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*The Business Case for  
Occupational Safety,  
Health, Environment and  
Beyond\**

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In a volatile economy, firms are constantly facing increased global competition, rapidly changing technology, and decreased access to scarce resources. Under these conditions, occupational safety and health (OSH) efforts to insure a safe and healthful work environment must compete with other organizational needs. Without compelling information about the value of OSH efforts to the organization, management may view these programs and activities as a lower priority than projects that have established a clearer connection to their bottom line.

In addition to informing investment decisions, demonstrating the value of OSH efforts can also position OSH professionals as essential contributors to business' bottom line. Demonstrating the value can also strengthen the moral argument for "doing the right thing" in protecting the health and safety of workers.

This chapter will provide a conceptual basis for deriving the value of OSH actions within the context of business operations. It will also provide information on the practical application of established methods for estimating the value contribution of OSH actions, including details for calculating financial measures commonly used by business. Finally, the chapter will present the value proposition method that can be viewed as the next generation of the business case for OSH.

## How is Value Defined?

The challenge for OSH professionals is to describe the value of OSH efforts in terms that are understood and accepted within the business community. However, value is a relative term, with meanings grounded in multiple disciplines. For purposes of simplicity and

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\* The findings and conclusions in this report are those of the author(s) and do not necessarily represent the views of the National Institute for Occupational Safety and Health.

clarity, the definition of value used in this chapter will be based on concepts found in economics, accounting, and general business.

In traditional economics, Adam Smith stated in his *The Wealth of Nations* Book 1, chapters IV and V that the concept of value has two distinctive meanings. The first meaning is called value in use and it is defined as the inherent usefulness of an object. Value in use is not an intrinsic quality of a commodity, but its capacity to satisfy, directly or indirectly, needs or desires. The second meaning is known as value in exchange and is defined as the value associated with the power of purchasing other goods. Value in exchange is the worth of a commodity in terms of its capacity to be exchanged for another commodity, which is usually money. The concept is referred to as market value. The existence of use value has been understood as a prerequisite for commodities to have value in exchange.

In accounting, value has been defined as the monetary worth of services provided, a specific asset, group of assets, or the business as a whole (Barron's, 2005). The framework for measuring value in the United States can be found in General Accepted Accounting Principles (GAAP), which are established by the Financial Accounting Standards Board (FASB). GAAP includes the standards, conventions, and rules that accountants follow when recording and summarizing transactions and when preparing financial information. Also included in the GAAP is a series of principles to help guide the recording and reporting functions to best insure the transparency, comparability, reality, and acceptability of financial results.

In business management, value is often an informal term that includes all forms of value that determine the health and well-being of the firm. Business value expands beyond economic or financial value to include other types of value, such as employee value, customer value, supplier value, channel partner value, alliance partner value, managerial value, and societal value. Many of these values are not directly calculated in monetary terms nor are they all pertinent to this discussion of how to demonstrate value in a practical fashion.

When defining the significance of OSH efforts, customer value is one of the more important criteria. The value can be expressed in terms of utility, quality, benefits, or customer satisfaction. Customer values are received by the end-customer as a result of an OSH action or practice implemented to control the risk of disease or injury. The end-customer may include external clients or customers as well as individuals within the organization who are an integral part of the business process.

The organization can also be viewed as a network of internal and external relationships. Value in this context is described as value networks or value chains. Each point in the network has an interest in the business process, such as a stakeholder group, a resource, end-consumers, interest groups, regulators, or the environment itself. To create value for the organization, there is a collaborative, creative, and synergistic process among the groups. If the organization is viewed as a network of value-creating entities (in this case, the OSH practitioner), the question becomes how each point in the network contributes to overall firm performance. While it would be beneficial if this value could be monetized into a single measure, it may not be feasible.

As a final note, Warren Buffett provides a most insightful definition in his commonly stated phrase: "Price is what you pay. Value is what you get." Whether value is measured in accounting, economic, or business terms, the value of OSH practices and programs is determined by the *impact* or the *effect* they have on the organization.

## How is Value Measured?

Although there are a number of ways to measure, estimate, or demonstrate value, one of the more widely adopted methods in the business community is accomplished through developing a business case. A quick search of the Internet reveals a variety of definitions for the term business case. The following list presents verbatim those definitions that are grounded in the fields of project management, decision science, or financial management.

- A business case captures the reasoning for initiating a project or task. Wikipedia at [http://en.wikipedia.org/wiki/Business\\_case](http://en.wikipedia.org/wiki/Business_case).
- An explanation of how a new project, product, and so on is going to be successful and why people should invest money in it. Longman Business English Dictionary at <http://lexicon.ft.com/term.asp?t=business-case>.
- A type of decision-making tool used to determine the effects a particular decision will have on profitability. A business case should show how the decision will alter cash flows over a period of time, and how costs and revenue will change. Specific attention is paid to internal rate of return (IRR), cash flow, and payback period. Analyzing the financial outcomes stemming from choosing a different vendor to sell a company's product is an example of a business case. Business Dictionary at <http://www.businessdictionary.com/definition/business-case.html>.
- Information necessary to assess benefits of a project against costs and resources to assess whether the proposal should go ahead. The Department for Business and Innovation Skills in the UK at <http://www.berr.gov.uk/aboutus/corporate/projectcentre/glossary/page10895.html>.
- Structured proposal that justifies a project for decision makers. Includes an analysis of business process performance and requirements, assumptions, and issues. Also presents the risk analysis by explaining strengths, weaknesses, opportunities, and threats. US Department of Interior, Bureau of Land Management at <http://www.blm.gov/wo/st/en/prog/more/bea/Glossary.html>.
- The business case provides justification for undertaking a project, in terms of evaluating the benefit, cost, and risk of alternative options and rationale for the preferred solution. Its purpose is to obtain management commitment and approval for investment in the project. Association for Project Management in the UK at <http://www.apm.org.uk/Definitions.asp>.
- A form that provides detailed information about a proposed standard's business implications and its impact on processes and resources. Ontario Health Care Information Exchange at <https://www.ehealthontario.ca/portal/server.pt>.
- A collection of descriptive and analytic information about an investment in resource(s) and/or capabilities. International Enterprise Architecture Institute at <http://www.internationaleainstitute.org/ea-terms-definitions/>.

Each of these definitions have similarities and merit, but the following definition has been adopted by the Centers for Disease Control and Prevention: *Investing in Health and Safety: A Business Case Resource Guide* will be used as the basis for the remaining discussion.

