

# Quantifying the costs and benefits of occupational health and safety interventions at a Bangladesh shipbuilding company

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**Background:** This study is the first cost–benefit analysis (CBA) of occupational health and safety (OHS) in a low-income country. It focuses on one of the largest shipbuilding companies in Bangladesh, where globally recognised Occupational Health and Safety Advisory Services (OHSAS) 18001 certification was achieved in 2012.

**Objectives:** The study examines the relative costs of implementing OHS measures against qualitative and quantifiable benefits of implementation in order to determine whether OHSAS measures are economically advantageous.

**Methods:** Quantifying past costs and benefits and discounting future ones, this study looks at the returns of OHS measures at Western Marine Shipbuilding Company Ltd.

**Results:** Costs included investments in workplace and environmental safety, a new clinic that also serves the community, and personal protective equipment (PPE) and training. The results are impressive: previously high injury statistics dropped to close to zero.

**Conclusions:** OHS measures decrease injuries, increase efficiency, and bring income security to workers' families. Certification has proven a competitive edge for the shipyard, resulting in access to greater markets. Intangible benefits such as trust, motivation and security are deemed crucial in the CBA, and this study finds the high investments made are difficult to offset with quantifiable benefits alone.

**Keywords:** Cost–benefit analysis (CBA), Economics, Occupational health and safety (OHS), OHSAS certification, Shipbuilding, Bangladesh, Returns on investment (ROI), Health

## Introduction

Bangladesh's shipbuilding industry has flourished in recent years, influenced by low labor costs, an abundant workforce, and coastal infrastructure. Bangladesh produces ships up to 15% cheaper than other shipbuilding nations and the industry is projected to contribute 4–5% of the national gross domestic product by 2015.<sup>1,2</sup> The Bangladeshi shipbuilding industry has recently started targeting international markets, requiring shipbuilders to fulfill international quality standards.

Meanwhile, shipbuilding injury rates and associated costs are high in Bangladesh. Low levels of education, lack of awareness of occupational dangers, insufficient personal protective equipment (PPE), high levels of stress, and exploitative management with little regard for legality compound the effects of already dangerous working conditions.

While occupational health programs and policies often exist, they are rarely enforced in low-income

countries where most employers and governments do not sufficiently protect workers.<sup>3</sup> Recent and serious occupational accidents in Bangladesh have put a new public focus on worker safety and well-being and the stricter enforcement of existing regulations. These measures add to company and government costs, and the development and enforcement of occupational health and safety (OHS) regulations have resulted in an increased interest in cost–benefit evaluations of such measures.

This study analyzes the costs and benefits of OHS measures at a shipyard in Chittagong, Bangladesh. It aims to fill a gap in the scientific literature by evaluating how and if OHS measures and international OHS certification processes benefit those involved in the construction and shipping industries in economically developing countries. This study is the first to quantify OHS costs in Bangladesh. It also one of few studies to investigate the bottom-line costs and benefits of OHS measures in countries.

In Bangladesh, high rates of unemployment, low levels of education, and limited job opportunities means that the shipbuilding industry faces few

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barriers in recruiting workers. The inexhaustible labor supply results in a situation where workers' rights, especially with respect to safety and health, are not highly valued by management or workers themselves. Recent incidents garnering worldwide attention have increased awareness of the unfavorable working conditions in the Bangladeshi textile industry. Pressure from aid agencies and workers have led to a shift in priorities for employers not only in textiles, but also in the shipbuilding industry.<sup>4</sup> Employers are beginning to shoulder the responsibility of respecting the human rights of the shipbuilding workers and their families. In a public private partnership (PPP) with the government of Bangladesh and the German Agency for International Cooperation (GIZ), a Bangladeshi shipbuilding company named Western Marine Shipyard Ltd. (WMSHL) undertook measures to comply with all legal requirements and attain two international OHS safety accreditations (OHSAS 18001 and ISO 14001) in three years. WMSHL is the first Bangladeshi shipyard (and only at the time of writing) to attain OHS certification.

