AN INDUSTRY AND UNIVERSITY COLLABORATIVE SAFETY EFFORT

William J. Reimann, University of Utah/Black Diamond Equipment, Ltd.
Richard F. Sesek, University of Utah
Phillip Drinkaus, University of Utah/University of Michigan

billr@bdel.com

ABSTRACT

This paper discusses the collaborative efforts between Black Diamond (BD), a small manufacturing company, and students and faculty from the Ergonomics and Safety Program at the University of Utah. This ongoing collaboration began in 1999 and has resulted in several safety initiatives that were implemented at BD. The results were:

1. The company's estimated OSHA recordable incident to worker ratio decreased from 7.3 to 2.9 from 1997 to 2004.
2. From 1997 to 2004, the Insurance Experience Modifier (EM) decreased from 1.54 to 0.67. The insurance premium decreased by over 60% resulting in significant savings.

Audits by OSHA, the EPA and the DEQ have also shown marked improvement during this collaboration. The collaborative safety efforts between BD and the University of Utah have been beneficial to BD, the University of Utah, and the students participating in these projects.

INTRODUCTION

In 1997, Black Diamond Equipment LTD's (Salt Lake City, Utah) safety program activity had decreased markedly, due in large part to the departure of a key human resources employee. The fiscal impact of increasing insurance premiums was a consistent topic at management meetings and led to the investigation of ways to reverse or at least slow this trend.

High insurance premiums are, in part, a reflection of the high prevalence of injury in the workplace. In 1994, the Center for Disease Control reported that "workplace hazards inflicted a tremendous toll in both human and economic costs" with employers reporting over 6 million work injuries with over $120 billion in lost wages and lost productivity, administrative expenses, health care, and other costs. This figure does not include the costs of occupational diseases (NIOSH, 2005). BD's experience of increasing insurance premiums in not unique to BD, in fact, as medical costs increase, insurance premiums industry wide have been steadily increasing.

Recognizing the scope of safety concerns at BD and the lack of a dedicated full-time safety professional, Black Diamond began collaborating with the University of Utah. The initial

contact between BD and the University of Utah was facilitated by a BD employee who had taken several ergonomics and safety classes offered by the Mechanical Engineering Department's Ergonomics and Safety Program in 1999. The first field trip to the manufacturing facility took place in 1999 and joint safety projects soon followed. As a reflection of management's support for safety and this collaborative effort, an employee based Safety Committee was created and was given the following mission statement:

> *The objective of the Safety Committee is to create a documented system to encourage safety awareness, motivate employees to follow safe practices and provide feedback to identify, correct and prevent hazards at an early stage.*
>
> *Members of the Safety Committee are committed to working in a proactive fashion to be advocates for safety at Black Diamond Equipment. Their mission is to promote continuous improvement in safety related matters, and to utilize the [management] systems in place to address concerns and allocate necessary resources. Meetings are held each month and notes are maintained for each meeting along with a Tracking Report to monitor the status of action items*.
> (BD Employee Handbook)

A collaborative relationship developed between BD and the University of Utah during the following six years. This relationship has provided an opportunity for university students to contribute to the safety efforts of an ongoing manufacturing operation. Black Diamond now has a company-wide Safety Committee and Program with representatives from different departments, monthly meetings and review of action items relating to injuries, near misses and preventive actions. In addition to this traditional approach to safety, Black Diamond has partnered with the University of Utah to create student/employee projects.

METHODS

Overview

University of Utah professors and Black Diamond representatives reviewed existing safety programs and policies to prioritize which areas needed the most attention during semester tours and student projects. These projects may be at a higher level (i.e., review of current company wide safety program) or at a lower, more specific level (i.e., selection and replacement of air nozzles). Decision criteria included recent injuries, accidents, areas with a potential for injuries, student skill sets and anecdotal input. Not all project areas directly correlated to a specific OSHA standard or emphasis area and each project often addressed more than one safety and health concern.

At the beginning of each semester, students toured the entire facility. Project ideas were proposed and refined after interaction and discussion with faculty, hourly personnel and management. Typically, a project would take place over the course of a single semester and involve one to three students and/or employees and required typically 50-150 hours of combined student and faculty time. Considerably more time was required when a student's project rose to the level of a MS thesis. Each project usually cost less than $1,000 in materials. Projects

included: air nozzle replacement, forklift training, improved dock landing area, hoist/lift program, audit of manufacturing area, hearing conservation program, improved lockout/tagout program, respiratory protection program, quantitative respirator fit testing, improved machine guarding, among other programs. Two of these projects are discussed in some detail. These projects were chosen because they illustrate how the process of ergonomic and safety evaluations can generate multiple outcomes from one project.

