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**The six sigma approach in
performance management to
reduce injury rate at work**

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ABSTRACT: This case study uses the Six Sigma process framework in performance management to explore and improve the injury rate of an international waste disposal firm. The results indicate that an employee-management consensus approach to continuous improvement in safety management in the workplace is essential. The evidence from this case suggested that the DMAIC Six Sigma process and analysis tool such as the fishbone diagram can be easily adopted as measurements in the workplace. Furthermore the case shows that management commitment and employee ownership of the Six Sigma program is the key to continuous improvement, and the development of a safety culture and a learning organisation.

KEY WORDS: *Six sigma, performance management, safety culture, continuous improvement, DMAIC, injury rate*

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1. Occupational injury

Occupational injury is an important factor in the work place. Successive governments in Australia have encouraged companies to increase employee education as a means to reduce injury rates at work. Governments have established Work Safe in each State (NSW Workcover, Victoria Worksafe etc) to assist in this crucial area. The case for an improvement in safety performance can, in most organisations, be argued on financial, legal and moral grounds. Many studies, both here and overseas (Mayhew 1997, Monk 1994, Gallagher et al. 2001, Clarke 2006, Fuller 1999, Health and Safety Executives 1997, 2001) conclude that employee co-operation and management commitment are key factors for achieving effective safety practices. Reducing injury rates benefits many stakeholders; it causes less suffering to the individual and family and makes economic sense to the firm through productivity improvements and decreases in insurance premiums payout. However, rhetoric on safety in the workplace is insufficient to reduce injury rates. It must be accompanied by concrete actions and a systemic approach.

Safety performance depends not just on management policies and procedures but on the development of effective operational practices and employee commitment and ownership of these practices. These practices are appropriate to the working environment which are also perceived to be appropriate by the workforce implementing them. Furthermore, continuing high performance culture requires employers to audit and review their management systems and operational practices in order to identify current strengths and weaknesses. Hence, it takes an employee-management consensus approach to continuous improvement in safety management in the workplace. In recent years, both government regulators and management are keen to adopt a more structural and holistic approach in measuring the occupational health and safety performance of firms in various industries. The two common performance management approaches used are: the Balanced scorecard approach (Lin & Mills 2001, Gallagher et al 2001, Kaplan and Norton 1996) and the Six Sigma (HKSAR 2003, Arthur 2002). Although these two approaches have been adopted by many firms to evaluate performance, the use of the six sigma process to improve injury rates in organisations is still uncommon.

This study aims to introduce the Six Sigma approach to determine ways that employees and management can further promote a continuous improvement culture in injury rates in an Industrial Services Division of an international waste disposal firm in the state of NSW in Australia. The findings in this study can assist management and employees to implement the key processes based on the Six Sigma framework in measuring, evaluating and improving occupational and safety culture for the firm. Furthermore, the evidence in this study showed that both management and employee can use a systemic approach like the six sigma program to continuously improve the safety culture of the organisation. (Note: The name of the firm used in this study has been omitted for business sensitivity reasons.)

2. Background of Environmental Services Ltd

Environmental Services Ltd offers comprehensive urban waste management operations including: collection, recovery and treatment of solid, liquid and hazardous waste on behalf of local authorities, industry and consumers; along with commercial, urban and industrial cleaning. Environmental Services Ltd is a major player in the national industrial services market.

The activities of the Industrial Service Division include:

Industrial Services: Water Jetting, Concrete Cutting & Hydro demolition, Cold Cutting, Surface Preparation, Coatings Application, Scaffolding & Industrial Rope Access, Tank Degassing & Cleaning (Centrifuging), Manway Cannon, Plate Filter Press, Belt Press, Remediation, Vacuum Loading, Catalyst Handling, Refractory Installation, Insulation & Sheet metal, Asbestos Handling, Inert Entry & BA Capabilities.

3. Six sigma framework

Six sigma is a structured method for improving business processes. The structure consists of five areas: define, measure, analyse, improve, and control (DMAIC); it is supported by an assortment of statistical tools. A process that performs at the Six Sigma level produces only 3.4 defects out of every million opportunities to produce a defect. Processes that perform at lower levels (such as one sigma or four sigma) produce more defects per million opportunities. It is possible for a process to perform at an even higher level (and thus have even fewer defects), but Six Sigma has become popular as a standard of excellence for process performance. Six Sigma is used in an organisational mindset in which people make decisions based on data, look for root causes of problems, define defects based on customer rather than internal requirements, seek to control variation, and track leading indicators of problems to prevent them from happening (Gupta 2004). This paper focuses on enhancing the level of occupational safety among operators within the Industrial Services division by determining and controlling the key factors contributing to the number of injuries at work according to the Six Sigma (DMAIC) technique.