## Background

Nearly all cost-benefit research of OHS-related programs, policies, and interventions to improve workers' health focuses on the economically developed world, especially the United States. Analyses in low-income countries are rare and available literature concentrates primarily on providing health care to vulnerable communities rather than on OHS measures. As Nuwayhid noted in 2004, the implementation of OHS measures in developing countries competes with other urgent social, economic, and political challenges.<sup>5</sup> Governments often lack the means to translate scientific findings and recommendations into effective policy. Implementation problems notwithstanding, OHS laws provide minimal oversight for only about 10% of low-income country populations.<sup>6</sup> An analysis in South Africa found that beyond a lack of implementation, worker apathy and the failure to educate employers hindered the success of OHS measures.<sup>7</sup> High levels of unemployment and underemployment also contribute to the low priority of occupational health. Studies on occupational health, both in Asia and in Latin America,<sup>8,9</sup> point out that occupational health in the developing world must be viewed in broad terms and take into account individual characteristics of employees and larger structural health factors (e.g. availability of healthcare services).

### *Measuring the impacts of OHS*

Although criticized by some,<sup>10</sup> most mainstream economists make a strong case for the use of cost-benefit analysis (CBA) to calculate the impacts of health management policies.<sup>11</sup> Several approaches to quantifying the value of safety regulations at work have been developed (see Dorman).<sup>12</sup> CBAs prove

useful in optimizing development and in the evaluation of environmental, health, and safety regulations.<sup>13</sup>

Many companies in the developed world have introduced occupational health promotion programs, responding to growing evidence of negative health effects of long working hours spent sitting or performing repetitive tasks. One systematic review of workplace health programs found that occupational health promotion programs have a positive effect on more than half of the health indicators tested by randomized trial, including increased physical activity rates and decreased body mass index, mental health issues, and smoking rates.<sup>14</sup> A systematic review of studies calculating the financial returns of disease management programs found that the avoidance of medical costs results in positive returns for the employer even in the short term (1–2 years) for many conditions, including asthma and diabetes. Another systematic review found, however, that most studies on the effectiveness of OHS management system interventions had methodological flaws, making conclusions difficult.<sup>15,16</sup> Robson *et al.*'s systematic review of the effectiveness of OHS measures took into account both the intangible benefits to health and the tangible economic benefits.<sup>17</sup> They found OHS measures to be effective (or at least not harmful), however the authors warn that unfavorable results are rarely published.

Indirect costs are harder to measure than direct costs. In a study investigating the return on investment (ROI) of employee wellness programs, Berry and colleagues note that companies' monetary benefits include higher employee morale.<sup>18</sup> Results from a US survey found that nearly two-thirds of employees said that they would work harder for a company that invested in health programs, while three-quarters made a direct link between their productivity and health.<sup>19</sup> One study of accounting practices related to safety issues list "uncertainty, valuation, perimeter of analysis, and quantification of costs and benefits" as obstacles in quantifying the benefits of safety certification.<sup>20</sup>

Does formal certification generally improve safety in the work place? Abad *et al.* explored the drivers and consequences of internationally recognized certification by Occupational Health and Safety Advisory Services (OHSAS) on productivity and accident rates.<sup>21</sup> The authors found that when an OHSAS certified company in Spain implemented safety regulations, worker-related safety increased. Another Spanish study found that of 455 companies adopting safety measures for certification, all showed improvements in safety, competitiveness, and financial performance.<sup>22</sup>

### *Costs of occupational injuries*

While many studies focus on the total costs of disease to national health systems, few consider the costs of

work injuries, especially in the developing world. A study of the construction industry in the UK showed a strong positive correlation between the costs of accident prevention measures and the reduction of work-related accidents,<sup>23</sup> although the study did not provide details on the economic value of these reductions.

As this study will show, quantifying the value of accident reduction is difficult, requiring the quantification of both direct and indirect costs (e.g. pain suffered). In an examination of the less quantifiable factors that contribute to accident related expenses, French estimated the costs of workplace injuries beyond medical and lost wages.<sup>24</sup> He used a willingness-to-pay model to assess pain and suffering costs incurred by injured workers in the American railroad industry. The study concluded that a complete estimate including pain and suffering is much higher than the medical and staffing costs alone. The problems associated with quantifying such intangible concepts has led to much debate among researchers, as highlighted in a book by Ackerman and Heinzerling.<sup>25</sup>

## Methods

### *Cost–benefit versus return on investment analyses*

Although economic CBA is typically used to assess interventions before implementation, this study provides an analysis of the return on investment of an internationally accepted OHS system at WMSHL which included the provision of occupational health services for WMSHL employees and a primary health care center (PHCC) serving the community (approximately 25 000 people).

