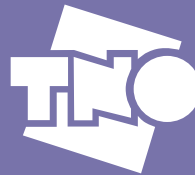


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**Protecting Workers
Health Series
No 2**

Understanding and Performing Economic Assessments at the Company Level



**WORLD HEALTH
ORGANIZATION**

**Protecting Workers'
Health Series
No 2**

Understanding and Performing Economic Assessments at the Company Level

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Preface

This document is the second in a series of occupational health documents entitled: *Protecting Workers' Health*. It is published by the World Health Organization (WHO) within the Global Programme of Occupational Health. It is the result of the implementation effort of the Global Strategy on Occupational Health for All as agreed upon at the Fourth Network Meeting of the WHO Collaborating Centres in Occupational Health which was held in Espoo, Finland from 7-9 June 1999.

The text was prepared by TNO Work and Employment, a service organization in the areas of innovation of work, organization and technology, and employment research. TNO is a WHO Collaborating Centre in Occupational Health, and a member of the European Association of National Productivity Centres. The document was sponsored in part by the WHO Regional Office for Europe.

Improvement of safety and health of workers can bring appealing economic benefits for both companies and societies as a whole. It is difficult, however, to convince employers and decision makers of the profitability of improving working conditions. An effective way is to make financial or economic estimations. This publication describes a hands-on approach that can be used in making economic assessments. After a brief introduction in Chapter 1, the most important pitfalls and explanations about relevant principles are summarized in Chapters 2 and 3. Chapter 4 provides practical outlines. References and suggestions for further reading are listed in Chapter 5.

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Introduction

1

1.1 Background

By means of economic appraisal, the costs and the benefits of health, environment and safety management can be made clear at the national level, at the company level and also for the individual worker. As such it can be a useful tool in advocating good practices. Economic appraisal also shows under which circumstances economic benefits will not be sufficient for prompting preventive action in enterprises.

In recent years, a number of methods and tools for assessing the costs and benefits of occupational health have been developed. Also estimations of national costs have been made in several countries. International comparisons of methodologies and studies on relevant variables in cost-benefit assessments (at company and national level) have shown that many fundamental and practical differences exist in the purpose of economic assessments and the way they are conducted in practice. As a consequence, users should construct their own procedure and see that it is applicable in their country and their company.

1.2 These guidelines

Estimating the value of good occupational safety and health in companies should not be restricted to economists or specialists. Everyone involved in improving safety and health should be able to understand or make estimations of costs and benefits. Getting an idea of the costs and benefits of

improving safety and health at work is not difficult. However, there are some pitfalls which a practitioner should recognize.

These guidelines are meant for companies or safety and health professionals who want to demonstrate the value of safe and healthy work as objectively as possible or have to work with assessments that have been made by others. However, this is not a cookbook with recipes for standard approaches to cost-benefit analysis. It is an open document that gives some structure, some thoughts and some ideas. The guidelines offer a way to proceed in making an assessment that will fit the situation at hand. Therefore this document presents the most important dilemmas, questions and commonly used methods. In the text, the most important recommendations are highlighted. Each section discusses a single topic.

Target group:

- ✓ **professionals in occupational safety and health;**
- ✓ **external specialists; and**
- ✓ **managers and decision makers.**

In order to structure the process of performing economic assessments a stepwise approach is presented. Again, this is not meant to prescribe the procedure, but to present current insights and a possible (logical) way to proceed for users that have no experience with economic analysis.

Chapter 2 gives some background information which explains how safety and health at work affects costs and benefits in companies. Also some issues in measuring economic effects are discussed. The context in which evaluations usually take place is described in Chapter 3. The context helps in understanding the results of an evaluation and is important in deciding how an economic assessment is going to be performed. Finally, Chapter 4 gives practical outlines. In this chapter a simple 5-step approach is presented and illustrated with checklists and calculation schemes. Go directly to this chapter if you prefer a hands-on approach. Each section is concluded with some advice or remarks.

The background of economic appraisal in occupational safety and health



2.1 The economics of occupational safety and health

Safety and health at work have clear economic implications. Occupational injuries and work-related illnesses impose a burden on workers, companies and society as a whole. Besides, good working conditions enhance workers' productivity and improve quality of goods and services. For the individual company, however, it is not always clear what costs are related to occupational diseases and injuries. Also the potential benefits of better safety and health management are often unknown. Indeed, the potential benefits from improving the working environment differ from one situation to another.

Occupational safety and health (OSH) can affect company performance in many ways, for instance (see Figure 2.1):

1. Healthy workers are more productive and can produce at a higher quality.
2. Less work-related illnesses lead to less sick leave. In turn this results in lower costs and less disruption of the production processes.
3. Equipment and a working environment that is optimised to the needs of the working process lead to higher productivity, better quality and less health and safety risks.
4. Reduction of injuries and illnesses means less damages and lower risks for liabilities.

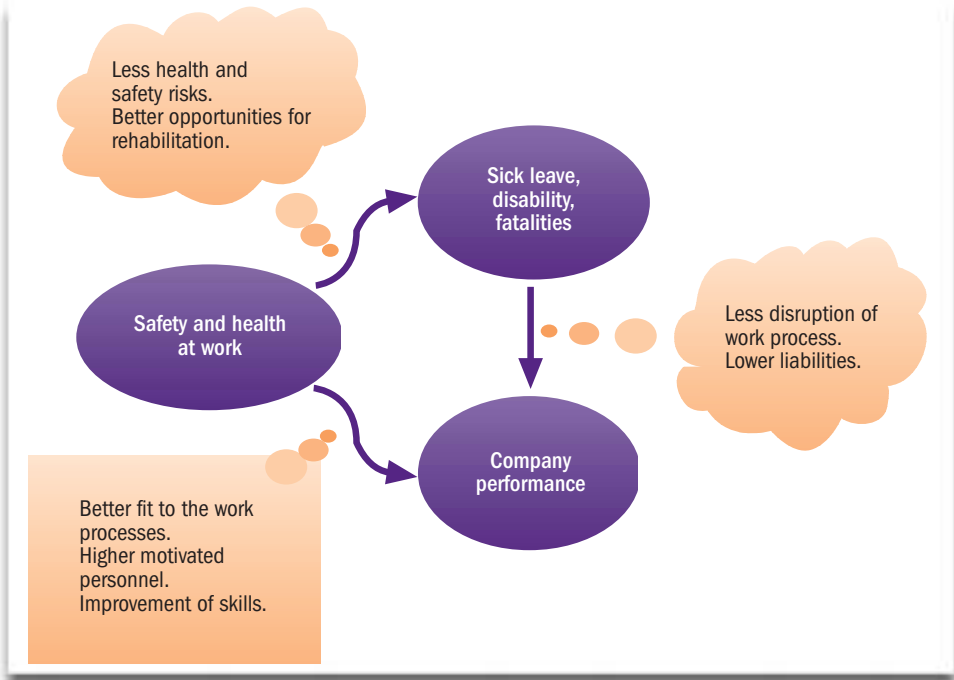


Figure 2.1. Relationship between occupational safety and health, work-related diseases and injuries, and company performance.

Though there is a general conceptual relation between OSH on the one hand and economic performance on the other, the actual quantitative and qualitative relationship is sometimes difficult to discern. Economic appraisal can help to find better information to improve decision making, for instance, by showing how many (company) resources are lost due to work-related illnesses and which way is most cost-effective to obtain a good working environment. It is definitely not the purpose to rationalise decision making about working conditions to hard figures and rigid methodologies. Preventing injuries and improving workers' health also has human and social values that are generally very hard to incorporate in formalised methods.

Economic analysis can be used to show financial benefits, but do not forget the intangible benefits of improved health and well-being. While it is hard to find a causal and quantifiable relationship between improved OSH and increased quality of products or worker morale, the benefits can still be recognized. This means that the cost-effectiveness of OSH and health programs is underestimated, or that more benefits are incurred than can be measured.

2.2 Costs and benefits for whom?

Work-related illnesses and injuries at work may result in costs for many different persons or groups (see Figure 2.2). Likewise the benefits of an investment by one actor may be advantageous for many others. Money invested in safety measures by a company may also be profitable for other companies, the workers, and insurance companies. The workers' healthy way of working is beneficial to the shareholders of a company as well. Of course, a benefit for one party may result in costs for others. For instance, omitting investments in safety by a company may cause costs for workers, insurance companies, public funds, the workers' families and other companies.