4. Overview of the six sigma program

Industrial servicing by Environmental Services Ltd incorporates many dangerous and potentially fatal job roles that take skilled team effort to ensure safe procedures are carried out. Environmental Services Ltd has experienced a number of varying injuries including not properly using personal protective equipment, using incorrect procedures and injuries caused by poor equipment. However, according to Environmental Services Ltd internal records, a high percentage of injuries occurring at Environmental Services Ltd are due to manual handling injuries. Two sections with a high number of injuries analysed for this report are the industrial services and the pipeline rehabilitation groups. According to internal company data, many of these are manual injuries that have occurred through operators not handling, lifting or manoeuvring equipment or objects in a technically proficient manner, named officially as ‘manual handling injuries’. This is not unique to Environmental Services Ltd. “Manual handling injuries” is one of the main challenges in Occupational and Safety practices (Worksafe 2006, Workcover 2005).

The focus of this paper is to apply the DMAIC method to highlight the root causes leading to, and suggestions to reduce, manual handling injuries occurring in these two sections. Furthermore, a DMAIC Six Sigma framework as described in table 1 is provided to adopt and improve the safety culture of the organisation.

Table 1: DMAIC

Define	The causes of risky behaviour that lead to injuries by interviewing a variety of members of the Industrial Services team and examine previous and current levels of injuries. This step can be seen as the stakeholder analysis.
Measure	Both frequencies and circumstances that cause this risky behaviour to occur and the number of incidents per year were collected. There are a number of tools that can be used in this stage. (e.g. improvement bar chart; sigma chart)
Analyse	Results of the interviews and survey to highlight the key causes of injuries and the level of safety culture within the organisation were produced. Furthermore, the safety culture and commitment of the firm in health and safety policies and the employees' mindset in safety practices are also determined. The common techniques in analysis are: cause-and-effect-diagram (Fishbone diagram); relations diagram; scatter diagram; Pareto chart; Hypothesis testing and Regression analysis.
Improvement	An achievable goal should be set and key performance indicators (KPIs) should be introduced to achieve these goals (e.g., an improvement check list can be presented). Industry norms, world's best practice and benchmarks should be used to establish the target goal for each year. For example, it is the intention of Environmental Services Ltd to achieve an injury reduction rate of 20% per year.
Control	Evaluation processes need to be established and key milestones are used to provide wins for achievements and reviews. For example, process documentation checklists; sample control charts; control chart selection trees and process dashboards). Based on the KPIs, feedback from employees and other stakeholders, and the Six Sigma principle, a clear reward system and communication plan is used to sustain the organisation learning process and a continuous improvement culture.