### *Our model*

The costs of OHS intervention include the registration, certification, and training procedures and the ongoing costs over a 5-year period (2011–2015). Costs are expressed in monetary terms; future projections were adjusted for the time value of money in terms of their net present values. Intervention implementation began in 2011 and costs included the following categories: training and information, procurement and provision of PPE, construction, staffing, furnishing and day-to-day operations of the PHCC, the certification process (including reporting,

data collection, application submission, inspections, etc.), and future recertification costs.

Table 1 provides an overview of the required cost and benefit groups for CBA analysis of the OHS intervention.

### *Data sources*

Data come from WMSHL and the German development agency GIZ. In addition, we conducted semi-structured interviews with shipyard stakeholders and external consultants involved in the implementation of the OHS.

Factors providing companies a competitive edge over others include productivity and production range, research and development capabilities, and the quality of the workforce, including employee skills and competencies. Unfortunately, the detailed and long-term data needed to conduct such an analysis were not available. Available data, limited to bookkeeping records at the PHCC and shipyard, made an analysis of total intervention costs difficult, requiring several assumptions.

Data on injuries, treatment costs, introduction of OHS, and certifications were complemented by information from personal interviews to enable calculations of as many monetized costs and benefits as possible. Comparisons to other studies were included when applicable and results were tested when possible. Finally, an appraisal of the results was expanded to include implications and un-monetized costs and benefits central to the final evaluation.

## Results

The investments made to improve safety and health are described in detail below. This section is divided into two subsections: the associated benefits and the costs of the OHS interventions at the shipyard.

### *Benefits*

The OHS measures at the shipyard included the introduction of comprehensive PPE, OHS trainings for all employees, and the establishment of the PHCC. These measures produced immediate and significant benefits: worker injury rates dropped from over 500 (and in some cases 1000+) injuries per month before the introduction of OHS measures to nearly zero within a few months after the beginning of implementation (Fig. 1). Injury figures have remained low, suggesting that the OHS measures

**Table 1** Costs and benefits for CBA analysis of the OHS intervention, Bangladesh

Costs	Benefits
Tangible direct costs e.g. costs of PPE, training, certification	Tangible direct benefits e.g. lower risk of injury, lower medical costs
Intangible direct costs e.g. inconvenience of wearing PPE	Intangible direct benefits e.g. higher level of worker motivation, access to new markets
Indirect costs e.g. opportunity costs (such as work time lost during training)	Indirect benefits e.g. increased productivity