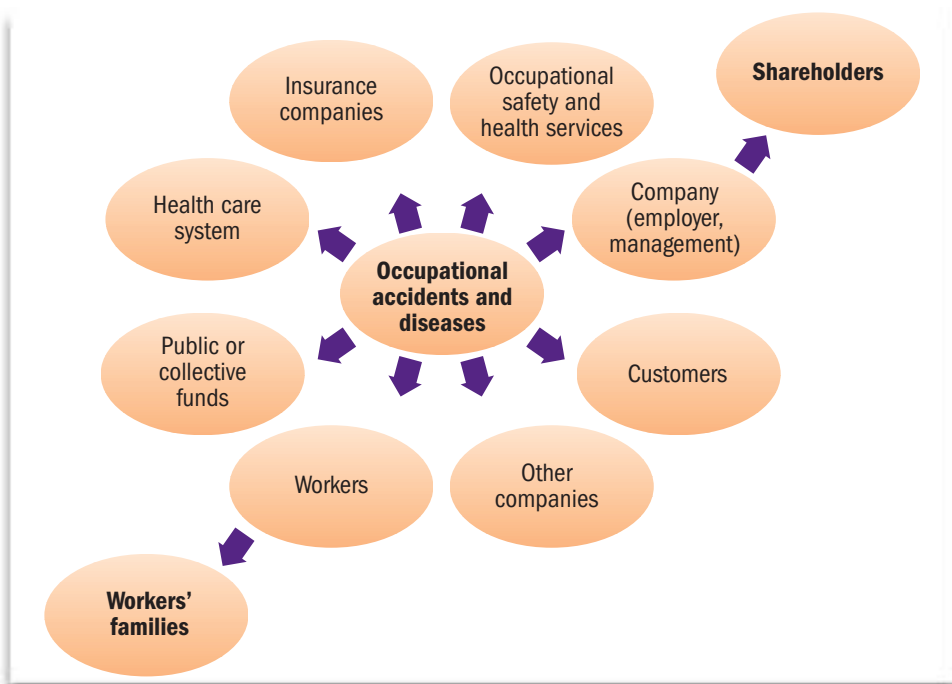


Figure 2.2. Who pays the cost of occupational injuries, occupational diseases and work-related illnesses? (adapted from Krüger 1997).

When it comes to improving working conditions, there are two key actors: the worker and foremost the company. The worker is responsible for safe and healthy behaviour. The company decides on safety and health policies and improvement.

Finding out which persons or groups benefit from improved working conditions is the first step in good economic decision making.

2.3 Economic behaviour: what motivates employers

Decision making is not a strictly rational activity. Indeed many, even far reaching business decisions, are at best partly rational. Often, strategic choices are based on very uncertain information or on the vision of management. At the operational level, decision making tends to be supported more often by economic assessments. Nevertheless, no employer can persist in an economically irrational way of decision making.

The importance of occupational health is what decision makers believe it to be. Information and perceptions about future effects of decisions, preferably expressed in terms of money, help employers in the decision making process. The true value of economic appraisal is influencing the beliefs of decision makers and policy makers. For maximum effectiveness in this respect, economic appraisal should be a joint activity.

Making cost-benefit analyses is essentially about predicting the future. Applying scientific techniques may give the impression that the predictions are quite exact, but in reality the predicted outcomes are generally uncertain. Mind that uncertainties and assumptions give the opportunity to criticize or even reject the assessment. However, companies are usually well capable of dealing with uncertainty in forecasts when it comes to marketing expenditures, or investments in information technology and advertising.

If the outcomes of an economic analysis are uncertain, then why is it done? The process of making an assessment gives many insights. Beside the final answers, positive effects of economic assessments are:

- ✓ Potential costs and benefits are treated in a structured way;
- ✓ The structured approach diminishes the effect of prejudice; and
- ✓ All stakeholders are given the opportunity to bring forward their interests.

Economic analyses are not neutral. Experienced users may well be able to manipulate the outcomes by overemphasizing certain cost factors or leaving others out of the assessment.

Cost-benefit/cost-effectiveness analysis helps structuring and balancing arguments.

2.4 Safety, health and company performance

For most organizations, the bottom line in company performance is the financial balance. Even non-profit organizations need to break even. Yet, in some situations overall financial indicators may not be appropriate:

- ✓ Non-profit or not-for-profit organizations may be less interested in financial indicators, whereas quality and efficiency can be more important;
- ✓ Financial statements look back, but the ability of a company to generate attractive results in the (near) future is as important; and
- ✓ Financial results are influenced by many factors, and effects of safety and health are very hard to isolate.

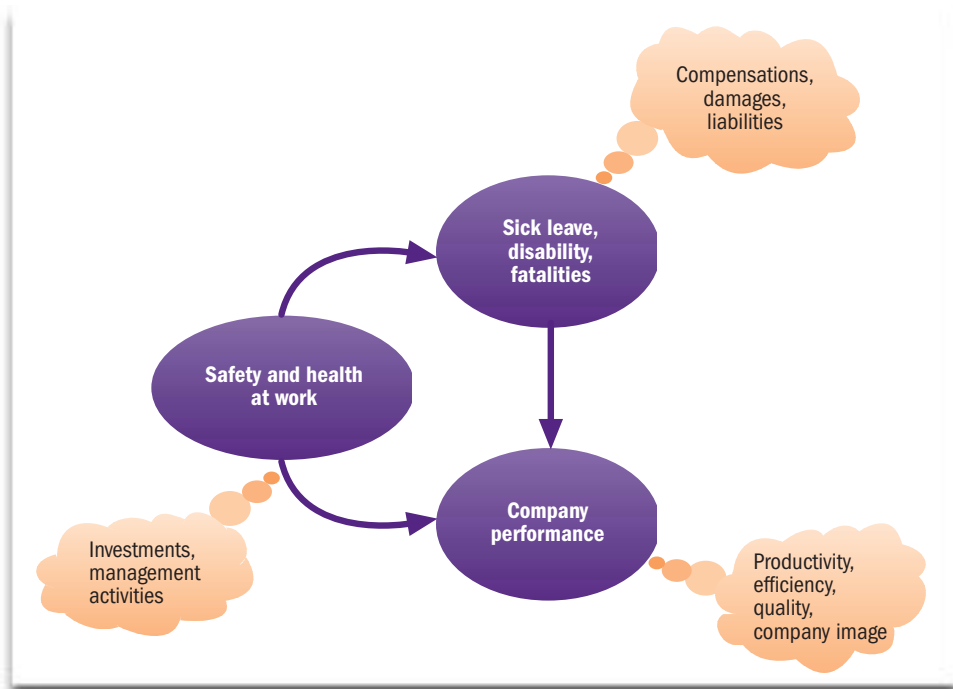


Figure 2.3. Economic effects of safety and health at work.

Of course, these are no excuses to refrain from economic analyses. It should be clear, however, that economic appraisal should not be limited to financial aspects only. An assessment should concentrate on the contribution of occupational health to the company's competitive strength. Assessments in non-profit organizations can focus on effectiveness and

the quality of services. Recent developments in assessing company performance make clear that occupational health contributes to a company's success in many ways. In this respect, the financial costs or benefits offer too narrow a view. (See Figure 2.3.)

Modern methods in company performance measurement try to define and measure indicators that contribute to the success of a company. In addition to financial indicators, it is very useful to define indicators with respect to:

- ✓ the attractiveness of a company (and its products) for customers or for potential employees;
- ✓ internal organization, the efficiency and flexibility of the production processes; and
- ✓ the ability to innovate products, services and production processes.

As markets, visions and goals differ enormously among companies, each organization has to define its own indicators and establish for itself how safety and health at work contribute to each of the indicators.

Widen the scope to performance indicators other than just financial results.

Since cost-benefit and cost-effectiveness analyses are two methods which are well suited to company-level analysis, it is appropriate to highlight the differences between them. The most significant difference between the two is in the way that costs of illness or injuries are calculated. In cost-effectiveness analyses, costs are calculated according to the cost-of-illness or human capital approach. While direct and indirect costs are accounted for in this method, pain and suffering are not. This technique represents the lower bound of the true costs of illness and injuries. In cost-benefit analyses, costs are calculated according to the willingness-to-pay approach. Estimated costs implicitly include pain and suffering, and they represent the upper bound of the true costs of illness and injuries.

From the societal perspective, direct costs of occupational injuries and illnesses include inpatient care, physician services, and medications (although these may be paid indirectly by the employer in the form of

higher insurance premiums). Indirect costs would include reduced productivity, time spent by the patient in seeking medical services, and income lost by the family. Pain and suffering are considered to be intangible costs. Other examples of intangible costs include psychosocial costs associated with disfigurement or disability, social isolation, family conflict, and changes in social functions and daily activities. (See Haddix and Shaffer (1996) for more information.)

2.5 What should an economic analysis do?

An evaluation of economic effects of safety and health can have one of many purposes (see Figure 2.4). For instance, it can be used to convince decision makers that occupational diseases and injuries are too costly or an evaluation can be applied to find out whether an investment is economically feasible.