*The business case assesses the quantitative and qualitative performance of an intervention from a business perspective. Ideally, a business case is an ex ante or a priori structured proposal that assists executives, medical and financial officers in decisions to invest in health protection interventions. The business case can also take the form of an ex post proposal in cases where the success or failure of a current intervention needs to be examined or a rationale is needed for securing funds to revamp, revise, continue or expand an existing program.*

(Carande-Kulis, Biddle and Sotnikov, 2009)

## What Tools are Available to Develop the Business Case?

There are a number of general guidelines for developing the business case, but few that address the OSH field. Furthermore, the number of systems or full models—those that include a model, data collection instruments, and instructional documentation—to capture the benefits and costs to the business of implementing OSH interventions are also limited.

In 2004, the US National Institute for Occupational Safety and Health and the World Health Organization (WHO) co-organized the conference “Economic Evaluation of Occupational Health and Safety Interventions at the Company Level” to explore the current status of the use of tools to demonstrate the economic gains from OSH actions. Six key economic or financial evaluation tools that evaluated the impacts of OSH interventions from an individual company perspective were presented at this conference (Eijkemans and Fingerhut, 2005). These tools ranged from individualized approaches suitable for small businesses to complex computerized systems designed for the corporate client. The following examples are three of the most widely used models or methods to develop a business case for OSH issues that were presented during that conference.

### Productivity Assessment Tool

One of the earliest cost-benefit analysis tools for OSH, the Productivity Assessment Tool, was developed and published in *Increasing Productivity and Profit through Health & Safety* by Oxenburgh in 1991. This tool was developed for the service and manufacturing sectors and was designed to show that productivity and profit for an enterprise are compatible with safe and healthful working conditions for its employees (Oxenburgh and Marlow, 2005). This computerized tool or program evaluates the potential costs and benefits of specific changes in working conditions by exploring the changes in the employee productivity.

The Productivity Assessment Tool consists of four parts—data on employees, the workplace, the intervention, and a report. Table 2.1 is presented to demonstrate the concept of the Tool.

This model measures productivity changes against what is termed the “ideal state.” Simply put, this is the production level if all resources were operating at full capacity. The model captures the annual hours paid by the employer minus the hours that the employee is not actively producing. Losses of productive time include absences from injury, illness, training, vacation and holidays, or other absences such as maternity or military service leave. The hours of productive time are multiplied by the wage of the worker.

**Table 2.1 The Productivity Assessment Tool**

	<b>Initial case enter data on:</b>	<b>Test case(s) enter expected changes for:</b>
Data concerning the employees	<ul style="list-style-type: none"> <li>• productive hours</li> <li>• wage costs</li> <li>• overtime</li> <li>• reduced productivity</li> </ul>	<ul style="list-style-type: none"> <li>• productive hours</li> <li>• wage costs</li> <li>• overtime</li> <li>• reduced productivity</li> </ul>
Data concerning the workplace	<ul style="list-style-type: none"> <li>• recruitment</li> <li>• insurance</li> <li>• reduction in waste</li> <li>• energy use</li> <li>• other overheads</li> </ul>	<ul style="list-style-type: none"> <li>• recruitment</li> <li>• insurance</li> <li>• reduction in waste</li> <li>• energy use</li> <li>• other overheads</li> </ul>
The intervention	Costs, or estimated costs, for the intervention	
The reports	Cost-benefit analysis calculations and reports of the workplace and the employees	

Source: Oxenburgh, Marlow and Oxenburgh, 2004, Figure 4.1.

This is not an individual wage for each employee, but rather an average for an employee category or occupation. The most robust of the available programs will allow up to five employee categories to be considered. Any additional wages, such as overtime, should be added to finalize the annual productive value.

The program collects data concerning the employee using a series of screens with sections for the initial and test cases. The first of the series asks for data on the number of employees, hours per week, and the absences associated with the individual employee or employee group. Employer costs, administrative, managerial, and supervisory costs, are captured in the next screen. The final screens in the series for capturing employee data request a percentage of reduced productivity. This information is also used to identify the need for intervening or modifying the working conditions for the group of employees being examined. Oxenburgh provided Table 2.2 as an overview to the *Reduced Productivity* data screen.

**Table 2.2 Oxenburgh’s overview to the Reduced Productivity data screen**

<b>Reason for reduced productivity</b>	<b>Typical interventions that would lead from these factors</b>
Low skill	Improve or increase training
Hand tools	Replace or improve hand tools with a design better suited to the work tasks
Capital	Improve maintenance, replace machinery
Other	Factors not covered above
Reduced productivity (%) and cost per year for the year for the employee group based on employee costs	

Source: Oxenburgh, Marlow and Oxenburgh, 2004, Figure 4.4.

Capturing data concerning the workplace is completed through two screens. The first screen collects information on allocated costs, which includes overhead costs that should be proportioned to the employee group being analyzed. A second screen captures recruitment costs, which are the costs associated with employment of new employees and the skill loss when employees leave. Intervention costs are entered in the allocated costs screens under the test case column and include capital costs, management, and consultant time and costs. The effects of the intervention are entered on the remaining screens as appropriate.

In summary, this model presents estimated productivity changes and health effects of a proposed action and produces savings per year and payback periods for use in creating other financial metrics. By far, ergonomic interventions have constituted the largest share of the analyses using The Productivity Assessment Tool.

## CERSSO

The Regional Center for Occupational Safety and Health (CERSSO) developed the Tool Kit for use in Central American garment factories (Amador-Redezno, 2005). This computer-based cost-benefit tool was deemed an “instrument designed for you to test it within the confidentiality of your business and which through a simple manner can help show you how much money you are losing by not investing in the Safety and Health of your employees” (Biddle et al., 2005). This six-step model begins with defining the magnitude of the problem and ends with an analysis of the costs and benefits of an OSH investment—integrating epidemiology, risk assessment, industrial engineering, and accounting discipline.

Table 2.3 presents a summary of the steps to complete the CERSSO model entitled “Self Evaluation of the Cost-Benefit on the Investments in Occupational Safety and Health in the Textile Factory.”