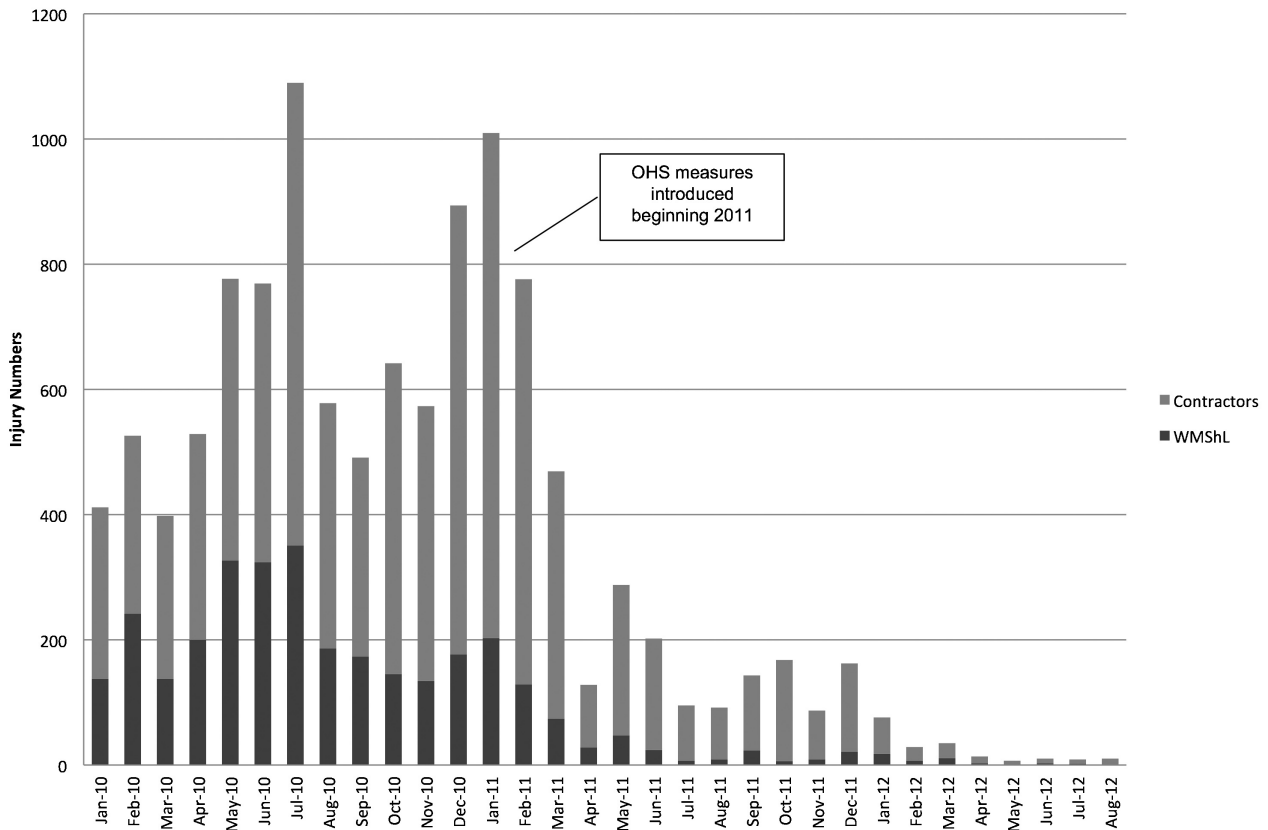


Figure 1 Total injuries per month at WMSHL January 2010–August 2012 (source: WMSHL 2012).

had a lasting impact on the safety of employees and contractors. In the Bangladeshi shipbuilding industry, contractors commonly provide the shipyard with workers. At WMSHL, contracted workers make up between half and two-thirds of employees.

Figure 2 lists the saved costs and the beneficiaries of savings. For example, work accidents not only lead to injuries, but also to the damage or disruption of working equipment, tools, and property. Savings were not recorded by the company.