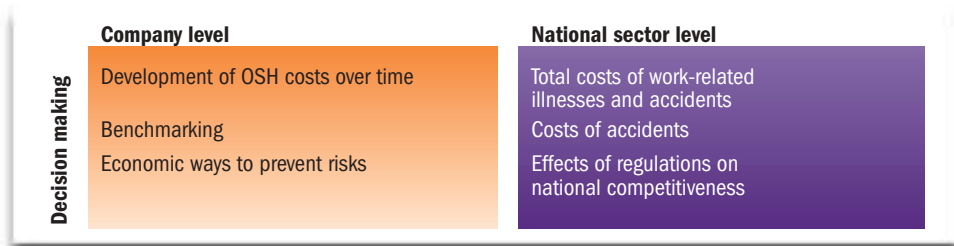


Figure 2.4. Common questions that can be addressed by an economic analysis.

Besides finding answers to questions about costs and benefits, economic assessments have some other functions:

- ✓ Establishing and communicating the importance of safety and health at work to the company;
- ✓ Finding, structuring and balancing arguments; and
- ✓ Creating involvement and commitment in decision processes concerning safety and health at work.

Use cost-benefit analysis to support decisions on actions or investments. Summarize costs of safety and health to monitor performance.

The context

3

3.1 Legislation, regulation and social security

Occupational health is as much an issue in the social and public health domain as it is in the economic or business domain. The motives to pursue better safety and health at work stem from social goals as well as from economic goals. In most countries health, social security and economic affairs are separate policy areas. Each makes its own regulations. When improving safety and health at work, all three domains are influenced.

The costs of OSH for companies, but also for individual workers, are very much influenced by the national system of social security. Also the national health care system may have cost effects.

The most relevant issues in social security and the health care system are:

- ✓ Is there a national compensation system for disability due to occupational illnesses and injuries; if so, which illnesses are accepted as occupational?
- ✓ Can employees claim damages and financial consequences; are employers liable to damage claims by their (former) employees?
- ✓ Do funds or subsidies for improvement of working conditions exist?
- ✓ Are social security or insurance premiums dependent on safety and health risks or past performance of the company?

The balance of costs and benefits is influenced by legislation and the social security system.

3.2 Stakeholders and their interests

As decisions about working conditions will affect the interests of many persons or groups, an exploration of possible stakeholders is an essential part of an economic assessment. Many different stakeholders can be distinguished, but in practice only some of them are significant. Table 3.1 may give some hints about stakeholders, their interests and possible influence. Stakeholders may want to emphasize certain costs or benefits according to their interests. In some cases stakeholders are likely to change the questions that an economic evaluation should answer. The best way to deal with all influences is to be aware of these and to involve important stakeholders (those with much interest and much influence) in the process of the assessment.

Table 3.1. Overview of possible stakeholders, their interests and their potential influence.

Stakeholders	Examples of possible interests	Indication of influence with regard to the assessment
Employer	Company performance Company image	Key actor, decision maker
Management	Performance of department	Decision maker
Workers and their families	Health, safety and job security	Often limited
Workers' representatives (works council, trade unions)	Health, safety and job security	Often limited
Customers of the companies	Price and quality of products	Market behaviour
Authorities (local, labour inspectorate)	Compliance with regulations; worker protection as a social goal	Enforcement of regulation (penalties, fines)
Public or collective funds	Reduce damages, lower compensation payments. Better safety and health as a social goal; worker protection	Creation of economic incentives
Private insurance companies	Reduced damages and liabilities; premiums adjusted to risk and damages	Premiums

Identify stakeholders and find out what their role in the assessment will be.

3.3 Internalizing costs

Companies often do not bear the full costs of occupational diseases, occupational injuries, or work-related illnesses. For instance, health care costs may not be covered by the company or disability pensions may be borne by collective funds. In many countries regulations exist that somehow bring back the costs to the company or person who caused the costs (so called cost internalisation). This may work as an economic incentive to prevent future injuries or diseases. Economic assessment is particularly useful if the company has to pay for the damages it causes and also benefits from improvements. (See Table 3.2.)

Table 3.2. Overview of the most important principles to internalize costs to the companies.

Method of cost internalisation, economic incentive	Principle or examples
Liabilities	Workers or insurance companies can claim damages due to occupational injuries or diseases.
Legal sanctions, fines	Labour inspectorate can give financial penalties or temporarily stop production.
Differentiation in premiums	Insurance companies or public funds adjust premiums for increased risk of occupational injuries and diseases. Premiums may also be adjusted according to past performance with respect to occupational injuries and diseases.
Payment of sick leave	Obligation to (partly) pay wages during period of sick leave.
Market regulation	Attractiveness for new personnel, advantages in obtaining government orders.

The more costs can be internalized, the stronger the incentive to improve safety and health at work.

3.4 The value of health, well-being and human life

The power of a cost-benefit analysis resides partly in the fact that the value of incomparable concepts is expressed in a common denominator: money. Therefore, it is presumed that every cost and every benefit has a market value. In practice, it is often very difficult and sometimes merely impossible or even undesirable to put a price on the benefits of better safety and health at work. Important questions in this respect are:

- ✓ Is there a value of a statistical human life, and if so, how can that value be assessed?
- ✓ What is the value of health, or not being ill?
- ✓ How much is job satisfaction and well-being at work worth?
- ✓ Why aren't these prices the same for everybody?

The benefits of better working conditions include more than the absence of illnesses or injuries. Improved job satisfaction, well-being at work, welfare and a longer healthy life expectancy are additional benefits. For these benefits, no reliable or generally accepted pricing method is available. Some techniques have been developed to find some indications (e.g., by asking people what they would be willing to pay for good health).

3. THE CONTEXT

Application of strict economic techniques may lead to rather cynical outcomes in some situations. Typical situations in which the results of an economic assessment are controversial are:

- ✓ Fatal events are relatively cheap in comparison to non-fatal events;
- ✓ Hearing impairments due to noise at work have little economic impact for the employer. The worker has many intangible costs concerning the quality of his (social) life; and
- ✓ For employers it is the most attractive to invest in work with high added value. The savings of a prevented lost work day are higher if the wages are higher.

Putting a value on human health is difficult and may give adverse results. It is best not to include the money value of health in an economic assessment, but not treat health as a separate goal.

3.5 The problem of time

In economic assessments, time poses some interesting dilemmas and problems.

The value of money, depreciation

The key element is that an amount of money today is worth more than the same amount next year. Economic evaluation techniques are available that take money depreciation into account and adjust for the future value of money (discounting). Health effects need to be discounted as well, if a cost-effectiveness analysis is being done.

Risk

Money which is owned now, is more certain than money which may be owned in the future. Investing money always has some risks; no investment is absolutely safe. The longer the span of time before an investment returns revenue, the greater (in general) the risk. Furthermore some investments are riskier than others. Investing in safety and health at work has (within the context of present knowledge) rather high risk, as little is known about the efficiency and efficacy of interventions in this area. In practice, decision makers deal with risks by applying high interest rates or requiring very short payback periods. Conventionally, intervention effectiveness studies do not deal with risk, other than to conduct sensitivity analyses to address uncertainty.

OSH and planning horizon in companies

The time period during which an OSH intervention takes place (time frame) is typically much shorter than the time period during which the consequences of the intervention take place (analytic horizon). The analytic horizon should thus be long enough to capture all the economic consequences. Some diseases, e.g. asbestos-related diseases, have latency periods of more than 20 years. From the societal perspective, the analytic horizon could be 40 years for an illness which affects a worker for the rest of his/her life. These periods are far too long in the context of company decision making. Planning horizons (at operational and tactical levels) are usually 3 to 4 years. In many industries, investments have payback periods of 2 to 3 years.

Technological innovation is important when considering the time horizon. In particular new legislation tends to work as a driver for the development of new technology that makes complying with OSH standards and regulations easier and cheaper. The risk of having new, more effective and cheaper methods available within a timeframe longer than 2 to 3 years is too big.

At the company level, take only a few years into account. Economic assessments that consider 5 years or more are often unreliable or even irrelevant to company decision making.

3.6 Perspectives

An analysis of costs and benefits is always related to a decision making party, which may be a company, a complete sector, or a government. Personal costs, benefits, and perspectives tend to influence decision makers.

This document is primarily concerned with economic appraisal at the company level, in which only costs and benefits incurred by the employer are considered. However, in a larger sense, an analysis could be conducted according to a societal perspective, in which all costs and benefits of an intervention are considered. While it is true that employers and managers are usually interested in hearing which intervention is most attractive in terms of saving money, it is also true that they are usually interested in maintaining a positive public image and being viewed as “good corporate citizens.” Examples of the societal and the employers’ perspectives on selected factors are compared in Table 3.3.

