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# the synergist

May 2014

## WEIGHING RISK-COST TRADEOFFS

*Industrial Hygiene and  
the Economics of Risk*

### THE ECONOMICS OF RISK

#### *STRATEGIES FOR FINDING THE OPTIMAL RISK LEVEL*

Economic analysis can help IHs consider risk-cost tradeoffs when assessing risk control decisions.

BY FRANK HEARL, RENE PANA-CRYAN, AND CRISTINA MCLAUGHLIN



### SETTING THE STANDARD

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AIHA members serving on standards development committees provide meaningful input on standards that are critical to IH.

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### THE BANDING MARCHES ON

#### *NIOSH PROPOSES A NEW PROCESS FOR OCCUPATIONAL EXPOSURE BANDING*

NIOSH's proposed occupational exposure banding process addresses the need for guidance for chemicals without exposure limits.

BY LAURALYNN TAYLOR MCKERNAN AND MELISSA SEATON



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EHS Opportunities for IHS | Nuclear Plant Decommissioning | AIHce 2014 Wrap-up

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# *The Economics of Risk*

## Strategies for Finding the Optimal Risk Level

BY FRANK HEARL, RENE PANA-CRYAN, AND CRISTINA MCLAUGHLIN

**W**e make personal decisions about risk every day. These decisions depend on our understanding of risk and the options we have to reduce or control it. To understand risk, we need to understand both the probability and severity of the potential loss. We may have many options to control risk, but their potential costs and benefits may vary widely. Considering the risk-cost tradeoffs allows us to understand which risk control options make the most sense.

We generally want to limit the risk of potentially large losses by buying insurance. With insurance we pay a fixed premium and share the risk of damaging financial losses with a large group of other insured persons. How much we insure ourselves against depends on many factors, including the probability of a large financial loss and the cost of the insurance premium.

The economics of risk decisions concerning insurance can be easily evaluated in dollars and cents. But we also make decisions about safety and health that illustrate risk-cost tradeoffs. For example, you probably have smoke detectors installed in your home. The cost of these risk control systems is easy to assess—you paid for the smoke detectors, and you spent your labor and time installing the system (or paid a technician to do it). To estimate the potential benefit of installing the detection system, you need to assess the probability that a loss would occur if you had not installed the system and the potential cost of property damages and injuries *that would not occur* because the system was there.



You may assess the risk-cost tradeoff using national statistics. For example, in 2012, 365,000 dwelling fires were reported in the United States, which caused 2,380 deaths (not including firefighters) and \$5.7 billion (in 2012 dollars) in property damage.<sup>1</sup> From Census data we know that there are 115 million households in the U.S., which yields a risk estimate of about 320 fires per 100,000 households. In addition, out of all home fire deaths, 38 percent occurred in homes without smoke detectors.<sup>2</sup>

While it is relatively easy to assess the cost of the loss prevention or control systems, the benefit or value of the expenditure is a much more difficult problem. To estimate the benefit you need to assess the potential cost or value of the *loss that did not occur* due to your prevention system and the probability that the loss would have occurred if not for your installed system. The calculation for the expected benefits of control is:

$$(\text{Prob}_0 - \text{Prob}_1) \times (\text{Cost of Damage, \$})$$

Here,  $\text{Prob}_0$  is the probability of a bad event without control,  $\text{Prob}_1$  is the probability of a bad event with control, and the cost of damage is the cost that will be incurred if the bad event happens.

While you will want to protect yourself and your family from potential harm regardless of your analysis of risks and costs, the safety argument may be less persuasive for some landlords who have less personal stake in controlling risk and more personal stake in its cost. The landlord and landlord's family are not at physical risk, and their property is most likely covered against catastrophic loss by insurance. For these reasons, local governments often require landlords to install smoke detectors in rental properties.

## ECONOMICS AND RISK IN THE WORKPLACE

Employees, like homeowners or renters, face risks of injury and illness due to potential hazards in the workplace. Like landlords, employers produce and sell goods to make a profit. Employers may think of the cost of protecting worker safety and health as an overhead cost of doing business. Minimizing costs often results in maximizing profits, and there may be immediate pressure to increase short-term profits. However, treating worker safety and health as an overhead cost can be short-sighted and lead to missed opportunities to increase competitive performance while enhancing a business' reputation, improving its sustainability, and increasing its long-term profits.

