

*Costs and Benefits of Occupational
Safety and Health in the European Union*

*Report of the first year of the SHAPE
(Safety & Health and Performance of Enterprises)
project for the European Commission - DG V*

author(s):

Jos Mossink
Peter Smulders
Per Lunde-Jensen
Luise Vassie
Richard Wynne
Emma-Jane O'Brien
John Klein Hesselink

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Polarisavenue 151
P.O. Box 718
2130 AS Hoofddorp
The Netherlands
Tel. 023 554 93 93

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Preface

This report presents the results of the first year of the 3-year SHAPE-project (Safety and Health and Performance in Enterprises), commissioned by the Commission of the European Communities, DG-V (Contract SOC 97 2000378 05F05).

In this project the socio-economic costs of occupational accidents, occupational diseases and work-related illnesses are the central issue. In 14 EU Member states of the European Union current methods, practices and possibilities on the assessment of socio-economic costs have been investigated. The result of this first year is a methodology to be used for the assessment of socio-economic costs in companies in the EU. In the remaining two years the methodology will be further developed and tested in a large number of companies throughout the EU.

A project with this goals and scope requires the contribution of institutes from all Member States. The Netherlands' team (NIA TNO) was the co-ordinator of this project. The whole project team was composed of the following institutes and persons:

- *Finland*: FIOH (Finnish Institute of Occupational Health) in Helsinki (Markku Aaltonen and Heikki Laitinen);
- *Sweden*: University of Stockholm/Paula Liukkonen AB in Stockholm (Paula Liukkonen);
- *Denmark*: DWES (Danish Working Environment Service) in Copenhagen (Per Lunde-Jensen);
- *Germany*: Bergische Universität Gesamthochschule Wuppertal in Wuppertal (Wolfgang Krüger and Karsten Stegemann);
- *Austria*: AUVA (Allgemeine Unfallversicherungsanstalt) in Vienna (Klaus Wittig);
- *Great Britain*: CHaRM (Centre for Hazard and Risk Management) of Loughborough University (Luise Vassie);
- *Ireland*: WRC (Work Research Centre) in Dublin (Richard Wynne);
- *Netherlands*: NIA TNO (Netherlands Labour Institute TNO) in Amsterdam/Hoofddorp (Peter Smulders & Jos Mossink); assisted by the NEI (Netherlands Economic Institute) in Rotterdam (Kees Zandvliet & Vincent van Polanen Petel);
- *Belgium*: PREVENT (Institute for Occupational Safety and Health) in Brussels (Marc de Greef);
- *Luxembourg*: PREVENT in Brussels (Marc de Greef with Paul Weber and Paul Ambrosini in Luxembourg);
- *France*: ARACT Ile de France (Action Regionale pour l'Amélioration des Conditions de Travail) in Paris (Evelyne Polzhuber);
- *Spain*: University Pompeu Fabra in Barcelona (Joan Benach);
- *Italy*: INAIL (Istituto Nazionale per l'Assicurazione contro gli Infortuni sul Lavoro) in Roma (Maria Virginia Tirone, Diego Alhaique);
- *Greece*: Ergonomia Ltd in Athens (Ilias Banoutsos);
- *Portugal*: no partner was found.

The effort of these institutes in the national studies that were part of the project, resulted in both a wide and a detailed overview of data sources that can be used in assessments of socio-economic costs in the European Union, both at national and the international level. The results of this studie will also be made available on CD ROM, which also includes the full text of the national reports.

Hoofddorp, The Netherlands
October 1998
Jos Mossink
Peter Smulders

Summary

1. Goals, relevance, concepts and methodology of the project

Accidents at work and work-related diseases represent a major cost factor for society, companies, and employees. Adequate health and safety management may not only reduce costs by preventing accidents and sickness, but also make a positive contribution to the efficiency, long-term development and overall performance of companies, for instance by better work organisation, higher motivation of employees, leading to improved quality and productivity.

In recent studies on assessment of socio-economic costs of occupational accidents, occupational diseases and work-related illnesses methodologies have been developed to make estimations, both at national and the company level. The scope of these studies, however, is limited to some countries. Also the potential benefits of improved safety and health as a competitive factor for companies is generally not taken into account. The hypothesis that improved workplace safety, health and welfare will lead to improvements in the competitiveness of the industry is rather often postulated, but only few studies testing this hypothesis quantitatively have been found.

This research into the costs and benefits of occupational diseases and accidents may serve a number of goals like the anticipation on the socio-economic impact of new regulations or legislation, enhancement of the discussion between social partners and between member states in this area, and improved decision making at national and at company level.

The SHAPE project (Safety & Health and Performance of Enterprises) for the European Commission (DG-V) deals with costs and benefits of Occupational safety and Health (OSH). It has a duration of three years and includes six phases. In this report the work done in the first year (September 1997- October 1998; phase 1 and 2) is described. Later phases concern the further development, application and testing of the methodology in a number of companies in all Member States. The key activities of the first two phases are:

- Description and analysis of the criteria and parameters currently used in the 15 EU-countries to evaluate the costs and benefits of accidents at work, occupational diseases and work-related illnesses, taking into account the different perspectives and interests of all stake holders.
- Development of a set of criteria and parameters and a methodology for carrying out an analysis of the situation in the 15 Member states of the EU that is applicable and acceptable in all member states and by all stake holders.

The study has been carried out by performing three surveys in 14 Member States of the European Union (no survey was conducted in Portugal). The surveys consisted of:

- Interviews with officials and representatives of social partners;
- Interviews professionals;
- Literature and document study.

An analysis of comparability was performed that focused on the variables (e.g. which variables are included, who uses the variables and what is the quality of data), definitions (e.g. what is meant by occupational or work-related illnesses),

pricing and costing principles applied, the issue of time and how prevention costs are dealt with.

Safety and health at work have economic effects and have an influence on the use of resources at national, company and the individual level. For understanding the nature of these economic effects it is necessary to develop a conceptual framework in which the relation between factors in work and management are related to the economic outcomes related to health and safety at work. To this end a set of variables is defined reflecting the use of resources for management, the existing situation (also with regard to safety and health) and a set of economic effect variables are distinguished (see figure 1).

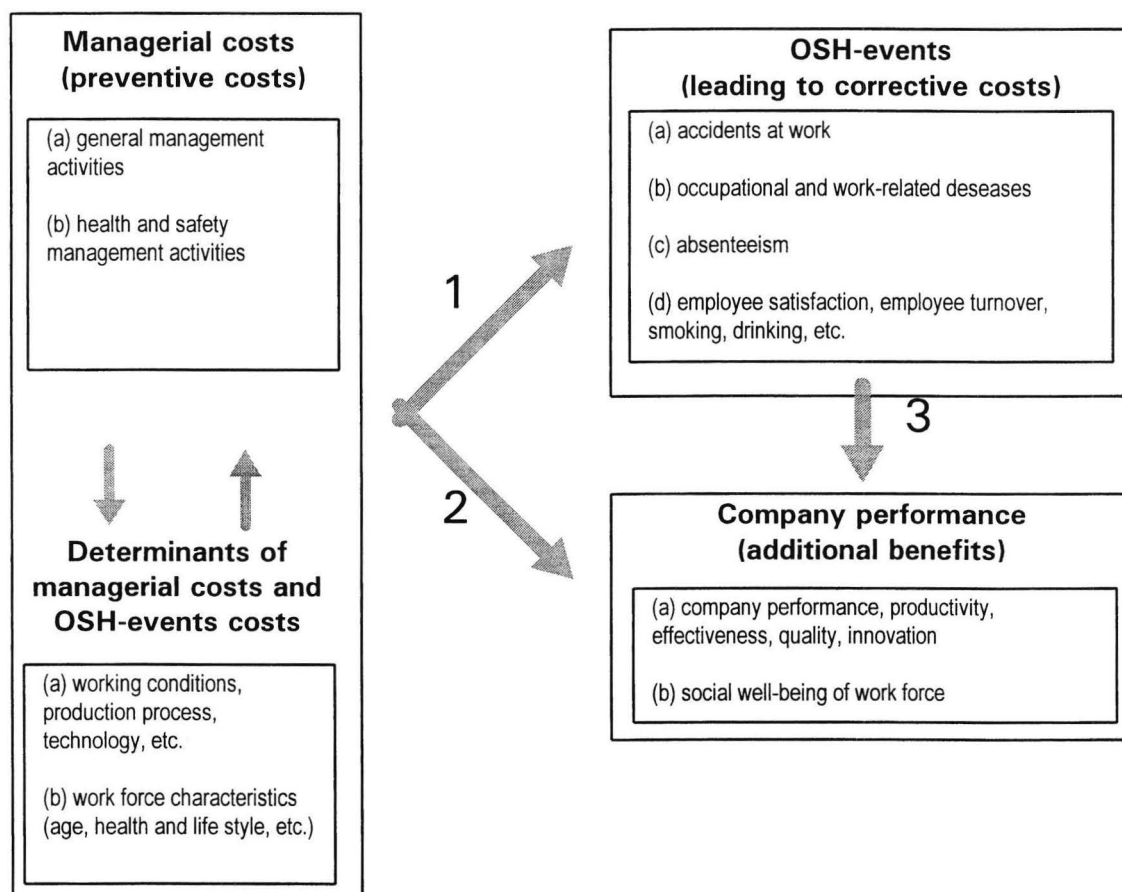


Figure 1 Global conceptual framework on costs/expenditures and benefits in the field of occupational safety and health.

The model adopted assumes that a number of effects in the field of occupational safety and health (such as accidents, occupational diseases, absenteeism and employee behaviour) leads to expenditures (costs) to the company. Managerial activities, for instance safety and health management or investments, aim at reducing the health effects, resulting in less expenditures (benefits). Furthermore, accidents, sick leave and employee behaviour influence company performance. Also managerial activities and investments have effects on company performance.

Of course, the actual situation at the workplace and characteristics of the workforce are determinant for both the managerial activities and the effects on health and company performance.

2. Theoretical and practical viewpoints on economic OSH-evaluations

In the course of years, two types of cost-benefit studies have been developed for socio-economic assessment at the national level: costs-of-illness studies and cost-benefit analyses. The costs-of-illness studies were designed to estimate all costs that are related to occupational safety and health in a country. Cost-benefit analyses aim at comparing the costs of interventions and the benefits hereof in terms of cost reductions are.

Comparable applications exist at the company level (see figure 2). Studies can have a monitoring goal (OSH costs monitoring: evaluation of costs of accidents, costs of occupational diseases or costs of preventive activities), or studies play a role in decision making (cost benefit analysis and cost effectiveness analysis).

	National Level	Company level
Monitoring	Costs-of-illness Costs of accidents	OSH costs monitoring Benchmarking
Decision making	Ex-ante evaluation Cost-effectiveness	Investment cost-benefit analysis Cost-effectiveness

Figure 2. Overview of types of economic studies

The costs and benefits of safety and health at work at company level, but also to individuals and society are heavily influenced by policies concerning the social security system and choices in social insurance. Also choices with regard to the methodological approach and data sets have an impact on the results of an economic assessment. For understanding the implications on assessment some issues are particularly relevant:

- *Cost passed on to third parties (externalities) and cost internalisation:* The costs at company level are much influenced by the extent to which costs are covered by insurance or individuals. At national level, estimations may be low as part of the external costs are not registered.
- *Work relatedness of diseases and accidents:* Sick leave is commonly used as the most important effect variable. Nevertheless, the relation between sick leave and safety and health at work is not always clear. Relying on formal occupational diseases only, is likely to lead to underestimations.
- *Economic effect measurement:* At national level several economic effects measures are possible besides the monetised costs. Examples are (national) welfare, employment levels and healthy life expectancy. However, in practice these measures are not often used. At company level, the performance can be expressed in various dimensions. Besides the financial aspect this could also include productivity, quality, innovation and the like. Practical studies generally focus financial outcomes.
- *Time.* The issue of time poses several problems, especially for cost-benefit analysis in which forecasting future benefits is an important part. Problems refer to the long latency period of some occupational diseases, discounting (correcting

for the future value of money) and the emergence of new technologies that make high safety and health standards cheaper.

The general approach to an assessment of socio-economic costs both at national and company level includes three activities. First basic health data are collected. These cover sick leave, hospitalisation, disability, fatalities and the like. Several strategies can be used to collect the health data required:

- *Use of notification data:* The use of data from social insurance or social security may give rise to difficulties in interpreting what is understood by work-related illnesses. Furthermore, notification data suffers from underreporting in some countries, in particular when the incentive to notify is low.
- *Workforce surveys:* By choosing this strategy, the problem with notification incentives is overcome. However, because the work-relatedness in this strategy are based either on self-reporting or on the judgement by general practitioners, both the problems of knowledge and recognition and of determining causal factors in individual patients remain. The links to workplace risks or exposure at the workplace has been weakly reported so far.
- *Epidemiological studies:* The main limitation of this data strategy is that the economically relevant health outcomes (sickness absence, early retirement) are also influenced by behavioural and legal factors, and may therefore be difficult to derive from the medically defined health outcomes which is preferred in epidemiological studies.

As the data sets on basic health data are at least rather general, the second activity is to extract or construct relevant quantified indicators from the basic health data.

Part of this process involves attribution of health data to work.

The third activity is to assign monetary values to the quantified indicators (valuation or pricing). In economic assessments various methods for assigning a monetary value to health variables are in use, varying with the nature of the variable.

- *Lost productive hours:* The most common and simple method to assign a money value to lost productive labour hours is to take wages as the opportunity cost of time. This method is valid under the assumption that wages adequately reflect the value of production. In some cases (especially at the company level) more accurate pricing methods have to be applied.

Assessing the loss of potential future earnings can in principle be based on statistical data of life expectancy and career development patterns.

- *Health care:* current costs.
- *Material damage:* The common method to price material damage is to take the replacement or repair costs as the monetary value, possibly adjusted for depreciation of the damaged equipment or materials.
- *Human costs:* There is no generally accepted method for calculating a money value for permanent effects on health, pain and suffering, the quality of life and (healthy) life expectancy as no market prices for these commodities are available. Methods like “willingness to pay” (WTP) or “willingness to accept” (WTA) are used to make estimates, but the outcomes are often criticised, as different techniques yield different results.

3. Variables used in socio-economic assessments at national level

Literature survey

From literature it appears that in a number of Member States national estimates of the socio-economic costs have been made. The general objective of these studies is to establish an order of magnitude of the costs of occupational accidents, occupational diseases and work-related illnesses to society. The coverage of these studies is in general occupational accidents and work-related diseases. However, the definitions of work-related diseases used vary widely and some studies are restricted to a few occupational diseases. The variables commonly included in these studies are health effects (hospitalisation, sick leave, disability, fatalities, emergency costs) and material damage. Some studies also include other variables on health effects and corrective costs. None of the studies on costs-of-illness at the national level includes a full set of relevant variables.

The data strategies are usually workforce surveys, notification data and in some studies epidemiological data, relating exposure and excess risk.

The availability of relevant and accurate data is the major problem. To overcome this problem, estimates and approximations are made which, however, may lead to methodological problems.

The monetary value is in most studies estimated by lost output and resource costs of health care. Household production is included in some studies. Estimates of human costs are only performed in the UK in which cases the ‘willingness to pay’ method is used for pricing.

National-level estimates are often difficult to interpret. In order to increase transparency, it is recommended to perform as much of the estimation as possible in “non-economic” terms (i.e. number of hospital bed-days, volume of days/years lost in production), and to publish both the economic costs and the volumes of sickness occurrence. This broadens the range of possible uses of the data sets, allowing the same data sets to be used both for financial and socio-economic analyses.

With regard to health effects, national level studies commonly use the costs of :

- hospitalisation;
- out-patient treatment;
- rescue and emergency costs (accidents);
- sickness absence;
- permanent disability;
- deaths (for relevant diagnoses);
- damaged equipment (for accidents leading to injury);

These variables are relevant both for a cost-of-illness calculation at a specific point in time and for “benefit” quantification in cost-benefit analysis.

Of the non-health related costs only “material damages” are included in studies. Administrative overhead of sick leave is to be added, but only the variable part that can be related to the incidence of sick leave.

There are a number of variables that denote the prevention costs. The relevance hereof depends on the goals of the study. Prevention costs are calculated from specific interventions (such as changes in regulation), or from the costs of specific institutions.

The additional benefits cover various effects of an intervention on production. These are denoted “additional” as the direct goal of an OSH intervention is to influence health and safety. Note that managerial activities such as safety and health interventions can also have direct implications for productivity and quality. In the

economic assessment, special care has to be taken to avoid double counting. In conclusion, the additional effects are highly relevant as a checklist for design of ex post evaluations, longitudinal analysis of industry and technology development or job development studies at the national or industry level.

Cross national comparison of studies

Even if a strict comparison of the quantitative results have not been performed as a part of our analysis, it is quite evident that all the cost-of-illness studies - which relates to the benefits from prevention - show some national bias which originates from the basic quantification of work-related sickness occurrence. The data used - both in socio-economic and financial cost estimates - reflects a national perception of work injuries and work-related disease, and the importance assigned to these phenomena.

Analysis of comparability of data sets used at national level

There are many problems relating to the data sets gathered at national level which may be used for calculating the costs and benefits of occupational accidents and diseases interventions. These problems not only make it more or less difficult to generate useful calculations within many countries; they also make it almost impossible to undertake valid and reliable international comparisons of costs and benefits. Among the most important problems with these data sets to emerge from the surveys are:

- Different sets of data are collected in the EU Member States. In some countries relatively little is collected, while in others there are many potential sources of data. There are few data sets collected which are common across all countries. Also within countries, data sets tend not to be integrated with one another, thereby making it extremely difficult in most countries to relate, for example, the costs of accidents with their occurrence.
- There are few data sets which are concerned with occupational diseases. Those which are available appear to severely under-represent the true situation. Data reliability is a problem with regard to the accidents which are notified as well, the data which are collected are in many cases not accurate.
- Data sets on occupational diseases appear to have different bases, i.e. the definition of occupational disease varies between countries.
- Social insurance systems differ widely in the provisions made for compensating for occupational accidents or diseases. Some of the more relevant dimensions of difference include the provisions for the distribution of costs between social insurance agencies and employers, the period of liability for payments and the presence or absence of incentives within the system.
- The coverage of data tends to seriously under-represent the reality of the costs and benefits of accidents and disease prevention.
- The definitions of variables in the data sets available vary from country to country.
- With regard to absence statistics and disability statistics, differences in the length of time taken to resolve legal aspects may contribute to spurious elevations of time off.
- Many of the variables reported as being available are not directly so. These can only be derived from scientific studies.

It is clear from the above summary of the main findings from the survey of data sets, that the issue of generating international comparisons is enormously

complicated. The implications of these constraints on data for purposes of undertaking comparability analyses are also clear. These include:

- At the national level the greatest concentration of data sets concern health related variables so any approach to assessment should try to use the variables that are highly likely to exist.
- If there is a need for comparisons between countries, it is necessary to develop complementary approaches to socio-economic assessment dependent of the data sets available.
- One way forward is to develop a minimum data set which might be collected or already available in all countries.
- In the interim, it may be possible within the limits of reliability and validity constraints to conduct longitudinal analyses of the costs health and safety and disease within countries, thereby enabling trends in costs to be monitored.

In a strict sense, estimates of the costs of work-related sense can only be added cross-nationally if the work-related sick leave is quantified by the same method. In the short or medium term, such data cannot be produced for all EU countries, and neither for all major relevant diagnoses. It is necessary to rely on national data. What can be done, however, is to increase the transparency of the data used for cross-national comparison and analysis. With respect to the prevention cost side there are no inherent problems in adding data across country borders. As with the benefit side, comparability can only be ensured by a parallel analysis of economic data and the basic quantities.

4. Variables used in socio-economic assessments at the company level

Literature survey

Three basic types of studies are found:

- *Intervention studies*, which analyse the effects of health and safety prevention activities as compared to the situation before intervention.
- *Accident costing studies*, which estimate the costs at a point in time, adding the costs occurring after (as an consequence of) a registered work accidents.
- *Accounting and controlling models*, which cover models designed primarily to monitor the state of OSH in the company at points in time. These models are used for supplementary accounting.

The number of papers introducing methods and models rather than reporting empirical results is relatively high, while the number of convincing empirical studies is low. Furthermore it is observed that relevant background parameters are too often neither reported nor discussed or controlled for.

The international perspective is almost absent, and only one study was found that is truly cross-national in its design and methodology. The literature survey did not reveal much information on the problems involved in building a general model which can also be adjusted to the specific conditions in each of the EU countries.

Variables used

With regard to health effects, most of the intervention studies use the volume of general sickness occurrence as the main health variable. Only some of the studies include additional measurement of the incidence of specific, work-related diagnoses.

Non-health correction costs like investigation time, management time, transport of victims to hospital and the like, are rather detailed in accident costing studies. Most accident costing studies are precise with respect to identifying the marginal costs of an accident, though problematic examples using average per worker costs.

When the perspective of studies and models are broadened to *all* work-related health problems in intervention, accounting and controlling models, these variables are much more difficult to identify, and they are only sporadically included.

Judged by the purpose of the various types of models, prevention costs should be identified in all intervention studies and in controlling/accounting models, but not in the accident costing studies, as the latter category should focus on marginal costs due to the accident.

It is surprising that a significant proportion of the intervention studies treats the prevention costs rather superficially, both in descriptive terms and with respect to quantification. The explanation may be that the marginal prevention activities are difficult to distinct from general decisions, investments or work procedures.

Additional benefits like productivity and quality are not specific for analysis of occupational health and safety - they consist of general production variables which would be used to evaluate the impact of any major change in production technology and work organisation.

Though the effects of changes may be both positive and negative on some variable, no reference to productivity losses, quality deterioration etc. caused by OHS interventions have been recorded in our basic material, and the conceptual models seems to also take the positive sign ahead of the variable for granted. Variables like worker productivity, product quality and product quality are mentioned frequently in conceptual references and models, while there are few specific estimation procedures proposed. When it comes to empirical studies, work productivity the number of complaints/scrapped products (quality) and throughput time are the only variables quantified in terms that could be transformed into "costs".

Conclusions with regard to the variables and data sets in use at company level are:

- The definition for occupational diseases appears to vary between countries, with some using a list system of registered diseases, while others allow for the linking of potentially any disease with the workplace
- The data sets which are collected at national level are very difficult to compare because of the facts that different data sets are collected, and reliability and validity tend to be poor
- The data sets which are collected at company level may be more comparable, but reliability and validity also tend to be problematic here
- There are many missing areas of data at both national and company level which would be needed to perform a sophisticated cost or cost benefit analysis
- There is almost no data collected at the individual level
- Occupational accidents and diseases are underreported. This may be due to the complexity of the procedure in being able to register a disease as related to occupation or due to collection systems of data not being integrated.
- There is a lack of centralisation and integration of all data collected
- There is a low awareness of the need for methodologies for socio-economic assessment of occupational accidents and diseases in companies
- A mechanism linking insurance premiums paid by enterprises and their performance in OSH prevention may offer financial incentives to enterprises for

OSH prevention. This occurs only in some countries, for example, France, Greece.

Analysis of comparability of data sets used at company level

Most of the data available at company level is concentrated in the area of the health related effects of occupational accidents and illness with a special focus on absenteeism data, registered accidents and illness data and personnel turnover data.

In addition, there is a relatively high concentration of data sets on some of the corrective costs for illness and accidents, especially in relation to administration costs, damaged equipment, lost production time, insurance premiums and legal liabilities. However, data sets relating to preventive costs and especially the benefits of prevention were much less widespread.