5. Project implementation

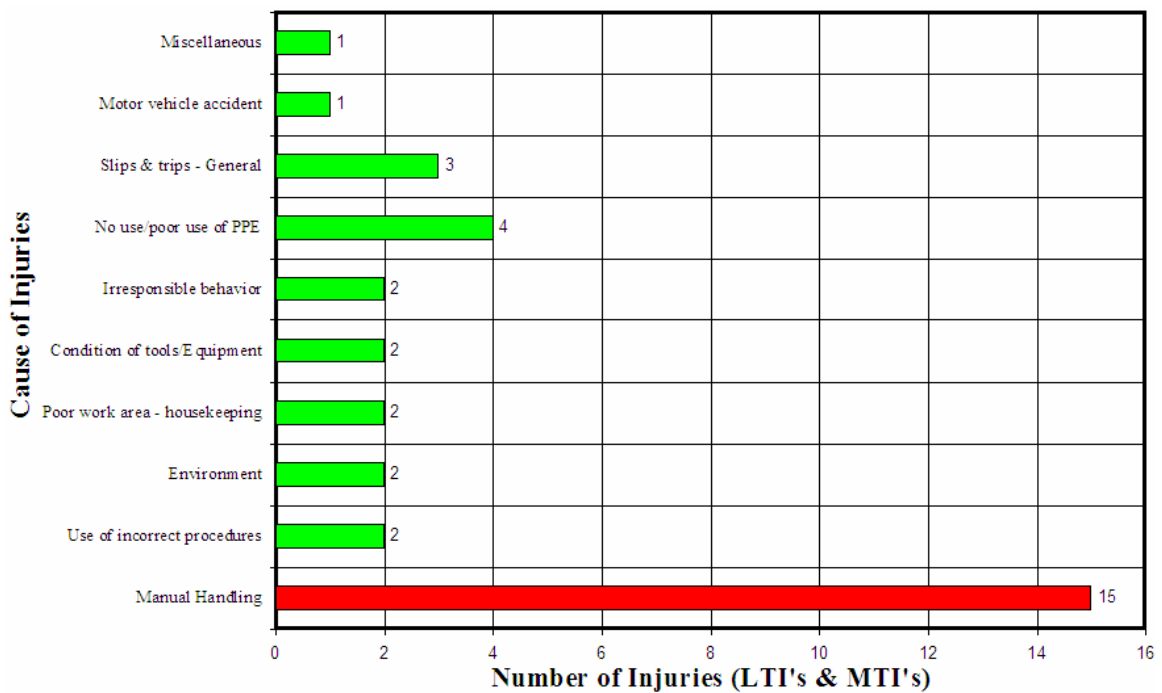
The various phases according to the Six Sigma (DMAIC) framework were adopted to study the historical data on injury rates in Environmental Services Ltd. The focus of this study was on "manual handling injuries", as they accounted for almost 50% of Lost Time Injury (LTI) and Medical Time Injury (MTI)(see definitions below) incidents. Two sites were selected by management to be included in this study. Site 1 and 2 had the highest number of incidents (7 out of 34 and 4 out of 34 respectively) in NSW in 2005. Initial interviews with randomly selected supervisors and operators from each site provided feedback about their perceptions on safety issues in the firm (a total of 2 supervisors and 4 operators from each site were interviewed. Based on previous company data, and the data from the interviews, a survey (based on key employee activities and the firm's existing policies such as training, supervision, fatigue and overtime, safety briefings and improvement suggestions) was used to reassess the employees' attitude towards injuries in the workplace. Both survey and interview data are complementary. The Six Sigma DMAIC technique was adopted for implementation.

Phase 1: Define

In this study, the two key components of “manual handling injuries”: Lost time injury (LTI) and medical time injury (MTI) are examined. A lost time injury is a work-related injury or illness which results in an employee (including casuals and contractors to Environmental Services Ltd/VES) being absent from work for a full scheduled day/shift, subsequent to the day/shift during which an injury or illness. A medical treatment injury occurs when treatment, other than first aid, is usually administered by, and can only be performed by, a physician, medical practitioner, or by a registered health professional under the standing orders of a physician and is diagnosed as work-related illness/disease.

Environmental Services Ltd’s data (2005) showed that manual handling has the highest incident rate (Figure 1).

Figure 1: Past Statistics on Injuries at Environmental Services Ltd (2005)



The breakdown of LTI and MTI also revealed an increase in incident rates in previous years. There was a substantial growth of injuries from 2003 to 2004 and a minimal decrease from 2004 to 2005 (Table 2).

Table 2: LTI & MTI Comparison (Injuries at site 1 & 2: 2003 – 2005)

Year	LTI's		MTI's		Total Claims	Total % Change
	Claims	% Change	Claims	% Change		
2003	3	NA	6	NA	9	
2004	7	133% Increase	16	167% Increase	23	156% Increase
2005	4	43% Decrease	7	56% Decrease	11	52% Decrease

This consistent rise shows room for considerable improvement. Other Basic Principles of Effective Workplace Safety Program (Du Point) were also obtained for comparison. (<http://dupont.com/safety/philosophy.html>, access on 12 Sep.2006).

Phase 2: Measure

Interviews were conducted with supervisors and operators. Interview questions were based on the 5 key categories of: Legal/Policies; Personal impression about safety; Environment and safety culture; Safety practices while at work; Structured items were prepared and open ended questions were used (appendix 2). The purpose of these interviews was to obtain an accurate idea of the different tasks and issues faced by operators daily in these two sites. The interviews were held with 4 supervisors and 8 operators (from 2 sites), with over 50 years of industry experience amongst them.

Survey items were derived from the interview data. The survey was constructed to complement and verify the interview data. The survey had 5 categories with 39 items (Appendix 2): Legal/Policies; Personal impression about safety; Environment and safety culture; Safety practices while at work; and possible outcomes. These 5 categories were derived from the analysis of the interview data and previous findings from the firm. A Likert scale ranging from strongly agree (7) to strongly disagree (1) was used. A pilot study of 15 was used to establish reliability of items. Reliability index (Cronbach Alpha) was obtained for each section: Legal/Policies (0.81); Personal impression about safety (0.62); Environment and safety culture (0.75); Safety practices (0.68); and possible outcomes (0.86). The overall reliability for the entire survey was 0.80.