**Table 2.3 A summary of the steps to complete the CERSSO model**

<b>Parts</b>	<b>Measures</b>
Step 1 Definition of the magnitude of the problem according to causes and effects	1.1.a. Description of operations
	1.1.b. Prioritizing the causes (risks and demands)
	1.2. Description of the male and female employees in their operations
	1.3. Description of the CAUSES (risks and demands) by their operations.
	1.4. Description of EFFECTS and their relationship with the causes
Step 2 Risk appraisal	2.1. Appraisal of the probability of the effect
	2.2. Appraisal of the severity of the effect
	2.3. Appraisal of the risk
Step 3 Definition of the preventive measures to be undertaken	3.1. Definition of the preventive measures to be undertaken

**Table 2.3 A summary of the steps to complete the CERSSO model concluded**

Parts	Measures
Step 4 Graphing the relationship between the preventive measures and their positive impact	4.1. Graphing the relationship between the preventive measures and their positive impact
Step 5 Evaluating the cost of prevention and its effects	5.1 Identifying the costs of the preventive measures made at the source, individuals and preventive medical actions
	5.2. Identifying the direct costs caused by the potential effects
	5.3. Identifying the indirect costs caused by the potential effects
	5.4. Totaling the costs
Step 6 Analysis of the costs-benefits	6.1. Compare and contrast the costs of the measures taken and the costs of the potential effects

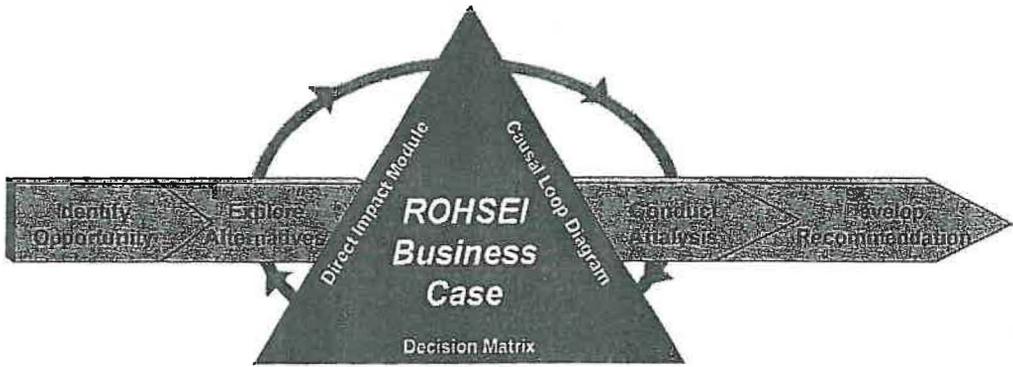
## ROHSEI

Fifteen member companies of the ORC Occupational Safety and Health Group—ALCOA, AlliedSignal, ARCO, Bayer, Bristol-Myers Squibb, Colgate-Palmolive, Dow, Duke Power, Eli Lilly, IBM, Johnson & Johnson, Monsanto, M&M Mars, Rhone-Poulenc Rorer, Schering-Plough—formed a task force to work with ORC Worldwide and Arthur Andersen to tailor traditional financial investment analysis approaches and apply them to achieve a better understanding of the business impacts of health, safety, and environmental investments (Linhard, 2005).

The “Return on Health, Safety and Environmental Investments” (ROHSEI) process and tools were developed through interviews with financial, health and safety, and operational professionals, data collection from more than a dozen companies, focus group sessions, and field testing. Since 1997, ROHSEI has demonstrated that analytical tools currently used and accepted by the financial community can be applied to health and safety investments when appropriate data elements underpin the analysis. The process allows users to evaluate health and safety investments on a cost/performance basis. For each alternative, the ROHSEI process facilitates consideration of direct benefits and costs as well as hidden impacts, such as worker productivity. Building the business case employs the following four steps:

1. Understand the opportunity or challenge.
2. Identify and explore alternative solutions.
3. Gather data and conduct analysis.
4. Make a recommendation.

Figure 2.1 highlights the relationship among these four steps and the business case development. It also introduces the four tools that support the analysis: a Business Case Summary, a Causal Loop Diagram, a Direct Impact module, and a Decision Matrix.



**Figure 2.1** Overview of the ORC Worldwide ROHSEI method

Table 2.4 demonstrates how the tools are aligned with the process steps. For example, the Causal Loop Diagram is a tool designed to brainstorm alternative solutions, explore relationships, and identify other impacts of the project. It helps develop a comprehensive view of how each of the alternative investments impacts business performance, considering both direct and hidden benefits and costs.

**Table 2.4** How the tools are aligned with the process steps

ROHSEI Process	ROHSEI Tools			
Understand the opportunity or challenge				Business case summary
Identify alternative solutions	Causal loop diagram			Business case summary
Gather data and conduct analysis	Causal loop diagram	Direct impact module	Decision matrix	Business case summary
Recommend a solution based on the analysis				Business case summary

## Centers for Disease Control and Prevention (CDC) Business Case Guide

Also in 2004, the Centers for Disease Control and Prevention (CDC) Office of Public and Private Partnership in the National Center for Health Marketing held a brown bag lunch to begin discussions on "Building The Business Case for Prevention: public health policy research agenda." The fourteenth year class of the Public Health Leadership Institute consisting of four of the top management officials within CDC (Ileana Arias PhD, Director of the National Center for Injury Prevention and Control; Hamid Jafari PhD, National Center for Immunization and Respiratory Diseases; Verla Neslund JD, CDC Foundation; Tanja Popovic MD PhD, Chief Science Officer for CDC) embraced the need for CDC to develop a definition and template for creation of a business case. It was understood that the mission of CDC is to improve the quality of life and reduce disease, disability, and injuries.

CDC addresses this mission through a broad array of activities including establishing business partnerships. Businesses are important channels of safety and health protection and promotion for CDC. As a result, the *Investing in Health and Safety: A Business Case Resource Guide* was developed with the intent to provide guidance which would allow consistency, flexibility, and transparency, and have a broad utility to CDC, businesses, academics, and health and safety practitioners (Carande-Kulis, Biddle and Sotnikov, 2009).

The guidance provides a methodological approach for conducting business cases for health and safety actions, and includes those actions implemented by businesses, on the premises of business, or under the direction of business. It describes the techniques and procedures used to develop business cases from the business perspective. The document identifies the following seven steps, shown in Table 2.5, to develop the business case for investing in safety and health.

**Table 2.5 Seven steps to develop the business case for investing in safety and health**

Steps	Components
Step 1 Describe the current situation	Describe current interventions
	Identify the health protection problem
Step 2 Consider business and national health and safety goals	Consider business goals
	Consider national goals
Step 3 Identify intervention options	Develop a long list of options
	Select a short list of options
Step 4 Define the analytic framework	Define the audience
	Define the perspective
	Define the time frame and analytic horizon
	Consider study design
Step 5 Assess outcomes, costs, and benefits	Measure health and non-health outcomes
	Measure or estimate costs
	Assess and value benefits
Step 6 Identify preferred option(s)	Calculate financial metrics
	Conduct sensitivity analyses
	Rank and prioritize options
Step 7 Finalize the business case	Business case template
	Report the business case
	Consider factors influencing approval
	Final thoughts

## The Next Generation of the Business Case: The Value Proposition

The previous section illustrates tools or methods that have been used to develop OSH business cases since the late 1900s. Despite the light that the results have shed on the value of OSH efforts and the assistance in OSH decision-making efforts, the next generation of the business case should be expanded to include the impact on non-financial measures to a much greater extent. The new business case methods must demonstrate that mitigating potential safety and health hazards with effective and efficient solutions creates a competitive advantage for the firm. The new business case methods need to demonstrate that OSH professionals are important partners with business executives in managing enterprise risks—which includes the risk of adverse safety and health incidents. The next generation of the business case must include measures to demonstrate the contribution of OSH to corporate social responsibility, sustainability, and product stewardship.