From the point of view of making comparisons between company levels costs, especially on a transnational basis, the relative availability of data needs to be balanced against the following issues:

- Legislative changes in some countries have reduced the incentives for companies to maintain data on short-term absences due to accidents and occupational ill health (costs can more easily be externalised);
- The impact which social security legislation and regulations have on definitions and on the apparent rates of accidents, illness and absenteeism;
- The issues of the validity and reliability of data are also of relevance at the company level.

The problems of comparability of data sets at company level are somewhat less than those at national level. Even if there are problems with definitions, there is a greater potential availability of data when compared to national level.

Implications for methodology development

The limitations on currently available data sets are not the only ones to be faced by a methodology for calculating costs and benefits of health and safety activity. Other issues include:

- The failure of many companies to maintain accurate records on absenteeism;
- The difficulty of measuring assessing productivity effects of illness;
- The difficulties of assessing the benefits of prevention.

If the requirement to make simple models for the companies prevail, then one can decide to use wages which would be paid during the sick leave spell as an approximation for the value of lost production time or the costs of adequate replacement of the worker on sick leave.

If the requirement of precision and flexibility towards companies with different characteristics prevails, then a calculation should include the choice of strategies to compensate for the absence of the worker. This can be determined from the actual situation of the company. The response to absence should be quantitatively distributed on the variables : internal and external replacement workers, reduction of customer service (delays, services not delivered), and costs must be assigned to all the variables. Finally, the interrelations of these variables must be modelled, allowing for company characteristics to determine the outcome.

In both cases, attention should be given to sick payment arrangements - the net effect of financial transfers must be taken into account. Corrections must be made

for sick payments, wages saved, refunds from public or insurance funds if companies are compensated by public or sick insurance funds.

5. Methodology for OSH-economic evaluation in companies

Development, analysis of obstacles and requirements

There is a need for adequate instruments for economic evaluation analysis at the company level. These instruments will be important for the company's economic position with regard to the improvement of working conditions. An accepted economic evaluation will support decision making on safety and health management, as it clearly indicates both the costs and the benefits that may be expected. Better information on the benefits of attention to safety and health at work is likely to prompt action in enterprises.

In practice users in companies are confronted with a wide range of situations in which an economic evaluation is useful. Therefore a number of variations for methodologies exist. To the user it is not always clear which kind of assessment is best suited, and this is particularly true for the inexperienced user. The methodology will therefore not only support the user in performing calculations, but also in selecting and detailing the most appropriate way for the economic assessment and in the interpretation of the results.

The development of the methodology takes seven stages:

1. Exploration of the problem to be addressed
2. User requirements analysis
3. Development of a prototype methodology
4. User feedback
5. Amendment of the prototype
6. Testing of the prototype
7. Development of a final version of the methodology

The obstacles to developing and implementing the methodology are organised into six main categories on the basis of a content analysis. Obstacles are expected with respect to motivation of potential users, the lack of adequate data, difficulties in calculating the benefits, the complexity, the accuracy of calculations, and a lack of specific aims. By far the most important category was the 'Motivation and Marketing'. Here the main concern was with issues of persuading stakeholders to use the methodology, especially when they had low motivation to do so. In addition, there were concerns about the overall marketing strategy which might be adopted. The best that can be achieved is to develop a methodology which is capable of being used in as wide a range of enterprises as possible and to develop an appropriate marketing strategy for its dissemination.

The most important requirements concern the fit with company practices and the awareness raising function of the methodology. The next most prevalent sets of requirements are the need for the methodology to be kept simple in relation to its usage and accurate.

The message for methodology development is clear - it must be both simple to use and accurate and reliable enough to enable valid conclusions to be drawn. To some extent these requirements may be in conflict, as simplicity might seem to imply that rigour should be compromised. One final significant category of requirements

concerned the need for the methodology to assist in the process of goal setting. This category refers to the ability of the methodology to set realistic OSH goals and also to the capacity of the methodology to assist in making cost-effectiveness decisions.

Outline of the methodology

The methodology supports a number of applications in the field of:
monitoring (such as OSH-costs monitoring, evaluation of accident costs, benchmarking);
decision support (such as cost-benefit analysis, cost-effectiveness analysis);
some additional applications (e.g. sensitivity analysis, 'what-if' analysis, multi-criteria analysis).

The construction of the assessment from the needs of the user requires four basic steps, each step further detailing and performing the economic assessment (see figure 3).

1. which applications best reflect the question at hand?, which economic assessment technique is adequate for the situation? what kind of results are required?
2. what variables or indicators are needed and are possible?
3. where can data be obtained, or - if data is not available - how can estimations be made?
4. how should calculations be performed and how are the results to be interpreted and used?

Furthermore, the methodology includes a support system that helps the user in constructing a useful economic evaluation in a number of steps, starting with the actual need of the user. It also provides help for the interpretation of results. In each of the steps a number of specifics of the assessment are determined by the user. Once the construction of the assessment is complete, a calculation of costs, benefits and economic indicators can be performed, starting from the data (or data strategies) specified by the user. In table 1 some examples are presented of the content of the methodology.

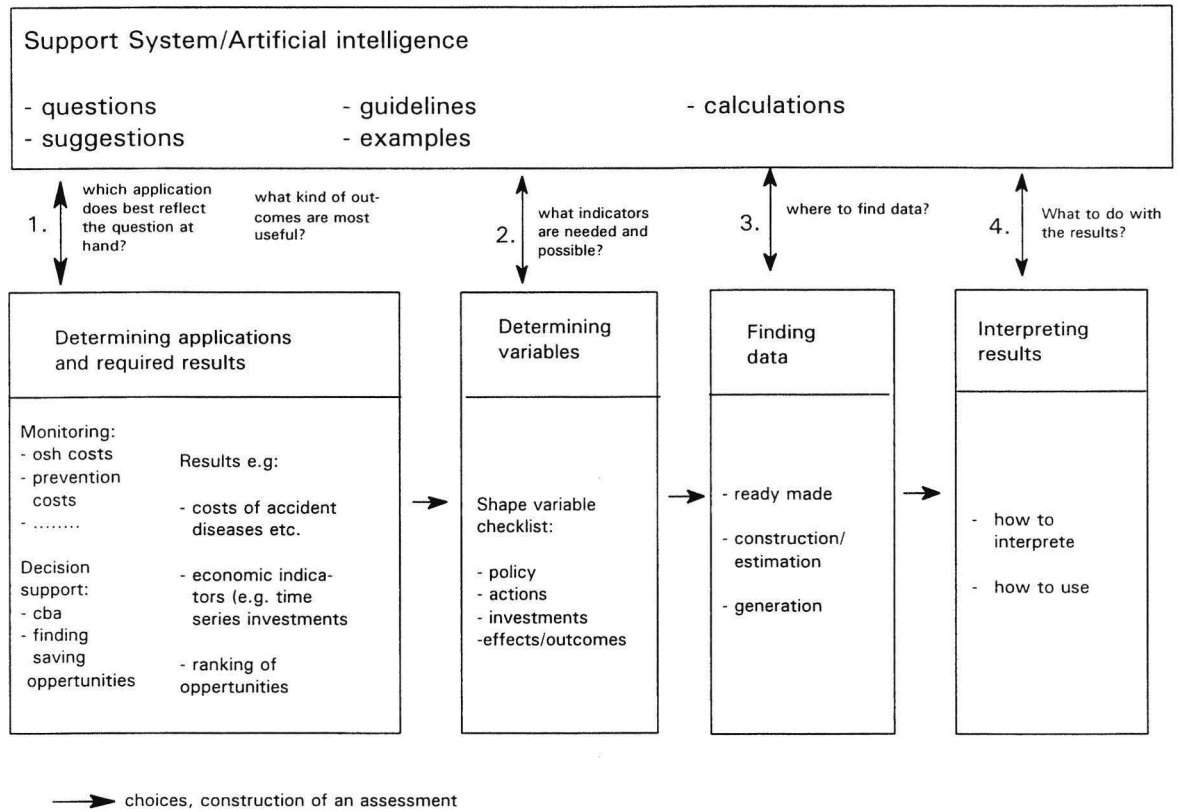


Figure 3. Functional overview of the methodology in four basic steps

Table 1 Content of the methodology

Item	Goals	Examples of tools
Introductory module description of the methodology	• Overview of the methodology's structure and goal • Overview of the problem areas the methodology addresses	• Case studies of cost benefit analysis and other procedures • Frequently asked questions about economic appraisal
Step 1 Choosing an application and required results for the methodology	• Choice of an appropriate application • Determination of criteria against which evaluations are performed	• Inventory of types of analysis • Minimum requirements of each type of analysis • Strengths and weaknesses of each type of analysis • Selection support
Step 2 Conducting the analysis: selection of variables	• Selection of variables to be included in the assessment	• Checklist and description of relevant variables • Selection guidelines
Step 3 Conducting an analysis: finding data or making estimations	• Identification of data sources • Generating data • Inputting data	• Possible data sources • Guidelines on data quality • Guidelines on how to generate useful data • Common pitfalls in data • Suggestions for estimation or approximation techniques
Step 4 Performing calculations and interpreting results	• Calculation of economic effects • Clarification of meaning of results	• Guidelines for interpreting results • How to move from results to action

Support system

The support system gives guidelines during the construction of the assessment and assists in the process, for instance by asking questions, outlining options, suggesting optional courses of action, providing explanations and definitions, giving examples, referring to data sources and the like.

The support system consists of a number databases and decision rules that have as a purpose to support the user in performing the steps of an assessment of socio-economic costs.

Step 1: Applications and required results

One of the first activities is to determine what kind of results are required. For a large part these result reflect the questions a user may have. As a consequence, the application required is chosen on basis of the user needs, but also the context in which economic evaluations are conducted plays a role. For instance, a small company that has little information available would require a different kind of economic evaluation than a large company with an extensive registration on health data.

Step 1 of the methodology deals with three questions:

1. which application is the most appropriate and will give results that best answers to the user's questions?
2. what criteria will be used to evaluate the results of an assessment?
3. What are the goals of the monitoring system or intervention in question; the results of the assessment of socio-economic costs should be in line with these goals.

Step 2: Selecting variables and indicators

This step deals with the selection of appropriate variables. This selection deserves some attention as several considerations play a role. Most important considerations:

- what are important criteria to the user, the company or other stakeholders, try to translate these criteria into (preferably quantifiable) variables and indicators;
- what are the objectives of a monitoring system, these objectives should be reflected in the variables and indicators used;
- what are the goals of safety and health management in the company, which indicators give information about the performance;
- which variables are needed in order to perform a specific application.
- what are the goals interventions, these goals can be reflected in the choice of variables.

At the company level three groups of effect variables can be indicated:

- corrective costs or costs that are incurred to maintain production and quality level; here a distinction is made between health related effects without cost calculation and effects that can readily be expressed in monetary terms (such as damaged equipment);
- prevention costs, all expenditures for preventive action;
- other effects on company performance, e.g. productivity, quality, operational effects and impact on non-economic company values.

Step 3: Quantification, finding data, pricing principles

The actual determination of socio-economic costs of health effects, but also for productivity or quality effects, involves two activities: first quantifying the selected variables and, second, the estimation of a monetary value. Several pricing principles are available and will be used in the methodology, depending on the cost item, available data, needs of the user and the like.

This section deals with the first activity: finding data for the quantification of variables. Three topics are addressed:

- finding data;
- attribution to safety and health at work;
- cause and effect relationships.

Note that the accuracy and reliability of the data usually is the limiting factor in the accuracy of assessments of costs and benefits. Estimation or approximation techniques that are applied to overcome missing data also have limitations with regard to accuracy. Therefore, the use of data deserves some extra attention.

Step 4: Calculation and interpreting results

Starting from the data and keeping the kind of application and its use in mind, calculations are performed to put a monetary value to a number of variables. During the calculation the specific situation in each of the EU Member States (with regard to e.g. the social security and national infrastructure on OSH) are included. The general idea is to complete a table in which (selected) variables and monetised values are listed and totals are calculated. In addition to the presentation of a cost calculation one can choose to present the results as from a different perspective, for instance by presenting scores on effects that cannot be expressed in terms of money (such as company image). In general it concerns the same results, but presented from an other angle.

Further development

The further development includes detailing and refining of some parts of the methodology. Most important however is an extensive practical application in a number of companies in different EU Member States. Additional cycles of testing and amendment are to be carried out in the second and third year of the SHAPE project.

1. Introduction

1.1 Background

1.1.1 The relevance of the project

The practical relevance of the project

Accidents at work and work-related diseases represent a major cost factor for society, companies, and employees. Adequate health and safety management may not only reduce costs by preventing accidents and sickness, but also make a positive contribution to the efficiency, long-term development and overall performance of companies (better work organisation, modernisation, better training and motivation of employees).

The knowledge relevance of the project

In some recent costs-benefits studies methodology has been developed and for some countries calculations have been made. The scope of these studies, however, is limited to some countries. Also the potential benefits of improved safety and health as a competitive factor for companies is not taken into account. This study will fill in existing gaps by extending the number of countries to all members of the European Union.

Research into the costs and benefits of occupational diseases and accidents may serve a number of goals:

- the socio-economic impact of new regulations or legislation may be anticipated on the basis of research;
- more insight in criteria and parameters will enhance the discussion between social partners and between member states in this area;
- demonstration of the positive (economic) effects of improvement in occupational safety and health will stimulate action (both at the company and at the national level);
- decision making with respect to the choice between policy options or preventive actions may be improved;
- insight in the socio-economic impact of occupational diseases and accidents may give rise to innovations in social security systems, workers compensation systems or incentive systems.

The methodological relevance of the project

The combination of research at the national level, the company level and the individual level is relevant since it will offer opportunities to gain more insight into the division of costs and benefits between the various levels involved. Involving the company level is of great importance because individual companies are the key actors in the reduction of occupational diseases and accidents. In this light, regulations and social security systems give the framework and limitations.

By involving all member states of the European Union, the best of experiences may be combined. For any initiative on harmonisation involvement of all member states is a prerequisite. In order to establish a widely accepted set of criteria and parameters involvement of social partners in all member states is required.

1.2 Goals and planning of the project

1.2.1 The goal and the planned six phases of the three-year project

This report deals with the results of the first year of a project, which is aimed to be carried out in three years. The whole three-year project includes six phases:

Phase 1	5 months	Inventory of cost-benefit criteria and parameters used in the EU to evaluate the socio-economic and human impact of accidents at work, occupational diseases and work-related illnesses.
Phase 2	7 months	Development of a set of criteria and parameters into a methodology applicable and acceptable in the EU member states
Phase 3	10 months	Application of the methodology in 90 companies all over the EU
Phase 4	4 months	Analysis of the effectiveness of the methodology used
Phase 5	4 months	Development of a final and acceptable methodology
Phase 6	6 months	Application and evaluation in 30 EU-companies

1.2.2 Goals, activities and deliverables of the first year

The goals, activities and deliverables of the two phases in the first year are:

Phase 1 goal:

Description and analysis of the criteria and parameters currently used in the 15 EU-countries to evaluate the socio-economic and human impact of accidents at work, occupational diseases and work-related illnesses, taking into account the different perspectives and interests of all stake holders.

Phase 1 activities:

- Survey # 1: Carrying out - by way of oral interviews and analysing documents - a survey of criteria and parameters in the 15 Member States at official level;
- Survey # 2: Carrying out a survey - again by way of interviews and analysing documents - of the same criteria and parameters in the 15 Member States among professionals, trade unions and employers' organisations;
- Survey # 3: Carrying out a survey of the same criteria and parameters in scientific and technical studies;
- Analysis of survey results: Analysis of the comparability of the information gathered in the three surveys.

Phase 1 deliverables:

Phase 1 will be concluded with a report with the following contents:

- Review of recent and ongoing studies and initiatives in the EU.
- Brief review of relevant economic theory and practice.
- Inventory of criteria and parameters currently in use at individual, company and national level
- Brief description of the national context (like social security system, history or cultural factors) in which criteria and parameters have their meaning.
Assessment of the impact of these factors on socio-economic impact of occupational diseases and accidents.
- Assessment of comparability of criteria and parameters, description of differences between member states.

Phase 2 goal:

Development of a set of criteria and parameters and a methodology for carrying out an analysis of the situation in the 15 Member states of the EU that is applicable and acceptable in all member states and by all stake holders.

Phase 2 activities:

- Definition of evaluation-criteria and -parameters: Development of one or more sets of appropriate criteria and parameters to evaluate the socio-economic and human impact of accidents at work, occupational diseases and work-related illnesses
- Seminar (in Amsterdam, 3-4 September 1998): Presentation of this set of criteria and parameters to a seminar, to be attended by about 50 researchers, government officials and social partners
- Methodology in report and database: Completion of this set of criteria and parameters in the form of a methodology ('how to apply the criteria and parameters') and creation of a computerised database on CD-ROM containing all the criteria and parameters used in the Member States.

Phase 2 deliverables:

Phase 2 will be concluded with:

- A report with the following contents: results and conclusions of the Amsterdam-seminar; general methodology for assessing costs and benefits including a set of criteria and parameters, ready to be used in phase 3 of the project; comments for application in all member states.
- A computerised database containing all the criteria and parameters. The computerised version will be ready on CD-ROM for the 'public' and also for to use in the case studies.

1.3 Conceptual thinking about costs and benefits of occupational safety and health.

This section describes the main lines of thinking about the economic effects of occupational diseases, occupational accidents and work related illnesses. Discussed are the issues of relevant variables, the level of description (individual worker, company or society as a whole), the concepts of costs and benefits and the understanding of occupational accidents, occupational diseases and work related illnesses.

Based on the basic conceptual framework that is described in this section, a methodological approach for this study is developed (see section 1.4). Current issues in research and policy development that are important to economic appraisal are further elaborated in chapter 2.

Variables and interdependencies

As said, safety and health at work have economic effects and have an influence on the use of resources at national, company and the individual level. For understanding the nature of these economic effects it is necessary to develop a conceptual framework in which the relation between factors in work and management are related to the economic outcomes related to health and safety at work. To this end a set of variables is defined reflecting the use of resources for

management, the existing situation (also with regard to safety and health) and a set of economic effect variables are distinguished (see figure 1.1).

The situation at work (describing existing safety and health risks) cannot directly be expressed in terms of money. However indirectly it influences the relation between the expenditures of safety and health management and its economic effects. The closer the ideal situation in terms of working conditions is approximated, the more expensive further results are: prevention of the last accident will be infinitely expensive (Lehmann & Thiehoff, 1998).

Two kinds of effect variables are distinguished: health and safety outcomes and outcomes for company performance on the other hand. The introduction of company performance is essential as changes in company performance are likely to have major economic consequences.

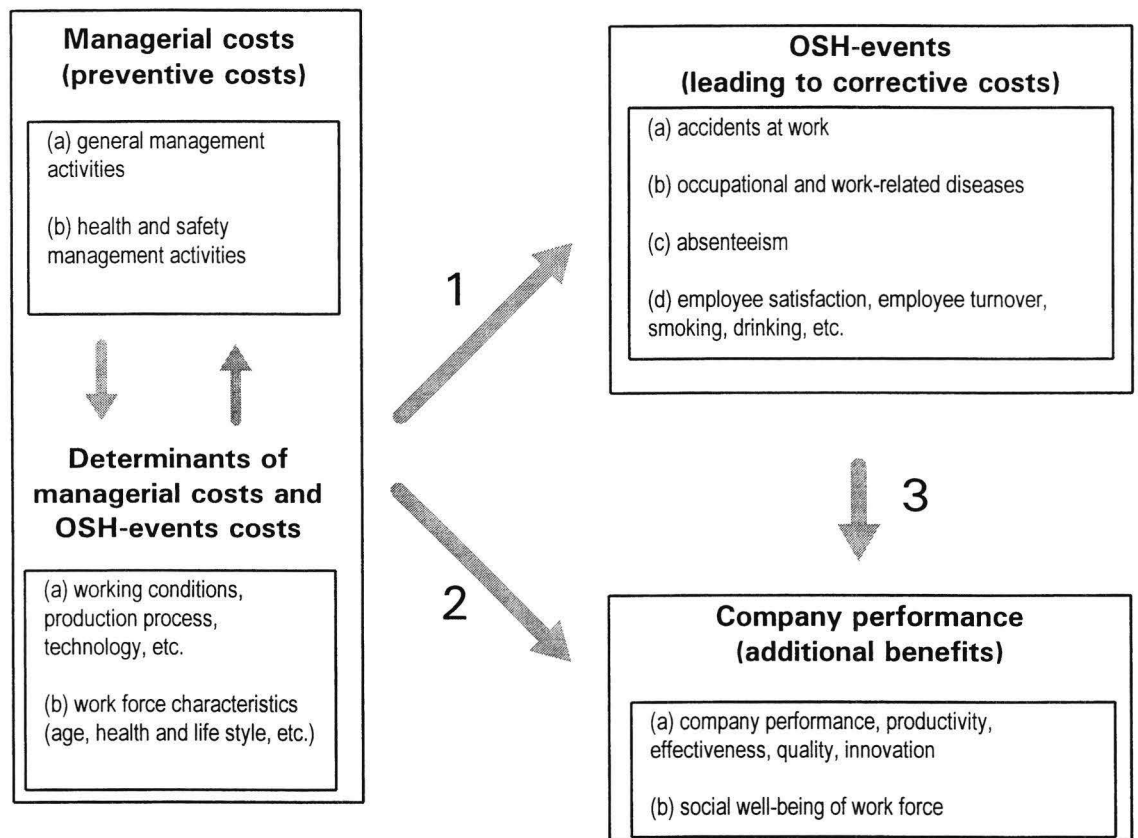


Figure 1.1 Global conceptual framework on expenditures and benefits in the field of occupational safety and health.

The variables in the conceptual model (figure 1.1) interact in a number of ways and interactions will be of a complex, dynamic and ever changing, nature.

For this study a number of simplifications have been made, resulting in the following key dependencies:

1. Health at work or the occurrence of occupational accidents and diseases are related to the complete set of causal variables; managerial activities have an effect on health at work, for instance by changing the technological structure or

the characteristics of the work force. However, the precise mechanism is not considered relevant in this moment.

2. Together with health effects, there will always be simultaneous effects on company performance. For instance, new technology may have less health risks, but it will also enable higher productivity or quality.
3. Outcomes on health and social well-being at work will in its turn also affect company performance, for instance fatigue and reduced fitness will have an effect on productivity and quality levels.

Costs and benefits

In this study the concepts of costs and benefits are used as follows:

- Expenditures for work related illnesses and accidents are costs. This includes all money spent, or lost income, as a result of occurrence of accidents or diseases; expenditures would not have been made if the accident or illness had not occurred (or incomes would have remained at its initial level). These are considered costs. If the expenditures are done to restore the initial situation (reparations, health care) these are called corrective costs.
It may not be possible to restore the initial level (e.g. in case of irreversible health damage). The remaining 'damage' is also a cost, though it may be very difficult assign a monetary value.
- Activities in the context of health and safety management use resources, which usually have a monetary value, referred to as costs. If the activities take place to improve safety and health at work these are called preventive costs.
- If some preventive action has a reduction of expenditures or an increased income as an effect, these are called benefits. Also improved health or social well-being is a benefit.

Note that in most situations costs or benefits reflect differences in expenditures or income, such as before and after an intervention, or with or without occurrence of accidents and illnesses. Therefore it is important to be clear with regard to the reference level.

Levels of description and externalities

It is emphasised that, with respect to levels of description (individual, company and society), this study will not only focus on the company costs but also on the individual and societal costs. This is important since, for example, costs at company level may come back as benefits at the individual or the societal level. For instance, if a company invests improvement of the health of the workers, the national demand for health care may decrease, at least after some time. Therefore the costs of health care will go down. Benefits of this type will not be perceived by individual firms and will not be taken into account in their decision making. In the same line of thinking, costs can be caused in the company (e.g. as a result of unhealthy working conditions), but the major burden (in the form of reduced health, grief, extra expenditures or reduced income) can be for individual workers and their families. These are called externalities.