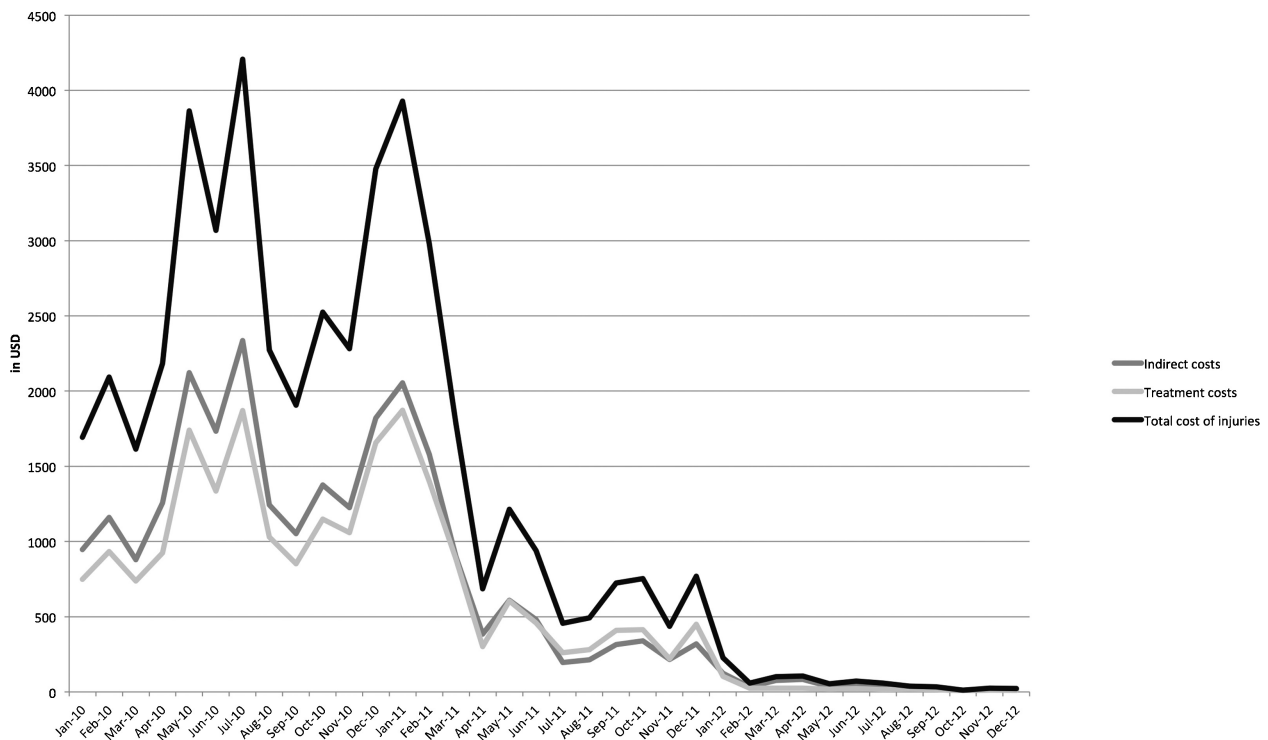


Figure 2 Total monthly worker injury treatment costs at WMSHL, January 2010–November 2012 (USD).

**Table 2 Costs of worker injuries**

Direct costs	Covered by	Indirect costs	Covered by
Treatment costs	Worker, insurance, company, state	Care for patient at home	Family
Worker replacement costs	Company	Lower future expected life income	Worker
Loss of income	Family	Retraining costs	Company
Damage repair costs	Company		

Connected with the drop in injuries, direct benefits associated with the OHS intervention included the reduction in direct and indirect costs from injuries (Table 2). Anecdotally, it appears that access to new or larger markets was another direct benefit of the OHS intervention. Many foreign governments insist on OHSAS certification and in December 2013 the shipyard won a bid from the government of New Zealand for an ocean-going vessel for the Government of New Zealand.<sup>26</sup> They would not have been eligible for the contract without OHSAS certification.

While results show that the tangible benefits had a positive economic impact on the shipyard, the intangible benefits also constituted significant economic gains. Intangible benefits include:

- access to new markets: WMSHL management reported that certification enabled the shipyard to win the bid for the construction of two ferries, the largest vessels commissioned to a Bangladeshi ship-building company;<sup>27</sup>
- a more stable workforce influenced by the reputation of a certified employer. This reduces hiring and training costs and helps avoid contract penalties resulting from delays due to workforce fluctuations;
- improvement in the productivity, precision, and efficiency of the workforce. Other studies note intermediate effects due to a better safety climate;<sup>28</sup>
- access to bank loans and lower public liability insurance premiums;

**Table 3 Costs associated with establishing and running a healthcare facility at WMSHL (USD)**

Item	2010	2011	2012
Cost of land	77 670	...	...
Building cost	50 342	32 957	...
Furnishings	3 596	4325	2379
Maintenance	7430	10 176	9808
Salaries	18 544	29 324	39 528

Note: All conversions from BDT to USD in this study use the interbank rate for 2012 (annual average).

**Table 4 Treatment costs per case per injury category (USD)**

Cost category	Injury category			
	Minor	Eye	Severe	Hospitalization
Personnel	1.99	1.99	6.75	25.64
Equipment incl. audiometry and spirometry	incl.*	incl.*	incl.*	incl.*
Disposables	incl.*	0.38	incl.*	incl.*
Medicine	0.50	0.27	incl.*	incl.*
Total in USD	2.49	2.64	6.75	25.64

Note: No separate data is available, only aggregate costs entered as personnel costs.

- avoidance of costs associated with litigation as a result of injured workers.

### *Costs and benefits of a community healthcare facility*

Part of the PPP was the development of a community health care center serving WMSHL employees and the local community.

### *Benefits*

The healthcare facility was built in an area with previously limited access to health services. Access to health care improves life expectancy or faster recovery from illness.<sup>29</sup> While the clinic benefits the whole community, it was established to treat and prevent illness in shipyard employees. Beyond the direct benefit of fewer missed workdays, indirect benefits, which cannot be comprehensively included in this study, also exist. Injured workers increase costs and lower productivity for several reasons beyond the direct cost of their lost manpower.