Phase 3: Analyse

The interview data generally highlighted a number of communication and morale issues that had in their opinion led to injuries. These included 1) lack of manual handling techniques training from more experienced to less experienced operators; 2) not enough support for basic safety and health care issues (i.e. not enough first aid available or channels to discuss issues) and 3) non-supportive measures to encourage the reporting of near misses (i.e. leading to a 'catch 22' situation of not reporting issues that should have been originally reported in the Jobsite Analysis or not reporting them as near misses and breaking company policy. The interviewees revealed key weaknesses that were associated with work safety at Environmental Services Ltd (Appendix 1).

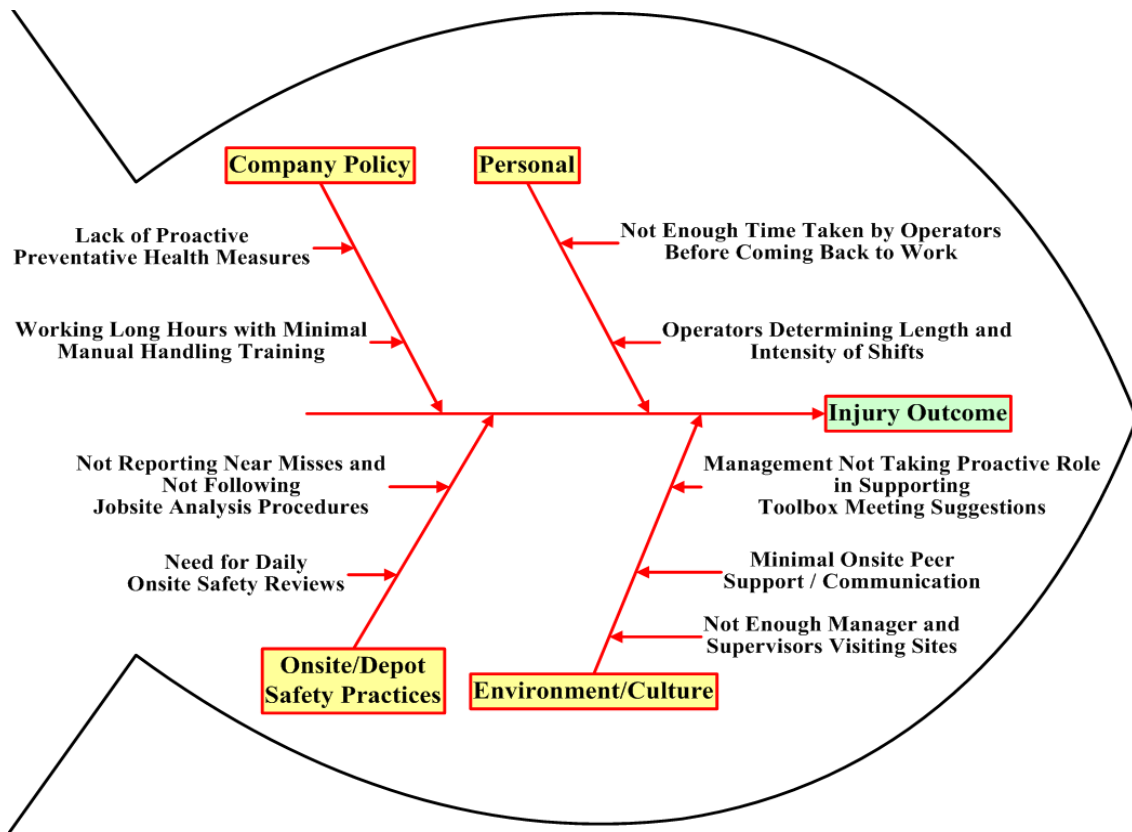
Further analysis of interview data indicated that there were four major challenges (Table 3).