An other example is that costs at society level may sometimes be benefits for companies, such as a national infrastructure for research, training and information and the national social security system.

Aaltonen and Söderqvist (1988) developed a 3-levels-typology or classification of occupational safety costs and benefits (see Figure 1.2), based on the Scandinavian situation, which gives a good illustration. They distinguished costs and benefits at

three different levels, namely in relation to individual employees, to enterprises and to the society as a whole.

The model shows that preventive health and safety activities (first column) may be carried out by individuals, enterprises as well as the society as a whole. Using safety equipment is an example of an individual activity, workplace health inspection is a company activity and legislation is an activity on society level. Consequences of accidents (second column) also may be felt at the three different levels. Pain and suffering occurs at the individual level, production loss at company level, and costs to the national economy are seen at the societal level. Finally, the analysis of safety costs and benefits (third column) may also be carried out at three different levels, as figure 1.2 shows.

	Examples of prevention activities (‘preventive costs’)	Examples of consequences or effects of an accident and diseases	Possibilities of analysis or evaluation of costs and benefits
Individual employees:	• using personal safety equipment • effort in adopting safety attitudes and healthy life- and work-styles	• pain and suffering • consequence to relatives and friends • losses in second job or household	• evaluation of own safety and health activities
Enterprises:	• developing safety and health management • carrying out work-place safety and health inspection • developing a safety climate • planning production • measures to improve working conditions	• production losses • insured and uninsured costs of accidents • quality losses • legal sanctions	• evaluation of effects of preventive measures, efficiency measurement • insurance: compensations and premiums • evaluation of production process • costs and benefits in decision-making techniques • profit-loss analyses
The society as a whole:	• social attitudes and values • safety and health legislation and inspection • trade union and sector organisation activities • safety and health research, education and information	• medical treatment and rehabilitation • accident investigation and administrative and legal actions • insurance activities • costs to the national economy • social costs	• evaluation of national safety attitudes and safety programs • cost-benefit analysis of new regulation • evaluation of trade union and sector organisation activities

Figure 1.2: A classification of safety and health costs and benefits, as well as examples of methods to evaluate the costs and benefits (adapted from: Aaltonen & Söderqvist, 1988)

It is clear that to understand the country- or society-costs knowledge of country-bound social security systems, economies, cultures, norms and values, and the like is needed. Knowledge of this is necessary to be able to make assessments of the socio-economic impact of occupational accidents and diseases and work related illnesses.

Concepts of health, occupational accidents, occupational diseases and work related illnesses

Definitions of and approaches to occupational accidents, occupational diseases and work related illnesses vary throughout the European Union. In this study the differences in formal definitions, in particular on occupational accidents and occupational diseases are taken as part of the research. Work related illnesses are those illnesses which are (mainly) caused by work, but need not formally be recognised as an occupational disease. For the concept of health, the WHO definition is used, which implies that health is not just the absence of illnesses, but also includes social well-being.

The approach set out in figure 1.1 and illustrated in figure 1.2 is applicable to both occupational diseases and accidents. However, since diseases do not occur on one special moment, but grow slowly, a different approach of economic evaluation may be needed (as will be discussed in chapter 2). The consequences of work-related diseases cannot be registered and mapped on company-level from a well-defined starting point, since patients may leave the company. Work-related diseases found at the national level do not always show up in enterprise-level statistics because cases develop gradually and victims may drop out of the labour market gradually. Thus, it should be kept in mind that several work-related diseases can only be documented with epidemiological methods and studies.

1.4 Methodological approach

As said, a goal of the first year of the project was the description and analysis of the criteria and parameters currently used in the 15 EU-countries to evaluate the socio-economic and human impact of accidents at work, occupational diseases and work-related illnesses, taking into account the different perspectives and interests of all stakeholders.

A second goal was the development of a set of criteria and parameters and a methodology for carrying out an analysis of the situation in the 15 Member states of the EU that is applicable and acceptable in all Member States and by all stakeholders.

1.4.1 The three surveys

In the first year of the EU-project three surveys were distinguished (see § 1.1). These are carried out by way of:

1. interviews with officials (i.e. from governments or national/collective bodies) and analysis of official documents;
2. interviews with professionals, representatives of trade unions and employers' organisations and analysis of documents in use among these groups;
3. analysis of (technical) studies, reports and articles.

The goal of the three surveys is to get an overview of variables or measures that are used in the 15 EU Member States to specify or calculate the socio-economic costs of occupational accidents, occupational diseases and work-related illnesses at three levels.

In the surveys (both interviews and document-study), a clear distinction is made between the national level (for which the basic data are aggregate statistics and/or national surveys) and company level (which includes only measures which can be found and registered in individual companies). Finally, attention should be given to the individual level (grief, suffering, health expectancy).

1.4.2 Checklists for the Surveys #1 and #2

There is a number of variables or measures that can be included in a socio-economic assessment. Checklist 1 presents an overview of possible variables or measures at the national level, Checklist 2 for the company level. Both checklists are divided in three main categories:

1. corrective costs,
2. prevention costs, and
3. benefits.

Checklist 3 gives some variables or measures that can be used to assess socio-economic costs at the level of the individual. Corrective costs are divided into health-related costs (part 1.1) and other costs (part 1.2), such as costs for administration, equipment and the like.

Health-related costs (part 1.1) are calculated in two steps. The first step is to quantify basic health effects and outcomes. Then the second step is to estimate the monetary value. In the second step a number of different pricing principles may be used (see Checklist 1). The background to this procedure is further elaborated in chapter 2.

The checklists are based on variables used in recent literature on economic appraisal of occupational safety and health (Beatson, 1998; Koningsveld & Mossink, 1997; Baum & Niehus, 1993; Arbejdstilsynet, 1996) and the COST 313 systemisation of costs of road accidents (Davies et al., 1995). In order to assess the effects on production performance of companies, a number of variables reflecting productivity, quality and the like have been added.

Checklist 1. Possible variables/measures at the national level (and for systemisation of studies/databases in survey # 3)

National level	
1.1	Corrective costs (health related):
Basic health effects or outcomes:	
1.1.1	Hospitalisation (bed-days)
1.1.2	Other medical care, such as non hospital treatment, medicines
1.1.3	Non-medical (e.g vocational) rehabilitation, house conversions
1.1.4	Sickness absence spells (days or weeks)
1.1.5	Permanent disability (numbers, age of patient)
1.1.6	Fatalities (Numbers, age of patient)
1.1.7	Other health effects
Costing or pricing-principles:	
1.a	Financial costs (expenditures for an economic actor/agent/institution)
1.b	Loss of potential output, opportunity costs
1.c	Human costs (willingness to pay for avoidance of grief, suffering, ill health, risk)
1.d	Transfers, such as compensations
1.2	Corrective costs (non-health related costs or damages):
1.2.1	Administration of sickness absence etc.
1.2.2	Damaged equipment (by accidents)
1.2.3	Other workplace cost categories
1.2.4	Other, non-health related, costs
2	Prevention costs ('expenditures for preventive action')
2.1	Investment in safety and health equipment, exhaustion systems etc.
2.2	Additional investments in capital goods, equipment and buildings
2.3	Additional costs of substitution products (per year)
2.4	Purchase of personal protective equipment (per year)
2.5	Additional costs for changed working procedures and maintenance (per year)
2.6	In-house preventive services, administration, meetings, OSH training
2.7	External services (e.g. occupational health services)
2.8	Other workplace level costs
2.9	National level infrastructure, inspection, registers etc.
3	Additional costs and benefits
3.1	Productivity
3.2	Quality of products
3.3	Market penetration of certain (low-risk) products
3.4	Technology development (process and products)
3.5	Human resources
3.6	Competitiveness of regulated industry relative to other/other countries
3.7	Other secondary effects

Checklist 2. Possible variables/measures at the company level

Company level	
1.1	Health related effects (without cost calculation):
1.1.1	Deaths, fatalities
1.1.2	Absenteeism or sick leave (work time lost, costs)
1.1.3	Personnel turnover, including early retirement and permanent (partial) disability
1.1.4	Non-medical rehabilitation (except transfers to patients)
1.1.5	Registered accidents, occupational diseases
1.1.6	Reduced well being, job satisfaction and poor working climate
1.1.7	Complaints about health and well being (without sick leave)
1.2	Corrective costs (non-health related costs or damages, costs incurred to maintain production levels):
1.2.1	Administration of sickness absence, accidents etc. (work time, costs)
1.2.2	Damaged equipment (accidents)
1.2.3	Lost production time, services not delivered
1.2.4	Other, non-health related costs (e.g. investigations, management time, external costs)
1.2.5	Effects on variable parts of insurance premiums, high risk insurance premiums
1.2.6	Liabilities, legal costs; penalties
1.2.7	Extra wages, danger money (if the company has a choice)
2	Prevention costs (costs or expenditures for preventive actions):
2.1	Investment in Safety and health equipment such as exhaustion systems
2.2	Additional investments in capital goods, equipment and buildings
2.3	Additional costs of substitution products (per year)
2.4	Purchase of personal protective equipment (per year)
2.5	Additional costs for changed working procedures and maintenance (per year)
2.6	Extra work time of direct personnel: meetings, training, participatory developments
2.7	Costs of internal or external OSH services, other preventive services
2.8	Compensations received from insurances
2.9	In-company activities: human resource management, health promotion, OSH policy
2.10	Other workplace costs
3	Additional costs and benefits
3.1	Productivity
3.2	Quality of products and services
3.3	Innovative capacity of the firm
3.4	Opportunity costs (orders lost or gained, competitiveness in specific markets)
3.4	Other operational effects (reduced costs for facilities, energy, materials)
3.5	Company image effects
3.6	Impact on non economic company values

Checklist 3. Possible variables/measures at the level of the individual

Individual level	
1	Health and quality of life:
1.1	grief, suffering
1.2	healthy life expectancy
1.3	reduction of quality of life or welfare
1.4	grief en suffering of relatives and friends
2	Costs and damages:
2.1	income losses, loss of potential earnings;
2.2	expenses and costs that are not covered by insurances or compensations

In addition to details on the variables and criteria in use, the interviews with officials, representatives from social partners and professionals have to give information for the development of a methodology for assessment of socio-economic costs. To this end, respondents were asked for requirements and potential obstacles.

1.4.3 Survey #3

The main purpose of survey #3 was to accumulate practical experience with economic models describing the state of the working environment or the effects of preventive activities as described in the literature and documents..

At the national and also the individual level survey # 3 includes documents, articles and reports on:

- notification data (authorities or insurances);
- work force surveys, e.g. like the 'Second European survey of the Working Environment', which may give information on exposure and some health outcomes which can be associated with exposure or jobs;
- epidemiological studies, provided that they quantify the volume of work-related diseases at the national level - this is the data strategy tested and recommended in the national-level 'Stress'-report from the European Foundation;
- general health and social statistics, which may be useful to calculate 'standard prices per case', but could also be the data basis for national level calculations (as the Danish and Dutch Costs of Illness-estimates), provided that other (epidemiological) studies quantify the proportion of diseases that can be related to work.
- national cost or cost of illness studies;
- ex-post and ex-ante evaluations of legislation. The experience with these kind of studies varies enormously between the Member States. Especially the variables or measures used in these studies are relevant;
- data on activities of companies with respect to (preventive) OSH activities;

At the company level five kinds of economic studies are of interest:

- accident costing studies, where the consequences of a well-defined class of events (accidents) are mapped in order to calculate 'the typical costs of an accident'. An important distinction within this tradition is whether non-injury accidents should be counted.
- intervention studies, where effects is measured before and after a project. Most case stories reported by companies themselves are intervention (effect of projects) studies. Effect measures may or may not be monetised in the reported studies. Both 'occupational health and safety' and 'health promotion' studies may be relevant sources.
- efficiency indicators studies, which cover both the German 'controlling' (Effizienz Kontrolle) studies and various OSH indicators studies used in annual accounts or environmental accounts;
- comparative studies, known from bench marking, or case-referent studies, applied on cases with variations in working environment quality;
- instrument development and testing, a number of instruments (mainly for investment evaluations) have been drawn up.

Note that 'Economic' studies should be understood as:

- either studies and references including economic calculations,
- or intervention studies where the effects are measured by variables which could be valued by monetary terms, e.g. sickness absence, productivity effects.

1.4.4 Analysis of comparability

One of the outcomes of the project concerns an analysis of comparability with regard to the variables and parameters in use in the EU Member States. This analysis is performed on basis of the five criteria.

1. Variables and parameters

Variables and parameters are generally well described in the national reports and available in tabular format. Issues addressed in further analysis and comparison:

- who uses and generates the dataset;
- general quality of the datasets;
- applicability, coverage over groups of workers (e.g. exclusion of certain sectors);
- known shortcomings of the data such as underreporting;
- differences between economic sectors within one country;
- are estimations used.

Furthermore, any characteristic of the dataset that can affect the quality of cost estimates is mentioned.

2. Definitions, interpretations and coverage

This issue gives indications of what is understood as occupational diseases, occupational accidents and work related illnesses in the Member States and which are included in (or excluded from) the statistics. Some questions:

- what is meant by accidents (such as: should commuting accidents be included), real and declared occupational diseases, work related illnesses;
- coverage (which illnesses are included)
- how to deal with “new” work related illnesses, ways of declaration of occupational illnesses.
- what are the effects of the characteristics of the social security system on the calculation of costs (e.g. if employers pay for sick leave, during a limited time and further absenteeism is covered from social security, how does this affect the cost estimations).

3. Pricing and costing principles

It turns out that a number of different pricing or costing principles are in use (as was anticipated in the checklist).

- what is the rationale behind the choice for a certain costing principle;
- which pricing principles are acceptable to the member states, which are likely to get some opposition;
- what estimations are used (if precise data are missing).

4. Time

The issue of time is relevant, also to national cost studies. For the analysis of comparability the following issues are relevant:

- to what year do the calculations apply;
- calculation method COI studies (prevalence, incidence or yearly costs);

- how are long term benefits or damages included, for instances illnesses that become first apparent after retirement (in case of prevalence or yearly cost methods);
- details of discounting, anticipation of technological and organisational development (in case of incidence methods).

5. Prevention costs

Specifying prevention costs in national studies can be difficult, especially with regard to preventive action. Issues addressed are:

- investments and policy development;
- definition of prevention level: compliance with legal requirements or extra;

1.5 Overview of this report

This report is in the first place a research report in which the results of the first year of the SHAPE-project are presented. The structure of the report reflects the main research questions of the project. It is an interim report in the sense that the methodology development is not completed yet. The second and third year of the SHAPE-project will be used to test the methodology in a number of European companies and to finalise its development.

Nevertheless the contents of the report may be of interest for different groups of readers, as a wealth of studies, methods and datasets available and in use in the European Union have been reviewed. The description of the methodology may be of interest to professionals and researchers in this area.

The contents of the report are as follows

Chapter 2 sets out a number of theoretical and practical viewpoints regarding the assessment of socio-economic costs of occupational accidents, occupational diseases and work-related illnesses. The purpose of this chapter is to present current scientific developments and to address some of the issues of present discussions in policy making. In particular, attention is paid to topics that are likely to have an effect on the methodology for assessment of socio-economic costs at the company level. These are the issue of cost internalisation, the work-relatedness of illnesses, economic effect measurement and the issue of time. Furthermore some aspects of social security (as far as relevant to cost assessment at company level) are discussed.

In chapter 3 an extensive review of literature and documents is presented. Also a short overview of recent initiatives at the European Level is given. The review of literature and documents is divided into two parts: national level and company level. The literature study concentrates on a number of questions, such as:

- which variables or cost components are included, what is the coverage;
- which strategies for obtaining relevant data have been applied;
- which principles for costing are applied.

Also an assessment of the comparability is made. The main result of this chapter are recommendations for a set of variables that can be used in an methodology for application at the company level.

Chapter 4 presents an analysis of variables and parameters currently in use in the European Union. The analysis is based on interviews in 14 Member States, resulting in a description of datasets and statistics that can be used in the assessment of socio-economic costs. These descriptions cover national level, company level and

the individual level. The analysis concentrated on the coverage of data sets (which variables and what definitions are in use), and the reliability of the dataset.

Chapter 5 and 6 cover the methodology development. In chapter 5 attention is paid to the development process and the requirements for the methodology. A sound analysis of requirements is considered of crucial importance for the methodology development process.

In chapter 6 the outlines and part of the content of methodology are sketched. The methodology is developed as an open, non prescriptive system that will support a user in conducting an analysis. The chapter details the steps of the methodology and proposes some calculation schemes that are likely to be acceptable in all Member States.

The conclusions of the report are presented in chapter 7.

2. Theoretical and practical viewpoints on economic evaluations regarding safety and health at work

One of the goals of the project is to collect indicators of the costs and benefits of occupational health and safety investments and expenditures. As stated in chapter 1, this can be done at different levels: the national, the company and the individual level. In this chapter, theory as well as practice of occupational safety and health assessments are examined more closely. An overview is given of common applications of economic appraisal (section 2.1). Current issues in policy development and research are discussed in section 2.2. A general approach to economic appraisal is discussed in section 2.3. In section 2.4. the impact of social security systems on economic appraisal is shortly described. The practical aspects of the assessment of costs and benefits at national level is discussed in section 2.5. In section 2.6. and 2.7. this is done for the company and individual level.

2.1 Applications of economic appraisal of safety and health at work

Over the course of some years, two types of cost-benefit studies have emerged at the national or societal level: costs-of-illness studies and cost-benefit analyses. The costs-of-illness studies were designed to estimate all costs that are related to occupational safety and health countrywide, but most of them concentrate on damages or losses due to ill-health, absenteeism and accidents. Cost-benefit analyses include ex-post and ex-ante evaluations, in which both the costs of implementing and the benefits in terms of cost reduction are estimated and compared. One important difference between these two types of studies is the number of measurement moments. Costs-of-illness studies are designed for single use, though they can be repeated periodically. Cost-benefit studies have to be carried out at least two times to evaluate the difference before and after a certain action or intervention. Comparable applications exist at the company level (see figure 2.1). Studies exist which have a monitoring goal (OSH costs monitoring: evaluation of cost of accident, cost of occupational diseases or cost of preventative activities), and studies which play a role in decision making such as cost benefit analysis and cost effectiveness analysis.

	National Level	Company level
Monitoring	Costs-of-illness Costs of accidents	OSH costs monitoring Benchmarking
Decision making	Ex-ante evaluation Cost-effectiveness	Investment cost-benefit analysis Cost-effectiveness

Figure 2.1 Overview of different applications of economic appraisal at national and company level.

2.2 Current issues in research and policy development

The costs and benefits of safety and health at work to companies, but also to individuals and society are heavily influenced by political choices with regard to regulation on occupational safety and health issues, policies concerning the social security system and choices in social insurance. For understanding both an assessment of variables and indicators presently in use in the EU and the development of a methodology it is necessary to describe some of the current issues in policy making and research. The main issues are:

- externalities and cost internalisation;
- work relatedness of diseases and accidents;
- economic effect measurement;
- time.

2.2.1 Externalities and cost internalisation

External benefits

It is not easy to precisely attribute the cost savings of preventive policies and measures to concrete health and safety effects and (Krüger, 1997; Lehmann & Thiehoff, 1998). All kinds of unmanageable external and spill-over effects occur inside and outside the organisation. From the company perspective, money goes out to insurance and tax systems, workers and their family, other companies, subcontractors, clients, and the like. OSH investments of an organisation always have beneficial effects for these external parties and the costs of investments do not automatically flow back to the purse of the investor. Problems intensify when prevention is aimed not only at accidents, but also at work-related diseases, where most positive effects are external. Even if positive effects of work-related diseases are internal, they usually only become noticeable in the long term.

External costs

Occupational accidents and work related illnesses incur costs to several actors. Part of the costs have to be paid by the company, but part is passed on to individual workers, to other companies, insurances, collective funds or to society. Often the externalised costs are not visible as these are not registered or cannot be claimed. As a result, much of the external costs are not assessed in national studies.

Effects of cost internalisation

It is obvious that the extent of cost internalisation has a major impact on the outcome on economic appraisal at the company level. The more costs that can be passed on to others (externalised), the less likely it is that prevention will give financial benefits. As a consequence, the possibility of exporting the burden of ill health outside the company can hamper application of health, safety and environment management within the company. Externalising costs to society, individual workers or other companies may offer an economic advantage to the company, as the damage (e.g. in the form of ill health) is not paid by the company itself. As a result there is no direct incentive to take action.

Cost internalisation is a necessity to stimulate preventive policies at the company level. The costs are to be paid where these are caused, just like the payment for the use of any other production resources is a cost factor in the production process. Prevention is likely to lead to less damages (and costs) in the future for the

company Apart from the economic aspects, there is also a moral argument to promote cost internalisation. Profits should not be made at the expense of preventable risks to workers (Dorman, 1998).

Options for cost internalisation

A number of options are available and actually used in several countries used to (partly) internalise the costs of occupational accidents and diseases to companies:

- Differentiation of premiums according to safety and health risks or number of accidents and diseases in the past or based on present risks. Premium differentiation and 'no-claims bonus systems' as an incentive for occupational safety and health and corporate health promotion measures are already in use (European Foundation, 1995).
- Liabilities, right (and practical possibilities) of workers to claim the costs of occupational accidents and diseases to their (former) employer;
- Changes in (social) insurance systems, such as limiting possibilities of insuring the costs of sick leave;
- Full cost pricing, this system suggests (Dorman, 1998; Den Butter, 1998) that employers in the whole world should be forced to sell products at prices that include the costs for OSH investments and damages due to work-related illnesses.
- Point out the beneficial effects of good safety and health to company performance. Cost effectiveness studies can help to make the costs and benefits of OSH interventions more transparent. Powerful incentives are to be sought in competitive advantages and new business opportunities to companies that invest in preventive action and health, safety and environment management.

For a number of reasons it is doubtful whether full cost internalisation can be obtained. Extensive use of employer liabilities is criticized because employees often have difficulties in claiming their rights. Procedures can be long and costly, employees may lack relevant knowledge and this kind of procedure could affect their relationship with the employer. Furthermore liabilities only act as an incentive when employers cannot be insured against claims. Lehmann and Thiehoff (1998) observe that new concepts of economic incentives (tax abatements or subsidies) offer fascinating internalising possibilities but pose many questions on closer inspection. Dorman (1998) points out that technical problems are a serious impediment to internalisation. In particular the attribution of illness to work and the reliability and acceptance of economic appraisal of health effects to individual workers and their families are problematic. Hopkins (1995) questions whether economic self-interest gives sufficient drive for action. Morality and non rational behaviour are of key importance in decision making. The focus should be on getting management attention.

Any serious attempt to use the costs of insurance as incentives to reduce occupational disease and injury must recognize the perverse incentives of social insurance schemes. These systems have two objectives which address two different social goals: (1) to ensure payment to the injured and (2) to act as a deterrent for the firm to cause injuries. The primary goal is the first and is achieved through the spreading of financial risk among the insured firms though the assessment of premiums. This risk spreading function guarantees that no firm will ever bear the full cost of injuries, although some systems adjust premiums and apply deductibles for "at fault" behavior. Thus, the financial deterrent for acute injuries is small, at

best. In the case of occupational disease which is difficult to trace to working conditions, it is absent altogether. Even with so-called “signature diseases”, such as mesothelioma, which is clearly traceable to occupational exposures of asbestos, the latency of disease results in financial incentives coming far too late to stimulate investments in prevention (Ashford & Stone, 1991).

2.2.2 Occupational diseases and work-relatedness

Though causal relationships are not often expressed, almost all occupational health and safety cost-benefit studies – both scientific studies and practical experience described – seem to operate implicitly with some derivative of the model described in Figure 2.1.