Indirect benefits include:

- decreased work disruptions for other employees caused by individual injuries;
- cost associated with replacing injured workers (administrative, training);
- the re-introduction of the injured worker into the workplace upon their return.

### *Costs*

Costs of the healthcare facility are shown in Table 3, including construction, facility set-up, ongoing maintenance, and personnel costs.

Treatment costs vary by diagnosis and include variable staff costs and expenditure on medical equipment, disposables, and medicine. This paper only considers the costs of treating shipyard employees and contractors. Reported injuries treated at the clinic were split into four categories:

1. minor injuries, estimated to result in the loss of half a day's work.

2. eye injuries requiring separate treatment, estimated to result in the loss of half a day's work.
3. severe injuries requiring specialized care, estimated to result in the loss of 2 days of work.
4. cases requiring hospitalization, estimated to lead to a loss of 5 days of work.

To calculate the costs of treatment, the average costs of personnel, medical equipment, disposables, and medicines were summed by category. Table 4 shows the costs for each injury category for each recorded case at the PHCC using averages of cost data for 2010 to 2012.

Combining these data with injury statistics from the shipyard over the 3-year period shows that total treatment costs of injuries to workers at the shipbuilding company declined dramatically from USD 20 155.00 in 2010 to USD 455.00 in 2012. Figure 2 shows the decline in monthly treatment costs, which are benefits of OHS measures.

The difference in per capita treatment costs for worker injuries represents a monetary benefit of the OHS measures. Per capita figures enable consideration of employee number fluctuation — the numbers of workers at the shipyard varied during the study period due to economic factors such as the worldwide economic downturn after 2008. Calculations show that the shipyard realized a savings of USD 7.82 per worker for injury treatment costs over the study time period. Per capita treatment costs were USD 7.97 in 2010 and USD 0.15 in 2012. The number of injuries has remained low since the beginning of 2012.

#### *Alternative approaches to benefit calculation*

Additional approaches exist for calculating the costs of injury treatment to assess the economic benefit of OHS implementation. Using French's approach,<sup>30</sup> the costs of injury to the worker can be expressed as willingness-to-pay. In this study, this is equal to the salary bonus a worker expects as compensation for the risk of suffering an injury. Calculations of the salary bonus are difficult. The lack of alternative employment opportunities and low wages could lead to underestimations of compensation. The various indirect costs such as pain and suffering and costs to the family also need to be considered. The risk of injury for employees dropped from 300% in 2010 (each worker needed treatment for an injury three times per year on average) to 6% in 2012. Therefore, the compensation for the risk of injury is considerably lower post-OHS intervention.

#### *Returns to the company*

The number and total treatment costs of injuries have decreased considerably, translating to a direct benefit for the employer in the form of reduced treatment costs and lost workdays. Workday loss is calculated under the assumption that the workers' salaries equal their marginal product, or in other words, that the

value of their contribution to the company's production is exactly equal to their salary. The average daily wage of a worker is BDT 350.00 (approximately USD 4.25). However, contact workers earn significantly less and are not paid the "sickness benefit." The severity of injury and number of missed working days are necessary to calculate worker injury costs. The cost of replacement workers should also be considered when the injury requires a replacement worker. Replacement workers are typically paid BDT 250.00 per day (approximately USD 3.38). Using the same injury categories as above, the costs of work time lost amounted to USD 17 142. in 2010 (pre-OHS implementation), USD 7148. in 2011, and USD 607. in 2012 (post-OHS and PHCC implementation). This translates to an annual labor cost savings of USD 16 536.00 beginning in 2012. Future labor cost savings projections assume future injury statistics will remain stable.

#### *Intangible benefits*

The gains in productivity and competitiveness are theoretically available in the company's records. However, available data did not allow for such calculations. This is not unusual. In the USA, 34% of companies do not track workforce productivity.<sup>31</sup> We conducted interviews with company stakeholders and external experts to learn about intangible benefits. Interviewees indicated that productivity and worker retention increased after certification and costs were lowered, leading to a one-third reduction in the time needed to construct and deliver a ship.<sup>32</sup>

Two recent contracts from international clients highlight a difficult point to assess: the effect of OHS certification on client behavior. One indicator favors the certification as a boost to business, exemplified by the contract to New Zealand. Although we cannot assume that OHS certification was the reason WMSHL won this contract, they would have been unable to acquire this contract without the certification. In contrast, even clients from countries with a seemingly high regard for occupational health such as Denmark do not necessarily value high levels of OHS when deciding on contractors. In an interview with a Danish shipping company that ordered a ferry from the Bangladeshi shipyard, they mentioned that in addition to quality and capability, the decisive factor for choosing this shipyard over competitors ultimately was attributed to the low price. This is in contrast with the New Zealand contract, which specifically mentioned OHS standards as playing a role in their contract decision.