## SOME COSTS TO THE EMPLOYER

To account for the full costs of injuries and illnesses, employers need to consider:

- Medical expenses not covered by insurance
- Disability payments not covered by insurance
- Hiring and training replacements
- Workers' compensation premium increase
- Citation fines and penalties
- Damage to facilities
- Reduced productivity; presenteeism, i.e. not being fully productive due to injury or illness
- Penalties for late deliveries due to production interruptions
- Impact on sales, reputation
- Worsened labor-management relations

## SOCIETY'S BURDEN

Section 2 of the Occupational Safety and Health Act of 1970 states, "personal injuries and illnesses arising out of work situations impose a substantial burden upon, and are a hindrance to, interstate commerce in terms of *lost production, wage loss, medical expenses, and disability compensation payments*." In 2007, the economic burden of occupational injury and illness in the United States measured as medical costs and productivity losses exceeded \$263 billion (in 2012 dollars).<sup>3,4</sup>

The Act also made employers responsible for providing employees with safe and healthful workplaces, free from recognized hazards that are causing or are likely to cause death or serious physical harm. However, setting the rules for controlling hazards was delegated to regulatory agencies. Creating specific rules came with requirements, as interpreted by the U.S. Supreme Court (Benzene decision), to conduct risk assessment showing that proposed rules are reasonably necessary. In other words, a proposed rule has to demonstrate that a significant risk due to exposure to a hazard currently exists and that, if the rule is enacted, it will eliminate or significantly reduce that risk. Agencies are further required to ensure that proposed rules are technically and economically feasible. Presidential executive orders 12866 and 13563 require comparative economic analyses of regulatory and non-regulatory policy options.

Economic theory provides methods to characterize risk-cost tradeoffs. For example, marginal analysis can be used to compare the marginal costs and marginal benefits of each level of risk and governmental policy option. Net benefits are maximized at

the point where marginal cost equals marginal benefit, which is the minimum of the total cost curve.<sup>5</sup> In Figure 1, total costs are equal to the sum of the costs to control risk and the costs of harm. The costs to control risk refer to costs of implementing changes such as substituting harmful with less harmful materials, using engineering controls, and providing workers with personal protective equipment. The cost of harm is the cost of injuries and illnesses and other damages arising from the uncontrolled risk. The optimal level of expenditure to control risk ( $R^*$ ) is where the total costs of risk are minimized.

The economic burden of worker injuries and illnesses can be estimated by different methodologies. Common methodologies include “cost-of-illness” and “willingness-to-pay.” The cost-of-illness approach estimates the costs of treating worker injuries and illnesses (medical costs) and productivity and income losses associated with these injuries and illnesses (productivity losses). The willingness-to-pay approach estimates the monetary amounts individuals are willing to pay to avoid the risk of a specific injury, illness, or death.<sup>6</sup> This latter approach takes into account the value individuals place on avoiding pain, suffering, and disability, which is not considered by the cost-of-illness approach. Because “willingness-to-pay” includes pain and suffering, this approach is used by U.S. government regulators to assess societal costs.

Although cost-benefit analysis is not required for OSHA to set new regulations, the U.S. Supreme Court ruled in *American Textile Mfrs. Inst., Inc. v. Donovan* that technical and economic feasibility analyses are required. While economic analyses can help decision makers select feasible strategies that benefit society, for OSHA, risk minimization to levels below  $R^*$  may be required to achieve the worker protection requirements of the OSH Act.

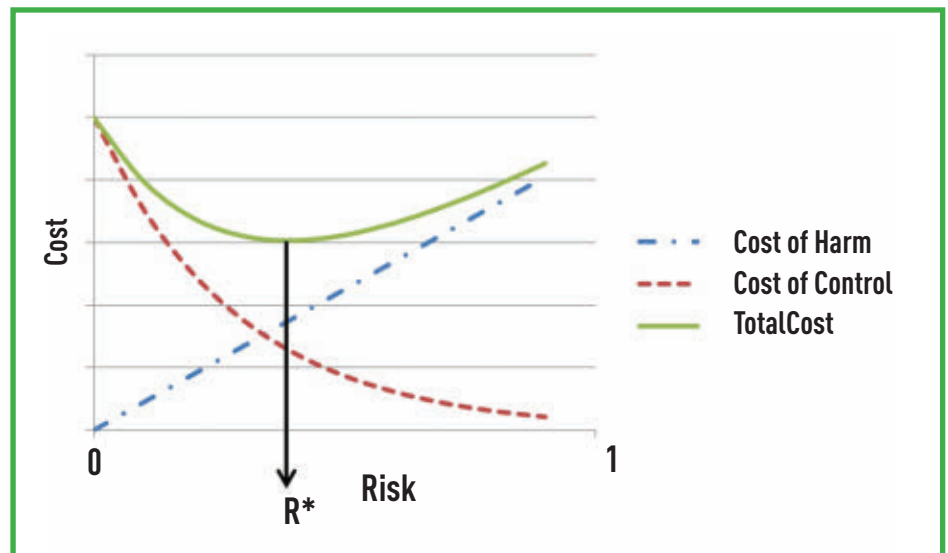
### THE BUSINESS CASE FOR SAFETY AND HEALTH