The elements in the model in the shadowed boxes represent the main causal model: the working environment determines the health outcomes, and the subsequent sickness behaviour, which in turn has certain economic consequences. During an intervention programme, changes in health outcomes and economic effects are interpreted to be caused by an intervention in the working environment. Sickness behaviour includes, in general, absenteeism, personnel turnover, health complaints and job productivity etc.

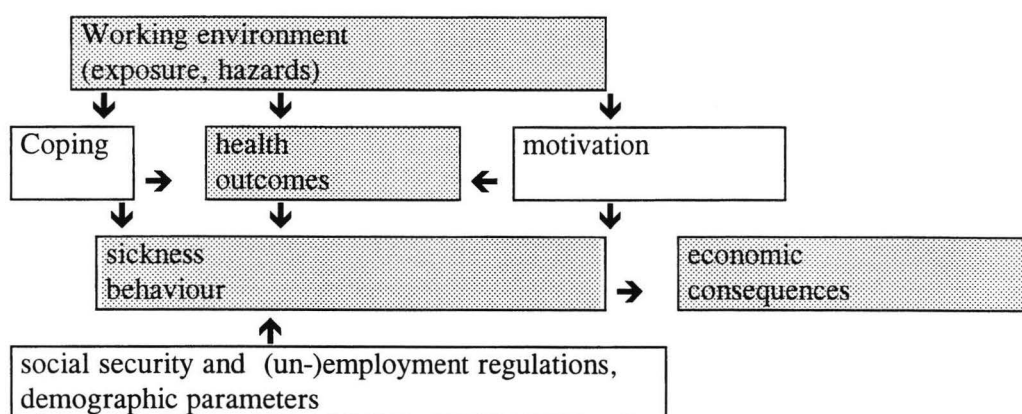


Figure 2.1 Standard model of working environment, health outcomes, sickness behaviour and economic impacts.

However, sickness behaviour is not determined solely by health outcomes. This behaviour may be determined by a coping strategy of individuals in response to specific stressors at work, or it may be influenced by more diffuse, motivational factors among the workers in this workplace or by social security or unemployment regulations (see white boxes).

Some economists tend to explain sickness behaviour (e.g. absenteeism) mainly by the external economic incentives and personal or demographic parameters (white boxes). Though these factors certainly play an important role, in the model they should be considered as possible confounders which must be controlled to some extent.

2.2.3

Economic effect measurement

National level

There are several effects measures at the national level. The most common is monetarised costs, these are costs directly related to the occurrence of occupational accidents and diseases. These costs reflect the costs of 'repairing' material and health damage. A second option is to estimate the total loss of resources to the national economy. This would also include the loss in terms of the productive capacity of workers. Both can be related to the gross domestic product.

Economic effects are sometimes expressed as the total of compensations and benefits. These compensations, however, are money transfers and do not contribute to the national economy.

Indirect effects on the national economy are seldom evaluated (e.g. how will consumer expenditures and purchases be affected and what is the effect on the national competitiveness).

Socio-economic evaluations should also reflect social values. However until now only a very limited number of studies include effects on employment. Measures that quantify national welfare, health or quality of life are not used, though these are available to some extent (e.g. life expectancy, QALY's and the like).

Company level

Traditionally economic effects of occupational safety and health in companies are evaluated in terms of direct costs (extra expenditures) or opportunity costs (lost potential business).

An innovative way of looking at the improvement of Occupational Safety and Health investments is the change in scope from a cost, moral and social security point of view to a company's performance point of view. Licher and Mossink (1997) characterised this movement as 'social policy as a production factor'. Technically, it is not easy to determine the significant economic effects of OSH measures on company performance. Lehmann & Thiehoff (1998) mention two main causes:

- it is generally not possible to demonstrate a causal connection between individual and occupational safety and health measures and incidents that did not take place: the accident that was prevented or the disease that was avoided;
- losses of human resources have an impact on a company's financial results if planned production can no longer be achieved by appropriate substitutional measures. Built-in flexibility, reserve capital or planned or unplanned production buffers are in most cases able to absorb lost production time.'

For that reason, the effect measures to determine the exact contribution of safety and health interventions to company performance have to be carefully designed. This can be done by measuring company performance on a global level and by means of indirect production measures, such as the number of uninterrupted production hours (the number of normal working hours minus the hours lost due to, for instance, accidents). Besides these measures, there are several indirect (mostly qualitative) indicators (Lehmann & Thiehoff, 1998). The ultimate message of this list is that costs and benefits must be made clearly visible to the organisation. Guaranteed production, improved productivity and a decrease in disease-related personnel buffers are the most visible potential benefits of occupational safety and health. However in the current movement, in which companies increasingly rely on

lean production and teamwork concepts, reliance on a healthy and safe contribution of the remaining personnel, becomes increasingly important too.

Despite these difficulties in assessing company productivity and performance, case studies in Finland (Kuusela, 1998) and Sweden (Johanson, 1998) claim to have demonstrated positive effects on company performance. In Finland it was found that ergonomic improvement as well as the enhancement of the working environment had positive effects on company productivity. In Sweden the profitability of investments in work life rehabilitation recorded positive effects.

Recent literature (Liukkonen, 1997; Kokke, 1997; Kaplan & Norton, 1992; A.D.Little, 1998) shows that company performance should not be evaluated in financial terms only. Strict monetary evaluations may give useful information for the short term profitability and the shareholders value. But usually they give little insight into the company's profitability in the medium and long term. It is argued that besides the financial perspective, also other perspectives have to be considered, such as the customer perspective and the ability to integrate innovative procedures. Until now, with the exception of the OSKAR model (Liukkonen, 1995), multiple perspectives, such as the balanced scorecard (Kaplan & Norton, 1992) have not been used extensively to assess the influence of occupational safety and health on company performance.

It is often stated that a healthy and motivated workforce is an asset to the company. Attempts to include the human resources into companies' financial statements have been made (Gröjer & Johanson, 1992; Liukkonen, 1995), but are not generally accepted as standard components of company annual reports.

Individual level

Costs to individual workers and their families are usually measured in several categories:

- loss of present and/or future earnings;
- medical costs;
- reduced (healthy) life expectancy;
- pain and suffering.

Medical costs and loss of earnings are relatively easy to express in terms of money. The actual costs for an individual, however, are influenced by insurance and social security schemes. There is no market value for health, pain and suffering. For approximation of this value indirect techniques have to be used. This issue is further discussed in section 2.7).

2.2.4 Time

Time is an important issue in economic assessments of occupational safety and health for several reasons. First, whenever more points in time are considered (as is the case in cost-benefit analysis), corrections have to be made for the changing value of money over time (discounting). Discount rates for public projects (in real terms, i.e. without inflation or risk correction) are 4 - 6 % (Davies et al, 1995, Polanen Petel et al, 1996). For companies discount rates of 15 % or higher are not unusual.

Second, for many diseases, it takes considerable time for the disease to develop. Up to 20 years or more may pass between exposure and the first symptoms of disease. Also it may take considerable time before the effects of an intervention become apparent. In the case of cost benefit analysis, this would require discounting over

considerable periods of time, e.g. 10 years (Davies et al., 1995) or 15 years (Polanen Petel, 1996).

This long period poses some specific problems. The most important is that in order to make practical calculations, one has to assume that all circumstances remain unchanged and prices develop at the same rate as inflation. Davies et al. (1995) observe that the value of life is likely to rise over time. Ashford (1998) indicates that technological and organisational innovations, caused by changes in regulation, have a large impact on the costs to comply with that regulation.

For economic assessments at the company level, 10 or 15 year periods are well beyond the time horizon of most managers, which is usually 3 to 4 years, or even less. Also, for many (technical projects) pay out periods of 2.5 to 3 years maximum are acceptable and the technical life of many measures does not exceed 5 to 10 years. This would imply that long term (health) benefits are likely to remain outside the scope of managers.

In addition to valuation problems of non-monetary, or not clearly monetizable, costs and benefits, a major problem encountered with the comparison of costs and benefits is that the cost and benefits accrue over different periods of time (time horizons) (Ashford 1998). The usual practice is to “discount” cost and benefit streams to what is called “present value”. Using a positive discount rate, this has the effect of shrinking both costs and benefits that occur in the future. However, in the case of benefits that are not realized until much later -- and these can be future acute events avoided such as accidents, as well as chronic disease -- benefits are reduced much more than costs. This has the effect of biasing prevention initiatives towards the more immediately-avoidable events, and disadvantages long-term investments in reducing occupational injury and disease. When placing a monetary value on death and injury, discounting the monetary values make them look smaller. Even if one avoided monetization, discounting also makes the number of lives saved, or injuries avoided, appear as a smaller number.

One of the uses of cost-benefit analysis is to calculate the “payback period” for investments in safety and health. Problems exist with the application of this exercise for both chronic disease and injuries. For chronic disease, even where the risk assessment is quite well-known as in the case of noise-induced hearing loss, the discount rate for the benefits of cases of hearing loss avoided (longterm in the future) will depend crucially on the discount rate. For accidents, where the effectiveness of interventions can not be known precisely, how can a payback period be calculated? Thus, the practical usefulness of cost-benefit analysis for planning purposes is greatly compromised by both problems in estimating the reduction of risks, problems in estimating or valuing the risks reduced, and finally by the discounting problem.

2.3 General approach to economic appraisal

In general the procedure for economic appraisal at the national level (but also practicable at the company level) involves three steps. First basic health data is collected. This covers health, hospitalisation, disability, fatalities and the like. Several strategies can be used to collect the data required as discussed in paragraph 2.5. As the basic datasets are at least rather general, the second step is to extract or construct relevant quantified indicators from the basic health data. Part of this

process involves attribution of health data to work. Examples of quantified data are sick leave, summaries of activities for prevention and accident data. The third step is to assign monetary values to the quantified indicators (valuation). To this end, several pricing principles are used in practice. However, pricing methods vary considerably and are sometimes controversial.

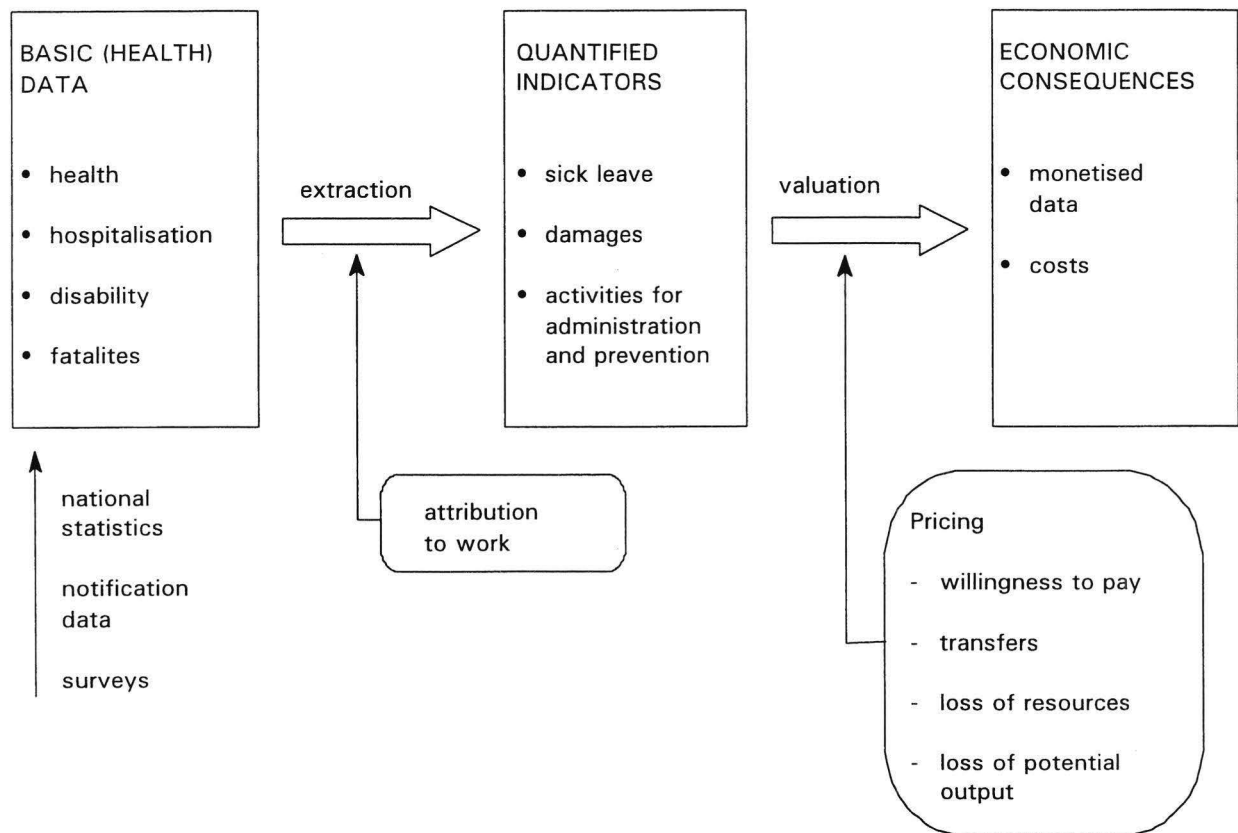


Figure 2.2 Basic scheme for assessment of socio-economic impact of occupational diseases, occupational accidents and work related illnesses.

2.4 Impact of social security systems on economic appraisal

2.4.1 Classification of systems

To assess the reliability of indicators of costs and benefits of occupational safety and health from the data of social security systems, differences between the country systems have to be dealt with. For that reason first a short overview is given of the possible differences between the systems of the countries. As will be seen, the systems differ in a more or less systematic way.

Einerhand et al. (1995) compared in their study the social security systems of seven European countries: Belgium, Denmark, Germany, France, the Netherlands, the United Kingdom and Sweden. In their classification of systems, they differentiated between two systems: the Bismarck type and the Beveridge type system.

The Bismarck type system emerged around the years 1880 when in Germany, under the Bismarck regime, social insurance was introduced to protect workers against the financial risks of (occupational) illnesses and accidents, invalidity and old age. After the second world war, social security for the whole society became the leading principle. The Englishman Beveridge proposed a new national social security system, that integrated the existing systems into a general system. The social security system was not only restricted to specific working groups as it had been, but extended to society as a whole. In this new system, all citizens have the minimum right to some minimum amount of care and protection and this basic security is universal and not income-related. Labour market fluctuation was integrated into this system, by combining it with additional social security insurance systems for workers above the social minimum level. Two principles guided this development: the equivalence principle, which related presentation to the amount of benefit paid, and the solidarity principle, which proposed a minimum amount of protection for everyone, regardless of the quantity of premium paid. The resulting social security systems included a worker-related type of social insurance (Bismarck type) and a society type of social insurance (Beveridge type). Table 2.1 summarises the principles of these two types of systems.

Table 2.1 Characteristics of the Bismarck and Beveridge social security models (Source: Einerhand et al., 1995)

	Bismarck model	Beveridge model
Goal	Secure social status	Secure minimum income
Coverage	Selective (workers)	Universal (all citizens)
Benefits	Income-related	Need-related
Financial basis	Premiums	Taxes
Administration	Private	Public
Country of development	Germany	United Kingdom

In the publication 'The social security in Europe' (Commission of the European Communities, 1994), the systems of twelve member states were compared. This publication stresses the similarities between the countries more than the differences. All member states nowadays provide support in case of old age, illness, invalidity, motherhood, unemployment, child care and health care to all citizens. Differences in systems involve the following dimensions and factors (Commission of the European Communities, 1994):

- income-related versus a general basic level of benefits in case of problems;
- the use of criteria for the nomination and the height of the benefits;
- the right to receive a guaranteed minimum income level;
- the extent to which concrete benefits (for instance health care) are available for everyone in the right time in the right place;
- the financial basis, i.e. premiums paid by employers, employees or tax systems;
- the controlling function by employers and employee organisations and/or the government;
- the relationship between the role of the government and private organisations in delivering aid and benefits.

Considering these basic features and dimensions of the social security systems in the member states, four main groups of systems can be distinguished (Commission of the European Communities, 1994):

- Insurance based systems. In these systems the magnitude of the benefits and the premiums are closely related. Countries as Germany, France, Belgium and Luxembourg belong to this group;

- Tax based systems. In these systems the magnitude of the benefits is related to the need for the most important life resources. Tax based systems can be found in the United Kingdom, Denmark and Ireland;
- Insurance and tax based systems. These systems are positioned somewhere in between the two previously mentioned systems, though they also resemble also the first and the second group. Countries in this group are the Netherlands and Italy;
- Developing systems. These systems resemble those of the other countries, but are not completely developed yet. Countries in this group are Spain, Portugal and Greece.

However the distinction between these four groups is somewhat artificial, because all member states use insurance systems and all member states have formulated basic needs. Besides this, the boundaries between these systems become more vague as time passes by, because member states are under some pressure to revise the systems so that a standardized European system is created (Commission of the European Communities, 1994).

Einerhand et al. (1995) also proposed a division of social security systems into four categories. This division integrates recent theories of classification of social security systems in modern welfare states (Titmuss, 1974; Esping-Andersen, 1990; Liebfried, 1992; Kvist, 1993). However their typology results in a more or less similar division as that of the Commission of the European Communities. They distinguish between a Scandinavian, a Anglosaxian, a Continental and a South-European model.

2.4.2 Cost consequences of social security systems to companies

The basic question to be answered in relation to the different characteristics of the social security systems, concerns the information that can be extracted from these systems by the individual companies in the different member states. Two main types of risks can be specified: absenteeism and disability. Besides this in most countries a separate insurance system exists in case of occupational accidents and diseases. In principle three different kinds of cost groups can be specified:

Premiums and taxes to be paid.

In all countries companies pay premiums and/or taxes to cover the different social risks of the employees. However these payments are standard amounts of money, that are calculated on the basis of the number of employees in the company, the total amount of salaries paid by the company, the average number of accidents/illnesses of the company, the annual turnover costs, etc. The questions to be asked relate to: what costs are fixed and what costs are variable. Besides this there is possible differentiation's in some countries based on history or branch risks (see table 2.2.).

Benefits to be paid.

In most countries companies are in charge in the payment of benefits to the disadvantaged employees. The benefits to be paid are included in the salaries of the employees. These costs can be claimed back from the social security administration. However in some countries the company has to continue to pay the salary in case of illness of accidents at their own risk. In other countries, only a certain percentage of

the salary is covered by the social insurance and the additional percentage is paid by the company. So the questions to be asked involve the amounts of money to be paid by the company in case of concrete risks to employees and the amounts of money that can be claimed back.

The coverage of risks.

Not all risks are fully covered by the company. In some countries only a limited list of occupational diseases is socially insured, in other countries sickness absence is not insured, etc. Risks that are not insured often pass by unnoticed. One of the advantages of the comparison of social security systems of countries, is that in the comparison all risks are treated systematically and will be recognised by the companies in the countries. Risks that have been gone unnoticed by the companies in the past can be specified for the future.

Table 2.2 Insurance for occupational diseases in EU Member States: some characteristics regarding premiums and expenditures (source: Bakkum, 1997)

	Premiums for employers in 1995			Governmental	Expenditures
	differentiation by sector	mean premium	differentiation by company	suppletion	as percentage of BBP (1992)
Austria	no	1.3		no	?
Belgium	yes	0.3/1.1	yes	no	0.51
Denmark	yes		partially	no	0.23
Finland	yes	1.2	partially	yes	0.63
France	yes	2.3	yes	no	0.58
Germany	yes	1.4	yes	yes	0.74
Greece			not applicable		
Ireland	no		no	yes	0.1
Italy	0.5 to 16	3.1	yes	no	0.55
Luxembourg	0.5 to 6		yes	yes	0.71
Netherlands			not applicable		
Portugal	yes	?/1.1	yes	no	0.41
Spain	yes	2.8	yes	no	0.51
Sweden	no	1.4	no	no	0.88
United Kingdom	no		no	yes	0.1

2.5 Assessment of costs and benefits at the national level

2.5.1 Data strategies and sources at national level

At the national level, the volume of work-related sickness occurrence can be established from three different categories of sources: (1) notification data, (2) general health surveys or (3) epidemiological studies, where associations between exposure and excess sickness occurrence are established.

Notified cases.

Cases notified to an insurance company, to company registers or to registers in the national health and safety authority are often assumed to be the 'safe' source of information for all official purposes. However, all notification systems are heavily influenced by the incentives to notify (i.e. the chance of receiving compensation) and by the attention to workplace exposure or workplace risks in the health system. Both factors lead to bias against 'new' work-related diseases. Furthermore, notification systems rely on the proposition that the work-relatedness of each individual case (patient) can be demonstrated, which is not often the case (e.g. lung cancers or cardiovascular diseases).

The influence from the administrative and legal system is reflected even among the Nordic countries, whose national registers are technically rather similar (Nordic Council of Ministers 1996). International comparison of data requires both a common classification system and a careful validation of data for each country. This seems to be most possible for work accidents, but even here, Eurostat has chosen to publish comparable accident data that is adjusted for the rate of notification (Eurostat, 1998). The different criteria of recognition of occupational diseases in national insurance systems is likely to prevent any real comparison of data based on this source.

Notified cases are primarily suited for financial calculations for the economic agent responsible for workers compensation. 'Total costs of accidents' based on insurance costs are calculated in many countries (AUT, B, I, D, IRL, P, S). Depending on the national compensation rules, individuals' income losses may also be calculated from this data. In some countries, e.g. Italy and Austria, the data base is considered reliable for a comprehensive calculation of socio-economic costs of accidents.

General health or workforce surveys.

This data strategy has been followed in calculations of the socio-economic costs for a number of EU countries (FIN, DK, NL, S, UK).

Surveys of general health or work-related health problems may be carried out among the workforce, relevant age groups or among patients in contact with the health sectors. This data is easy to aggregate to the national level, e.g. total costs of work-related diseases or the percentage of sickness occurrence with a disease which can be related to work.

By choosing this strategy, the problem with 'notification incentives' is overcome. However, because the work-relatedness in this strategy is based either on self-reporting or on the judgement of general practitioners, both the problems of 'knowledge and recognition' and of determining causal factors in individual patients remain. The links to workplace risks or exposure at the workplace has been weakly reported so far, which means that the concept 'work-relatedness' is not very precisely defined.

This strategy is likely to be the only feasible way to collect a 'grand total' estimate, covering all significant work-related diseases within a country. A comparison of the results with those of other countries may be useful as a very rough measure of reliability - but variations between countries in work-relatedness are likely to reflect different levels of attention to working environment problems as well as different risk levels.

Epidemiological studies

Quantification starting from workplace exposure and the excess risk associated with this exposure has been applied to specific work-related diagnoses only, e.g. cardiovascular disease (Levi & Lunde-Jensen 1996), cancer (Arbejdstilsynet 1996, Hansen 1993, Fahs et al 1989), noise (Weinberger 1992) and alcohol-related accidents (Gutierrez-Fisac et al 1992). The main limitation of this data strategy is that the economically relevant health outcomes (sickness absence, early retirement) are also influenced by behavioural and legal factors, and may therefore be difficult to derive from the medically defined health outcomes which are preferred in epidemiological studies.

It is possible to start from the prevalence of workplace exposure factors which can be associated with an excess risk of a specific sickness occurrence. This data can be obtained from epidemiological studies that try to establish causal associations between exposure and a specific health outcome, provided that the risk of the exposed is compared to the risk of the general population which is not exposed to this particular factor (relative risk).