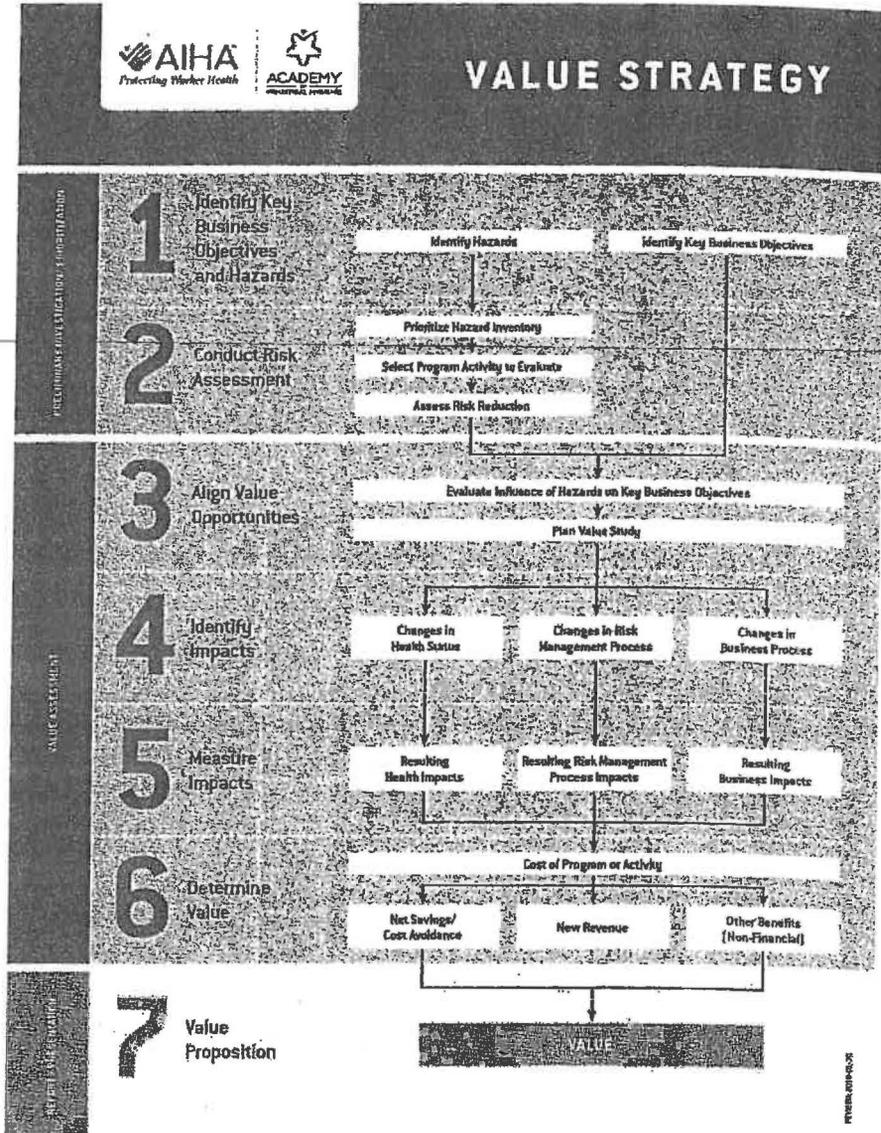
An effort to provide such a methodology began in 2003 with American Industrial Hygiene Association and the American Board of Industrial Hygiene sponsoring the Value of the Profession Study. The goal of the multi-year study was to determine which mechanisms allow the industrial hygienist to demonstrate business impact of industrial hygiene programs and interventions and to create a strategy to provide the basis for efficient and effective illustration of the value of occupational health actions.

By June 2008, the Value of the Profession Strategy was finalized by an ORC Worldwide-led team (Elyce Biddle, Steve Newell, Reepa Shroff, and Dee Woodhull). The Strategy included the eight steps shown in Figure 2.2.

The formulative phase of the strategy is reflected in the first two steps. These steps provide the background for determining the value of industrial hygiene activities in current and future time frames. Identifying the OSH hazards—one of the primary functions of an industrial hygienist—is captured in the first step of this phase. This phase also includes gathering those business objectives which might be influenced by the work of the industrial hygienist. Because a number of value studies could be undertaken, the second step prioritizes those potential value studies with the goal of insuring that the best opportunity to demonstrate the value of the industrial hygiene program or intervention is seized.

Collectively, the next five steps describe the necessary methods to develop the value proposition. The first step of this phase is a familiar and routine task for industrial hygienists and other occupational health and safety practitioners, conducting risk assessments of those jobs or tasks associated with processes or services that have been selected for evaluation. Ideally, risk assessments would be conducted prior to implementing any programs or activities to mitigate risks, and again following the implementation as a measure of improvement in risk management. At this point, the Strategy provides an opportunity to select the methods of assessing the value—either a quantitative approach, a qualitative approach, or a combination of both. Which method is selected depends on a number of factors including the needs of the organization, the time available for analysis, and the availability of tangible data.

Both the quantitative and qualitative methods determine the effects of implementing programs or activities on employee health (injury or illness), risk management, and the business process. The quantitative approach determines the monetary impact by capturing detailed cost data and generating customary financial business metrics, such as net present value (NPV), return on investment (ROI), and discounted payback period (DPP), which are meaningful to business management.



**Figure 2.2 Value of the Profession Strategy**

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The qualitative method captures the value of the contribution of the occupational health program or intervention by tracking its impact on health, the risk management process, and the business process but also through an *evidentiary cause and effect analysis* patterned after legal methodology. The qualitative method isolates and extracts other factors that could have produced the same effects. The results are generally expressed in narrative explanations or non-monetary numerical values, such as the percent change in output.

In general, a quantitative analysis using generally accepted financial business metrics is preferable to a qualitative approach. However, the Strategy architecture can tie the quantitative and qualitative approaches together and provide common framework for capturing and presenting benefits. Regardless of the approach, there must be adequate

time allocated to explore the changes in employee health outcomes, changes in the requirements for conducting the industrial hygiene functions, and changes in any downstream business processes of the organization. These changes can be converted into value—whether monetized savings, increased capacity, or a reduction in resource requirements.

The eighth and final step is to develop a package for presentation to the target audience. In addition to the requirements of the target audience, the organizational culture determines the exact presentation content, form, and style. In the quantitative approach, the effects of implementation of the programs or activities on health, risk management, or the business process are the sources of value in the analysis. Benefits of implementation are determined by calculating the difference in costs related to health status, the risk management process, and the business process before and after the intervention. The benefits derived through cost savings and new revenue are expressed in terms of financial metrics, such as NPV, ROI and DPP, that are meaningful to business management. Contributions to business objectives are summarized and presented in specific terms.