Table 3.3. Comparison of societal and employers' perspectives in economic analyses.

Variable	Examples from the Societal Perspective	Examples from the Employers' Perspective
Target audience	Government decision makers, society as a whole	Company management, ownership
Problem or question	Framed in terms of society, includes vulnerable subpopulations, the environment	Framed in terms of the company, includes mostly healthy workers
Intervention strategies	Economic controls, regulatory intervention	Substitution of raw materials, installation of ventilation system
Time frame	Years to decades	Months to years
Analytic horizon	Years to decades	Months to years (probably does not include full life-cycle of chronic diseases)
Costs	Implementing and managing a regulatory controls program, social security payments to injured workers	Lost work days due to employee illness, repair of damaged equipment
Benefits	Higher Gross National Product resulting from lower injury rates, improved ecosystem health from proper disposal of toxic wastes	Lower insurance premiums associated with reduced injury rates, improved worker morale and productivity
Health outcomes	Chronic injuries and illnesses which result in early retirement and collection of benefits	Injuries, acute health conditions which are readily associated with occupational exposures
Discount rate	Very important to consider in long analytical horizon	Not as critical to include in short analytical horizon
Uncertainty	Health effects on sensitive populations, national economic growth	Demand for company products, rate of employee turnover
Terms and/or measures	Related to societal impacts	Related to company finances
Distributional effects	More important, as more difficult to determine the distribution patterns of costs and benefits	Less important, as easier to identify who benefits and who does not

The process of making an assessment

4

This chapter describes five steps in making an economic assessment. It is assumed that the assessment takes place in the context of a company or non-profit organization, from the perspective of the company or employer.

4.1 Five steps

Basically, any process of making an economic assessment consists of five steps, including preparation (see Figure 4.1). The way each of the steps is performed depends on the situation at hand. Some steps take very little time; other may take more. The order of the steps is not necessarily fixed, it is possible to perform a step quickly first and then later come back to it. This is useful if some information is missing and becomes available later. If necessary some cycles of refinement can be performed, for instance by adding cost factors in a later stage, or by modifying some parameters to see the effect.

In this five-step approach, the first and the last steps are directed at the context in which the assessment takes place. The goals of these steps are to maximise the usefulness and the effect of the assessment.

One of the major problems in economic assessment of OSH is that neither companies nor authorities keep track of OSH costs. Furthermore there are no data on cost effects of interventions. Economic consequences

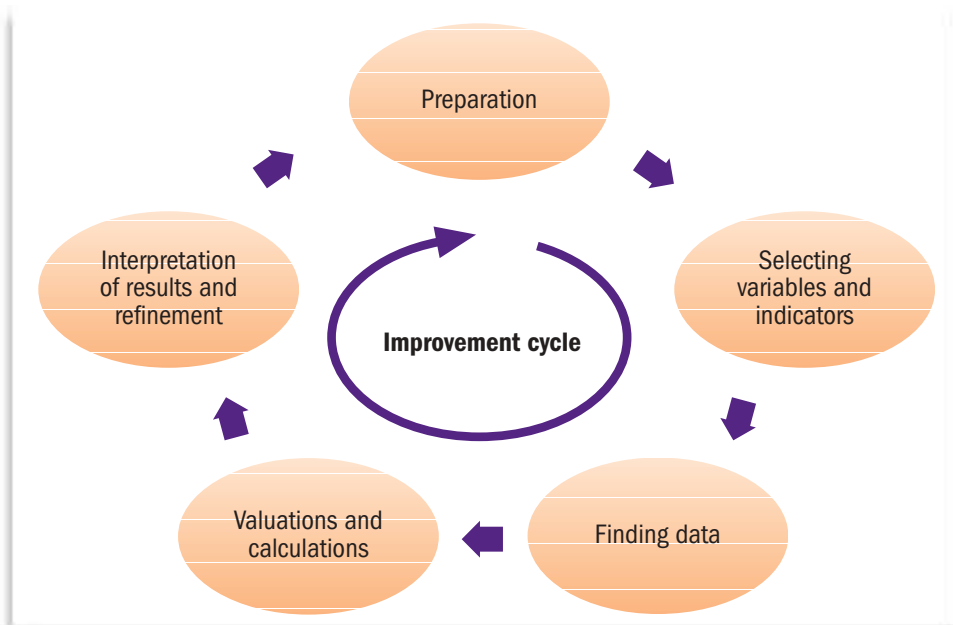


Figure 4.1. Five steps in an economic assessment.

have to be estimated in an indirect way. Steps 2, 3 and 4 are the technical steps in which the link between safety and health at work and the (money) value thereof is established. The actual economic calculation is also part of these steps.

In these steps different approaches can be taken. One is “data-oriented”: from available records and data sets one tries to extract the data that relate to safety and health at work (Figure 4.2).

The second approach focuses on the content of OSH and tries to make a conceptual relation between OSH activities and the (money) value (Figure 4.3). In practice, a combination is often used.

Both approaches have fundamentally the same elements: determining the variables or indicators (step 2), finding data (step 3) and then finding a money value (step 4).

Finding adequate and relevant data is essential in any economic assessment. Take some time to explore the possibilities in finding facts and figures.

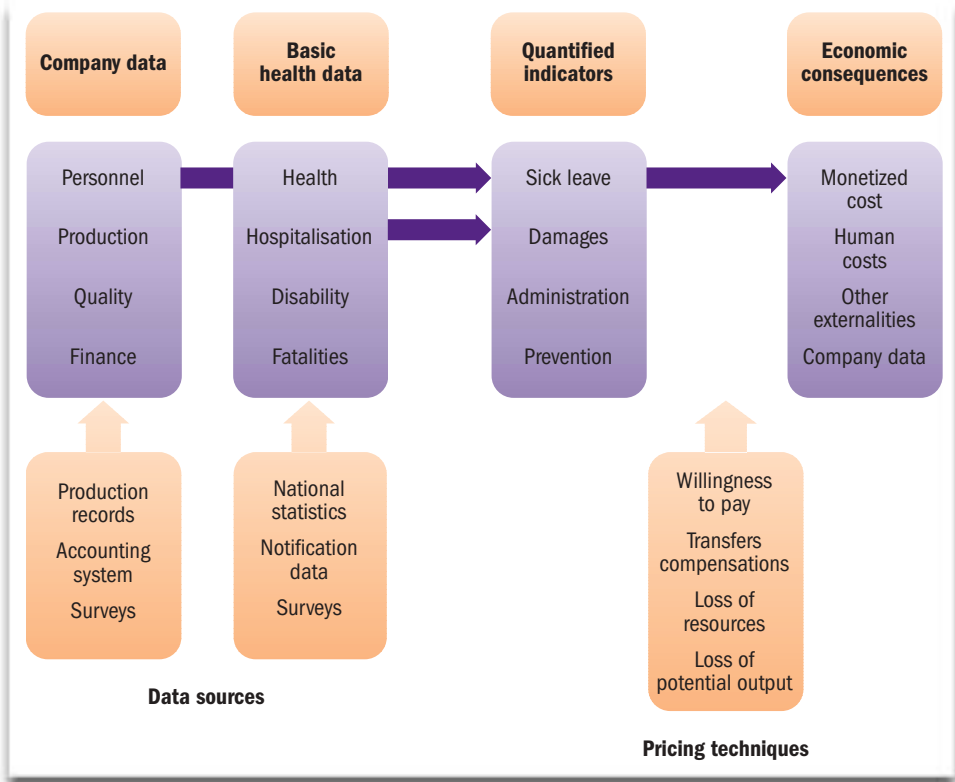


Figure 4.2. From available data to an overview of economic consequences: the data - oriented approach. Note that the valuation will depend on whether a cost-effectiveness or a cost-benefit analysis is conducted.