The business case for safety and health refers to an economic evaluation at the employer’s level that identifies the least costly safety and health interventions. This type of analysis can demonstrate to employers that improvements in productivity, profitability, or sustainability can result from the implementation of *interventions*, such as engineer-

ing controls, that reduce the risk of worker injury and illness. To make an argument that resonates with employers, results of economic analysis at the employer’s level may be expressed in terms of the return on the investment (ROI) from different interventions. Depending on the method of analysis, summary results also can be expressed as net costs or savings, or as ratios of the net amount of dollars spent divided by a measure of effectiveness or net benefit gained.

Implementing risk controls at the employer level may not result in moving smoothly up or down a continuous risk-versus-cost curve like the one shown in Figure 1. Controlling risk at the employer level would likely involve discrete changes in risk for several control options. For example, modifying work practices may eliminate 40 percent of the risk; installing a barrier may eliminate 90 percent of the risk; while redesigning the process to eliminate the use of a particular toxic substance may eliminate the

FIGURE 1: The optimal level of expenditure to control risk,  $R^*$ , is where the total costs of risk are minimized.



entire risk. Each of these control options has different engineering, installation, training, personnel, and utility costs that need to be estimated. Gains in productivity, improved quality, or other benefits due to the intervention itself should be included as reductions to the cost of implementing these risk-reducing interventions.<sup>7</sup>

Changes that reduce risk do not always result in extra costs to employers. Some changes can increase



productivity or improve the quality of the product, and may result in benefits that increase companies' profit over and above the potential benefit of harm averted. For example, an economic analysis of Washington State's heat-related illness rule estimated an 8 to 15 percent productivity gain saving employers between \$16-35 million annually by ensuring that workers do not become dehydrated.<sup>8</sup> These benefits would be subtracted from the costs of implementing controls to arrive at the net cost to control risk. The benefits of injuries and illnesses averted due to reductions in risks can be expressed as reduced costs. In Figure 1 this would result in moving down the "cost of harm" curve as we move to lower risk levels.

To assess the potential safety and health benefits of an intervention, employers also need to know the risk of harm—that is, the probability and severity of worker injury and illness at each of the risk levels being assessed. It is difficult to assess the risk of occupational illnesses because they often take years to develop, are difficult to diagnose, and may occur only after workers have retired. The consequences of some injuries and most illnesses may be underestimated and employers may not account for their full cost. (See the sidebar on page 36.)

The costs employers bear might also be lower than the true cost of the illness or injury. Some medical and disability costs will be paid by workers' compensation, health insurance, or disability insurance.<sup>9</sup> Thus employers may underestimate the risk, and they have incentives to underestimate the consequences. The injured or ill employees (through insurance premiums) and taxpayers pay for the difference of the employer-borne cost and the true cost of worker injury and illness. Because these costs, which include suffer-

ing, are spread among many, it may be difficult to convince some employers to control risks as much as they should. Successful businesses are those that correctly identify how employers' current and potential alternative activities, including efforts to prevent worker injury and illness, affect their total costs.<sup>10</sup>

### A TOOL FOR DECISION MAKING

Risk assessment results that are used to make risk management decisions generally do not have bright lines of demarcation for deciding safe from unsafe. The level of risk deemed to be safe (or tolerable or acceptable) is often a judgment based on ethical considerations and technical and economic factors in addition to risk estimates. Regardless of how risk management decisions are made, economic analysis is an additional informative tool that can guide these decisions. ●

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*The findings and conclusions in this article are those of the authors and do not necessarily represent the views of NIOSH or the Food and Drug Administration.*

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