The Strategy was tested by the ORC Worldwide-led research team by determining the value of industrial hygiene activities at 15 companies. These tests were designed to evaluate the ability to implement the strategy. However, in addition to demonstrating that the strategy could be employed by an industrial hygienist, a series of unexpected findings unfolded. Most importantly, significant contributions to the business and operations were found in a wide range of interventions implemented by industrial hygienists. Industrial hygienists have worked to:

- eliminate lead from a raw material stream that saved tens of thousands of dollars in operating costs and kept a facility from closing;
- substitute a less toxic material for a chromate primer that saved an aircraft company nearly a half-million dollars in processing costs and added capacity to build an additional aircraft each year. This increased the revenue stream several million dollars annually;
- install engineering controls at a small company to control exposure to nanoparticles that resulted in a ten-fold increase in production capacity; and
- use containment strategies to minimize exposure to potent active pharmaceutical powders that resulted in employee health improvement, reduced personal protective equipment usage, and reduced industrial hygiene sampling expense. This action also assured regulatory compliance, reduced the need for cleaning, and increased employee productivity.

Each case study explored in the research study illustrated essential contributions to business value that are rarely associated with industrial hygiene. One site visit identified a key industrial process that generates billions in revenue annually that would not exist without the active involvement of the industrial hygienist. A challenge to the profession is to identify and document such critical contributions.

The study also identified the relationship between the hierarchy of controls and the value of increasing investments to improve workplace exposures and, subsequently, generate significant financial returns on those investments. In some of the case studies and site visits, the research team observed that as one selects hazard control measures

higher in the industrial hygiene hierarchy of controls, business value increased. In a few cases, recovery of initial investments, the greatest cost savings, and other benefits were found to result from eliminating hazards through engineering controls and through the use of personal protective equipment by workers. Other case study results show that with little capital investment, material substitution and containment projects also can have very large pay offs while reducing the potential for worker exposures to hazardous materials. In short, increased investments in industrial hygiene programs or interventions, when using the hierarchy of controls for guidance, have shown to not only have positive impacts for protection of worker health, but often produce a substantial positive business return.

## Financial Metrics

As illustrated in the previous examples, the steps and elements required to develop a business case can vary substantially by system design or by the program or intervention being analyzed. The methods can vary depending on the number of employees being affected, the length of time required to implement the program or intervention, or the length of time until the effects of the change are felt. The methods can also vary by the business type and size or the requirements set by the management of the business. However, one element that can be found in all business case analysis is the calculation of financial metrics. For that reason, a thorough understanding of how to derive and interpret the basic financial metrics is important.

Financial metrics describe the effect that an investment has on profit and the financial condition of the company. While accounting standards are published and interpreted in the United States through the Financial Accounting Standards Board (FASB), the same is not true for more general financial metrics. Definitions may vary somewhat by source and may diverge from GAAP. The following are common financial measures used to evaluate business investments within a corporate or commercial enterprise, including short- and long-term investments. Within this context, OSH activities or programs are the investments being evaluated, whether they affect capital investment or working capital management

### CASH FLOW (CF)

Cash Flow (CF) is the basis for deriving the majority of financial metrics for the business case. The CF statement provides a list of the actual or undiscounted investment outflows (costs and expenses) that will be required to implement the intervention, the actual or undiscounted inflows (monetized benefits) that the intervention is expected to produce, and the time those inflows will occur during the analytical period. Each benefit or cost identified leads to either an expected CF result, or a value which is monetized in CF terms. CF entries should include non-cash charges such as depreciation and can reflect after-tax values.

Cash flows can be entered daily, monthly, or annually. Tables 2.6 and 2.7 provide examples of CF statements associated with the "status quo" (also known as a base case) and another one for a proposed intervention or program. These examples provide the net CF for each year under consideration, since they generally serve as the starting point

for budgeting and business planning activities. A number of external factors, such as inflation, changes in tax rate, and the overall economic environment may influence the CF in future years. For example, costs in the third or fourth year of an OSH program may be substantially higher because of inflation in the costs of materials and labor required to implement the program.

**Table 2.6 Cash flow for a status quo intervention or program**

<b>Benefits or Gains (Cash Inflows in \$)</b>	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>	<b>Total</b>
Benefit 1	45	66	165	228	279	783
Benefit 2	428	588	641	699	777	3,133
Benefit 3	781	677	620	755	819	3,652
<b>Total Cash Inflows</b>	<b>1,254</b>	<b>1,331</b>	<b>1,426</b>	<b>1,682</b>	<b>1,875</b>	<b>7,568</b>
<b>Costs and Expenses (Cash Outflows)</b>						
Cost 1	(90)	(87)	(87)	(95)	(110)	(469)
Cost 2	(165)	(165)	(255)	(280)	(320)	(1,185)
Cost 3	(975)	(777)	(645)	(700)	(710)	(3,807)
<b>Total Cash Outflows</b>	<b>(1,230)</b>	<b>(1,029)</b>	<b>(987)</b>	<b>(1,075)</b>	<b>(1,140)</b>	<b>(5,461)</b>
<b>Cash Flow Summary</b>						
Total Cash Inflows	1,254	1,331	1,426	1,682	1,875	7,568
Total Cast Outflows	(1,230)	(1,029)	(987)	(1,075)	(1,140)	(5,461)
Net Cash Flow	24	302	439	607	735	2,107

**Table 2.7 Cash flow chart for a proposed intervention or program**

<b>Benefits or Gains (Cash Inflows in \$)</b>	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>	<b>Total</b>
Benefit 1	120	170	150	275	300	1,015
Benefit 2	500	615	704	755	812	3,386
Benefit 3	866	876	812	900	1,010	4,464
<b>Total Cash Inflows</b>	<b>1,486</b>	<b>1,661</b>	<b>1,666</b>	<b>1,930</b>	<b>2,122</b>	<b>8,865</b>
<b>Costs and Expenses (Cash Outflows)</b>						
Cost 1	(90)	(95)	(88)	(85)	(89)	(447)
Cost 2	(400)	(350)	(387)	(320)	(300)	(1,757)
Cost 3	(1,010)	(849)	(597)	(650)	(650)	(3,756)
<b>Total Cash Outflows</b>	<b>(1,500)</b>	<b>(1,294)</b>	<b>(1,072)</b>	<b>(1,055)</b>	<b>(1,039)</b>	<b>(5,960)</b>
<b>Cash Flow Summary</b>						
Total Cash Inflows	1,486	1,661	1,666	1,930	2,122	8,965
Total Cast Outflows	(1,500)	(1,294)	(1,072)	(1,055)	(1,039)	(5,960)
Net Cash Flow	(14)	367	594	875	1,083	2,905

*Incremental cash flow* shows the difference between the status quo CF and the CF associated with implementing a new program or intervention. Simple CF does not consider uncertainty and the value of time.