A certain workplace exposure must be assumed to be equally dangerous - i.e. lead to the same excess risks - across countries. Different levels of other exposures or lifestyle factors may influence the total level of e.g. cardiovascular disease, but the excess (relative) risk for a population exposed - e.g. to stressors at work - are measured by comparison with a 'normal' situation, where 'competing' risks may also exist. The relative risk should therefore apply to all countries. Consequently, the etiologic fraction (fraction of total sickness associated with the specific exposure) varies only due to different levels of exposure, and the preconditions to make cross-country comparisons are present - at least from a theoretical point. Measuring the number of exposed persons thorough workforce surveys must be considered far more precise than measurement involving the respondents judgement on the work-relatedness of certain symptoms or diagnoses.

According to theory, the etiologic fraction quantifies the sickness occurrence that would not have occurred if the risk factor had not been present (Olsen & Kristensen 1991). This concept is therefore closer to the ideal requirements of the regulatory cost-benefit analysis, compared both to current notification data and other direct measures of sickness behaviour. Because exposure may change more rapidly than sickness occurrence, data is also less biased by historical conditions compared to the other two methods.

2.5.2 Pricing principles and other cost calculation concepts

In economic assessments various methods for assigning a monetary value to health variables are in use. In general, the principles applied vary according to the variable to be priced (see table 2.4. Davies et al. (1995).

Table 2.4. Applicable pricing principles for some variables (economic and human costs)

Variable	Unit of measurement	Applicable pricing principles
sick leave	lost production time	Lost output: full wages, opportunity costs of labour
health care costs, medical rehabilitation	number of cases, duration	market price (costs of health care)
disability, early retirement	age of victim	Lost output: future wages of non-working life years
fatalities	age of victim	Willingness to pay, willingness to accept
		Lost future output of lost life-years
		Willingness to pay

In this project the framework of economic appraisal as set out by Davies et al. (1995) will be loosely followed. This paragraph describes some additional issues.

Material damage and losses

The common method is to take the replacement or repair costs as the monetary value, possibly adjusted for depreciation of the damaged equipment or materials. This method is useful for assessing the value of damage to property, products, premises and the like.

Health effects

For estimating the value of health-related variables, a distinction must be made between reversible temporary health damage and permanent health damage (generally defined as those effects that remain after one year).

For the temporary effects, summing the costs (or market price) of medical consumption and treatment is the most common pricing principle.

There is no generally accepted method for calculating a money value for permanent effects on health, pain and suffering, the quality of life and (healthy) life expectancy as no market prices for these commodities are available. Methods like “willingness to pay” (WTP) or “willingness to accept” (WTA) are used to make estimates, but the outcomes are often criticised, as different techniques yield different results. Both willingness to pay and willingness to accept estimates are ex ante or before-the-injury willingness to accept, or to pay to avoid, the risk of injury.

They are indiscriminately equated to the value of a human life saved or value of an injury avoided. These latter values are described as ex post valuations. Thus, the WTP and WTA estimates are criticized not only because different studies yield different results, but also because they pretend to measure what they can not measure. The value of a human life saved, or injury avoided, inferred from ex ante valuations are almost always much smaller than ex post valuations, and herein lies the main objection to their use for decision-making purposes. Other methods are based on financial compensations, which may vary from jurisdiction to jurisdiction.

In addition, it is possible to quantify permanent health damage: “quality adjusted life years (QALYs, life expectancy, corrected for diseases) or disability adjusted life years (DALYs, life expectancy, corrected for the victim’s mobility and ability to take care of oneself). However, there are no adequate pricing systems available for the measures.

Lost production

The most common and simple method to assign a money value to lost productive labour hours is to take wages as the opportunity cost of time. This method is valid under the assumption that wages adequately reflect the value of production.

Furthermore it is assumed that the lost working time is not replaced by, for instance, the unemployed. This pricing method is usually called the human capital method. Application is possible both at the national and the company level. It must be noted that wages may not give an adequate estimate of the opportunity costs of production at the company level.

For permanent disability, application of the human capital method (with prevalence data) implies that estimations have to be made of future wages. Similar adjustments have to be made for persons who stopped working a long time ago. This estimation can be problematic.

If incidence data is used, an estimation of all possible or likely production (or wages) have to be made from the time of occurrence of disability until the moment of regular retirement or death. Also in this case, the estimation of potential future production is problematic.

The human capital method has had criticism by Koopmanschap et al. (1994). Their observation is that full employment (which is assumed in the human capital method) is extremely rare and that absent workers are usually replaced after some friction period. Costs are usually only incurred for the period during this friction period (which may be some months). An estimate for the costs of permanent disability at

national level would result in cost estimates that are only a fraction of estimates made according to the human capital method.

2.6 Practical aspects of assessment of costs and benefits at the company Level

2.6.1 Social security systems as sources of information

In most member states, public or private organisations that are in charge of occupational safety and health insurance regulations, publish statistics on the number of occupational accidents and health risks on an annual basis (European Agency, 1998). Usually such statistics include data on the number of working days lost, and the number of provided disability pensions as a result of occupational accidents and diseases. However, depending on the nature of these systems, the information available for company assessment purposes may not be complete. Over-estimation may take place because, for instance, non-work related accidents and illnesses are included. On the other side, underestimation can take place, because some countries only insure a limited number of accidents and illnesses. Besides this, all member states have different ways of organising their social security system. Thus the rules for assessing costs from insurance statistics, differ among countries.

2.6.2 Intervention studies

Most economic models in intervention studies at the company level consider three main elements:

- (1) the current costs-of-illness (repercussions of accidents and work-related ill-health);
- (2) prevention costs;
- (3) benefits due to prevention, which may be quantified as a reduction of the costs-of-illness compared to the situation before prevention and additional benefits related to changes in production technology and work organisation.

The models are in general based on practical micro-economic concepts. The differences between them are mainly caused by different strategies for data collection, rather than from diverging theoretical starting points.

Current costs-of-illness

Accident costing studies collect data 'before intervention'. A certain class of events (accidents, incidents) relevant to occupational safety are defined in these studies, and their consequences are registered and costed. Most of these studies calculate the current costs of accidents only, but average costs 'per incident' found during a sample period can be applied to future events and compared with the costs of prevention.

This research strategy establishes a strong association between cause and effects, and the hypothesis that costs can be eliminated by eliminating the accidents seems quite obvious. On the other hand, no examples were found where work-related diseases (or even occupational diseases) are analysed using this approach.

Accident costing studies are based on a long tradition from Heinrich's classical work of 1931. Heinrich's 'iceberg hypothesis' seems to influence many studies. This iceberg hypothesis relates to the idea that only a part of the costs become

visible. In HSE (1993), the division is made between 'insured' and 'uninsured costs', and the ratios are compared among company case studies. Other authors distinguish between 'visible' and 'hidden' costs, or between cost variables that are found in standard accounting practices in a particular country (e.g. Schneider 1984, Krüger & Meis 1991).

Finally, the concept of 'accident triangles' (Heinrich, 1931; Davies & Teasdale, 1994), counts the number of accidents of different classes of severity (e.g. deaths - serious injuries - minor injuries - non-injury incidents) and tries to establish a ratio between these incidents.

Though they are based on systematic empirical data, these ideas are not supported by any causal association, and ratios between visible/invisible costs (or 'insured'/uninsured costs) can only serve didactic purposes, but will not be a valid basis for aggregation or quantitative inputs to calculations.

Prevention costs and benefits due to intervention

Intervention studies evaluate an intervention programme by its prevention costs and its benefits. The literature survey in chapter 3 includes both studies where effects were calculated in money values, and studies measuring effects by health variables (e.g. sickness absence) to which costs may be assigned.

Depending on the time span analysed, this approach is usable both for accidents and work-related diseases. However, specific diseases are seldom analysed. General sickness behaviour (absence, personnel turnover) and complaints are used as effects variables in most cases. Consequently, the 'benefit' or 'effect' variables should be controlled both for confounders, as expressed in figure 2.1.

A subclass of intervention studies are health promotion studies. Health promotion includes both workplace intervention and interventions focused on individual behaviour (exercise, food, smoking). Effects (benefits) are often measured by sickness absence, personnel turnover or medical measurements, less often transferred into money values. Health promotion studies are relevant for the purpose of building models both as examples of workplace intervention and because the methodological challenge of establishing a valid programme-effect association are similar in both types of studies.

While intervention studies measure the effects of a specified programme, an alternative approach is to measure the effects at the level of the company as a whole. Changing this perspective does not change the theoretical list of variables, but some variables should be costed differently, as the 'marginal costs' perspective of specific interventions are less relevant.

A few examples of general business analyses have been found in our surveys. These studies applied general instruments for business analysis, for evaluation of major development projects in the enterprises, in a comparative design or as longitudinal business or industry studies. Only studies that included occupational health and safety data are reviewed. However, from the perspective of developing a methodology that can measure the effects of specific interventions, any economic study on the impact of introduction of new technology, of job modifications or other major development projects within enterprises could be relevant in principle. The EU-literature search did not reveal many studies with this broad approach.

2.6.3 Accounting and controlling studies

Accounting and controlling models are generally developed for the enterprise as a whole (or at least for larger departments within an enterprise). The primary purpose of accounting and controlling studies is to monitor some variables periodically, and to optimise the overall resource allocation within enterprises. Accounting and controlling studies could be used for the evaluation of interventions if the data collection periods coincide with the programme periods. Few examples of this use are available.

Besides economic values such as prevention costs or sickness benefits saved, various subjective data is used in some models, e.g. workers complaints, priority scales etc. It should also be noted that some variables (e.g. OHS services) should be entered into the accounts as aggregate costs while only the marginal costs would be relevant in intervention studies.

While the development of these models is motivated by lack of relevant OHS data in companies, several of the studies seem to be based on doubt or even disagreement with the 'safety pays' -hypothesis. Resource optimisation can concern both 'excessive' prevention costs and avoidance of costs related to work-related diseases.

One additional problem encountered with accounting practices is that the costs (and benefits) of prevention are not attributed to the specific production line or work operation that causes the injury. Instead, the costs of insurance, or the time spent by management on prevention, is usually calculated as "overhead" and not allocated among the different production or cost centers. Thus, both costs and benefits of avoiding injury are not "seen by the cost centers in the firm (Ashford et al., 1993).

2.6.4 Calculation of the costs of absenteeism

As already mentioned, most company studies were practically oriented in their economic methodology, and methodological deliberations in the references were often focused on the measurement of health and safety issues only (i.e. accident theory, intervention effects etc.). A few theoretical issues were also reflected at the practical level and should be mentioned here.

Almost all EU-studies made a distinction between financial costs (defined as direct outlays of the firm) and opportunity costs (i.e. the costs of inefficient use of production factors within the firm; all inverse effects on productivity, quality etc. can be classified as opportunity costs). Opportunity costs were most often measured with physical entities (e.g. a volume of work hours lost, days of delayed production) which then had to be costed based on some principles.

Fixing a cost to the volume of sickness absence raises two important issues. The first issue concerns the determination of the marginal cost of sickness absence, i.e. the resources that can be saved by reducing sickness absence. The second issue concerns the relationship between direct sickness absence costs and the methodology for measuring the additional effects, especially productivity effects.

For the calculation of costs of sick leave or employee absenteeism two calculation methods were applied: the human capital method and the friction cost method. The first method uses the total amount of paid wages during the period of sick leave as a proxy of the lost output. It is argued by Krüger and Meis (1991), Oxenburgh (1991) and by Koopmanschap et al. (1994) that this approximation of the human capital method may lead to serious overestimation of the real costs-of-illness to a company. It is better to make a calculation that only includes the extra costs a company makes to maintain its production and quality and real expenditures for reparations and compensation. This method is indicated by Koopmanschap as the friction cost (transitional) method.

Companies may have various strategies to maintain production, for instance by using the slack (that is present in every organisation), compensating lost production at a later time, increasing the workplace by colleagues and the like. It can be argued that rationally operating employers will choose a the strategy that minimises overall costs, while maintaining the productivity and quality level that is required at the time absenteeism occurs. Empirical information on the actual choices companies make in dealing with absenteeism is given for Belgium and The Netherlands by Lombeart et al. (1995) and De Roos et al. (1997) respectively.

The costs of sick leave to the company vary depending on the strategy chosen and may be higher or lower than the amount of wages a sick employee receives. However, little empirical information is known in this respect. Current estimations (e.g. Oxenburgh, 1991) give a range that is too wide to be practical. Furthermore, it is likely that differences between companies, economic sectors and EU Member States will affect the outcomes.

For this study it is concluded that a calculation approach according to the friction cost method is most appropriate because it better reflects the actual practice in companies. Three more arguments for using this method are:

- in most companies, colleagues can cover the work of a sick employee only for a short period of time without any effects on, for instance, quality. In general companies can only temporarily maintain higher production levels, for instance by postponing non-urgent work or increasing the workload;
- slack is present for different reasons, sick leave being one of these, to compensate for unexpected events or disruptions are also reasons; in this case sick leave diminishes the company's ability to deal with unexpected events;
- it may be impossible to remove slack from the company, for instance because labour is hired in discrete portions, firing people may lead to extra costs.

2.7 Assessment of costs and benefits at the individual level

2.7.1 General approach

The nature and the quantity of costs of work related accidents and ill health to injured workers was studied by Davies and Teasdale (1994). These authors looked at the financial costs on the one hand, and the losses due to the reduction in the quality of life and welfare on the other hand. Financial costs included short term losses in income as a result of absence from work and long term losses in the case of disability. Also some additional expenditures (for instance drugs and hospital attendance) were taken into account. Losses to the quality of working life were

calculated as estimates of the pain and suffering associated with the injury or illness, the worry and grief caused to the family and friends and, in some cases, the loss of life joy resulting from permanent incapacity.

For individuals, assessing the loss of potential future earnings can in principle be based on statistical data of life expectancy and career development patterns. These can be used to estimate potential earnings.

The calculation of the “subjective costs” is the most difficult part of the algorithm and was characterised by Davies and Teasdale (1994) as ‘purely arbitrary’. To give this subjectivity a more objective basis, two methods are proposed: court compensation awards and Willingness to Pay (WTP) estimates of people to reduce their risk of being killed or injured. Court compensation awards have serious limitations, which are depicted best in the case of death, when only financial losses to dependants with a token supplement for the distress suffered by the family are compensated. For that reason Davies and Teasdale (1994) proposed the method economists have developed in having people estimate their willingness to pay for reducing OSH risks.

From the calculations of Davies and Teasdale (1994) it can be seen that the economic costs to the injured or diseased individuals are high, despite the relatively high level of social protection in a country such as the United Kingdom. This high level of personal cost counteracts the argument that social security systems stimulate individuals to neglect their own security, as the system or the employer pays in the event of accident (or illness). This argument only holds in case of minor illnesses that do not harm the worker much. In all other cases workers are likely to be aware of the consequences of accidents and illnesses too, due to their disadvantageous personal involvement in the consequences.

2.7.2 Impact of social security systems to costs at individual level

Even the best social system or company regulation cannot prevent individual workers from suffering financial and welfare losses, when confronted with an accident or ill health due to working circumstances. The costs of these losses can be divided into two main categories: direct financial costs and indirect losses of quality of private life. Risks to the direct financial costs can be insured rather well but not completely. As illustrated in table 2.6. and table 2.5. social security or insurance systems cover only part of the financial costs to individual workers and their families.

Table 2.5. Sick pay in EU Member States (source Bakkum, 1997).

	basis	hourly paid workers		monthly paid employees		Remarks
		percentage of wages	duration	percentage of wages	duration	
Austria	legal + CLA	100%	4-10 w	100%	6-12 w	afterwards: 4 w 50%
Belgium	legal + CLA	100%	30 d	100%	30 d	
Denmark	legal + CLA	< 100%	14 d	100%	14 d	sometimes supplement
Finland	?	100%	7 d	100%	7d	
France	legal + CLA	90%	30 d	100%	3 m	
		66.67%	31 - 60 d			
Germany	legal	100%	6 w	100%	6 w	
Greece	legal + CLA	100%	30 d	100%	30 d	
Ireland	CLA					
Italy	legal + CLA	100%	3 m	100%	3 m	
Luxembourg	legal + CLA			100%	1 y	
Netherlands	legal + CLA	70 / 100%	1 y	70 / 100%	1 y	usually 100%
Portugal	CLA	100%	?	100%	?	
Spain	CLA	100%	15 d	100%	15 d	sometimes up to 18 m
Sweden	CLA	< 100%	?	< 100%	?	10% suppletion to sick pay
United Kingdom	legal + CLA		28 w	28 w		3 waiting days

CLA: collective labour agreement

Table 2.6. Compensation for permanent disability due to occupational accidents and occupational diseases, as percentage of wages (source, Bakkum, 1997).

		Degree of disability			Cumulation	Taxation
	100%	75%	50%	25%	allowed	
Austria	80	60	40	16.7	yes	yes
Belgium	100	75	50	25	limited	yes
Denmark	80		40		limited	yes
Finland	85/70		42.5/35		yes	yes
France	100	62.5	25	12.5	< 80% of wages	no
Germany	66.7	50	33.3	16.7	< net wages	no
Greece	60				yes	yes
Ireland		not related to income			yes	yes
Italy	100	75	50	13.2	< net wages	yes
Luxembourg	85.6	64.2	42.8	21.4	< net wages	yes
Netherlands	70	50.75	35	21	no	yes
Portugal	80		66.7		partly	no
Spain	100		55		partly	no
Sweden	100				partly	yes
United Kingdom		not related to income			partly	no

3. Review of recent and ongoing studies

In this chapter an overview is given of contemporary studies on the costs and benefits of occupational safety and health. First, four European initiatives are summarised in which the current situation and the comparability of the initiatives at the national and company level among the fifteen member states is studied. In the subsegment sections an analysis is presented on the literature at national level (section 3.2 and 3.3) and at the company level (section 3.4 and 3.5). The comparability of variables and criteria is discussed in section 3.6.

3.1 Recent and ongoing European initiatives

In the last ten years, interest in the cost and benefit analysis of occupational safety and health (OSH) issues is steadily growing. Some Scandinavian and Anglosaxon countries have laid a secure foundation for research and organisational practice, while other European countries have also discovered this novel way of examining old issues. At least two recent efforts stress the importance of this relatively new development in the European Union.

European Conference on Costs and Benefits of Occupational Safety and Health 1997

In May 1997, a European conference on the costs and benefits of occupational safety and health was held in The Hague in the Netherlands (Mossink & Licher, 1998). This conference represented one of the first systematic attempts to explore the economics of occupational safety and health at European national and company level. The main issues addressed were among other:

- international comparison of OSH systems;
- economic incentives in OSH;
- costs and benefits of stress prevention;
- cost-benefit models - theory and practice;
- the impact of OSH regulation on business;
- OSH as a factor in competitiveness;
- company decision making on OSH practice;
- cost effectiveness of OSH, especially in SMEs.

Though definite answers cannot be given in relation to a number of issues at the moment, the following conclusions were drawn from this conference:

- the cost items included in national level studies vary widely;
- the monetary value of benefits are more difficult to measure than the monetary value of costs;
- cost benefit analysis may not be the best tool for marketing workplace health promotion.

One of the main issues at policy level to emerge from these papers concerned the need for cost internalisation to take place in order to provide incentives for OSH improvement. Another issue concerned the need to develop better research and practical methodologies. The scope of research needs to be broadened at both basic and applied levels in order to further develop methods and tools and to help inform practice and policy. At company level, research needs were largely concerned with

the need for more research and for the need to support both research and practice with the development of practical tools.

Economic Impact Survey

Also in 1997, the European Agency for Safety and Health at Work conducted a survey in the national thematic groups on the “Economic impact of occupational safety and health policy in the Member States of the European Union” (European Agency for Health and Safety at Work, 1998). The aim of this project is to produce an overview of how economic aspects are related to the formulation of occupational safety and health policy in the Member States. Furthermore, it offers information for development of further actions. The project shows that the economic impact, and more specifically the estimation of the costs and benefits of occupational safety and health, is becoming a very important issue in most of the Member States. With regard to further actions, amongst others, dissemination of methodologies and development of company level tools are suggested.

This study also stressed that the estimation of costs is less difficult than the estimation of benefits. Estimating direct benefits has proven particularly difficult. Avoided costs of illness is the most common category. Reduction of health care costs and the costs for rehabilitation are estimated to a lesser extent. On the whole there is little experience in quantifying the effects on productivity and product quality. Apart from this, the approach for assessing costs and benefits varies across countries.

Economic incentives, a new forward looking approach

Since 1993 the European Foundation for the Improvement of Living and Working Conditions began developing an incentive system, based on proactive premium graduation. In the proposed system, premiums are partly dependent on existing risks in companies. This system was tested in France. The results indicated that the proposed system is both practical and sufficiently open and flexible for further application (Bailey et al, 1995; European Foundation, 1994).

The ESAW (European Statistics on Accidents at Work) project on costs on accidents at work.

Eurostat and DG V have designed a project under the title: “Preliminary study concerning socio-economic costs on accidents at work and occupational diseases” on this subject.

The data source is based on notified accidents resulting in more than 3 days of absence. The model presumes that the cost data can be adjusted to this data source. The model attempts to show breakdowns by industry sector, company size and injury type. The input tables distributed to the Member States are intended to collect the “direct costs” which are defined as “cash benefits and benefits in kind”, for the variables : sickness absence (1.1.4), permanent disability (1.1.5), hospitalization (1.1.1), and other health care costs (1.1.2). This seems to be an addition of financial costs across sectors (insurance, company, public sector), without adjustment for secondary effects (e.g. taxes). The preliminary response indicates that countries relying on insurance-based systems can provide most of the data required, while countries where sickness absence due to work accidents are compensated by employers through general social systems are less likely to be able to provide the data.

3.2 Literature overview at the national level

3.2.1 Approach

Before addressing the issues in relation to the correct methods and variables to describe the economic impact of (prevention of) work environment problems, this report must address the question: for whom are calculations made and for what purpose?

National level calculations are made for a number of purposes:

1. to compare the total social costs of work accidents and work-related sickness occurrence with other major problems at the general level of society;
2. to estimate the impact of these costs on GNP growth;
3. to estimate figures that can be used in cost-benefit analysis of new regulations;
4. to add up the financial costs of national or insurance-based compensation systems;
5. to analyse the distribution of costs among the economic agents and the economic incentives (disincentives) for prevention in the workplace.

The first three purposes are linked with a general notion of “society”, and the notion of “externalities”, i.e. that costs (income losses or intangible costs) are not covered by specific economic agents but are passed on to individuals or to society in general. This hypothesis seems to be a leading principle behind the data collection and modelling in the studies reviewed. The latter two concern the income and expenditure of specific agents, e.g. insurance systems or the public sector. The choice of perspective has consequences for economic methodology, such as the pricing principles applied for calculation of the benefits from prevention (or the costs of illness), and it will influence the choice of basic “health” data to describe the impact of work-related sickness occurrence.

The report is mainly based on European literature from the last 5-10 years ¹. The references have mainly been selected from:

- The national surveys conducted in the framework of this project;
- The national response to a survey on “economic impacts”, conducted by the European Agency of Occupational Safety and Health (European Agency, 1998);
- Earlier reports for the European Union on impact assessment of regulation (Danish National Institute of Occupational Health, 1989; HSE & DWES, 1995);
- The proceedings of the European Conference on Costs and Benefits of Occupational Safety and Health (Mossink & Licher, 1998);
- Non-European (US Congress, 1995) and other literature.

The national-level references collected have been classified into three groups:

- national cost-of-illness studies (table 3.1), which attempt to address the objectives no. 1, 2 and 4. Some of the limited, insurance-based studies have been excluded, as well as models without empirical data;
- ex-ante and ex-post evaluations of regulations, which attempt to address objective no. 3. No examples of ex ante² assessments are found in the national

¹ years (which means that a few earlier studies from Germany, U.K., Denmark have been deliberately omitted)

² A few Danish examples are given in Arbejdstilsynet (1996). HSE/DWES (1995) lists a number of EU Directives for which impact assessments has been made.

reports, but they would not be expected to add to the potential list of variables (table 3.2);

- other studies, (table 3.3) which include attempts to create various index measures of the quality of the total working environment and various longitudinal studies associating regulations with industry development.