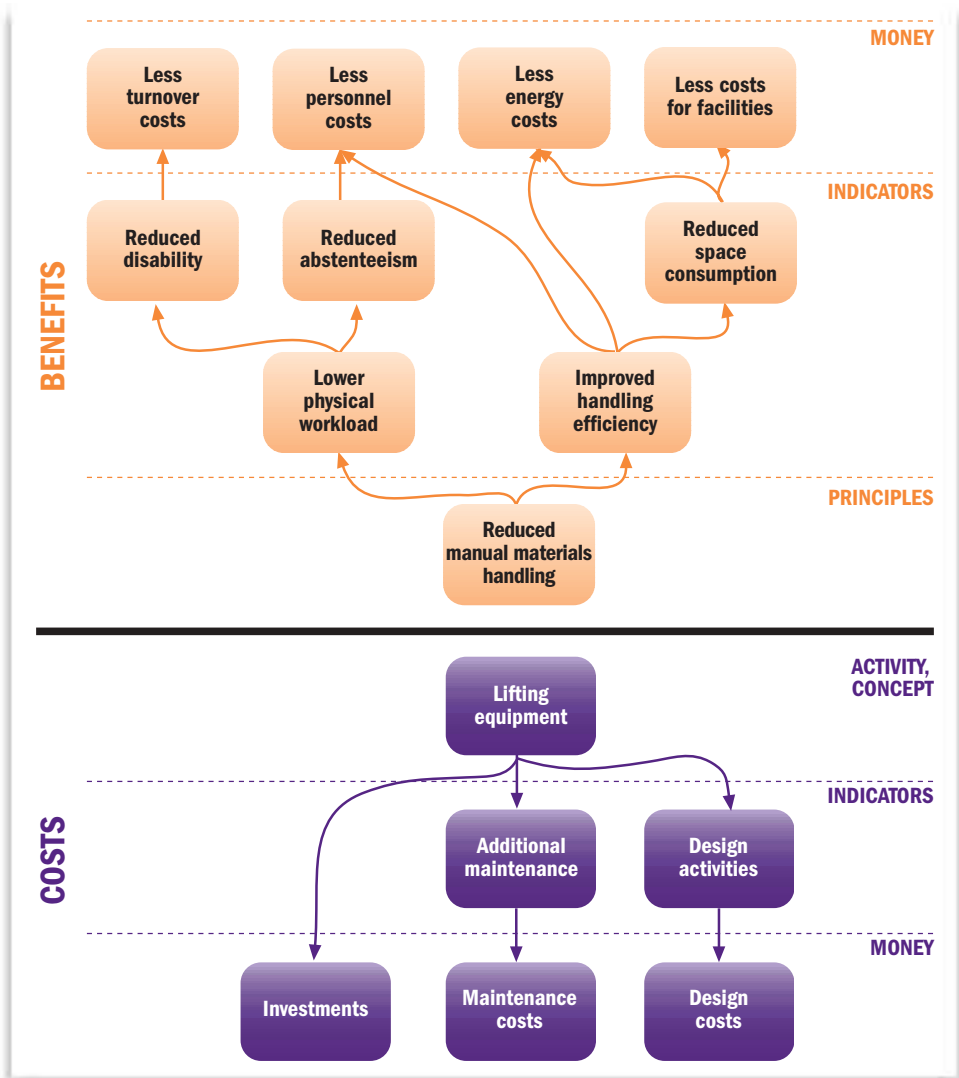


Figure 4.3. From the concepts of interventions to costs and benefits expressed in terms of money (adapted from Gröjer and Johanson 1996).

4.2 Step 1: Preparing an assessment

Essentially the first step of an assessment is to think about the purpose, the planning of the process, and how to “sell” the eventual results. Within the field of economic appraisal, many methods exist which can be applied to OSH. Some of the techniques are straightforward, but others can be quite complex and laborious. Most of the methods are designed to give answers to specific questions (see Table 4.1). The selection of the proper way to proceed should, therefore, be preceded by a clear view on the purpose of an assessment and the questions that have to be answered.

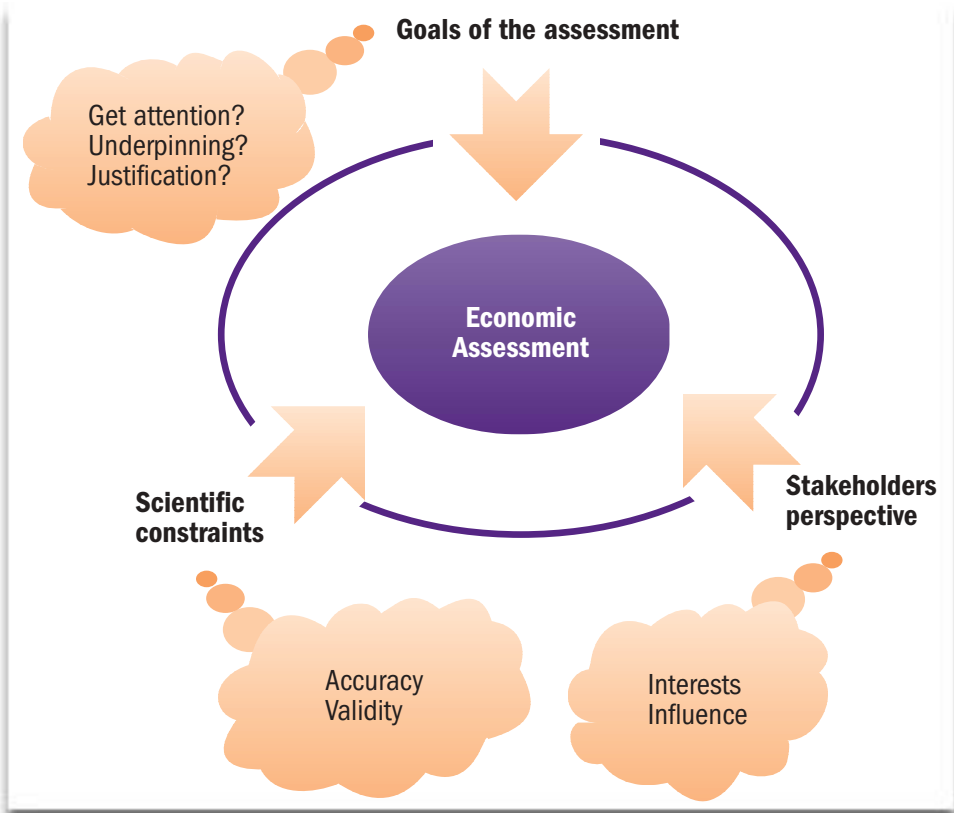


Figure 4.4. Balancing the needs and goals, (scientific) constraints and interests of stakeholders.

Economic appraisal is never a strict technical or scientific exercise; the outcomes are not neutral, and may have consequences. As stakeholders can have all kinds of interests, they may want to amend the outcomes or

4. THE PROCESS OF MAKING AN ASSESSMENT

even influence the process of making an assessment (see Figure 4.4). There will always be some flaws in the assessment. Data will be imprecise or not available, the effect of investments may be questioned or certain cost factors may be left out of the assessments. An issue that often leads to discussion is the valuation of “intangible” benefits. Balancing the goals of an assessment, the (scientific) constraints and the interests of stakeholders is crucial to the usefulness of an assessment.

Table 4.1. Selection of a suitable economic evaluation methods.

Objectives, questions	How to proceed, which tools are available
Monitoring, assessing costs <ul style="list-style-type: none"> ✓ What are the costs of occupational injuries in the company or specific departments or activities? ✓ What are costs of (specific) occupational diseases and work-related illnesses? ✓ How much money is the company losing due to safety and health? ✓ How much is spent on management, control and improvement of safety and health at work? 	Cost-of-illness calculation, summary of all costs related to occupational diseases and injuries
Comparison, benchmarking <ul style="list-style-type: none"> ✓ How are costs developing over time? ✓ Are there any differences between departments? ✓ How do costs compare to other companies in this sector? 	Cost calculations, record keeping
Support decision making <ul style="list-style-type: none"> ✓ Is an investment in safety and health economically attractive? ✓ How fast will an investment in safety and health at work pay-out? ✓ Which of alternative improvement options offers best value for money? 	Cost-benefit analysis Cost-effectiveness analysis

The effort put into economic appraisal should be balanced with the scope of the problem at hand. If the scope is unknown, start on the “back of an envelope” with a rough approach. If necessary, additions and refinements can be made later. Don’t forget, however, that many costs or benefits may be hidden.

Consider the purpose of the economic assessment and decide:

- ✓ **how much effort should be put in the economic evaluation;**
- ✓ **which kind of techniques are appropriate;**
- ✓ **what the role of various stakeholders may be.**

4.3 Step 2: Selecting variables and indicators

There is no ultimate or definitive list of cost factors to be included in an assessment. Nevertheless, a common set of cost factors has emerged from practice and theory. Additions or modifications are to be made depending on the purpose of the assessment, the structure of social security in a country, the company's possibilities to find adequate data, the company's business and so on.

Constructing the list of cost factors is one of the key activities in any economic appraisal. One decides herewith which kind of costs are counted and which are (deliberately) left out. As the selection of variables may have a major impact on the results, it is important to involve all relevant stakeholders in the selection process. Checklists can be very helpful to identify the cost components and potential benefits in practical situations. Tables 4.2, 4.3 and 4.4 present variables or indicators that are usually included in economic analyses concerning occupational safety and health. Three types of variables are distinguished (see also Figure 4.5):

1. Management activities, policy, investments related to safety and health at work;
2. Health-related effects; and
3. Company performance effects.