#### *Costs*

Measurable costs include:

- training of staff, management, and contractors;
- monitoring and administration;
- purchasing of PPE;

- planning, constructing, and equipping the PHCC;
- PHCC maintenance and staff costs not attributed to treatment costs;
- certification.

### Initial costs

The investments made for the environmental management certification ISO 14001 and the OHS certification OHSAS 18001 are straightforward. The certification agency performed on-site audits, standardized testing and inspections, and the certification for a charge of USD 10 000. Annual surveillance audits during the three year certification period cost approximately USD 3000 each. Table 5 shows the total costs associated with the certification process.

After the initial certification process, annual costs are expected to be lower. There is currently no data available for post-certification costs. Table 6 includes costs not clearly defined such as safety signage, safety mechanisms, and structural changes in the working areas. WMSHL records indicate that other OHS measures include staff and material. Table 6 shows the costs of these additional measures at the time of certification and after. Staff costs were high during the certification phase and are expected to decrease in the future. However, material costs remain high.

### Ongoing costs

Ongoing staff costs outside of the PHCC include a data manager and an OHS medical doctor. PPE purchase costs remain high, as equipment must be frequently replaced. Nearly a third of the PPE costs incurred during the certification phase (2010–2012) will be incurred annually for replacements.

Workers' surveillance systems also require ongoing updates. Prophylactic medical costs include the regular spirometry, audiometry, and fitness tests, which have become mandatory for all workers.

### Net balance and future discounting

This study uses projected costs and outcomes, requiring present value calculations. Discounting future costs is a method to enable comparisons of costs and benefits at different time points. In this case

study, large investments and high costs typified the first year. Many costs are expected to decline and become steady. Benefits are expected to remain stable. Discounting also enables the integration of time preference into the evaluation. The opportunity costs of capital expenditure are incorporated into the balance to express future costs and benefits from today's perspective.

The appropriate discount rate is debated and difficult to observe.<sup>33</sup> In this study, we estimated a discount rate of 6%, given that the central bank benchmark interest rate in Bangladesh was approximately 7% over the past 5 years (2008–2013). A sensitivity analysis resulted in an elasticity of minus 1.7% at the 6% benchmark discount rate.

### Results: ROI

The complete return on investment for the OHS measures and certification is negative over a 5-year time period. Total costs are USD 407 000 for the period including the original certification and OHS measure implementation. Yearly costs remain stable, only subject to the discount rate, and are approximately USD 98 000 (present value).

### Results: cost–benefit analysis

A CBA may better incorporate the different types of costs and benefits of OHS measures, including non-monetary benefits. As a result, this study measured the costs and benefits of the OHS intervention by setting them equal to the compensation needed to even out the risk of injury, introduced above as the willingness-to-pay (WTP) approach. Ikpel *et al.* recommend this approach to evaluate the benefits of effective health and safety management in the UK construction industry — using consumer surplus instead of worker compensation:<sup>34</sup>

$$\text{WTP} = \text{price paid} + \text{consumer surplus}$$

Prices for the OHS measures and consumer surplus can be calculated by examining savings within the company from the reduction in accidents and absenteeism. Consumer surplus includes benefits to the company and workers. Additional benefits that

**Table 5 Direct costs of OHS and ISO certification at WMSHL 2011 (USD)**

Item	Amount
PPE equipment	119 053.08
OHS training	10 000.00
First certification incl. pre-audit	10 000.00
Additional one-time expenses to improve occupational safety, incl. personnel	11 459.80

**Table 6 Ongoing costs of the OHS and environmental management system (USD)**

Costs	2010	2011	2012
Expenses to make workplace safe	1406.69	1246.72	2454.30
Structures to make workplace safe	1150.67	1351.67	1465.00
Expenses to make environment safe	719.17	811.00	854.58
Salaries for safety Personnel	34 461.07	70 822.13	58 124.77

form part of the consumer surplus include non-monetary benefits and indirect benefits (Table 1).