In order to approach the overall goal of developing economic models for the use in EU countries, some quality assessments have been attempted. The elements considered in describing the quality of models are:

- internal consistency (i.e. can the variables included be added to a total cost figure, avoidance of double counting);
- comprehensiveness (i.e. that the model can include all health and economic consequences that are considered important in the particular analysis);
- data availability;
- the theoretical foundation (i.e. acceptance from the academic world);
- control for confounders (especially in ex-ante and ex-post analysis of the impact of regulations).

Finally, as this project is conducted in an EU context, the question of comparability between countries is considered at various points.

3.2.2

Country overview : goals, coverage and data basis

Table 3.1 National cost-of-illness estimates - basic data and coverage

Country/source	Coverage	Data strategy	Main cost principles
AUT: Bensch 1993	Accidents	insurance cases	COI – output loss, household production
DEN: Kommunernes Landsforening 1991	All work-related, no diagnosis breakdown 1991	% of total sickness occurrence relative to total	Financial costs for the public sector – expenditure in current year, projections
DEN: Arbejdstilsynet 1996	Accidents + work-related diseases, 1992	Exposure-risk (cancer, cardiovascular); health surveys (other)	Socio-economic COI ; household production; public sector financial costs also estimated,
DEN + S: Levi/Lunde-Jensen 1996	Job strain/ Cardiovascular disease 1992/93	Exposure – excess risk	Socio-economic COI (same model as above)
D:Accidents Baum/Niehus 1993	Work and traffic accidents 1989	Notification plus estimated non-notified	Socio-economic COI, home production valued
D: Noise Weinberger 1992	hearing loss , cardiovascular dis	exposure-risk function	Lost production, health care costs ??
FIN: Min. Labour 1994	8 work-related diagnoses, 1992	notified accidents + % of total sickness	Socio-economic COI (lost market output)
FIN/S : Söderquist/Aaltonen 1989	accidents in furniture industry 1988 national, company	Aggregated from a sample of companies	ressource costs, lost output under var. presumptions
I: Andreoni 1986, Ortolani 1992(same model)	accidents + occupational diseases	Insurance cases	Financial costs; estimated GNP output loss; Prevention costs added
NL: Koningsveld/Mossink (ed) 1997	Accidents + work-related diseases, 1995	Workforce survey, % of total sickness	lost potential output plus financial transfers (early retirement); resource costs (health care, equipment damages; OHS service costs added
S/ FIN/DEN/N: Hansen 1993	Accidents + 7 major work-related diseases, 1989/90	Workforce surveys, (diseases not specified for Sweden)	Socio-economic COI
UK/ HSE 1994	Accidents + work-related diseases, 1993	Workforce survey, Some company-level costs aggregated from case studies	Lost market output + WTP estimate of “human costs” damaged equipment; Financial costs for employers

Table 3.1 includes only studies from the EU countries which attempt to estimate socio-economic costs (as distinguished from financial costs for one agent) for society as a whole. Studies from other countries are referred to later, but do not present alternative methodological approaches. A further number of countries have reported “costs of work accidents” to the European Agency survey of 1997 European Agency, 1998, but these estimates are less comprehensive in their approach.

The general purpose of the studies above is to establish an order-of-magnitude of the “costs to society”. For national authorities, a secondary goal is to establish background data to be used in practical cost-benefit analysis. Only one study (Kommunernes Landsforening 1991) had the distributional effects between various agents as its primary goal.

Estimates covering the socio-economic costs of work-related diseases and work accidents have been made for 5 countries. Five studies (from 4 countries) estimate the socio-economic costs of accidents, while two studies examined workplace exposure (noise and high speed repetitive work), where the effects are measured by

a limited range of diagnoses (hearing impairment and cardiovascular diseases; cardiovascular diseases).

The data source for the costs of illness is notification data in all the *accident-only studies*, except the Söderquist/Aaltonen study, which aggregates its results from a sample of approximately 20% of the furniture manufacturers in Sweden, Finland (and Norway). The Ministry of Labour estimates for Finland use notification data for its calculation of work accidents.

In the studies covering all work-related diseases as well as work accidents, general health surveys among the work active age groups are used to quantify the volume of work-related sickness occurrence (with the exceptions mentioned above). For the U.K. study, one specially designed workforce survey has been used, while the Danish and Dutch studies have targeted surveys at people seeking health care. The Danish study is based on secondary analysis of some earlier studies, which were not specifically designed for this economic analysis.

The Finnish study does not apply national background data to measure the percentage of total sickness occurrence that can be related to work, but is based mainly on the Danish figures presented by Hansen (1993). The latter procedure is quite problematic, as it bypasses the necessary assumptions that both denominator (general sickness occurrence and demographic composition of the workforce) and numerator (the level of workplace exposure) must be similar in the two countries. Two studies measure health consequences by examining a quantitative exposure-effect relationship. The study of Weinberger (1992) does not publish the quantitative relationship, while the Levi & Lunde-Jensen (1996) study uses the "etiologic fraction" approach. A similar calculation is used for work-related cancer in the Nordic studies (Hansen, 1993; Min. Labour (FIN), 1994; Arbejdstilsynet 1996).

Genuine cross-country comparison is only conducted in two studies (Levi & Lunde-Jensen, 1996 and Rohan & Brody, 1984), these studies use identical methodology and data source in both countries. Hansen (1993) presents tables juxtaposing results from 4 Nordic countries, but the background data estimating the volume of work-related disease differs in methodology, level of aggregation¹ and in the order of magnitude.

Analysis of the development of costs over time is only possible among the Italian accident studies, based on insurance notifications in two base years. The methodology of the broad, national studies in the UK, Netherlands, Denmark and Finland necessitate that the basic data gathered, i.e. health surveys, must be repeated in order to follow the development in the state of health and safety². Price and wage index adjustments are possible, but such calculations give no information on the basic question of the total volume of costs and consequences of work-related disease.

Studies based on exposure-effect associations (Levi/Lunde-Jensen 1996, Weinberger 1992) could be the basis of longitudinal analysis, if the exposure data was measured repeatedly.

¹ Swedish data allows only distinction between accidents, cancer and "all diagnoses"

² HSE in the UK plans to publish revised figures in 1998.

Table 3.2 Ex post evaluation of regulations and interventions.

Country/source	Study design	Cost data collection	Benefit estimation method
DK: Tilsted 1998	cost-benefit analysis of intervention - case-control design	programme participants, general health statistics	Accidents recorded in project period
FIN: Soukas 1993	c/e - development of protective methods caused by two regulations over an 8-year period	Case studies	Specific accident rates
NL: v Polanen Petel 1996	Cost-benefit analysis of alternative manual lifting standards	Company survey, 1500 responses from 15 industries	No. exposed (survey) * assumed effectiveness rate
S: Arbetsarkyddstyrelsen 1997	5 company case studies of two regulations ("ventilation and air quality" and "job adjustment and rehabilitation") - c/e design	Typical cases in industry (manufacturing, education, health care)	Partially: no. of rehabilitation cases; indoor air-related symptoms from case studies.
UK: Honey et al 1996	Evaluation of noise regulations	Postal survey, 1889 responses	Industrial opinion
UK: McCrea 1998	Survey of company sample, expenditure and assessed benefits	Investments, time, education programmes	Subjective evaluation by managers
AUS: Oxenburgh 1993	Cost-effect analysis (ex ante) of manual handling code, survey of companies	Aggregate investments in companies	no. of back injuries avoided * insurance costs pr. case

These papers outline costs to business calculations using a reasonably wide range of cost variables, while the quantification on the benefit side (reduced sickness occurrence) is rather weak. This view is supported by the Swedish reference (Arbetsarkyddstyrelsen, 1997). Part of the explanation for this is the short time span (2-4 years) between implementation of the regulation and the ex-post evaluation, as health effects cannot necessarily be expected within this time span. There is a dramatic shortage of explicit programme-effect relations. Only Oxenburgh (1993) and V. Polanen Petel (1998) give figures (interestingly assuming 80% versus 33% effectiveness of the manual handling regulations, none of the figures tested empirically within the studies). Compared to surveys of the practice in ex ante assessments of regulations in the Nordic countries (Hansen, 1993) and in the EU (Davies et al), the studies above are well above average, but the lack of information on expected impacts has deeper roots than just data availability: it raises the question whether the chosen regulatory instruments are effective in attaining some explicit goals.

Table 3.3 Other national-level economic studies.

country/source	Study design	cost variables	benefit/health variables
D : Total, steel, coal mining Krüger et al (1993)	benchmarking and C/E, regression of accident time series against economic indicators	productivity, output employment	accidents total, fatal
F: Krüger et al (1993)	benchmarking, as D		
DEN: Lunde-Jensen 1987	Industry survey of causes for technological change	Number of products withdrawn due to OHS considerations	Number of low-risk products introduced
DEN: Grønnebak /Lunde-Jensen (1987)	historical (time series) analysis of regulatory progress versus 1) market volumes and innovation in companies	Development costs not assessed	Market share of low-risk products; Number of new products introduced in market

It is perhaps surprising to find only one study aimed at quantitative analysis of the relationship between the traditional macro-economic variables (employment, output and productivity development) and occupational health and safety statistics. A number of industry-level studies from the late 70s and the first half of the 80s collected data on the long-term, and additional effects of OHS regulations, as measured by technological change, product innovation¹, or used variables such as market penetration of new products (Grønnebak Hansen/Lunde-Jensen, 1987). These studies are undertaken making the common assumption that the long-term competitiveness of companies can be measured by their capacity for innovation, rather than by short-term profits. Introduction of new products, or market demand for low-risk products are thus used as a success variable in assessing the companies' response to regulations².

3.3 Variables and costing principles used at the national level.

The tables 3.4 to 3.7 give an overview of the variables entered into the calculations performed. In general, it is attempted to dichotomise between variables "present" (Y) or "absent" (-). Whereas "absent" is precise, "present" may cover a range of alternatives: the variable can be measured directly and totally, parts of the heading (checklist number) may be quantified, it can be included in a more general variable, it may be included in budget figures but be indistinguishable from other variables etc. A short, explanatory text has been used to describe the degree of coverage in a particular study. "Quantified" for this table is defined as a figure that can be transformed to any relevant price system (financial, socio-economic etc). Data which is indistinguishable from a total cost figure (e.g. the average cost of an insurance claim in country X or industry Y or emergency costs included in a health sector total) is therefore not reported as "present" in the study.

It is evident from table 3.4 that the monetary value of temporary sickness or permanent disability has been estimated by some version of the "output loss" principle. The Dutch study adds financial costs of permanent disability to output loss estimates for other health variables, which is inconsistent, giving values that are difficult to interpret.

It also appears that the level of details in the analysis (the number of variables) depend on two characteristics: first, the level of details chosen for the "accident" studies, and secondly, whether the calculation method has been extended beyond output loss calculations for normal, paid work.

The Danish and Finnish studies include only health-related variables³, while the UK and Dutch studies include damaged equipment from accidents, aggregated from case studies. The UK study includes a considerable volume of costs due to non-injury accidents, which may be reasonable in the case studies where data was collected but seems irrelevant in a general COI.

The market output lost by sickness occurrence can be criticised for being too narrow a perspective on the welfare losses due to ill-health. The Danish study and Baum/Niehus (1993) add a valuation of lost household production to the variables

¹ See f.i. Asfords review in Mossink & Licher (eds) 1998. A more comprehensive review, covering both OHS and external environment regulation versus technological change, is found in Ashford/Heaton (1983).

² This has later been known in as the "Porter hypothesis" in environmental economics, though it was initially forwarded in a MIT study from 1978 by Allen, Ashford et al.

³ The same list of variables is used in Hansen 1993 and Levi/LundeJensen 1996.

1.1.3 to 1.1.6, while the UK study extends the scope by adding Willingness-To-Pay (WTP) values to the health variables. The latter procedure must be considered to be wider in its scope, and the values calculated are bigger than the "lost home production".

Non-health costs associated with accidents, such as damaged equipment and company worktime used to recover from accidents are included in some studies. As this data can only be collected either through insurance claims or directly from industry, the method of aggregation is crucial. Only the Söderquist/Aaltonen study with its limited scope seems methodologically convincing in that respect – the broader studies including these categories (HSE, 1993 and Koningsveld & Mossink, 1997) are based on a limited empirical background – the UK study on 5 case studies only and Koningsveld and Mossink make estimations based on German accident notifications. Woods (1989) attempts to aggregate the productivity effects of the "sick building" syndrome, though the foundation is even more obscure. It is difficult to evaluate the results based on insurance claims (Bensch, 1993; Baum & Niehus, 1993) without information on industry's incentive to insure versus self-containment of the costs of damages.

Table 3.4: Variables present in national-level cost-of-illness studies from EU countries.

Variable Ref to checklist 1	AUT Bensch	DEN Arbejdstils. 96	FIN Min.soc 1997	DEU Baum/ 1993	DEU Weinber ger 92	ITA Ortolani 1994	NL Nia- tno 1997	UK HSE 1994
Work accidents	Y	Y	Y	Y	-	Y	Y	Y
Occupational diseases	-	-	-	-	-	-	-	-
Work-related diseases	-	Y	Y	-	Y	-	Y	Y
Hospitalization 1.1.1	Y	Y	Y	Y	-		Y	Y
Out-patient treatment 1.1.2	Y	Y	Y	Y	-		Y	Y
Emergency, rescue, ambulance 1.1.2	Y	-	?	Y	IR		?	-
Non-medical rehabilitation 1.1.3	Y	only in financial		-	?		?	-
Aids, appliances, etc. 1.1.7		-			-		?	-
LABOUR MARKET COSTS (1.a, 1.b)	output loss	output loss + financial	output loss 1.b	output loss 1.b	output loss		output loss/fi nancial	output loss 1b
Sickness absence 1.1.4	Y	Y	Y	Y	?		Y	Y
Permanent disability 1.1.5	Y	Y	Y	Y	?		Y financi al	Y
Deaths 1.1.6	Y	Y	Y	Y	?		?	Y
NON-LABOUR MARKET COSTS (1.c, 1.d)	home production (1.b)	home production (1.b)	-	home production (1.b)	WTP		-	WTP
Sickness spells	partly	Y	-	Y	-		-	Y
Permanent disability	Y	Y	-	Y	-		-	Y
Deaths	Y	Y	-	Y	-		-	Y
NON-HEALTH COI								
National admin. of sickness occurrence 1.2.1		-	-	Y	-		Y	Y
Company administration of sickness 1.2.1		-	-	-	-			Y
Insured damages 1.2.2	Y	-	-	Y	-		-	-
Damaged equipment 1.2.2	?	-	-	Y	-		accid- ents only	accid- ents only
Management, co-worker time lost in companies 1.2.3	-	-	-	-	-			accid- ents only
Police and other non-health costs 1.2.4	-	-	-	-	-		-	-
PREVENTION COSTS (y/n – details in Tab.3.6)	no	no	no	no	yes, calcul.		yes, added	no
ADDITIONAL	-	-	-	-	-		-	-

Table 3.5 : Calculation parameters in national-level cost-of-illness studies from EU countries.

Calculation parameters Ref to checklist 1	AUT Bensch	DEN Arbejdstil s. 96	FIN Min.soc 1997	DEU Baum/ 1993	DEU Weinberg er 92	ITA Ortolani 1994	NL Nia-tno 1997	UK HSE 1993
Work accidents	Y	Y	Y	Y	-	Y	Y	Y
Occupational diseases	-	-	-	-	-	-	-	-
Work-related diseases	-	Y	Y	-	Y	-	Y	Y
WORK-RELATED VOLUME	notified	sample, exposur	sample	notified + sample	exposur- risk	notified	sample	sample
DATA BASIS:	individ. cases	general health	general health	notified cases	noisesurv ey	individ. cases	general health	sample
Health care, hospital 1.1.1 to 1.1.3	incid.	preval.	preval.	incid.	-		?	incid.
Sickness absence 1.1.4	incid.	preval	preval.	incid.	?		?	incid
Permanent disability 1.1.5	incid.	1 yr incid.	1 yr incid.	1 yr incid.	?		?	sample incid.
Deaths 1.1.6	incid.	incid.	incid.	incid.	?		?	incid
COST PRINCIPLES								
Health care 1.1.1-1.1.3	resource	resource + public	resource	resource	-		resource	resource
Sickness absence 1.1.4	NNP/ hour	average wage	average wage	average wage				average wage
Permanent disability 1.1.5	NNP/yr/p erson	yearly wage	yearly wage	NNP /yr /person	-		-	yearly wage
Deaths 1.1.6	same	same	same	same	IR		-	same
FUTURE OUTPUT LOSS ADJUSTED FOR								
Discount rate	3.2%	4% *	4%	nil	?			6%
Survival probability	Yes	Yes	Yes	Yes	?			Yes
Average unemployment by age groups	no	no	no	no	?			Yes
Working capacity left	Yes	no	no	Yes	?			no
VARIOUS COSTS								
National admin. and infrastructure 1.2.1, 1.2.4	-	-	-	resource	-		resource	resource
Company-level time re- allocation 1.2.1, 1.2.3	-	-	-		-			aggreg.ca ses
Damaged equipment 1.2.2	insured	-	-	insuredre source	-		?	aggreg cases
NON-LABOUR MARKET HEALTH IMPACTS					WTP f. neigh- bours			
Economic principle	home	home		home			-	WTP
Quantification	work days lost	persons with lost workday	-	work days lost				severity of cases
Valuation	MAHC ?	MAHC market price		WOCT cost of time				traffic sector WTP

incid: based on incidence data

preval: based on prevalence data

MAHL: market alternative = housekeeper cost

WOCT: wage = opportunity cost of time

NNP: net national product.

Table 3.5 describes the background parameters applied to the calculation for the cost-of-illnes variables in table 3.4.

The starting point is a volume of sickness occurrence. The “accident only” studies begin from notified cases and the health consequences (sickness absence, hospitalisation etc), of the accidents are recorded in records of individual victims. The study of Baum & Niehus (1993) study has a supplemental estimate of non-notified work accidents.

The 4 “general” studies (covering all or most work-related diseases) are based on samples which are extrapolated to the general workforce. The U.K. study collects its health consequence data within the sample, while the Dutch, Danish and Finnish studies apply the percentages of work-related diseases found in samples to general health and social statistics¹. It is argued in these studies that the national notification data does not give a sufficient coverage of work-related diseases and work accidents.

The excess risk associated with a specific workplace exposure is used to quantify work-related sickness occurrence in Weinberger (1992) and to a few diagnoses in Arbejdstilsynet (1996) and the Levi & Lunde-Jensen 1996 study on job stress. The apparent inconsistency in the data source for quantification of the volume of work-related sickness occurrence in the studies covering all work-related diagnoses (except HSE, 1994 and the accident studies) is also found in U.S. studies with similar broad scopes (Fahs et al., 1989; Neumark et al., 1991), reflecting the problem that the wide range of health outcomes related to work calls for various methods of measurement.

The subsequent health outcomes may be recorded as prevalence (“preval” in the table) of sickness occurrence during a year, or it may be based on incidence (“incid”) data, recording all consequences of each case from a point in time and onwards.

Data collected on incidence on basis is preferable for most uses. This data strategy may suffer from “short-sightedness” in practice, caused by difficulties in registration of both sickness behaviour before the registration period and long-term effects appearing years later². The mix of incidence data for future output losses (disability, deaths) and prevalence data for short-term outcomes (health care, sickness absence) in the Danish and Finnish studies³ is caused by the lack of longitudinal data on the progression of work-related sickness cases. The practical consequence is that sickness behaviour (hospitalisation, absence, use of other health care services) due to work-related diseases cannot be linked with a specific population of persons, and some problems occur in relation to double counting for persons transferred from “absence” to retirement” during the base year.

Resource costs (the actual expenditure on the cost item), are used in all studies that count health care costs, national administration and infrastructure costs. The same principle applies to equipment damages. Hospital costs are calculated by average, variable bed-day costs (i.e. investments in buildings are not included). It is debatable whether this figure represents really the marginal cost that could be saved by eliminating work-related diseases and work accidents.

¹ This procedure also applies to most of the diagnoses in Hansen 1993 (Denmark, Sweden, Finland, Norway) and in SINTEF (1992, Norway).

² An exception is calculations with the goal of assessing the distribution of the financial burden for the stock of presently disabled victims, see Kommunernes Landsforening (DEN) 1991; or assessments of the future insurance premiums.

³ This applies also to Hansen 1993 and Levi & Lunde-Jensen 1996.

The output lost from the labour market is calculated as average wages in all 4 “general” studies, while Baum & Niehus (1993) and Bensch (1993) use the higher figure of Net National Product per work hour. The “majority” method is an attempt to approach the marginal cost of additional labour. It is argued in some US studies that the average wage should be adjusted by the actual distribution of sex and wage levels within the (often low-wage) population mostly at risk. This would typically lead to lower values of lost workhours for women, which lead to unethical results in a preventive perspective. The two studies with separate calculations for men and women (Levi/Lunde-Jensen 1996; Bensch 1993) use the same wage/NNP per head for both sexes. Levi & Lunde-Jensen adjust for shorter working weeks among women. Bensch differentiates by differences in health effects and by the volume of household work. The latter component results in higher output losses for female victims than for men. The Dutch study uses financial costs to social insurance for the “disability” variable, which is inconsistent with the principle applied to sickness absence (loss of potential output).

The future output lost due to permanent disability and deaths necessitates a further range of choices. Standard economic procedures call for discounting of future production (losses), but Baum and Niehus (1993) have chosen to refrain from this. Arbejdstilsynet (1996) includes both discounted and non-discounted alternatives, though the discounted figure is used for subsequent administrative uses. For the financial calculation of the public costs, no discount rate is used (assuming “unchanged policy” with regard to the real purchasing power of pensions etc.). Neither the Danish nor the Finish estimates adjust the lost potential production for unemployment or other causes of early retirement. This may make it easier to use the figures directly in cost-benefit analysis of interventions, but the gross figures are difficult to interpret. The UK study applies a rough 50% adjustment, while the Baum/Niehus and Bensch studies adjust by the medical judgement of working capacity left from accident cases.

The inclusion of variables like damaged equipment, and time re-allocated in companies is based on aggregation from case studies, except for the Bensch and Baum/Niehus studies which count insurance indemnities.

The three studies including lost household production vary in their practical procedures. The Baum & Niehus study counts each workday lost as 100% (but adjust by the working capacity left for permanent disability). Bensch considers fatalities and severe accidents only (adjusted for working capacity left), while Arbejdstilsynet 1996 counts fatalities and hospitalisation days as 100%, and other lost workdays are assigned partial output losses. Furthermore, Baum/Niehus apply the WOCT principle (“wage = opportunity cost of time”), equalling the time spent for household production by the persons average wage¹. Arbejdstilsynet applies the MAHC principle (“market alternative = housekeeper cost”), using the lower wage level of housekeepers and assorted repair services for the valuation of household production. Bensch values each house-hold workhour at 100 öS (7 ECUs), which is probably closest to the MAHC principle.

A further difference is that Bensch and Baum & Niehus seem to use a rough average household working time in all households, while Arbejdstilsynet applies a lower value based on employed households without children in order to approximate to the older age groups retiring due to work-related diseases.

¹ Assuming that the time spent on household production could have been used on more paid work instead.