Many variables can be included in an economic assessment. In most situations, only part of the variables are relevant. Tables 4.2, 4.3 and 4.4 list a large number of variables of which the most relevant can be selected. Table 4.5 lists components of intervention costs. Use the following criteria for selection of variables:

- ✓ Relevance to the situation, company or national context;
- ✓ Relevance to the type of work; and
- ✓ Anticipated possibility of finding relevant data (if no data seems to be available, try to find ways to estimate).

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Figure 4.5. Overview of possible variables in an economic evaluation of OSH.

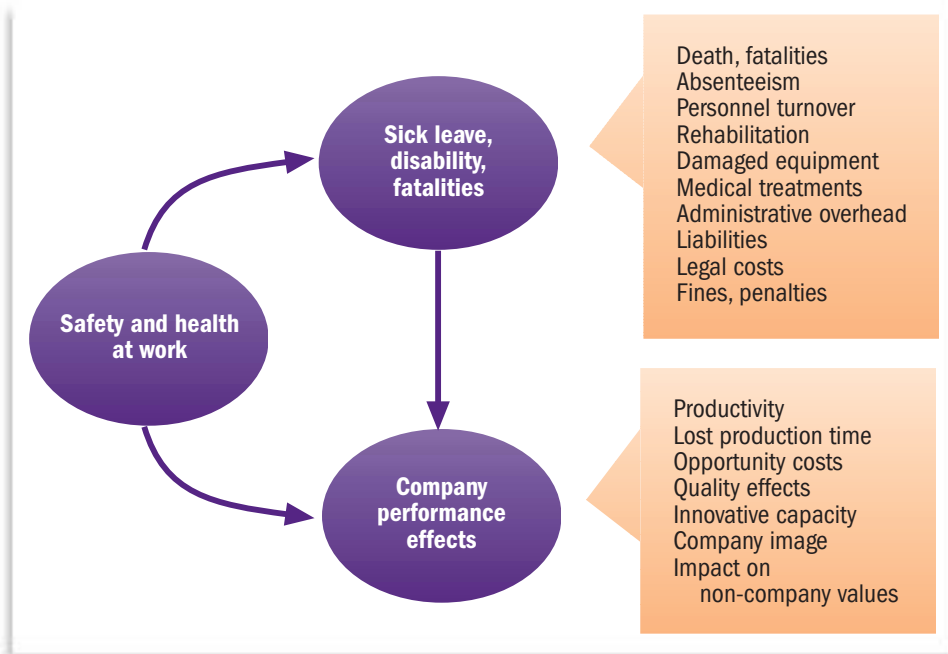


Table 4.2. Intervention costs (related to management and improvement of safety and health at work).

Variable	Description
Investments	Costs of specific 'OSH' equipment or additional costs of other investments related top OSH
Additional investments	Changes in non-OSH related capital goods to facilitate functioning of OSH equipment (e.g. reconstruction of buildings)
Engineering, consultancy and planning costs, related to investments	Expenditures for internal and external activities for design and implementation of new equipment or working procedures
Additional costs of substitution products (recurring costs)	Price difference (e.g. for non-toxic chemicals, lighter product)
Purchase of personal protective equipment (recurring costs)	Costs of protective equipment
Additional costs for changed working procedures and maintenance (recurring costs)	Price difference between old ways of working and new, directly related to the preventive action; note that new ways may also result in cost savings (e.g. extra costs to work according to safety standards)
Extra work time of direct personnel (recurring costs)	Time spent on meetings, training, participatory developments
Costs of internal or external OSH services, other preventive services (recurring costs)	
In-company activities	Human resource management, health promotion, OSH policy
Other workplace costs	Anything that is not covered in the previous headings

Table 4.3. Overview of variables related to costs of injuries and illnesses.

Note: If the willingness-to-pay approach is used, costs are all-inclusive.

Variable	Description
Direct Costs	
Absenteeism or sick leave	Amount of work time lost due to absenteeism, may be expressed as a percentage or as number of hours or days
Personnel turnover, including early retirement and permanent (partial) disability	Percentage or number of persons leaving the company in a period of time, preferably expressed as an excess
Non-medical rehabilitation (except transfers to patients)	Money spent by the employer to facilitate returning to work
Indirect costs	
Administration of sickness absence, injuries, etc.	(Managerial) activities that have to be performed by the company related to sick leave
Damaged equipment	Damages or repair costs of machines, premises, materials or products associated with occupational injuries
Other, non-health related costs (e.g. investigations, management time, external costs)	Time and money spent for injury investigation, workplace assessments (resulting from occurrence of illnesses)
Effects on variable parts of insurance premiums, high-risk insurance premiums	Changes in premiums due to the incidence of injuries and occupational illnesses
Liabilities, legal costs, penalties	
Extra wages, hazardous duty pay (if the company has a choice)	Extra spending on higher wages for dangerous or inconvenient work
Productivity	Changes in costs to produce the same amount of product or value of extra production with the same resources
Lost production time, services not delivered	Production time lost as a consequence of an event which results in injury (e.g. because it takes time to replace machines, or production has to be stopped during investigation)
Opportunity costs	Orders lost or gained, competitiveness in specific markets
Intangible costs	
Deaths, fatalities	Number of fatalities within a period of time
Registered injuries, occupational diseases	Number of formally recognized occupational illnesses and injuries
Reduced well-being, job satisfaction and poor working climate	
Complaints about health and well-being (without sick leave)	
Quality of products and services	Changes in product or service quality; reliability of deliveries
Innovative capacity of the firm	Ability to innovate in products and production processes
Effects on variable parts of insurance premiums, high-risk insurance premiums	Reductions in premiums due to the lower incidence of injuries and occupational illnesses

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Table 4.4. List of potential benefits from OSH program.

Variable	Description
Improved well-being, job satisfaction and working climate	
Reduction in complaints about health and well-being	
Other operational effects	Reduced costs for facilities, energy, materials
Company image effects	Attractiveness to customers, attractiveness to labour market, ability to recruit personnel
Impact on non-economic company values	To be derived from mission statements and the like
Compensations and subsidies received from insurance	Support for prevention only, compensations received for sick leave or disability are to be excluded
Quality of products and services	Changes in product or service quality; reliability of deliveries Value depends on company strategy Cost of quality and productivity are linked
Innovative capacity of the firm	Ability to innovate in products and production processes

Table 4.5. Examples of components of intervention costs for installation of a ventilation system (adapted from Gorsky et al. 1996).

Category	Specific Example
Personnel costs, including salary and fringe benefits	Design of ventilation system
Provider of each service	Mechanical engineer
Support staff	Maintenance staff
Administrative staff	Accounting department
Equipment	Hoods, ducts, fans
Supplies and materials	Wiring, connectors
Maintenance for facilities and equipment	Replacement of damaged parts
Transportation costs and travel expenses	Delivery of equipment
Educational materials	Video on maintenance of ventilation system
Training costs	Training of maintenance staff
Outside consultant services	Review of engineering designs
Evaluation costs	Evaluation of ventilation system
Operation	Electricity

Be aware that some costs or benefits can be calculated in different ways or can appear in calculations under different names. Double counting (that is, adding two indicators that represent the same) is one of the most frequently made mistakes.

With respect to occupational injuries, occupational diseases and work-related illnesses, it is important to know when injuries or illnesses can

be attributed to work. In many countries the compensation system has precisely defined which injuries or diseases are occupational. In these circumstances many illnesses that are (for the larger part) related to work may not be counted. New diseases, for instance certain forms of cancer, allergic reactions, musculo-skeletal disorders or mental problems due to work stress, may not be accepted yet as occupational. As an example, Figure 4.6 shows that the choice of diagnoses that are included in a cost assessment may have a large impact on the outcomes.

List the relevant variable, but remember:

- ✓ Find the most important variables first;
- ✓ Be aware that some costs are hidden or indirect; consider all possible effects of injuries and diseases;
- ✓ Some variables may represent the same effect in a different way;
- ✓ The national system of social security or legislation may consider only part of the work-related illnesses; and
- ✓ Agree with most important stakeholders which variables are to be included in the economic evaluation.