Sample Project: Air Hoses

Concern. Compressed air nozzles (used for cleaning) located throughout the factory did not contain nozzle tips that would limit air pressure to 30 psi when the nozzle end is obstructed or dead-ended. Many areas with the older generation air nozzles also had noise levels greater than 90 dBA TWA.

Potential Effects. Without pressure limiting nozzle tips there is an increased risk of air embolisms and lacerations and punctures of exposed body parts from particulate matter driven by air pressure.

High noise levels can trigger increased noise abatement requirements, damage hearing and reduce communication and efficiency in the adjacent areas when this equipment is in use.

Applicable Standards. 29 CFR 1910.242(b) and 29 CFR 1910.95

Action Taken. Researched available nozzle tips that limit air pressure to 30 psi and significantly reduce noise. Twenty-one nozzle tips were installed.

Results. The maximum pressure to which the workers are now exposed is 30 psi. Noise was reduced an average of 12 dBA at each nozzle location and resulted in a decreased number of production areas with noise levels greater than 90 dBA TWA. This work was part of a master of science of public health (MSPH) thesis for a University of Utah student in the Rocky Mountain Center for Occupational and Environmental Heath (RMCOEH). This project also included a complete isopleth noise map of the entire facility before and after these and other noise reduction efforts.

Sample Project: Hazardous Materials

Concern. Material safety data sheets (MSDS) were not maintained and available for all hazardous materials in the facility. Some materials were not correctly handled, labeled and were often stored improperly.

Potential Effects. Injuries may occur due to employee lack of knowledge and understanding concerning characteristics of hazardous materials. Increased waste production due to non-optimal handling procedures required expensive disposal.

Applicable Standard. 29 CFR 1910.1200

Recommended Action. Obtain material safety data sheets from all suppliers of hazardous materials. Store these sheets in places that are accessible to all employees at all times. Train all employees about the hazards associated with these materials and how to access the information contained in the MSDS.

Results. MSDS sheets were placed in well-marked areas and training was implemented to help employees understand what information is contained in the MSDS material and how to safely handle the materials. Also, labeling and storage of these materials improved.

Because of the awareness that accompanied this initiative, it was learned that separating some of these materials allowed for reuse and recycling. In this case it was the separation of the cutting coolant and the metal chips. This had immediate economic benefits beyond safety and health.

OSHA Recordable Incident Rate (ORIR)

The purpose of the ORIR is to normalize the recordable incident rate to a company with 100 full time employees working an entire year. The ORIR can be calculated as follows:

$$\text{ORIR} = 2000\frac{\text{hr}}{\text{worker year}} * 100\text{workers} * \frac{\#\text{ of recordable incidents}}{\text{Total \# hours worked during year}} \quad (1)$$

Where: 2000 hr/(worker year) is the number of hours a worker works over an entire year without overtime. 2000 hr is derived from 50 work weeks * 40 hrs/week

Unfortunately, at the time of publication, the total number of hours worked each year was not available from the payroll department. For the purpose of this paper, it is assumed that workers did not work any overtime. This assumption may overestimate the ORIR if there had been significant overtime during the year.

RESULTS

Economic Repercussions of Student/Industry Projects

Determining the economic repercussions of safety and ergonomic programs is as sophisticated and complicated as it is important and interesting. While direct costs and savings may be relatively easy to document and quantify, indirect benefits and synergies, in contrast, are by their very nature more difficult to quantify. The purpose of this section is not to present an in depth financial analysis, rather present some of the information that is typically used to illustrate the effectiveness of a safety program and remind the reader that companies operate in dynamic environments that interact and may confound the evaluation methods. It is also important to recognize that collaboration between departments within a company is also necessary to help quantify the effects of safety efforts. Understanding the scrap rate, medical expenses, machine down time and other reflections of direct and indirect expenses associated with injuries requires a company-wide effort that requires management's full support.

With these caveats in mind, the economic impact that the Safety Committee and student/employee projects has had are discussed. To aid in this discussion, the Insurance Experience Modifier (IEM), the nominal insurance premium, the actual premium paid and the difference between the two premiums are presented Figure 1. The IEM is assigned by the facility's worker's compensation insurance carrier based on comparable facilities where 1.0 is the industry standard or "average". Savings is defined as the difference between the nominal insurance premium (what the "average" company would pay) and the actual premium paid.