The WTP (willingness-to-pay) measurement of “grief and suffering” in the U.K. study (HSE, 1993) is a transformation of data from research in traffic safety and hospital treatment. The exact procedure is not described thoroughly, but the text indicates at least two serious methodological flaws: firstly, that the loss associated with any permanent disability is considered to be identical disregarding the diagnosis; and secondly, that it is not considered whose willingness to pay (and how) should be applied to workplace safety and health (see the discussion in 3.4). Comparison of “benefit side” (cost-of-illness) calculation results can only be considered after accounting for these methodological differences. In order to analyse the causes of variation, some comparison points and common denominators (e.g. X per person employed, volume relative to total sickness occurrence) must be developed. This analysis has not been conducted.

Table 3.6: Prevention cost variables in national-level ex post evaluations plus COI studies.

Variable Ref to checklist 1	FIN Soukas 1993	NL Polanen1 1998	S/ASS 1997 indoor	S/ASS 1997 rehab	UK Honey 1997	UK McCrea 1998	DEN Grønnebak 87	NL Nia-tno 1997
STUDY TYPE	C/E	C/E	ex post	ex post	C/(B)	ex post	ex post	COI
Benefits y/n	n	Y	partly	partly	Y (?)	Y	second	Y
PREVENTION COSTS								
Risk assessment 2.6	-	-	-	Y	Y	Y	-	-
Modify workplace 2.1	Y	Y	-	IR	-	Y	-	-
Retrofit equipment, exhaustion system 2.1	Y	Y	Y	IR	?	-	-	-
Investment in buildings, capital goods 2.2	-	-	Y	IR	Y	-	-	-
Additional costs for substitute products 2.3	-	Y	-	IR		-	-	-
Purchase of PPEs 2.4	IR	-	IR	IR	Y	Y	-	-
Maintenance, changed work procedures 2.5	Y	-	-	Y		-		-
In-house preventive services, meetings OHS training 2.6	IR	Y	-	Y	Y	Y	-	-
External services 2.7	IR	-	-	-	-	Y	-	Y
Other company costs 2.8	-	-		-	Y	-	-	-
National level infrastructure etc 2.9	IR	IR	-	-	-	-	-	Y
SECOND-ORDER EFFECTS (costs/ benefits)	-	yes	-	-	benefits = 25% of costs	benefits	costs benefit	-
Productivity 3.1	-	-	-	-	-	Y	costs	
Product quality 3.2	-	-	-	-	-	Y	+/-	
Market shares 3.3	-	-	-	-	-	-	=	
New Technology 3.4	-	-	-	-	-	-	benefit	
Human resources 3.5	-	-	-	-	-	Y	benefit	
Relative competitiveness 3.6	-	Y	-	-	-	-	NA	
Other sec. effects 3.9	-	employ- ment	-	-	-	-	-	

IR = irrelevant

C/B = cost-benefits analysis

C/E = cost-effectiveness analysis

CDI = costs-of-illness.

Besides the studies in this table, both Oxenborg (1993) and Weinberger (1992) present cost-benefit balances of regulations, but the cost variables entered are not sufficiently specified in the published sources. National authorities in Denmark and the Netherlands have produced a standard variable list for ex post assessment of limit values for dangerous substances. These lists have been used to establish the variable list 2.1 to 3.9 used to classify the studies above.

The list of cost variables used in each study wholly depends on the subject of the evaluation, and some categories (e.g. "national infrastructure etc) will be irrelevant (IR) for some purposes. The quantification of "workplace assessment" in several study indicates that this item should be added to the SHAPE project list of variables. Experience from the field of limit values suggests that the variables 2.6 and 2.9 may be sub-divided to account for the specific procedures of classification, notification and risk information to workers, both at the company level 2.6 and for authorities receiving notifications etc. 2.9.

The two U.K. studies include measurement of secondary production-oriented benefits and, in the case of the VDU regulations, of health-related benefits. In both cases these variables are measured by subjective judgements from employers (have the regulations improved productivity, reduced sickness absence, improved worker welfare etc.). This U.K. approach seems to emphasise the production-oriented variables most. In the case of noise regulations it is surprising that there are no attempts to calculate the expected health benefits by the exposure-effect method, as this association is well established (see e.g. Arbejdstilsynet 1996, chapter 6 describing the Danish ex post analysis of noise limit regulations).

The characteristics of the results from the two UK studies are largely similar to the results found in various scientific studies of the (medium or long-term) impact of regulations on technological development (see section 3.2), from the view that "technology" studies record some economically relevant variables with a positive sign (in most cases), but abstain from monetarization of the dynamic benefits. The design of these "regulations and technology" studies have typically been longitudinal studies of innovation, and the profitability of new products was not tested.

Grønnebak & Lunde-Jensen (1987) analysed the development of paint manufacturing during a period of technological change through case studies and general industry statistics. Both positive and negative quality effects (for the consumers in general) are recorded, the price to consumers of professional painting increased, while the industry succeeded in marketing a wide range of low-risk products (paints). However, the "human resources" variable – the need to attract new apprentices to the professional painters' trade – may be the most important positive variable, but it could not be quantified separately in a context of general change in the industry.

3.4 Literature overview at the company level

3.4.1 Approach

This section reports on the company level studies. As the general goal of the SHAPE project is the development of economic models at the level of the individual enterprise, we have chosen to use the data collection procedure (rather than the level of analysis) as the dividing line between "company" and "national" level.

Subsequently, a few studies aimed at aggregation on industry level or national level may be included as "company study", if the methodology is designed to collect data from individual companies exclusively.

Though it is not necessarily stated explicitly in our references, the development of company-level economic models related to health and safety can be linked to one or more of the following propositions on the economic impact of OHS for enterprises:

- firstly, that the accounting standards and information systems applied in private and public enterprises do not give sufficient data on preventive projects and the effects of these projects;
- secondly, that the incentive to extend preventive activities would be enhanced if more enterprises were aware of "the real costs and benefits";
- thirdly, that there are considerable "hidden costs" of workplace accidents and work-related diseases;
- finally, the proposition that "safety pays" for companies or "good health is good business", to quote the title of a recent EU conference (HSE 1998).

The propositions are to some extent in contradiction with one of the basic propositions behind the national-level methodology, namely the hypothesis that companies externalise costs to society in general. It should also be considered that the three latter propositions are often advanced by OHS professionals rather than by business economists. They should be considered as hypotheses to be investigated, rather than as basic assumptions on which economic models should be built.

Though few people would disagree with the first proposition, it should be considered together with the demands for "practical models", as this proposition indicates that one cannot build a relevant model based on existing information flow in the company.

In order to approach the overall goal of developing economic models for the use of companies in EU countries, some quality assessments are attempted. The elements considered in describing the "good model" or "good study" are:

- internal consistency (i.e. can the variables included be added to each other, avoidance of double counting);
- control of confounders (i.e. whether developments "before and after" can really be attributed to the intervention analysed)
- comprehensiveness (i.e. that the model can include the health and economic consequences that are considered important);
- data availability (within the company, could national statistics supply "standard" data);
- the theoretical foundation (i.e. acceptance from the academic world);

Finally, as this project is conducted in an EU context, the question of comparability between countries must also be considered.

The selected "most illustrative" studies are compared on a large number of variables in the following tables. In order to focus on the treatment and use of variables, rather on description of each individual study, we have divided information according to the variables. The first-order correction costs (health and non-health related) plus prevention costs in are in tables 3.8, 3.9, 3.11 and 3.12, while the second-order costs/benefits are compared for intervention studies and accounting & controlling models in table 3.10 and 3.13¹.

¹ The accident costing models did not register second-order effects.

3.4.2

Country overview

Except for the Irish and Luxembourg contributions, all national reports have delivered some examples of this type of study. Finland, Germany and Sweden seem to be the countries where enterprise-level economic calculations play the most important role as judged from the number of references available.

Table 3.7 includes a rough listing of variables that are counted in the model. More detailed comparisons of estimation methods for each variable are found in tables 3.8 to 3.13.

A positive indication of prevention costs in "costs-of-accidents" studies indicates that they are added to the illness-related costs. In other types of studies (intervention and controlling studies) prevention and corrective costs (benefits from prevention) are registered separately. In some accounting studies, preventive costs are interpreted as positive indicators of health and safety.

The personnel turnover column is filled in only by a few studies from Sweden, Finland and Denmark (Arbejdstilsynet, 1996; Ministry of Social Affairs (FIN), 1997; Liukkonen, 1987, 1996; Högström & Nilsen 1990, Liukkonen & Suurmäki 1994). A common characteristic of their approach to the problem is that models have their origin in general personnel economics, rather than in epidemiology or accident research.

Second-order effects (the SHAPE variable list 3.1 to 3.9) are effects that follow indirectly from improved health (reduction of accident rate), and which to some extent are theoretical effects, in the sense that they must be calculated under some basic assumptions in order to reach a money value (output volume per xx working hours etc.). These variables may be present either in money values or by qualitative indications, for instance in studies where companies are asked whether they have experienced a positive or negative effect. In the table "y" means that second-order effects have actually been costed (or that the model includes a specific procedure for costing), while (y) indicates that other levels of presentation are used.

Table 3.7 Country overview (EU studies) - empirical studies and main variables.

Country/ reference	Data basis, coverage	preven- tion costs	sick- ab- sence	person- nel turnov- er	material damage	addi- tional effects	other costs/ benefits	con- founder control
ILO:Andreoni 1986	model	y	y	-	y	y?	y	-
EU:Gründemann 1997	review of var. industry studies	y	y	-	-	y?	(y)	y/n
AUT:Kunz 1987	Electricity accidents	-	y	-	y	-	y	-
AUT:Kunz 1990	Model, accident costs	-	y	-	y	-	y	-
DEN:rbejdstilsyn 1996	5 public sector cases + model	(y)	y	y/n	-	-	y	(IR)
DEN:Tilsted 1998	100 farm accidents	y	y	-	y	-	-	y
GER: 1998Brandenburg	health promo.large comp.	y	y	y	-	-	y	-
GER:Krüger/Meis 1991	var. manufacturing	y	(y)	-	y	-	y	IR
GER:Schneider 1984/86	20 cases, manufacturing	-	y	-	y	-	y	-
GER:Zangenmeister 1997	controlling model cost-eff.	y	y	?	-	-	y	-
GER:Zangenmeister 1998	controlling model, c/e	y	y	?	-	-	y	-
GER:Jaques 1998	Model	y	?	-	-	(y)	(y)	IR
FIN:Liukkonen/Suurmäki 1994	hospital	y	y	y	-	y	y	IR
FIN: Min. Social Affairs 1997	model, case examples	(y)	y	y	?	(y)	-	-
FIN/SWE/NOR: Söderquist et al 1989	furniture industry	-	y	?	y	-	y	-
FIN:Kuusela 1995, 98	Model, comp.example	?	-	-	-	(y)	(y)	-
IT:Ortolani 1994	Model (aggr. data)	y	?	-	y?	-	y	-
IT:Prevcost 1988	model ?	y	(y)	-	y	?	y	?
NL:Nijhuis et al 1996	1 construction firm	y	y	-	-	(y)	-	y
NL:Zwetsloot 1998	Model, controlling	?	-	-	-	-	y	-
NL:Dekker et al 1998	ergonomic programme	y	y	?	-	?	?	?
ESP:Charbonnier 1995	Accident costs 1 company	?	?	?	?	?	?	?
ESP: Gil Fisa 1991	model	?	?	?	?	?	?	?
SWE: Johansson/J. 1996	Model, examples	y	y	y	-	(y)	-	-
SWE: Parenmark 1993	engineering, comparative	-	y	y	-	(y)	y	-
SWE: Brulin/ Nilsson 1994	var. industries	y	y	?	-	y	?	-
SWE:Johansson 1998	108 cases - var. industries	y	y	y	-	y	y	(y)
SWE: Högström/ Nilsen 90	20 cases manufacturing	-	y	y	y	-	y	-
SWE. Kvarnström 1996	Company, job redesign	y	y	y	-	y	-	-
SWE: Liukkonen 1996	c/b model	y	y	y	-	y	y	IR
SWE: Sandkull et al 1987	comparative 2 companies	-	y	y	(y)	y	y	-
SWE:Liukkonen 1987	one foundry	y	y	y	(y)	y	y	-
UK:Monk et al 1983	farming	-	y	-	y	-	y	-
UK:Cortlett 1988	Conceptual, work design, ergonomics	(y)	y	(y)	IR	(y)	(y)	-
UK: Leopold/Leonard 1998	construction	-	y	-	y	-	y	-
UK:HSE 1993	5 industries	-	y	no?	y	-	y	-
Notes: "y" indicates that the variable have been quantified, or that models contain a specific estimation procedure. (y) indicates that the variable is mentioned, but neither quantified nor specified with respect to estimation procedure.								

A first impression of the list (and the national literature reports) indicates that the number of first-hand empirical studies is not much larger than the number of "pure" models, which could be explained in two ways: Either the barriers against testing the models in practice are quite substantial, or development of a nationally-based model is a precondition to gain acceptance in industry.

Secondly, this "headline" presentation of the variables present in references may give the impression that it is quite easy to establish detailed models that are useable in practice. However the selection in this table is based on the more detailed studies in each country, and is not intended to be representative.

Thirdly, only one model (Söderquist et al., 1989) has been tested in a cross-national setting. The Gründemann & van Vuuren (1997) study is a review of national studies with different economic methodologies. Various Swedish studies have, however influenced the debate and development both in Finland and Denmark.

The column confounder control indicates whether some procedures have been taken to account for external influence on the health or economic effect of variables used. Few studies (e.g. Nijhuis et al., 1996; Campion, 1991, 1993) include scientific methods like regression analysis, while other studies (Johansson, 1998; Brulin & Nilsson, 1994) use company judgement to measure the real effect (i.e. the proportion of the variance explained) of intervention. It is surprising that confounder control is not included in the theoretical models proposed (neither in the EU nor non-EU references). It could be argued that confounder control is irrelevant for "pure" controlling models (as they are built to monitor the state of the company rather than programme effects), but it may still be necessary for interpretation of year-to-year changes.

In the studies where confounder control has been conducted, programme effects have been controlled for general trends in sickness absence (Nijhus, 1996) Some of the practically oriented references have not performed formal analysis, but excluded some variables as effect variables. In Arbejdstilsynet (1996), one case study has experienced a yearly turnover of 35% (for nurses), but because similar rates were not found for other workers in the same organisation, this finding was related to the very low unemployment rate for nurses in Denmark.

3.5 Variables and costing principles applied at the company level.

This section describes the variables that are used in various kinds of company level studies. These studies are classified into three different kind of studies:

- intervention studies (ex-post and ex-ante economic evaluations of interventions to improve occupational safety and health);
- accident costing studies (what accidents and ill health cost to the company)
- accounting and controlling studies (monitoring of costs related to occupational accidents and work related ill health)

3.5.1 Intervention studies.

This section includes empirical studies of intervention programmes and theoretical models for ex post and ex ante evaluation of these programmes. Several of the references are textbooks based on consultants' experience (Liukkonen, 1996; Johanson & Jöhren, 1996; Ministry of Labour (FIN), 1997) which includes case examples to illuminate the methodology for each variable. Consequently, they cover a wide range of variables, but it is difficult to judge whether the data is accessible in an "average case".

Table 3.8 Intervention studies - main variables included in empirical studies.

Variables	Tilsted 1998	Branden- burg 1998	Liuk- konen 1987	Liukko- Suurm. 1994	Nijhus et al 1996	Parin- mark 1994	Johansson 1998	Sandkuil 1987
accidents 1.1.5	y	(y)	y	-	-	-	-	-
Specific diagnoses 1.1.5	-	y	y	-	-	y	-	-
General sickness behaviour	-	y	y	y	y	y	y	y
HEALTH RELATED EFFECTS								
Absenteeism 1.1.2 Directly measured hours	= 1.2.3	y	y	general time budget	y	y	short/long	y
Absenteeism 1.1.2 Adjusted for slack etc.	-	-	-	y	-	-	70%	-
Replacement workers (external) 1.1.2	y	?	-	-	-	-	-	y
Internal re-allocation of workers 1.1.2	y	?	surplus employ.	-	y, not costed	overtime	y	-
Personnel turnover 1.1.3	-	?	y	y	-	y	?	y
Non-medical rehabilitation 1.1.4	-	?	-	-	-	-	part of program	-
Job satisfaction, well being 1.1.6	-	-	y	y	by survey	-	-	by survey
Var. specific complaints 1.1.7	-	-	-	y	by survey	-	-	stress
NON-HEALTH CORRECTIVE COSTS								
Administration of absence etc. 1.2.1	-	?	y	part of over-head	-	-	?	-
Damaged equipment 1.2.2	insur.	?	-	-	-	-	y	-
Production downtime, services not delivered 1.2.3	y	?	-	-	-	-	-	y
Management time, investigations 1.2.4	IR	?	y	-	-	-	-	-
Variable insurance premiums 1.2.5	-	-	-	-	-	-	-	-
Liability, penalties, legal costs 1.2.6	-	-	-	-	-	-	-	-
Extra wages, danger money 1.2.7	-	-	-	-	-	-	-	-
PREVENTION COSTS								
Retrofit equipment, exhaustion etc 2.1	-	y	-	-	-	-	?	-
Investment in buildings, capital goods 2.2	-	y	y	-	-	-	?	-
Additional energy costs for exhaustion systems	-	y	-	-	-	-	?	-
Additional costs for substitute products 2.3	IR	y	-	-	-	-	?	-
Purchase of PPEs 2.4	no	y	-	(y)	-	-	?	-
Maintenance, changed work procedures 2.5	(y)	y	-	y	-	-	y	-
In-house personnel, OHS meetings, training, OHS programmes 2.6, 2.9	as lost prod. time	(y)	-	(y)	trainings tress manage	-	y	-
Mandatory OHS service (in-house or external) 2.7	IR	-	-	-	-	-	-	-
Compensations received 2.8	no	-	-	-	-	-	-	-
2.10 Other company costs	-	?	planning	-	-	-	-	-
other	-	-	loss of profit	-	-	-	-	-

< no > means part of the programme, but not counted and valued.

< IR > irrelevant to the design of the study

Table 3.8 presents a number of the most detailed empirical studies reviewed. Studies by Brandenburg (1998), Liukkonen (1987), Liukkonen/Suurmaki (1996), Nijhus (1996) and Pärenmark et al (1994) are single-company studies. Sandkull (1987) compares two companies, while Tilsted (1998) analyses the economic aspects of a case-control intervention study of approximately 100 self-employed farmers¹. Johansson (1998) evaluated a subsidy programme, covering 108 companies.

The follow-up study on job enlargement by Campion et al (1991-93) is also empirical rather than conceptual. With respect to the direct health-related variables, employee survey data is used (1.1.6 and 1.1.7) to measure elements such as job satisfaction, mental over/underload. These variables are not transformed to monetary values, but entered in a multiple regression analysis to correlate with some of the second-order costs and benefits.

When summarising experience from both empirical studies and models/review articles, it is evident that general sickness behaviour is commonly used as the basic health indicator, and that developments in the number of cases of selected diagnoses are added only in some studies. It is notable that some studies (e.g. Pärenmark et al 1994, Nijhus et al 1996), do not measure specific diagnoses even if the intervention programme has a specific goal (improvement of ergonomics, stress management). The (economic) impact of sickness absence days are treated differently from study to study. The model-used by Johansson/Johren (1996) emphasises company and job characteristics as the determining factor, arguing for different estimation principles according to the specific problem. The Finnish study (Ministry of Social Affairs.. 1997) seems to offer fewer options, but is flexible.

Turning to the empirical studies, it is less obvious whether the choice is based on the authors' preferences (theories), adapted to available data or a result of analysis of the job/industry characteristics. We find the following principles:

- average wage rate,
- same, assuming that only 70% of variance is caused by the intervention (Johansson 1998),
- average wage rate (Nijhus) but programme effects adjusted by general absence in same period,
- average wage rate plus overheads (Min. of Social Affairs... 1997);
- effects measured as both sickness absence days and reduction in overtime(internal re-allocation), though these studies (Liukkonen 1987, Pärenmark et al 1994) only list the effects, they are not added;
- sickness period valued by delays/sales losses plus internal and external replacement workers (Tilsted 1998). This apparent double counting is justified as the injured farmers have to buy workhours even to maintain the value of their crop/livestock, and delivery times may be crucial for the income of the farm.

The column "personnel turnover" is filled in by only a few studies from Sweden, Finland and Denmark ²(Ministry of Social Affairs (FIN), 1997; Liukkonen, 1987, 1996; Sandkull 1987; Liukkonen & Suurmäki, 1994). A common characteristic of

¹ This study includes both a socio-economic calculation and financial calculations for the average farm - from the perspective of the variables included it seems most relevant to include it here.

² Besides the intervention studies, this factor is included and quantified in the accident costing study by Högström/Nilsen 1990 and in some cases reviewed in Arbejdstilsynet 1996.

their approach to the problem is that models have their origin in general personnel economics, rather than in epidemiology or accident research.

To judge from the results of the studies above, the personnel costs of the enterprise due to excess turnover can easily be higher than the costs of absenteeism. In Danish municipalities, the cost of one employee forced into early retirement equals more than 50 weeks of sick absence (which is financed solely by the municipality as employer). Though these costs are caused by the specific financial arrangements in Denmark, the costs of appointing a permanent replacement worker may also be considerable according to the results.

In logical modelling, a number of additional variables can describe the organisational response to the absence period (administration, investigations etc., checklist no. 1.21. to 1.2.4). However, these variables seem to be difficult to register in empirical intervention studies (and 1.2.3, production downtime, may be off-set by internal re-allocation of workers even if the costs of re-allocation are invisible). In contrast to the accident costing approach (table 3.11), these variables do not seem to be recorded systematically. Liukkonen (1987) calculates loss of profit as an indicator of net output loss (1.2.3).

Surprisingly, only half of the intervention studies have included a precise quantification of prevention costs - the other studies have merely described the interventions. In some cases this may be justified by the character of the intervention, e.g. the Pärenmark et al study (1994) analyses fundamental reorganisation of production in a company, in which case specific OHS measures cannot be distinguished. The conceptual studies seems also to assume that the prevention cost side is self-explanatory, not calling for detailed descriptions.

In table 3.9, the conceptual references and models (with or without empirical examples) are summarised. As many of the models are "all-inclusive" in principle, variables that are described with calculation examples are indicated by "y". Variables only listed in the studies are indicated by "(y)".

Table 3.9 Intervention studies - main variables included in models and reviews.

Variables	Jacques 1998	Zangenmeister 1998	Kuusela 1995,98	Min soc (FIN) 1997	Corlett 1988	Johansson/Johren 1996
accidents 1.1.5	-	(y)	-	(y)	-	(y)
Specific diagnoses 1.1.5	(y)	(y)	-	(y)	(y)	(y)
General sickness behaviour	y	y	y	y	y	y
HEALTH RELATED EFFECTS						
Absenteeism 1.1.2 Directly measured hours	?	y	?	y	?	-
Absenteeism 1.1.2 Adjusted for slack etc.	?	-	?	overheads	?	y
Replacement workers (external) 1.1.2	?	-	y	y	?	-
Internal re-allocation of workers 1.1.2	?	-	y	y	?	y
Personnel turnover 1.1.3	?	-	?	y	y	y
Non-medical rehabilitation 1.1.4	-	-	-	-	-	?
Job satisfaction, well being 1.1.6		(y)	-	-	?	?
Var. specific complaints 1.1.7		(y)	-	-	-	?
NON-HEALTH CORRECTIVE COSTS						
Administration of absence etc. 1.2.1	?	-	?	part of overheads	-	overhead in 1.1.2
Damaged equipment 1.2.2	?	-	?	(y)	-	-
Production downtime, services 1.2.3	?		?	(y)	(y)	y
Management time, investigations etc. 1.2.4	?		?	y	-	?
Variable insurance premiums 1.2.5			?		-	-
Liability, penalties, legal costs 1.2.6			?		-	-
Extra wages, danger money 1.2.7			-		-	-
PREVENTION COSTS	(y) not specified	(y) not specified	(y) not specified	not specified	(y)	not specified
Retrofit equipment, exhaustion etc 2.1						
Investment in buildings, capital goods 2.2						
Additional energy costs for exhaustion systems						
Additional costs for substitute products 2.3						
Purchase of PPEs 2.4						
Maintenance, changed work procedures 2.5						
In-house personnel, OHS meetings, training, OHS programmes 2.6, 2.9						
Mandatory OHS service (in-house or external) 2.7						
Compensations received 2.8						
2.10 Other company costs						

References to variables are mentioned in the text for table 3.8.