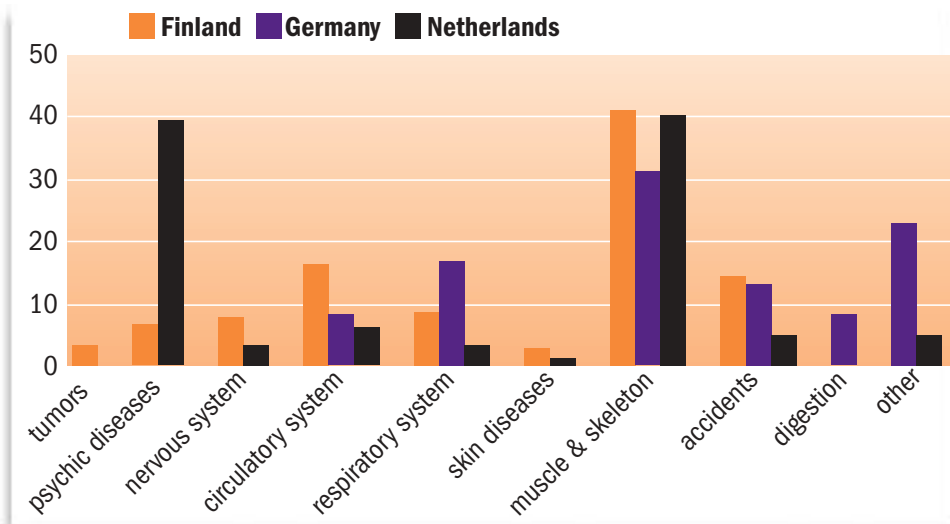


Figure 4.6. Costs of occupational safety and health by diagnosis in three European countries. Differences are mainly due to variations in the definition of work-relatedness of illnesses.

4.4 Step 3: Finding data

Most economic assessments suffer from lack of adequate data. Generally it is possible to find cost data because invoices are usually available and the amount of time spent in OSH management can be estimated. Finding data to quantify the benefits is much harder, partly because benefits are future effects and partly because little research is done into the effectiveness of specific improvements in working conditions and safety and health management in companies.

There are several strategies to find data or make estimations if necessary. The most important are:

1. Existing data sets. For instance, the costs of personal protective equipment will be included in the company's accounting system. Sick leave and personnel turnover may be registered already.
2. Estimations and projections, starting from available data or technical analysis. The number of work-related illnesses can be estimated from absenteeism records in the company. Also estimation from epidemiological data at sector or national level are viable options. Estimation of future effects of policies or investments can be derived from the description and goals of the intervention. Sometimes data from similar situations in other companies can be used.
3. Specific generation of new data. Useful for monitoring purposes.

Use of existing data

The best and easiest way is to use data that are available in company records and the company accounting systems. In particular, expenditures can be found here. Other examples of data are cost quotations, price lists of equipment and the like. Companies may also have records on sick leave, personnel turnover, production or quality. Unfortunately, in most cases there is not a direct link with OSH. As a consequence some estimations have to be made in order to make available data fit for an economic assessment. In general, more data is available on costs and expenditures than about potential benefits. In a cost-benefit analysis, this may lead to overemphasizing the cost.

Estimations and projections

In order to find data several kinds of estimations or projections can be made.

- ✓ From sick leave to work-related sick leave or sick leave related to specific diagnoses;
- ✓ From national or sector data to company data;
- ✓ Attribution of management activities or investments to safety and health at work;
- ✓ Projection of future effects of interventions on absenteeism, productivity or quality, for instance derived from the goal of the intervention.

New data generation

If reliable data are needed and none are available, new data generation is an option. Several possibilities are open:

- ✓ Additions to existing information systems,
- ✓ Conducting surveys among employees, and
- ✓ Implementing a dedicated information system.

Note that record keeping or surveying imposes an extra burden on the company. Additional registrations or measurements should be kept to a minimum unless (automated) systems make new data generation easy.

Use existing data as much as possible. If sector or national data are used, explain why these data apply. Be conservative in estimations; it is usually best to underestimate benefits and to maximise on the cost side. Estimations always need an explanation: how is the estimation made and what are the assumptions.

4.5 Step 4: Valuation and calculations

The next step in economic assessment is putting a money value to the variables and data. For some variables this is straightforward; for instance, the cost of external OSH services can be found directly in the invoices. For other variables the valuation is often more indirect. Common practices are summarized in Table 4.6. Usually, prices and costs can be found in company records. Only in rare cases are these costs registered as OSH-related costs.

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Table 4.6. Most common methods to find money values for some variables.

Variable	Common way to find money value
Safety and health management	Wages during time spent on OSH Invoices of external services and equipment
Lost working time	Total amount of wages
Damaged equipment	Repair or replacement costs, market price of new equipment
Time spent for OSH activities	Wages of total amount of time spent
Productivity	Total value of additional units produced
Quality	Value of lost products Value of time spent due to rework Warranties
Worker's diseases, injuries	Medical costs Indemnities
Workers' health, well being and job satisfaction	No reliable method available
Company image (to customers or labour market)	No reliable method available

In general it is best to express as much as possible in terms of money. If that is not possible or not wanted, try to quantify or use ranking methods. This can also help in decision making and can show improvement in safety and health management. The way calculations are performed depends on the methods used. In the remainder of this section, two examples will illustrate the way calculations can be performed.

Cost of illness

Figure 4.7 shows a typical calculation scheme for the costs of occupational illnesses or costs of injuries. This form can be used to summarize all costs related to safety and health at work. Registrations of this form are particularly useful to monitor the development of costs over time.

Yearly costs related to safety and health at work			
	Days spent	Cost/day	Amount
I. Safety and health management			
Extra work time (meetings, co-ordination)			
--direct personnel			
--management, specialists			
External OSH services			
Protective equipment			
Substitution products			
In company activities (promotion)			(+)
TOTAL (OSH management costs)			
Subsidies and compensations			(-/-)
NET (safety and health management costs)			
II. Safety and health related costs			
Work-related absenteeism (workdays)			
Excessive personnel turnover			
Administrative overhead			
Legal costs, fines, indemnities			
Damaged equipment and materials			
Investigations			
Effect on insurance premiums			(+)
TOTAL (OSH-related costs)			
Compensations from insurance			
NET (OSH-related costs)			(-/-)
III. Company performance			
Production effects due to OSH			
--lost production (reduced output)			
--orders lost			
Quality effects directly related to OSH			
--rework, repairs, rejections			
--warranties			
Operational effects			
--more work (e.g. due to safety procedures)			
Company image			(-/-)
TOTAL (effects on company performance)			
TOTAL OSH COSTS (I + II + III)			

Figure 4.7. Calculation scheme for costs of interventions, and of occupational injuries, occupational diseases and work-related illness.

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All investments are assumed to take place in the end of year 0

Choose a period of 3 to 4 years for expenditures or income

	Year 0	Year 1	Year 2	Year 3	Year 4
Investments					
equipment	-8000				
engineering, planning	-2000				
training	-2000				
protective equipment (saving)		400	500	300	300
reduced sick leave		500	900	900	900
administrative overhead (saving)		100	200	200	200
increased production		3500	4600	5000	5000
maintenance (extra cost)		-200	-300	-400	-400
Total	-12000	4300	5900	6000	6000

List selected variables

Money leaving the company or additional expenditures gets a negative sign, incomes or reduced expenditures a positive

Figure 4.8. Annotated calculation scheme for evaluation of investment that have beneficial effects over an extended period of time (cost-benefit analysis).

Cost-benefit analysis

Figure 4.8 shows a typical format for cost-benefit analysis. In a cost-benefit analysis all expenditures are balanced with all future benefits. There are some issues specific to cost-benefit analysis.

- ✓ It is necessary to take several years into account, in particular if the analysis is done to find out whether investments are economically feasible. Three to five years is a normal period. A longer period leads to greater uncertainty in projections or estimations.
- ✓ All costs and benefits are taken relative to the present situation. If an intervention leads to extra expenditures (e.g., an investment or extra costs for maintenance) the amount is negative. Money saved (e.g., less sick leave) or extra income (such as extra products produced) get a positive sign.

Perform calculations in a tabular format. Use a one-year period for monitoring purposes, and a period of about 4 years for a cost-benefit analysis.

4.6 Step 5: Interpretation, use and refinement of results

The results of a calculation have little meaning in isolation. Sometimes the figures need no explanation, but often the interpretation deserves some attention. The use of economic indicators can help in deciding which investments are financially attractive. Furthermore it is very useful to have some information about the reliability and accuracy of an assessment. This section briefly discusses the most relevant issues in this respect.

Economic indicators

There are several economic indicators that can be used as a decision making aid. Simple and easy to use are the “Payback Period (PP)” and the “Cost-Benefit Ratio (C/B)”. The Payback Period is the amount of time before the initial investments are earned back. A Payback Period of 2 to 3 years is usually acceptable in industry. In the example of Figure 4.8, the payback period would be about 2 years and a few months. The cost-benefit ratio is the ratio between the sum of all costs and the sum of all benefits. The smaller the ratio, the better. The C/B ratio in the example of Figure 4.8 is $12000/(4300+5900+6000+6000) = 0.54$. (In more advanced analyses it is possible to calculate indications like the return on investment, in which depreciation is accounted for.)