Table 3: Major challenges

Company Policy / Legal	<ul style="list-style-type: none"> • There are minimal limitations on overtime – operators only need 10 hours in between shifts, which can be no longer than 14 hours at a time. • Management does not currently have a monetary or other incentive program to reward safe behaviour or reward operators for documenting their near misses.
Personal	<ul style="list-style-type: none"> • Operators believe toolbox meetings need to happen more often. • The injuries occur most often when crewmen work too hard or long and push their body beyond their physical limits.
Safety Practices	<ul style="list-style-type: none"> • Near misses - if reported could be used to potentially penalize someone for working in a risky setting (poor Jobsite Analysis (JSA) analysis) or working in a risky way. • Breaks during shifts are voluntary as duties change from day to day and impossible to regulate. • Operators say there is time to be safe, but do not receive the guidance needed from management to ensure a safe environment (i.e. not promoting a safe working culture or having enough supervisors on hand at the job site).
Environment/ Culture	<ul style="list-style-type: none"> • Outstanding Safety Committee issues causing poor attitudes amongst operators. There was no Depot based learning and reporting system in these two sites. Many other sites have implemented the terminal system and not having a terminal compounds the resentment because the operators have the desire to share information amongst units and review Standard Operating Procedures for all around safer practices. • Resentment between older and newer employees leading to not enough information being shared, which has led to newer employees going about things the hard way and typically hurting themselves.

Results from the interview were analysed using a fishbone diagram (Figure 2). The fishbone diagram expresses the factors that contributed to the injury outcomes. The clustering of various factors is based on the feedback from interviews.

Figure 2: Fishbone diagram



The Fishbone diagram conceptually demonstrates the 4 major categories and highlights the 9 key factors leading to injuries. Out of these 9 key factors, 5 factors are seen as critical factors.

1. Critical factor 1: Minimal Onsite Peer Support / Communication (Environment/Culture)
2. Critical factor 2: Not Reporting Near Misses & Not Following Jobsite Analysis (Onsite/Depot Safety Practices)
3. Critical factor 3: Minimal Manual Handling Training & Working Long Hours (Company Policy)
4. Critical factor 4: Not Enough Time Taken By Operators Before Coming Back To Work (Personal)
5. Critical factor 5: Management Not Taking Proactive Role In Supporting Toolbox Meeting Suggestions (Environment/Culture)

A survey was designed from the interview data. The aim of the survey was to complement findings from the interviews. The survey was distributed by 2 managers from site 1 and site 2 respectively. 17 surveys were sent out in site 1 and 16 were returned. One had to be discarded because it was incomplete. 15 usable returns were used for the analysis translating into a response rate of 94%. 17 surveys were sent out in site 2 and 5 valid responses were returned resulting in a response rate of 30%. A total of 20 surveys (app. 60% of total population) were used for the final quantitative analysis. With such a small return, this is one of the major limitations in using the survey findings to complement the interview data.

Despite the reliability index for each dimension being satisfactory, due to the small sample returned this study could not perform multiple regression (using factor scores) to predict the influence of the each of the dimensions on injury outcome. A frequency distribution and group mean was performed on each dimension. The group mean of Legal/Policies was 4 (the range was 1-7); Personal impression about safety was 4; Environment and safety culture was 4.1; Safety practices was 4.3; and possible outcomes was 4. However, the survey results did not provide any supporting evidence towards our qualitative data. This may due to the sample size of respondents. However, a summary of the ideas (Appendix 3) suggested by respondents in the survey to achieve a zero injury rate was valuable and formed part of the baseline for continuous improvement.

Phase 4: Improvement

According to the Six Sigma methodology, after the 5 critical factors and hazardous procedure are identified, solutions to reduce the risks brought by these factors were recommended to Environmental Services Ltd's management for implementation.

Solution 1

Promote teamwork & communication amongst operators.

Since there was a lack of communication among operators and between operators and supervisors, issues and ideas were not ventilated. Regular time should be structured in each site for handovers between operators and items on agenda should be documented for follow ups. A structured communication plan would enable better information flow between operators, and between operators, supervisors and management.

Action 1

Currently, there is minimal communication to other operators unless you are handing over to the next shift. Regular team meetings (for all operators in that site) every two months (for 1 hour) could be introduced and the area supervisor could be used as the facilitator. Items and solutions will be documented for knowledge transfer to management and other sites. Key issues will be deposited in the Occupational Health & Safety folder and shared with others via the company's intranet.

Solution 2

Create team leaders, other than supervisors to promote safety practices (Taking ownership over safety and health).

As operators are the ones who are facing the daily hazard it is important for them to take ownership of the health and safety program. A health and safety team leader should be created in each site to coordinate daily operational issues and to orientate new members into the team in relation to health and safety.

Action 1

Team leader role should be earned based on best performance and proven leadership. Additional compensation should be given to motivate this operator to be a successful team leader.

Action 2

Provide small wins for all team members with no injuries reported every three months.

Solution 3

Introduce basic manual handling training regularly (multiple times throughout the year).