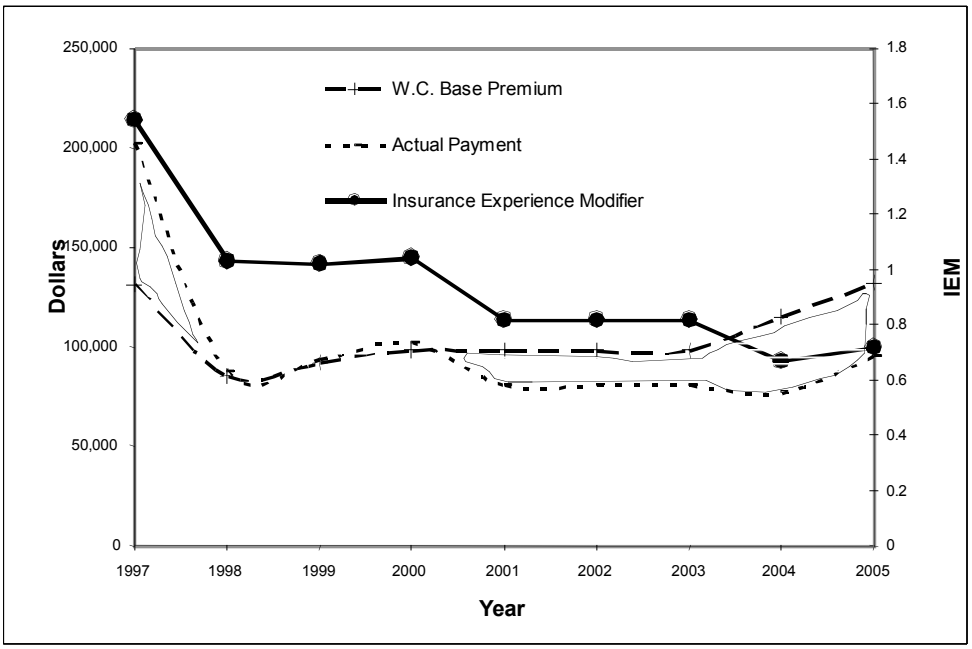

Figure 1. Chart of base premium (IEM=1), the actual premium paid, and the insurance experience modifier by year. The vertical hash marks indicate the amount of money paid by BD greater than the average producer would have paid. The vertical hash marks indicate the amount less (savings) that BD paid below what an average company similar to BD would have had to pay.

Figure 2 presents the IEM and the estimated ORIR from 1997 to 2004. Note that the final data point on this figure reflects only partial 2005 data.

Audits by OSHA, the EPA and the State of Utah Department of Environmental Quality audits were conducted in 2000 of the entire facility showed improvement over previous audits.

DISCUSSION

The impact of safety efforts on a company can be measured in several ways. Two metrics that best summarize the safety performance are:

1. The company's estimated OSHA recordable incident to worker ratio decreased from 7.3 to 2.9 from 1997 to 2004.
2. From 1997 to 2005 Insurance Experience Modifier (IEM) decreased from 1.54 to 0.67.

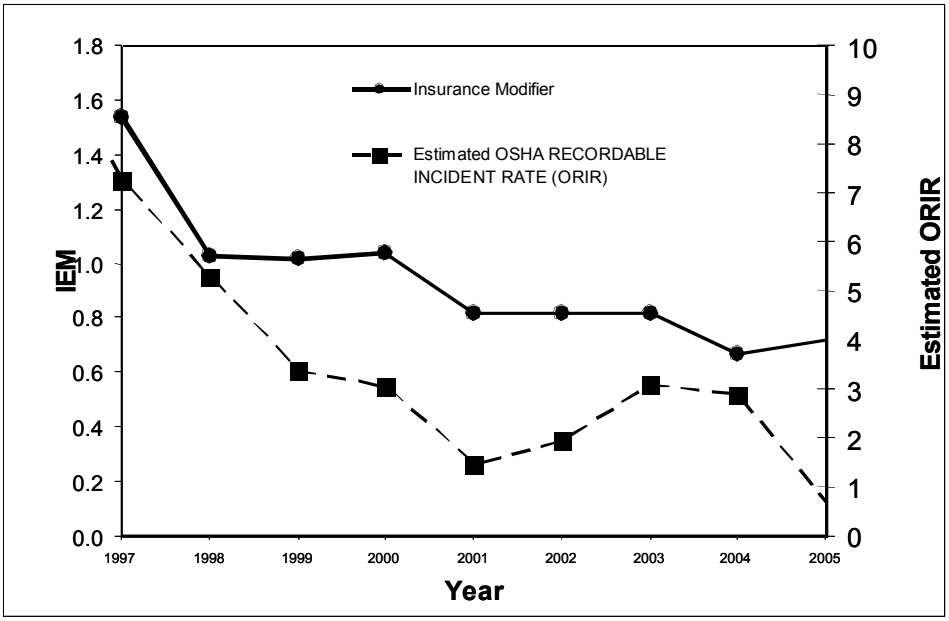

Figure 2. Chart of insurance modifier and estimated OSHA recordable incident rate (ORIR) by year. Note: the information for 2005 is not complete for the estimated ORIR.