It is conventional practice to use net present values in calculating cost-benefit ratios. At societal level, a discount rate of 3% or 5% is usually applied to account for the time preference for money; i.e., it is preferable to have money now rather than in the future. At the company level much higher discount rates are common. In general the discount rate should be the sum of inflation rate, the no-risk interest rates for lending money to a bank and a compensation for risk taking. Practical discount rates at the company level can be as high as 10% to 15% but also higher values are not uncommon.

The discount factor can be calculated as

$$\frac{1}{(1+r)^t}$$

where r = the discount rate,
and t = the time period.

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Using this approach with $r = 3\%$, the cost-benefit ratio for Figure 4.8 would be calculated as

$$-12000 + 4300 * 0.9709 + 5900 * 0.9426 + 6000 * 0.9151 + 6000 * 0.8885,$$

which results in a net present value of **\$8557.81**, for a cost-benefit ratio of **0.58**, which indicates a cost-saving intervention.

Refinements and dealing with uncertainty

Although working with figures gives the impression that making economic calculations is an exact activity, it is in fact more guessing than calculating. Fortunately, there are some tools that can help in dealing with estimations and imprecise data. The easiest way is to repeat the calculations with different assumptions. For instance:

- ✓ Upper and lower limits for a few indicators, e.g. sick-leave reduction varies between 1% and 2%.
- ✓ Make variations in the most important variables, e.g. 10% higher and 10% lower. This is known as sensitivity analysis. It is usually a good idea to have solid data on the variables that have the biggest impact on the end result.

Comparison of alternatives

Particularly in planning investments, comparison of alternatives gives insights in the most economic way to proceed. In a comparison, for each alternative, the same table with expenditures and incomes is made. The alternative that has the shortest payback period or the lowest cost-benefit ratio is economically the most attractive. These comparison techniques also allow for non-monetary data to be used as a selection criterion.

The figures of an economic assessment have little meaning in themselves. Always provide for an explanation. Have an idea about the quality of the outcomes: will the outcomes be about the same if assumptions are changed somewhat?

4.7 Summary of a standard procedure

This section gives a brief overview of a more or less standard procedure that can be used to make an assessment. Both a graphical (Figure 4.9) and a tabular (Table 4.7) format are presented.

Summary of study design (adapted from Farnham et al. 1996):

- ✓ Determine the target audience for the economic appraisal, and consider how they will use the results.
- ✓ Define the problem or question to be analysed.
- ✓ Describe the intervention strategies to be evaluated, including the “no action” alternative for comparison.
- ✓ Identify the perspective of the analysis. It is perfectly acceptable for the analysis to be conducted from the perspective of the employer, but this must be clearly communicated in the report.
- ✓ Decide on the time frame (time period during which an OSH intervention takes place) and how much of the analytic horizon (time period during which the consequences of the intervention take place) will be considered.
- ✓ Select the analytical method(s).
- ✓ List the relevant costs and benefits.
- ✓ Determine the health outcomes to be included; e.g., whether the analysis will include diseases with long latency periods, such as occupational cancers.
- ✓ Decide on the discount rate to be used.
- ✓ List sources of uncertainty, and decide if a sensitivity analysis will be conducted.
- ✓ Identify the terms and/or measures that will be used in the final report.
- ✓ If different subpopulations will benefit and/or incur costs from the various intervention strategies, decide if distributional effects will be examined.

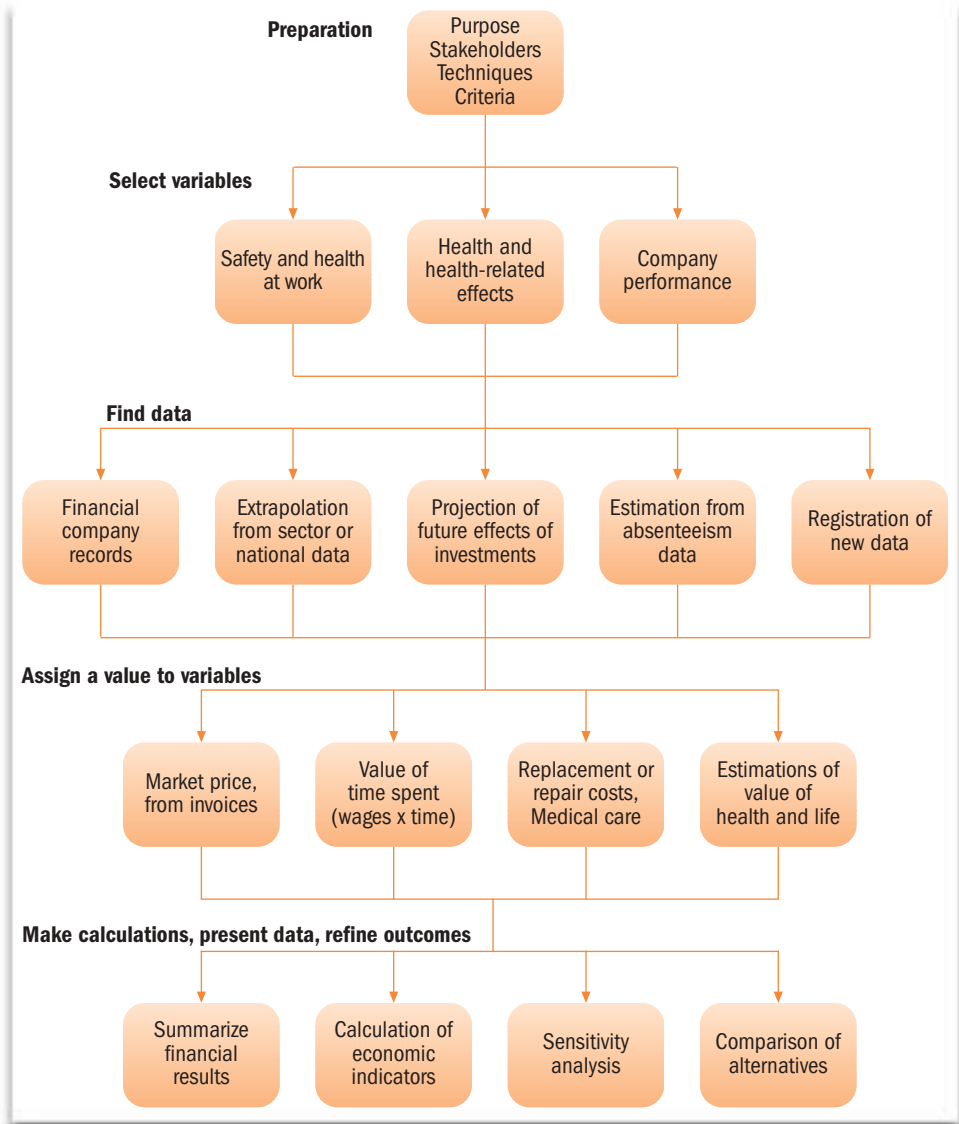


Figure 4.9. General flow scheme for economic assessments. The normal order of activities is in the vertical direction. Alternative ways to proceed within each of the steps are displayed horizontally. Use one or more of the alternatives if needed.

Table 4.7. List of actions that are usually part of an economic assessment.

Step 1. Preparation
a. Establish
<ul style="list-style-type: none"> ✓ purpose of the economic assessment ✓ goal of the project ✓ who are stakeholders, what are their interests, what is their influence ✓ what kind of results are needed ✓ how much time should be spent to make an economic assessment
b. Select a suitable technique
c. Plan the assessment and involve relevant parties
Step 2. Selection of variables and indicators
a. Choose variables:
<ul style="list-style-type: none"> ✓ that are in line with the selected criteria ✓ that reflect the purpose of the assessment ✓ for which data will probably be available (with acceptable effort to obtain and with adequate accuracy) ✓ that are agreed upon by stakeholders
Step 3. Finding data for selected variables
a. Data sources include:
<ul style="list-style-type: none"> ✓ readily available data from company records and accounting system ✓ estimations from epidemiological studies, external data sources, extrapolations from company data ✓ generation of new data
b. Determine which part is to be related to work (e.g. sick leave) and the intervention in question
c. Quantify effects (of injuries, diseases and/or of interventions) by estimation or analysis techniques, such as:
<ul style="list-style-type: none"> ✓ information from similar cases ✓ scenario calculations
4. impact analysis (extrapolation from the goals of an intervention)
Step 4. Make calculations
a. Attach money values to quantified indicators and variables
b. Create understandable presentation of results, for instance:
<ul style="list-style-type: none"> ✓ Tabular format (injury costing, cost-benefit analysis) ✓ Graphs or time series (monitoring applications) ✓ Comparisons to other companies (benchmarks)
Step 5. Interpretation and refinement
a. Present caveats for presented results:
<ul style="list-style-type: none"> ✓ Refer to assumptions, goals, limitations of estimations, quality of data and the like ✓ Use sensitivity analysis to estimate effects of assumptions
b. Decide on further action

Further reading and references

5

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