Manual handling injuries are by far the most common form of injuries reported. Although regular training is provided, the rate of injuries is still relatively high. Hence, it is more of a cultural rather than procedural problem. A cultural change problem is needed to change the mindset of operators.

Action 1

Provide introductory courses for all new operators within 1 week of hire and new courses focused on the critical areas of injuries (eg lower back lifting technique) throughout the year as refresher courses.

Action 2

Provide comparative improvement reports for all sites to enable operators to assess their improvements, both within and between units. Also, incentives could be used to encourage top team performers.

Solution 4

Actively following up toolbox meeting suggestions.

At present, ideas and suggestion can be given to supervisors and management without response for months. Hence, the new systems should encourage management and supervisors to provide solutions within 1 week of suggestions from operators. Actions and improvements need to be documented and circulated to create transparency and ownership.

Action 1

Supervisor must provide feedback to operators within 1 week and if the operator is not satisfied, he/she can go direct to management without fear.

Solution 5

Actively follow up near misses reports as they:

1. Highlights that operators were not following Jobsite Analysis procedures, or
2. The Jobsite Analysis was not originally done correctly at the site.

It is by reporting near misses that improved procedures could be generated to avoid future injuries.

Action 1

Follow up Job Analysis procedures and near misses reports every month. Management should encourage operators to report near misses to determine the correlations between them and actual incidents. Incentive should be provided if near misses are reported and the frequency of incident is down. Focus on continuous Jobsite Analysis improvement

through recognizing and rewarding those team members whom contribute the most to improving Jobsite Analysis.

Solution 6

Redefine the role and responsibilities of supervisors.

At present, supervisors are juggling between three areas: sales, foreman and client relationship manager.

Action 1

Re-align the current job function of Supervisors to allow them to focus on one set of duties and not the three they currently juggle (Sales, Foreman and Client Relationship Manager).

Solution 7

Align performance appraisals with safety KPIs.

Action 1

Ensure safety KPIs are achievable, and are supported by both management and operators. Therefore, all KPIs regarding injuries should be developed and agreed to by operators.

Phase 5: Control

A successful control plan would require the collaboration of both management and employees. In order to improve the safety culture in the workplace, employee ownership of safety procedures is paramount. At the same time, management is required to provide reward and supporting procedures to make this happen. In Australia, this is particularly crucial as the labour market for talented operators becomes more competitive and the mean age of the labourers continues to increase. A systemic control system was adopted in the firm to support the implementation of the six sigma program (Table 3).

Table 4: Control system in Environmental Services

Areas of control	Requirements	Control Method	Frequency
<ol style="list-style-type: none"> Continuous improvement for Environmental Services Ltd would be to continue the recent reduction of injuries and strive to reduce injury rates from 40% to 20% per annum. Safety awareness interviews and surveys should be conducted each year to assess the level of safety culture and highlight areas for improvement and management dedication to improving safety of the operators. Provide international benchmarks in safety best practices to encourage greater buy-ins of safety culture in the workplace. 	<ol style="list-style-type: none"> Clear documentation of incidents each week. Open discussion between operators and supervisors. Open communication between management and operators regarding loss in productivity and financial compensation with injury each month. Open feedback from management in regards to suggestions from operators and a transparent reward system to promote positive behaviour. Transparency in comparative reports between units for employees to follow up via the intranet. 	<ol style="list-style-type: none"> Continuous improvement in safety as a key KPI in performance appraisal. Bonus pay can be related to the savings achieved with reduced incident rate in that team/division/centre. This would include near misses reports. Any ideas directly contributing to the reduction of incidents could be rewarded as a small win. (i.e. a dinner ticket for two to show management's appreciation of efforts from the operators). This could be further complemented by acknowledgement in the monthly company newsletter. 	<ol style="list-style-type: none"> Built in small wins should be encouraged every three months if the reduced incident rate is achieved. Review of progress monthly along with consistent recognition of those promoting to the safety culture.

Continuous improvement is an essential part of the Six Sigma process. Based on the cause-effect analysis and the result of the measuring tools, incremental improvement can be achieved. Finally, success six sigma programs are no quick fix, it requires key people and resources and total commitment from both employees and management to make the difference.

6. Conclusion

The critical factors and the most hazardous activities related to injuries at the work sites in the Industrial Service Division have been identified. From the continuous improvement procedures outline in the Six Sigma methodology, we identified these critical factors (the 3Cs):

- *continuous* engagement with operators that improvement can be made in reducing injury rates in the workplace (sites).
- *credibility* and commitment from management regarding safety should be apparent and the level of trust between management and operators could be improved through open dialogue.
- *ownership* of the safety program by operators must be encouraged in order to sustain a safe work environment and a culture of continuous improvement.

