance of or reluctance to acknowledge safety issues.

Incidents were presumably caused by the improper use of tools. A last category of possible influence factors was related to poor working circumstances in the form of poor or missing safety measures or simply a mess on the work floor. A short list of the most important influence factors contained the following:

- Day of the week
- Time of the day
- Incident trigger (sharp object, tumbling, etc.)
- Function level
- Location
- Age
- Improper use of tools
- Poor working conditions
- Uninformed employees
- Inattentive employees

IMPROVE PHASE

Analysis of the relation between the possible influence factors and number of incidents led to the conclusion that there was no effect of day of the week. The incident trigger, location, time of the day, and age did have an effect on number of incidents.

The incident trigger and employee attitude were considered the most important influence factors. Investigation of the most frequently occurring triggers, defining preventive measures for these triggers and changing employee behavior to conform to these measures, were considered the keys to improvement. Incident reports contained detailed information on the triggers, which was used to construct Figure 3.

The frequency table shows clearly that the occurrence of incidents is dominated by injuries to hands, feet, and eyes. Eye- and foot-related injuries both have one single cause, whereas hand-related injuries apply to a different range of causes, though mostly sharp objects. Sixty percent of the incidents were related to hands, feet, or eyes.

Making this explicit gave a very specific focus toward improvements. The project team concluded that, in theory, the full 60% could be prevented if every employee on the construction site wore safety gloves and safety goggles and when the construction site was always tidy. It was decided not to have employees permanently wear safety equipment, because this might make people less cautious in unsafe situations. Adjusting the theoretical 60% reduction down to a more realistic situation led the project team conclude that 30% of the total number of incidents could be prevented.

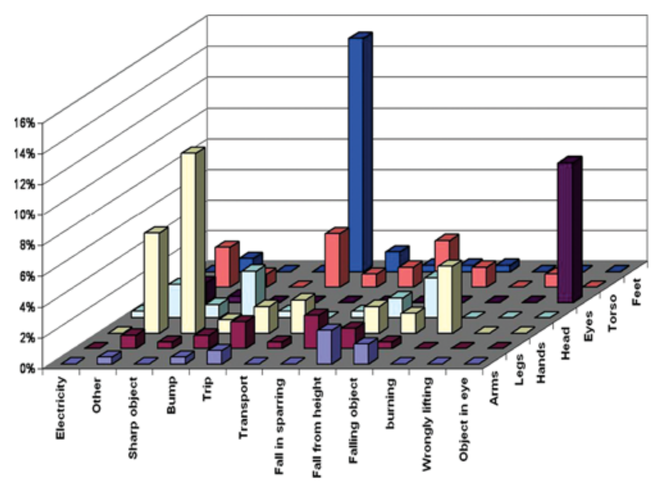

FIGURE 3 Frequency table of trigger versus injury. (Color figure available online.)

Some of the improvement measures were straightforward:

- Distribute safety gloves and promote their active use, with the aim of making employees conscious of the type of activities where incidents affecting hands occur most often and to prompt them to wear gloves during these activities.
- Distribute and promote the use of safety goggles, making the use of safety goggles obligatory when working on or above eye level. The aim, next to reducing the number of eye-related injuries, was to make employees aware of the growing number of eye injuries.
- Keep the work environment clean and tidy in order to compensate for the injuries caused by tripping over objects.

Other types of improvement measures related to reducing the impact of an incident rather than preventing it in the first place. These include mainly bureaucratic measures:

- Better use of procedures that are to be followed after an incident. This will lead to quicker follow-up and will reduce the time incident cases are pending.
- Creating a protocol leading to the direct use of injured employees in other parts of the organization where they can still function.

Other, more general, improvement measures are of a more informative nature:

- Inform employees about incidents.
- Inform supervisors of their duties and responsibilities on the construction site.
- Train supervisors on how to adequately address safety issues.

These measures aim to increase awareness and make safety more specific and workable.

CONTROL PHASE

Because the proposed improvement measures required a change in behavior, getting employees to conform with the new safety policy was the foremost challenge. The project leader was aware that it was of paramount importance to deal with the potential danger of nonconformity, which causes many Lean Six Sigma projects to fail in realizing the benefit potential. As a result, the project leader chose to take a creative stand on the subject and to introduce a system well known to most employees: yellow and red cards in response to improper behavior (see Figure 4).

This action was able to convert something intangible, such as behavior, into something very specific and tangible: a yellow card as a warning signal for unsafe behavior and a red card for suspension from the construction site.

In order to make this method work, the challenge was to make the process of assigning yellow and red cards as objective as possible. Strict guidelines were defined regarding when to use these cards:

Yellow card in case of the following:

- Unsafe activities; that is, deviating from instructions
- Not wearing prescribed personal protection equipment
- Not following up on warnings
- Smoking in areas where it is prohibited
- Untidiness resulting in increased risk of incidents

FIGURE 4 Red card for severe improper behavior. (Color figure available online.)

Red card in case of the following:

- Deliberate hazardous behavior, creating danger for others
- Working without fall protection where obligatory
- Repeatedly not following up on warnings
- Removal of safety measures without necessity
- Use or being under the influence of substances
- Theft or aggression

In addition, clearly stated consequences were related to both cards.

Yellow card:

- Correction on the spot
- Registration in the central database
- Team leader being informed

A yellow card expires after a period of 3 months if no new cards have been received.

Red card:

- Permanently removed from the construction site
- Team leader immediately informed
- Registration in the central database
- Depending on the situation: a possible fine, suspension, or ending of the contract

The cards registered in the central database are the subject of discussion at recurring meetings, ensuring that safety is actively monitored.

CONCLUSION

The proposed improvements were implemented in two pilot projects, and the results were promising. In the 6 months following implementation, the number of incidents was lower than ever. Currently, the new safety regulations are applied in every project. The average number of incidents dropped from 12 to 7.2 and the current target has been set at 6. Currently, actions are planned to implement the safety regulations in other subsidiary companies of Heijmans N.V. as well.

This project was very clearly defined from the start and, with data readily available, most steps in identifying the improvements were relatively straightforward. The challenge was in changing the behavior of the organization and its employees. The project team recognized the importance of this and took this seriously from the start. Focusing on implementation and coming up with a creative and recognizable system that was communicated to the entire organization aided successful implementation. Burgers Ergon has thereby managed to do what many organizations talk about but fail to implement—making safety an active point of action on the organization's agenda.

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