These examples do not present the Discounted Cash Flow (DCF), which accommodates for the uncertainty and value of time in the real world by discounting the CF stream. Discounting adjusts the value of future CF by giving more "value" or weight to the near term CF and less "value" to those in the more distant future. It is important to know when you should include a discounted cash flow in your business case presentation. If the intervention or programs being considered cover long periods of time or if the magnitude of the inflows and outflows are different within each time period, a DCF should be presented. A DCF should also be presented if the timing of the CF from each intervention or program differs substantially within the analysis period.

**Table 2.8 Incremental cash flow**

<b>Benefits or Gains (Cash Inflows)</b>	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>	<b>Total</b>
Benefit 1	75	104	(15)	47	21	232
Benefit 2	72	27	63	56	35	253
Benefit 3	85	199	192	145	191	812
<b>Total Cash Inflows</b>	<b>232</b>	<b>330</b>	<b>240</b>	<b>248</b>	<b>247</b>	<b>1297</b>
<b>Costs and Expenses (Cash Outflows)</b>						
Cost 1	0	(8)	(1)	10	21	22
Cost 2	(235)	(185)	(132)	(40)	20	(572)
Cost 3	(35)	(72)	48	50	60	51
<b>Total Cash Outflows</b>	<b>(270)</b>	<b>(265)</b>	<b>(85)</b>	<b>20</b>	<b>101</b>	<b>(499)</b>
<b>Cash Flow Summary</b>						
Total Cash Inflows	232	330	240	248	247	1297
Total Cast Outflows	(270)	(265)	(85)	20	101	(499)
Net Cash Flow	(38)	65	155	268	348	798

### NET PRESENT VALUE (NPV)

The *Net Present Value* (NPV) is the sum of the discounted values of a CF stream of net benefits (benefits – costs) over time. Mathematically, NPV is represented as:

$$NPV = \sum_{t=0}^n A_t (1+i)^{-t}$$

where,  $A_t$  represents the series of annual net CF of the intervention,  $i$  represents the designated discount rate,  $t$  is each expected year of implementation and  $n$  is the total expected years in the analytic horizon. NPV is a direct measure of the size of the benefits, net of costs, at the end of the analytic horizon, which the business would have gained by undertaking the program or implementing the intervention, accounting for the value of money. The discount rate for NPV and other measures calculated from the business perspective is usually the opportunity cost of capital for the business that is affected. The opportunity cost, also known as the minimum attractive rate of return (MARR)

or hurdle rate, encompasses the market interest rate for lending and borrowing and the risks associated with the investment opportunities. Sensitivity analysis may be used to look at the impact of the MARR on the NPV since the MARR is a difficult rate to measure or obtain.

The NPV is a preferred financial metric because it is not affected by the analytic horizon as long as the analytic horizon is greater than or equal to the useful life of the intervention. Table 2.9 demonstrates the NPV calculation associated with a proposal for a hypothetical intervention where the discount rate is assumed to be 8 percent in each time period.

**Table 2.9 Net Present Value calculation**

Year	Annual net cash flows	Discount factor for 8% interest	Annual discounted value
0	(317.2)	1.0000	(317.200)
1	295.5	0.9259	273.603
2	248.2	0.8573	212.782
3	245.0	0.7938	194.481
4	475.2	0.7350	349.272
5	591.3	0.6806	402.439
			NPV = 1115.377

## PAYBACK PERIOD

The *payback period* is the length of time needed for the business to recover an investment through the CF (described above) and is generally expressed in years. In other words, how long does it take for the intervention or program to pay for itself? The simple payback period is the smallest positive integer  $p$  such that:

$$\text{Payback period} = \sum_{t=0}^p A_{t,x} \geq 0$$

where  $A_{t,x}$  represents the annual net CF of intervention  $x$ .

Using data found in Table 2.9, the annual net CF presented are shown in the bottom row of Table 2.10. Here, the payback period occurs in period 2 because the sum of annual net CF for the project is  $<0$  until year 2. Alternatively, the payback period can be calculated to reflect portions of a year. Using the following example, the cumulative net CF are negative until sometime during year 2. Therefore the payback period =  $1.0 + (21.7 / 248.2) = 1.09$ , approximately at the beginning of the second month of year 2.

The payback period metric is generally both simple to calculate and easy to understand. As a result, this metric is routinely used by companies and is sometimes used as a crude measure of risk. The option with the shorter payback period is considered less risky. Despite these attributes, the payback period remains a rough estimate and even if all the assumptions and data are precise, the exact payback day is rarely known. If the net CF is never positive throughout the time horizon, then the payback cannot be calculated.

**Table 2.10 Payback period calculation**

For the year ending December 31, \$ in 1,000s							
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	
	2002	2003	2004	2005	2006	2007	Total
Net Cash Flow (CF)	(317.2)	295.5	248.2	245	475.2	591.3	1,538.0
Cumulative Net CF	(317.2)	(21.7)	226.5	471.5	946.7	1,538.0	

Any changes in CF (negative or positive) beyond the payback date are not accounted for. Finally, in the simple payback period, the CF entries are not discounted and therefore this metric does not incorporate the value of time. The analyst, however, may choose to discount the CF entries making the metric adjusted for the value of time. In this case, the measure is called discounted payback period.

### RETURN ON INVESTMENT (ROI)

Return on Investment is a widely used term with multiple definitions in the field of accounting. Examples of the various types of returns on investments include Return on Invested Capital, Return on Capital Employed, Return on Total Assets, and Return on Net Worth. Therefore, it is important that the methods for calculating this metric are clearly explained in the business case report.

For the purposes of this paper, the Simple ROI is less of an accounting term than a generalized term for the expected value of an investment in terms of added revenue or profits, or averted expenses.

$$\text{Simple ROI} = (P_b - P_c) / P_c$$

Where  $P_b$  represents the gains or benefits from the intervention and  $P_c$  represents the cost of that intervention. ROI can be presented as a ratio or as a percentage, that is, the simple ROI times 100 percent. As a ratio, the ROI measures the effectiveness of the investment by calculating how many times the net benefits (benefits from investment minus initial and ongoing costs) recover one dollar invested. As a percentage, the ROI measures the net benefits per hundred dollars invested.