A limitation of this study was the low return rate in the survey to be of any significant use in complementing the qualitative data. A bigger sample could be used in future studies to enable a complementary effect on interview data. Finally, the model used in the study is based on the Six Sigma method to achieve continuous improvement. The evidence provided in this case demonstrated that other firms could adopt this approach to create a positive result and a continuous learning organisation.

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Appendix 1: Summary of interview data

Company Policy / Legal

1. Continuous training is provided on all issues management and government deem as risky.
2. Lack of basic training in manual labour, and inoculations for things like hepatitis B,C, along with having minimal First Aid on trucks).
3. Operators do have a set of issued, policy mandated protective clothing they must wear.
4. No limitations on overtime – just need 10 hours in between shifts, which can be no longer than 14 hours at a time.
5. Management does not currently have a monetary incentive program to reward safe behaviour or reward people for documenting their near misses.
6. The pipe rehabilitation crews are invited to attend safety committee, but play little to no part in its dialogue, due to working great lengths from the location of the committee.
7. Some operators complained of being coerced to not follow safety guidelines due to time constraints.

Personal

1. Operators are allowed to stop work whenever they feel they are in danger of risking their health.
2. Operators say that toolbox meetings need to happen more often.
3. Individuals General lack of interest in interview regarding safety; it was seen as impossible to change the current attitudes at management and employee level.
4. The injuries occur most often when crewmen work too hard or long and push their body beyond their physical limits.
5. Some staff claims there is not enough time to recover from injury due to dependence on overtime pay.
6. Not enough morale support from supervisors.
7. Lack of talented staff making work difficult.

Onsite/Depot Safety Practices

1. Operators determine workloads during shifts when on site (i.e. if 6 then rotating the heavy physical tasks between them in 15-20 min segments).
2. Breaks during shifts are voluntary as duties change from day to day and impossible to regulate.
3. Near misses, if reported could be used to potentially penalize someone for working in a risky setting (poor safety guideline analysis) or with risky behaviour.

4. Onsite safety review and training should be done at each site for each day (i.e. review what potential movements are going to cause risk to injury and how they can go about preventing these injuries).
5. Operator say there is plenty of time to be safe, but does not receive the guidance from management (i.e. not promoting a safe working culture or having enough supervisors on hand at the job site).

Environment / Culture

1. Outstanding Safety Committee issues causing poor attitudes amongst operators (i.e. no clear central office available to report injuries and there is a desire to share information amongst units, and review Standard Operating Procedures).
2. Advance knowledge of site locations and jobs hampers mental preparedness.
3. Within the Pipe Rehabilitation group, two of the operators we spoke with said they had never seen their managers at the sites (4 and 6 months of being on sites respectively for both), which has led to resentment re: the lack of knowledge of the difficulties the operators come across day in and day out. Four of the operators interviewed with the Industrial Services group had ever seen their General Manager at a job site.
4. Not enough information being shared between older and newer employees – this leads to newer employees going about things the hard way and typically hurting themselves.
5. Resentment between older and newer employees around the potential of losing overtime or potentially their jobs.

Appendix 2

Environmental Services Ltd survey

Aim: to determine the key factors contributing to the injuries in your workplace

This survey is anonymous (no name is required).

Please circle the appropriate response

Please return completed survey to the sealed box provided by your supervisor.

Demographic data:

Age:

Year of service in Environmental Services:

Year of professional experience in this industry

Company Policy/ legal		Strongly Disagree	On Average	Strongly Agree
1	Adequate & continuous training is provided on Occupational Health & Safety issues (i.e. including user friendly Data Handling Material Sheet)	1	2 3 4 5 6 7	
2	Everyone (including supervisors) should have a yearly manual handling training workshop to achieve zero incident rate	1	2 3 4 5 6 7	
3	There is sufficient time, encouragement and support form management for me to attend Occupational Health & Safety courses	1	2 3 4 5 6 7	
4	The company talks to us about the minimum legal number of hours of OH&S training needed and provides us with those hours of training each year	1	2 3 4 5 6 7	
5	Everyone knows about the importance of safety, but not every one on the job sites are strictly following safety rules outlines by the JSA & training	1	2 3 4 5 6 7	
Personal		Strongly Disagree	On Average	Strongly Agree
6	Supervisors and management strongly praise the reporting of near misses by operators	1	2 3 4 5 6 7	
7	I feel the safety standard of everyone can be improved	1	2 3 4 5 6 7	
8	I feel the number of injuries reported each year can be improved	1	2 3 4 5 6 7	
9	I feel we can achieve zero minor cuts and injuries at the jobsites	1	2 3 4 5 6 7	
10	I believe we are having fewer injuries over the time I have worked here	1	2 3 4 5 6 7	
11	Safety courses have helped me avoid many near misses	1	2 3 4 5 6 7	
12	A yearly reward for zero injury incidents for my team would lead me to adopting safer work habits	1	2 3 4 5 6 7	
14	Safety training courses provided by the company are helpful to my needs at all jobsites	1	2 3 4 5 6 7	
15	Reporting near misses would highlight that I did not follow JSA policy	1	2 3 4 5 6 7	
16	Injuries occur most often when operators work too hard	1	2 3 4 5 6 7	