The additional premium paid by BD over the industry average from 1997 to 1999 (Figure 1) totaled approximately $79,000. These additional costs may be considered a penalty for having a below average safety record. The reduced premium paid by BD over the industry average from 2000 to 2005 totaled approximately $128,000. This savings may be considered a "reward" for a better than average safety record. Such savings are not directly recorded in a company's balance or income sheets and it may require that the safety department present these savings to management to ensure adequate future funding.

Potential Confounding Factors

It is important to realize that there are several additional contributing factors to the reduction of the OSHA Recordable Injury Rate and Insurance Experience Modifier. Black Diamond systematically reviewed and adjusted their insurance carrier depending on rates and services provided. It is proposed that the insurance premiums were reduced because of the ability to show successful company-wide safety efforts and the consequent injury reduction. At this time, it is not clear why insurance carriers had to be changed to enjoy these rate reductions. Other significant events that occurred during the time of this study included relocation of the sewing operation to an off-shore facility resulting in a 52 employee reduction in workforce at the end of 2001. Audits by OSHA, the EPA and the State of Utah Department of Environmental Quality audits were conducted in 2000 of the entire facility. It is believed that BD's improved performance on these audits was a direct result of its collaboration with the University of Utah.

Despite these confounding events, the IEM should be a good measure of BD's safety performance both in comparison to other companies within the industry and as a measure of relative yearly performance. Insurers are in the business of estimating the amount of risk to which a company is exposed. This relative risk is reflected by the IEM. This risk is related to the

type of work performed by employees of a company and the injury record of a company and therefore the IEM is a good measure of BD's safety and health performance.

General Comments about the role of RMCOEH, ERCs and Industry

The University of Utah's Rocky Mountain Center for Occupational and Environmental Health (RMCOEH) is a NIOSH Education Research Center (ERC) of which the Ergonomics and Safety Program within the Mechanical Engineering Department is a major core. One of the missions of RMCOEH and ERCs in general is to provide support for working ergonomics, safety and industrial health professionals, particularly in the intermountain west. One way it provides this support is by researching and responding to questions posed by working health professionals pertinent to health and safety. Often these interactions are conducted entirely via telephone. However, giving the most appropriate, specific answers to questions often requires intimate understanding of the workplace, its functions and its departments; information and understanding that can only be gained from an onsite visit. Often, without this information, the best support the ERC can provide may be general answers that may not be as specific as required for safety professionals. One way to ensure that this information is available to professors and staff of the ERC is through collaboration. The collaboration (specifically the onsite visit time) between BD and the University of Utah provides such understanding and can facilitate rapid response to specific questions and concerns as they occur.

CONCLUSION

Six years of cooperative efforts with the University of Utah Ergonomics & Safety program have provided student/industry projects that have contributed to an overall decrease in injuries and costs and an increase in safety awareness and morale. Additional benefits include improved processes, and more efficient operations. This case study indicates that collaborative efforts between industry and academia can directly impact a company's safety record and may significantly reduce costs. In addition, the working relationship has benefits for the students, the University of Utah, Black Diamond employees, and Black Diamond.

This successful collaboration in safety has led to additional collaborations between Black Diamond and other departments at the University of Utah. These collaborations have lead to energy audits and to the investment in renewable energy sources (solar power). These efforts have led to significant decreases in overall energy expenditures due to conservation and more efficient energy use.

The collaboration between Black Diamond and the University of Utah is ongoing and continues to integrate state of the art health and safety information with this dynamic manufacturing center. As this collaboration continues it is believed that better metrics to quantify the direct and indirect benefits associated with this relationship will be developed and that safety and efficiency at BD will continue to improve.

REFERENCES

1. Employee Handbook & Safety Committee Program. Black Diamond Equipment LTD, 2005.
2. National Institute for Occupational Safely and Health (NIOSH), 2005. http://www.cdc.gov/niosh/nora.html