For example, an equipment redesign intervention to decrease the risk of injury in the assembly line is undertaken, at a cost of \$1.25 million. It is expected to be in place for at least ten years. During that time it is expected to generate a discounted savings of \$1 million in averted medical costs and lost productivity. Additional discounted revenue streams from commercializing the technology are expected to produce \$3 million. The Simple ROI is  $(\$4 \text{ million} - \$1.25 \text{ million}) / \$1.25 \text{ million} = 2.2$ , which is generally expressed as a ratio, 2.2:1 or percentage, 220 percent. Consequently the investment produces a return of 2.2 dollars per dollar invested or 220 dollars per 100 dollars invested.

### INTERNAL RATE OF RETURN (IRR)

This financial metric determines the discount rate at which the NPV is zero. The IRR can be seen as the reverse of NPV, in that IRR computes the break-even rate of return showing the discount rate below which an investment produces a positive NPV. Like the NPV, IRR takes into account the time value of money by considering the CF over the lifetime of

a program or intervention. However, unlike the NPV, the IRR is an indirect method for measuring the value of an intervention, but nonetheless is a useful metric if a unique value exists. Mathematically, the IRR is represented as:

$$\text{IRR} = \sum_{t=0}^n \frac{A_t}{(1+i)^t} = 0$$

where  $A$  represents the annual net discounted CF of the intervention at time  $t$ ,  $i$  represents the interest rate, and  $n$  is the expected intervention's length. Notice that the IRR formula is merely the NPV formula set equal to zero, with CF known. Although the measure is conceptually simple, solving for the IRR can be more complex. Three basic methods are used to solve for the unknown interest value: trial and error, graphic representation, and a financial calculation or computational solution.

Programs or interventions that have large cash outflows during or at the end of its time horizon (as opposed to the normal case of one or more cash outflows followed by a series of cash inflows) can pose difficulties when employing the IRR as a financial metric. These types of analysis can have no solution, multiple solutions, or the solution can lead to an improper decision. To illustrate the latter assume two interventions with the following CF (see Table 2.11).

**Table 2.11 Financial metric comparison**

Intervention	Expected net cash flow		Financial metric	
	Year 0	End of Year 1	IRR	NPV ( $i=10\%$ )
A	(\$100,000)	\$120,000	20%	\$9,091
B	\$83,333	(\$100,000)	20%	(\$7,576)

Using the IRR as the financial metric and assuming a minimum attractive rate of return of 10 percent, both interventions would be desirable. However, the NPV suggests that intervention B may not be an acceptable funding opportunity.

## Comparison of Financial Metrics

Each financial metric has value and presents different information for consideration by the decision maker. The following case example should clarify the differences in these financial metrics. In this example, the analyst assesses two proposed mutually exclusive interventions both lasting four years. Development of CF and calculation of financial metrics can become more difficult when interventions are not mutually exclusive or have different timelines. A full discussion of more complex computational situations or conditions is beyond the scope of this paper, but can be readily found in financial management, project evaluation, or managerial accounting texts (Brigham, 1982; Au and Au, 1992; Sullivan and White, 1995).

Each proposed intervention in this example has a cost of \$10,000, and the MARR for both is 12 percent. Table 2.12 presents the net CF for each intervention. Table 2.13 presents the cumulative CF for each intervention, which are necessary to calculate the payback periods. And, finally, Table 2.14 presents the calculation of all financial metrics for both interventions. In this example, all financial metrics indicated that intervention A is better than intervention B.

**Table 2.12 Net cash flow calculations for competing interventions**

Year	Net cash flow (\$)	
	Intervention A	Intervention B
0	(10,000)	(10,000)
1	6,500	3,500
2	3,000	3,500
3	3,000	3,500
4	1,000	3,500

**Table 2.13 Cumulative cash flow calculations for competing interventions**

Year	Cumulative cash flow (\$)	
	Intervention A	Intervention B
0	(10,000)	(10,000)
1	(3,500)	(6,500)
2	(500)	(3,000)
3	2,500	500
4	3,500	4,000

**Table 2.14 Calculation of payback period, NPV, IRR, and ROI for interventions A and B**

Metric	Calculation	Results
Payback <sub>A</sub>	$2 + \$500/\$3000$	2.17 years
Payback <sub>B</sub>	$2 + \$3000/\$3500$	2.86 years
NPV <sub>A</sub>	$-\$10,000 + \$6,500/(1.12)^1 + \$3,000/(1.12)^2 + \$3,000/(1.12)^3 + \$1,000/(1.12)^4$	\$966.01
NPV <sub>B</sub>	$-\$10,000 + \$3,500/(1.12)^1 + \$3,500/(1.12)^2 + \$3,500/(1.12)^3 + \$3,500/(1.12)^4$	\$630.72
IRR <sub>A</sub>	$-\$10,000 + \$6,500/(r)^1 + \$3,000/(r)^2 + \$3,000/(r)^3 + \$1,000/(r)^4$	18%
IRR <sub>B</sub>	$-\$10,000 + \$3,500/(r)^1 + \$3,500/(r)^2 + \$3,500/(r)^3 + \$3,500/(r)^4$	15%
ROI <sub>A</sub>	$\$966.01/\$10,000$	9.7%
ROI <sub>B</sub>	$\$630.72/\$10,000$	6.3%

The "best" financial metric to be used when conducting a business case will depend on a number of factors. For example, the analyst could calculate and present all measures or only the customary measures used by the organization or industry in the analysis.

Alternatively, Brigham states that the accuracy of these metrics depends on the timing and magnitude of the CF. Regardless, for the metric to lead to consistently accurate decisions, it must exhibit the following three properties:

- the method must consider all CF throughout the entire life of an intervention;
- the method must consider the time value of money; that is, it must reflect the fact that dollars that come in sooner are more valuable than distant dollars;
- when the method is used to select from a set of mutually exclusive interventions, it must choose the intervention that maximizes the firm's financial performance.

As mentioned earlier, changes in CF beyond the payback date are not included in the calculations and, therefore, violate the first property. Undiscounted payback period violates the second property. However, it should be noted that many firms use payback period when the initial investment is small. The NPV, IRR, and ROI methods all satisfy the first and second properties. All three financial measures lead to identical and correct accept/reject decisions for independent interventions. However, only the NPV method satisfies the third property under all conditions. If two interventions are independent, NPV and IRR measures lead to the same conclusion. However, if both are mutually exclusive and not independent, the resulting measures may not lead to the same conclusions. Exclusive interventions are those when intervention *A* happens, then intervention *B* cannot, or vice-versa. Independent interventions are those when the outcome of intervention *A* has no effect on the outcome of intervention *B*. So, if intervention *A* and *B* are mutually exclusive, they *cannot* be independent. If events *A* and *B* are independent, they *cannot* be mutually exclusive (Brigham, 1982).