The six sigma approach in performance management to reduce injury rate at work
Rhodes, Lok, Diamond & Bhatia

	or too long							
On site/ depot Safety Practice		Strongly Disagree	On Average	Strongly Agree				
17	There are enough on site safety instructions as you move from site to site	1	2	3	4	5	6	7
18	There is enough on site support from supervisors on safety issues	1	2	3	4	5	6	7
19	Safety training courses have helped me minimise the chances of injuring myself at work	1	2	3	4	5	6	7
20	Safety training courses have helped me minimise the chances of injuring others at work	1	2	3	4	5	6	7
21	The issued PPE is helpful in achieving an injury free environment	1	2	3	4	5	6	7
22	The supervisors are too busy to support and remind workers of safety issues	1	2	3	4	5	6	7
Environment/ Culture		Strongly Disagree	On Average	Strongly Agree				
23	Less experienced workers are often injured due to poor handling techniques	1	2	3	4	5	6	7
24	There is not enough emphasis from management (compliance team) to share knowledge on near misses	1	2	3	4	5	6	7
25	Reporting near misses is seen as negative to operators and supervisors reputations	1	2	3	4	5	6	7
26	There is no suggestion box or other ways to allow workers to put in anonymous new ideas to prevent near misses and improve safety and morale	1	2	3	4	5	6	7
27	Although workers are invited to be part of the safety committee management often ignores suggestions from the safety committee	1	2	3	4	5	6	7
28	There are not enough onsite toolbox meetings to review safety issues	1	2	3	4	5	6	7
29	More experienced workers are not willing to mentor less experienced workers on safety issues	1	2	3	4	5	6	7
30	There is good team communication and support between team members	1	2	3	4	5	6	7
31	Management do not take our suggestions towards safety very seriously	1	2	3	4	5	6	7
32	Older workers (more experienced workers) are often injured due to poor handling attitudes	1	2	3	4	5	6	7
33	There is often not enough time to recover from injuries	1	2	3	4	5	6	7
34	There is often not enough time to assess all safety issues on jobsites before starting	1	2	3	4	5	6	7
Injury Rate Outcome		Strongly Disagree	On Average	Strongly Agree				
35	Injuries at the jobsite occur due to poor workplace safety practices and policies	1	2	3	4	5	6	7
36	Injuries at the jobsite occur due to poor safety attitudes amongst workers	1	2	3	4	5	6	7
37	Injuries at the jobsite occur due to poor safety training	1	2	3	4	5	6	7
38	Injuries at the jobsite occur due to poor supervision and management support	1	2	3	4	5	6	7
39	Injuries at the jobsite occur due to poor incentives	1	2	3	4	5	6	7

Other comments:

Appendix 3: Survey respondents suggestions for changes

1. Team Work & Co-operation between operators (Cited twice)
2. Increased communication between managers and operators
3. Have all staff take safety more seriously
4. More on the spot audits
5. Work less hours (Cited twice)
6. Enforce safer working rules that adhere to legislation. “We are forced to bend and break rules everyday”
7. Hire more operators to lighten the workload (Cited twice)
8. Hire more experienced operators instead of using hire companies. (Cited twice)
9. Morale needs improvement - “A thanks and a pat on the back goes a long way for the boys out on the tools, something which most of us are yet to experience. We work very hard and I think don’t get enough credit for it.”
10. Exercise penalties for unsafe practices
11. Create incentives for safer work practices
12. Create more frequent training courses
13. Create team leaders, other than supervisors to implicate these practices (Cited twice)
14. Spend more time and money servicing equipment (Cited three times)
15. More training at start of working with company
16. Better safety gear