### Limitations

One challenge of this study was assigning values to defined impacts of the intervention. In some cases, informed assumptions were used to perform sensitivity analyses. In other cases, the effects of OHS measures at the shipyard could not be monetized. Future cost benefit studies of OHS measures and/or certification can hopefully draw on more extensive data.

### Discussion

Our study found large potential benefits for companies in low income countries who invest in OHS measures and in internationally recognized OHS certification. Our results support findings of a study by Goetzel *et al.* on Dow Chemical's health program in the United States. They found that a reduction in occupation health resulted in a positive ROI for Dow.<sup>35</sup> The authors found that "even small reductions in health risks for Dow employees would yield large savings in health care costs for the company."<sup>36</sup> By "small risks," the authors refer to an average reduction of health risks by 0.17% annually over 10 years. In our study, the risk of injury (and need for health care) was reduced by nearly 300% in two years. Goetzel *et al.* were able to calculate these "large savings" for health insurance companies because the insurers accurately collect cost data.

Benefits can be divided into three categories: societal, shipyard administration, and developer.

#### The societal perspective

The local community benefited from this project through increased access to the PHCC, serving a population that previously had no service providers. Improving health access to the general population is a secondary benefit of this project. Larger societal benefits are expected if other companies follow suit and establish on-site company clinics accessible to the local population. Secondly, community members employed at the shipyard gained intangible benefits. These include:

- avoiding spousal compassionate leave;
- children attend school rather than earning money to cushion income losses for the household;
- a generally higher level of utility in the household resulting from good health and stable income levels.

Unsafe working conditions are a problem in Bangladesh. Companies typically win contracts as a result of low production costs without consideration of occupational safety. Workers bear the costs of these poor conditions in the form of low wages, insecurity, and poor working conditions.

#### Company perspective

The direct benefits to the company are lower costs and increased revenues described in the Results

section. There are also several indirect or intangible benefits to the company resulting in reduced costs including:

- reduced absenteeism;
- increased research and development leading to increased market competitiveness;
- higher quality of production and staff reliability resulting from healthier employees;
- more motivated and competent workers create a reputation as a desirable employer, leading to efficiency gains, a reduction in replacement and training costs, as well as contract penalties resulting from delays due to workforce fluctuations or low-quality work.

We argue that investment in OHS measures and certification made these benefits possible, providing better safety measures and company credibility. This study highlights company benefits, including decreased costs and increased revenue. However several costs could not be precisely calculated, due to a lack of data. Future research utilizing more complex economic modeling will provide a more robust estimate.

#### Development partner perspective

Development aid agencies have political programs and goals to reconcile with the needs of local governments and populations in receiving countries. Supporting WShL's certification procedure and the OHS measures related to it was partly funded by the German GIZ, which aimed to increase worker health and safety through (1) building sustainable capacity to serve as a model in the developing world and (2) empowering the local government and population to be responsible for the future of the project.

Analyses show that investments into OHS measures in the form of PPPs had positive results for local partners and have helped to achieve the goals of the German development agency.

#### Recommendations

Access to more detailed data is necessary to complete more robust CBA and ROI analyses. Future OHS projects should incorporate the collection of high-quality data in all phases of the project.

Results from this study can be used in several ways, including:

- by the Bangladeshi government offering OHS information, training, and support to national companies;
- by the Bangladeshi government to create and implement public policies to support the implementation of OHS measures;
- by the GIZ to promote PPPs in this area and enable other companies to make informed decisions on OHS certification;
- by WShL to promote the company to customers and the local population;
- as a foundation for future studies evaluating the benefits of OHS measures in low income countries.

Occupational health is neglected in most low-income countries. This study shows that by investing in OHS,



a company can achieve both business benefits and health benefits for employees. There is currently little research on OHS in low-income countries. This study makes an important contribution to the study of returns on investments in OHS outside of the developed world. We hope that this study leads to further research and OHS improvements in the shipbuilding industry in Bangladesh, as well as other industries in low-income countries. Additional research and awareness will hopefully also lead to more available and reliable data.

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