Selection of the financial measure or measures for inclusion in the business case is guided by the audience for that business case. Individual businesses routinely have preferences of measures. Some businesses prefer seeing the NPV while others prefer the IRR. The analyst should explore these preferences when the audience is a single business. If the audience is an industry or group of businesses, then the selection of the financial measure(s) to include may require additional exploration to determine the preferences of that group. However, with the completion of CF analysis, calculating the remaining financial measures may be prudent.

## IDENTIFY PREFERRED PROGRAMS, ACTIVITIES, OR INTERVENTIONS

Financial metrics aid in identifying the preferred programs, activities, or interventions through the use of decision rules. Generally, decision rules are determined by the specific organization in accordance with the financial strategies and their market position. However, there are general rules of thumb that are useful in the absence of company-specific rules. Despite whether the author of the business case is the final decision maker, it is important to understand these general rules if for no other reason than to eliminate any programs, activities, or interventions from your business case presentation that are clearly not feasible. When evaluating a single action, the rules are as shown in Table 2.15.

When comparing multiple interventions, Table 2.16 provides appropriate decision rules.

**Table 2.15 Decision rules for a single program or intervention**

<b>Metric</b>	<b>Decision rule</b>
NPV	Accept if $NPV \geq 0$ ; otherwise reject
Payback	Generally acceptable if within short-term time frame; 1–2 years
IRR	Accept if $IRR \geq MARR$ ; otherwise reject
ROI	Accept if $ROI \geq 0$

**Table 2.16 Decision rules for multiple interventions**

<b>Metric</b>	<b>Decision rule</b>
NPV	Select highest NPV value
Payback	Accept proposal with the shortest payback period
IRR	Select highest IRR
ROI	Accept if the largest positive ROI

## Conclusions

The business case is not a new tool or method in the business community, but it is relatively new to the OSH world. As was demonstrated through the application of the AIHA Value Strategy, reducing the risk to the worker can have a positive value to the business enterprise. As reported by Goetzel et al. it has been demonstrated through the use of developing the business cases that worksite health promotion and disease prevention programs save health care expenditures and produce a positive ROI for individual firms—Johnson & Johnson in 2002, Citibank in 1999–2000, Procter and Gamble in 1998, Chevron in 1998, California Public Retirement System in 1994, Bank of America in 1993, and Dupont in 1990.

As businesses continue to be under increasing pressure to be cost effective and more efficient, it becomes imperative that OSH professionals understand how to prepare and present the business case to successfully compete for scarce resources. OSH professionals must bridge the information gap by providing business decision makers evidence in the terms they understand—and have used since the early 1900s.

It is perhaps even more important for OSH professionals to understand the relative value of the interventions—programs or activities—they recommend for mitigating risks. The business case skills they develop can provide them with a new perspective regarding which solutions are best. For example, some OSH activities may not generate a positive NPV, but the results demonstrated by the business case will indicate that they are the best option to meeting regulatory requirements. Additionally, case studies have shown that commonly-held beliefs with respect to the cost-effectiveness of respiratory

protection versus engineering controls may be overturned when business case analysis is applied. Engineering controls are often the more cost-effective solution, as well as the more protective. Adding business case analysis to the set of tools OSH professionals have at their disposal can provide benefits on two levels—increasing the degree of protection for employees, and justifying the cost of OSH investments to management.

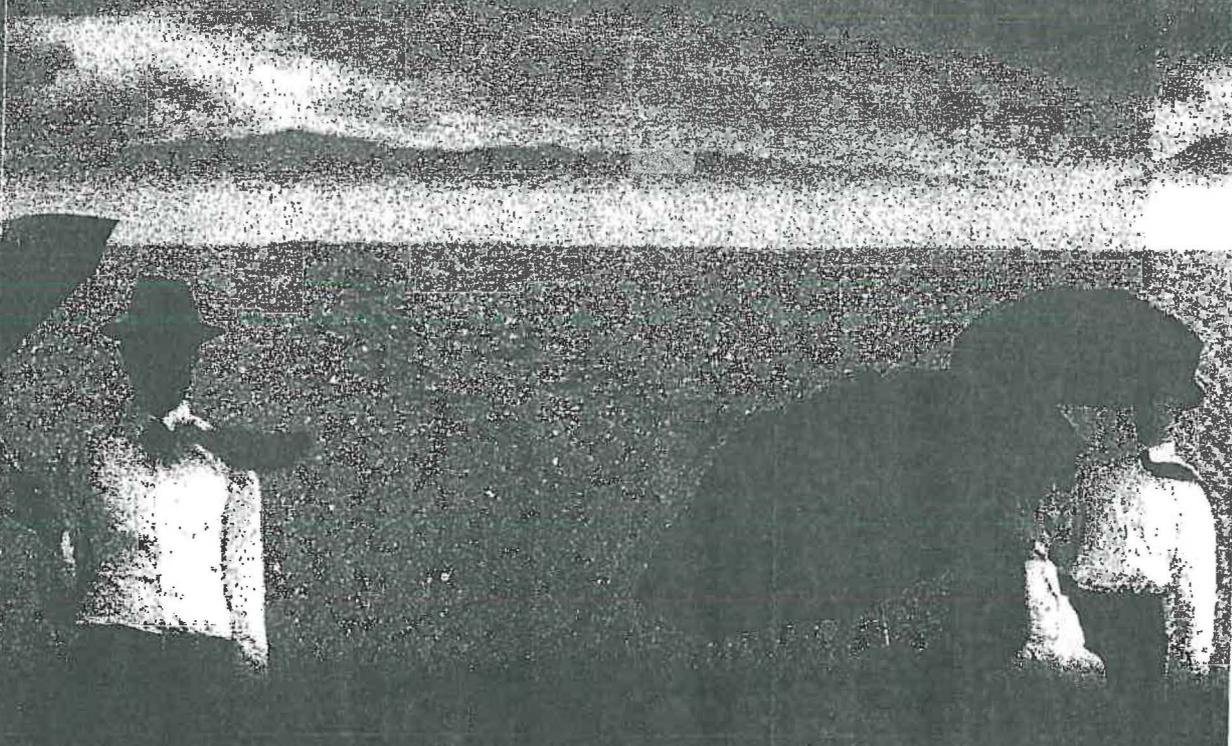
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# Occupational Health and Safety

A high-contrast, black and white photograph of an industrial or construction site. In the foreground, two workers are visible, one on the left wearing a hard hat and a light-colored shirt, and another on the right wearing a hard hat and a dark shirt. The background shows a large, bright, textured area, possibly a wall or a large piece of machinery, with a dark, shadowed area below it. The overall image has a grainy, high-contrast appearance.

PSYCHOLOGICAL AND BEHAVIORAL ASPECTS OF RISK

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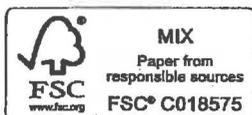
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