Johansson/Johren 1996 and the Ministry of Social Affairs in Finland (1997) are practical “do-it-yourself” models based on a number of case studies. Consequently, most important variables are quantified, and the methods are quite specific. On the other hand, they do not give precise indications of the data available in one individual company, as data for each “typical” calculation are taken from different cases.

Three references are mainly conceptual (Jacques 1998, Zangemeister 1998, Corlett 1988) and the level of analysis is rather general. The same applies to the English reference by Kuusela (1998). They focus on second-order effects at the aggregate

level of the company, rather than at the level of individual production processes. The line from the shopfloor level, where intervention is implemented, to the aggregate level is not specified clearly in the available texts. Jacques (1998) and Zangemeister (1998) are decision support models, developed by consultants with the purpose of clarifying targets and effects, rather than precise measurements. The available presentations focus on general analyses of the company.

Table 3.10 describes the methodology with respect to the variables classified as “second-order effects”. These variables consist of general production variables which would be used to evaluate the impact of any major change in production technology, work organisation etc. It must also be stressed that these variables are relative measures, i.e. they can only be quantified as the change between two measurement points.

The term “second-order” is therefore only descriptive in the sense that we have to assume, for the analytic purposes of the SHAPE project, that the primary goal of interventions is the improvement of health and safety, and that any production output goals are secondary to health and safety goals. Specific company projects may of course set other priorities, but if, for example, productivity increases are the primary purpose of a project, then it is problematic to define production-oriented variables as “effect variables” in relation to health and safety improvements.

“Production downtime, services undelivered” (checklist variable no. 1.2.3, analysed in tables 3.8 and 3.9) are also directly related to production, but these are “first-order” impacts in the sense that they can be directly related to the incident or absence spell of the victim. The relative productivity impact is measured independently of individual absence spells.

Table 3.10 Intervention studies (empirical and models) – additional benefits or costs.

Variables	Jacques 1998	Liukkonen 1987	Kuusela 1995/98	Johanson 1998	Kvarnstr. 1996	Sandkull 1987	Corlett 1988	Campion 1991, 93
Accidents	(y)	y	?	-	-	-	-	-
Specific disease diagnoses	(y)	y	?	-	y	y	y	-
General sickness behaviour	(y)	y	y	y	y	y	y	-
Is sickness absence costs included ? 1.1.2	y	y	y	y	y	y	(y)	-
adjustment procedure ?	-	no	-	-	-	not added	-	-
Productivity 3.1	(y)	y	(y)	total output per worker	-	-	(y)	job efficiency
Quality of products and services 3.2	(y)	y	(y)	-	-	y	(y)	self-evaluated service
Innovation capacity of the enterprise 3.3	-	-	-	-	-	-	-	-
Competitiveness, market shares 3.4	-	-	-	-	-	-	(y)	-
Operational effects (materials ,energy) 3.5	(y)	handtools costs	(y)	-	-	-	-	-
Company image 3.6	-	-	-	-	-	-	-	-
Non-economic company values 3.7	-	-	-	-	-	-	-	-
OTHERS/ SPECIFICATIONS: (3.8)								
flexibility	(y)	-	-	-	judgement	-	(y)	-
throughput time, delays, volumes in store	(y)	-	(y)	-	no. of days	time, value of storage	(y)	-
repair and maintenance needs	-	-	(y)	-	-	-	-	-
complaints, scrapping of products (3.2)	-	% of output	-	% of output	-	wage costs	-	y
personnel competence	-	-	-	-	-	-	-	y

As in former tables, only descriptive text or a “y” denotes actual quantification (or specific estimation methods).

The conceptual references (Jacques 1998, Corlett 1988 and Zangemeister 1998) and the reference to Kuusela’s study in the 1998 paper are all rather vague with respect to specification of variables, and it is therefore not possible to evaluate their applicability in practice. From the reference available, the purpose of the model in Jacques (1998) seems to be to structure the process of setting priorities, and quantification relies mostly on judgements by the companies.

Two review references from table 3.9, Ministry of Social Affairs (1997) and Johanson & Johren (1996), include secondary benefit variables based on references in table 3.10 (Kuusela (1995) and the cases used in Johanson (1998) respectively). The empirical one-company-only studies have quantified fewer variables, even though some studies (Liukkonen 1987, Sandkull et al 1987) conduct a broad background analysis of the companies. These studies have all been conducted in manufacturing industries, where it is generally assumed that productivity is easier to define. Campion & McClelland’s (1991,1993) follow-up study was conducted with financial service companies, and the variables are quantified by aggregation of

“yes/no” responses by respondents, but not transformed into monetary values. The quality variables measured were “catching errors”, “customer service” and the productivity variable measured by “job efficiency”.

It is a general data problem that production-related variables (apart from complaints/scrapping of products) are measured at the level of the company, while the intervention is focused on a specific work procedure or production process. The aggregate perspective and analyses proposed in Cortlett 1988, Kuusela 1998 and Jacques 1998 seem to be very difficult to support with empirical data, due to imbalance between the specific work process/workplace perspective of the intervention (prevention costs) on one side, and the available aggregate data describing output values, input of labour etc. on the other.

The problem of data levels also appears when study models include, on one side, first-order effects quantified directly from absence spells (1.1.2), including downtime (1.2.3) derived from absence spells and measured on the shop floor; and on the other side, second-order effects measured between two points in time at the level of the company.

As the (reduced) sickness absence influences the total worktime available in the company (i.e. the denominator in the calculation of work productivity), and the downtime may influence the yearly output of the company (numerator), some adjustments need to be made before these figures are added. The time basis for work productivity estimates should be the net working time (absence deducted), and the precise, narrow effects of downtime due to accidents etc. should not be included, if the total output per time unit is also used as an effect variable.

The method described by Liukkonen (1994,1996) and Johanson/Johren (1996) has a general time budget analysis as a part of the foundation, which meet the demands above. The Sandkull et al (1987) model includes both sickness absence, downtime and work productivity figures, but they are not aggregated to a formalised cost-benefit balance for a project, though they are very close to concluding within that framework.

Among the second-order variables, quality variables as scrapping of products and complaints plus operational effects (throughput time, volumes in store) seems to be the easiest to quantify. The studies by Sandkull and Johansson/Johren offer procedures to put monetary values on these variables.

Work productivity has been quantified and valued in some studies in the manufacturing industry, but the available models cannot claim to be applicable in general. The single study quantifying productivity effects in a service industry doesn't propose a method for valuation.

The checklist could possibly be reduced to the three variables of productivity (3.1), quality (3.2) and operational effects (3.5). Some of the specifications found in the references must be considered for specification of the three “headline” variables.

3.5.2 Accident costing studies.

In the accident costing approach, an accident (incident) is considered as the start of a chain of activities that leads to costs for companies. By tracking and recording the chain of activities triggered by the accident, it is considered possible to record the consequences of each accident. The purpose of this investigation is to clarify costs that are hidden from companies, in the hope that more information will lead companies to acknowledge their economic interest in more prevention.

Table 3.11 indicates that the SHAPE checklist is quite comprehensive for description of the variables in these studies, but it should be stressed that the actual lists applied for data collection are more differentiated in most studies. Data collection instruments are influenced by specific national features in accounting practices, by the components included in the wage system or social security rules. Finally, it is generally assumed that the variables should be added.

Table 3.11 Selected accident costing studies - main variables included.

Variables	Andreoni 1986	Kunz 1987	Schneider 1984 /1986	Charbonnier 1995	Söderquist 1989	Högström 1987	Leopold /Leonard 1987	HSE 1993
injury accidents 1.1.5	y	y	y	y	y	y	y	y
non-injury accidents	-	-	-	-	-	-	-	y
RESULT LEVEL	company model	average cases	average cases		average, industry	average cases	industry	individ. cases
HEALTH RELATED EFFECTS								
Absenteeism 1.1.2	part of spell	-	net		y	nil**	y, sick pay	-
Directly measured hours								
Absenteeism 1.1.2 Adjusted for slack etc.	-	80% of wages	over-heads		alternative calculation	-	-	100+ %
Replacement workers (external) 1.1.2	-	-	y		y (-0)	(0)	-	y ?
Internal re-allocation of workers 1.1.2	y	rescue only	y		y	y	y	y
Personnel turnover 1.1.3	-	-	-		-	y	-	-
Non-medical rehabilitation 1.1.4	y	-	y		(y)	(y)	-	-
NON-HEALTH CORRECTIVE COSTS								
Administration of absence etc. 1.2.1	y	y	y		y	-	y	y
Damaged equipment 1.2.2	y	gross	gross		y	gross	net	y
Production downtime, services undelivered 1.2.3	y	y	y		lost revenues	y	y	oppor- tunity c
Management time, investiga- tions etc. 1.2.4	y	-	y		y	investiga- tion	y	oppor- tunity c
Variable insurance premiums 1.2.5	var. + gross	-	var + gross		(y)	-	y	total prem.?
Liability, penalties, legal costs 1.2.6	y	y	0		(y)	(n)	y	-
Extra wages, danger money 1.2.7	-	-	-		-	-	-	-
Transport of victim 1.2.8	yes	y	y		y	y	y	y
Other costs 1.2.8	first aid	-	first aid		y	-	-	*
PREVENTION COSTS	YES	NO	YES		NO	NO	NO	NO
Retrofit equipment , exhaustion etc 2.1	y		-					
Investment in buildings, capital goods 2.2	y		in over- heads					
Additional costs for substitute products 2.3	y		-					
Purchase of PPEs 2.4	y		y					
Maintenance, changed work procedures 2.5	?		IR					
In-house personnel, OHS meet- ings, training, OHS programmes 2.6, 2.9	y		in over- heads					
Mandatory OHS service (in- house or external) 2.7	y		y					
Compensations received 2.8	-		-					
2.10 Other company costs	(y)		y					
* HSE1993: tracks costs by same components to other departments								
** Högström 1990 : wages saved.								

It is a general assumption in these studies that payment to the victim in the accident (full wages or the parts of sick benefits financed by the company) should be considered a cost to the company. Kunz 1987 and Söderquist et al. (1989)¹ add an assumption of "slack" in the company, assuming that a part of the worktime lost is regained by other workers. Schneider (1984, 1986) adds considerable overheads consisting of "workplace costs" and "wage-related costs" by a procedure where parts of investments in buildings, OHS services, personnel departments and the like are distributed to each "average" work hour. The HSE seems to add a few indirect wage components, though the actual calculation is obscured by asking the company to report "costs" directly, rather than "time lost".

All models include and add work hours by replacement workers. In most cases, re-allocation and overtime payment by fellow workers is recorded. Söderquist et al 1989 records very few extra hours, but estimates the costs by the opportunity costs of having the excess workforce that allows the victims who suffered accidents to recuperated without measurable extra hours. A specific feature of the "farming" studies not entered in the table (Monk et al., 1983; Tilsted, 1997) is that replacement worker costs are very high, as the farm is highly dependent on each individual worker or self-employed person. Though no studies are found in similar, very small companies, this specific conclusion is likely to be equally relevant to other small companies.

Only one study, Högström & Nilsen (1987), has recorded cases where the accident victim was forced to leave the company, leading to personnel turnover costs. Most studies seem to assume that all victims return to the workplace.

Damaged equipment, semi-finished goods and materials are included in all models. Only one study (Leonard & Leopold, 1987) seems to define "net materials costs" precisely - other references are not precise with respect to determining the residue value of damaged fixed assets. In the HSE (1993), it seems to be the case that companies judge whether to use gross or net costs of damaged capital goods.

The order of magnitude of these costs vary widely, with the HSE (1993) study in the high end, estimating the value of damaged equipment at 50-70% of the total bill to companies. This is largely caused by including, as the only study found, non-injury accidents in the definition. This methodological choice is legitimised by a general assumption, found in accident research literature, that both injury and non-injury incidents have a common root in insufficient control over production. The study is not designed with the possibilities to test or even to illuminate this hypothesis, and the subsequent results are problematic even as basis for further research.

Production downtime or services not performed are recorded and valued in all empirical studies except for Söderquist et al. (1989). This component is directly added to sickness absence and calculated replacement costs in all studies, though the workhours lost or re-allocated is probably the main explanation why output is lost or delayed.

The relevance of variable parts of insurance premiums depends on national features, but the addition of total insurance premium per worker in the models of Andreoni (1986) and Schneider (1984) contribute to a total figure which does not relate to the potential benefits from prevention in the individual company - only variable parts of the premium are relevant.

¹ This applies to other publications from the same project, e.g. Aaltonen et al (1988) and Klen (1989).

Four EU references (Andreoni, 1986; Schneider, 1984/86; Ortolani, 1994; and PREVCOST, 1988) include prevention costs in their "total costs of accidents". This principle is found also in some non-EU studies. Both in the direct form recommended by Andreoni and in the transformation of prevention costs to an overhead component of the hour wage makes the figures useless for estimates of the potential benefits from prevention, which must be the ultimate goal of accident cost estimates.

Accident costing studies have not until now included subjective "climate & complaints measures" (checklist items 1.1.5 to 1.1.7). As these studies count incidents before intervention, the secondary variables, which must be measured by the change during a period, are not relevant.

Because of the data strategy applied in accident costing studies, the variables classified as "additional cost and benefits" are not found. All indirect effects on production (output, revenue, quality etc) can be related to the accident/incident through the downtime/delays variable (1.2.3). A high accident rate in a company can of course influence the workers' behaviour in a more general sense, but the methods that are used in intervention studies to catch these secondary effects cannot establish the necessary link to individual accidents, and they cannot be included in the accident cost model.

3.5.3 Accounting and controlling studies.

The accounting and controlling models are developed for information purposes, rather than with the goal of making calculations. They are developed under the assumption that the impact of individual, preventive activities cannot be measured - therefore one should monitor the overall effect of a number of activities at an aggregate level, by periodic registration of a number of key variables. This registration is parallel to the traditional economic accounting in companies, and similar to what has been termed "satellite accounts" for the external environment.

Data that can be established at a specific point in time does not modify the basic list of available variables, as can be seen from table 3.12. So even if the purpose of these studies are not calculations, the methodology could still be used as the background for a cost-benefit oriented model. However, the marginal cost perspective needed to evaluate interventions or costs of accidents are not necessary to monitor the state of OHS in a company - in many cases, the fixed costs may be more descriptive of an established OHS system than project-related marginal costs. Some of the fixed costs may be easier to register (e.g. the total costs of occupational health service, total time used for OHS meetings during a year), compared to the marginal costs related to a preventive programme. This may be especially true for some of the general personnel costs (sickness absence, personnel turnover). With respect to the prevention cost variables 2.2, 2.3, 2.5, the problem of distinguishing the OHS part of investment poses practical problems similar to the problem found in intervention/accident cost studies.

Table 3.12 Accounting and controlling models - main variables included.

Variables	Arbejds- tilsynet 1996	Zwets-loot 1998	Liukkonen 1996	Liukkonen/Su- urmäki 1994	Kruger/ Meis 1993
accidents 1.1.5	-	-	y	-	y
Specific diagnoses 1.1.5	-	-	y	-	-
General sickness behaviour	y	y	y	y	-
HEALTH RELATED EFFECTS					
Absenteeism 1.1.2	y	?	time budget analysis	general time budget	*
Directly measured hours					
Absenteeism 1.1.2 Adjusted for slack etc.	y	-	overheads added	y	-
Replacement workers (external) 1.1.2	y	-	-	-	(y)
Internal re-allocation of workers 1.1.2	y	-	-	-	(y)
Personnel turnover 1.1.3	y	y	y	y	-
Non-medical rehabilitation 1.1.4	-	-	(y)	-	
Job satisfaction, well being 1.1.6	y	y	(y)	y	-
Var. specific complaints 1.1.7	y		(y)	y	-
NON-HEALTH CORRECTIVE COSTS			-	-	
Administration of absence etc. 1.2.1	y	y	in over-head	in OH	-
Damaged equipment 1.2.2	(Y)	?	-	-	y
Production downtime, services not delivered 1.2.3	-	?	?	-	(y)
Management time, investigations etc. 1.2.4	-	-	time budget ?	-	first aid material
Variable insurance premiums 1.2.5	-	-	-	-	
Liability, penalties, legal costs 1.2.6	-	-	-	-	voluntary comp. to victims
Extra wages, danger money 1.2.7	IR	-	-	-	
PREVENTION COSTS		not specif.	not specified	total budget for unit	
Retrofit equipment , exhaustion etc 2.1	y	-	-	-	y
Investment in buildings, capital goods 2.2	y	-	-	-	y
Additional energy costs for exhaustion systems	-	-	-	-	y
Additional costs for substitute products 2.3	y	-	-	-	y
Purchase of PPEs 2.4	-	-	(y)	-	y
Maintenance, changed work procedures 2.5	y	-	-	-	-
In-house personnel, OHS meetings, training, OHS programmes 2.6, 2.9	y	y	y	training	y
Mandatory OHS service (in-house or external) 2.7	-		(y)	-	y
Compensations received 2.8	IR	-	-	-	?
ADDITIONAL COSTS AND BENEFITS	NO				NO
Adjustment procedures (sickness absence etc)			y	y	IR
Productivity 3.1	-		work , capital produc.	-	-
Quality 3.2	-		customer satisfaction	client satisfaction	-
Others	-			bench-marking w. similar org.	

While the broad perspective on OHS and the focus on the aggregate level of the company is common to all the studies mentioned in the table, they differ with respect to other factors.

The model developed by Liukkonen (1996, Liukkonen/Suurmäki 1994), the less formal model proposed by Arbejdstilsynet (1996) and the model by Zwetsloot/Evers (1998) are meant to monitor organisations over time. These three models have their foundation in general personnel management and personnel economics.

It should be stressed that for monitoring purposes, “prevention costs” can be interpreted as a positive sign that companies take care of their employees. In addition to the reference Arbejdstilsynet (1996), a few large private companies and (in Denmark) public organisations have introduced similar variables as part of their regular reporting, often as a part of yearly environmental reports (Davies et al 1995). A typical example is to publish overall sickness absence, personnel turnover, work accidents and 1-2 selected occupational diseases.

Monitoring is also the objective in the Krüger & Meis (1993) model, but their purpose is to minimise costs relative to the total effective worktime (defined as worktime not disturbed by occurring accidents). This cost-effectiveness perspective diverges the attention to the prevention cost variables, which are treated in detail in their model.

The Zwetsloot & Evers (1998) model is influenced by the emerging field of “management standards” (quality, environment etc), and though the variables entered into this model are similar to those of the other models, the perspective is not “costs versus benefits” - the main distinction within the model is “enabling” variables and “result” variables. Some of the “enabling” variables are defined as costs in a money-oriented model, while others are defined as effect variables. The variable “job satisfaction” is divided into both “enabler” and “result” areas in the model. This study is therefore less precisely described in our comparison model. The list of variables is extensive, and non-economic variables (job satisfaction, specific complaints) are relatively more important in these models than in the intervention and accident costing studies reviewed. Quantification of prevention cost variables depends on the activities occurring within the “accounting year” chosen, but the checklist variables seems to be relevant.

3.6 Analysis of comparability, recommendations

3.6.1 Recommended variables and methods at national level

The conclusions concerning the methods for economic analysis at the national level are based on three types of studies.

Cost-of-illness studies, i.e. studies where the costs of work accidents and/or work-related sickness occurrence are added to reach the “total costs to society” at a given point in time (tables 3.1, 3.4). The studies reviewed are mainly socio-economic estimates. The available references to (financial) estimates of insurance costs are not sufficiently precise to indicate whether they are

Ex post evaluations of regulations, i.e. studies that estimate the economic impact of OSH regulations some years after implementation, as compared to the situation before implementation (table 3.2). Most references are made by consultants on behalf of national authorities.

A few other assorted studies measuring economically relevant variables.

Economic appraisal of OSH regulations before promulgation (ex ante) have *not* been systematically reviewed in this study. Based on the reviews published (Hansen 1993, Davies et al 1995) and the authors' own experience, these studies are not expected to broaden the range of relevant variables.

Health-related, corrective cost variables

Table 3.14 lists the variables commonly used to measure the health-related effects in national-level studies. Most cost-of-illness studies reviewed include all of these variables, while impact assessments of specific regulations (before or after implementation) only include one or two of these variables in most cases.

Table 3.14 List of variables, commonly used in national economic assessments at the national level

1.1.1	hospitalisation
1.1.2	out-patient treatment (though some treatments may not be covered)
1.1.2	rescue and emergency costs (accidents)
1.1.4	sickness absence
1.1.5	permanent disability
1.1.6	deaths (for relevant diagnoses)
1.2.2	damaged equipment (for accidents leading to injury)

These variables are relevant both for a cost-of-illness calculation at a specific point in time and for "benefit" quantification in ex post evaluations or ex-ante impact assessments. As a checklist, they are also applicable both to estimates of socio-economic costs and to financial cost estimates for insurance systems or the public sector.

National-level estimates are often difficult to interpret for the public. In order to increase transparency, it is recommended to perform as much of the estimation as possible in "non-economic" terms (i.e. number of hospital beddays, volume of days/years lost in production etc.), and to publish both the economic costs and the volumes of sickness occurrence. This broadens the range of possible uses of the data sets, allowing the same data sets to be used both for financial and socio-economic analyses. It is also the precondition for comparison and quality control by outsiders. If, conversely, only the compensation costs "per average sickness case" are published, it is impossible to see how the costs are influenced by the actual level of workplace exposure, administrative definitions and demarcations or the compensation level.

The variables 1.1.5 (permanent disability) and 1.1.6 (deaths) involve consequences for a number of future years (relative to the base year). In order to assign costs to these years, a comparison with an alternative course of events is needed.

The main components are:

the risk of premature death, (life expectancy of the age group in question);
the assumed length of working life in absence of the accident or disease, which is often approximated by the age at which persons enter into "age pension" schemes;
the degree of invalidity due to the incident.

These procedures are described as "adjustments" in table 3.4. There is little consensus among the empirical studies with respect to the treatment of the background parameters. Large parts of the methodology seem to be determined by the data available in national health, social and labour market statistics.

Finally, the economic tradition calls for discounting of future income or costs. However, this procedure is not really supported by specific arguments that take into account that monetary values are meant to be an indicator of health problems in the future. The arguments for discounting are stronger when the figures are used afterwards for practical cost-benefit analysis. It therefore is recommended to calculate figures both with and without discounting.

Non-health related corrective costs

This part of the checklist includes the consequences that are not directly linked to the health of the victim, e.g. administrative procedures and material damage. Only the variable “material damages” (insured or paid directly by the company) can unambiguously be defined as a “corrective cost” or a consequence of workplace incidents. The relative weight of this variable varies from less than 5% in Koningsveld & Mossink (1997) and Söderquist & Aaltonen (1989) to 20 to 40% in the HSE (1994) report. This variance discloses a serious problem in relation to finding an appropriate data base necessary to aggregate from case studies to the national level.

If national or company-level administration of illness, management time etc. (1.2.1, 1.2.3, 1.2.4) are to be added to cost-of-illness estimates or included in benefits (savings) due to intervention, the methodology must ensure that only the *variable* costs are counted reduced as a part of the “costs of illness”, i.e. counting only the part of the activity that disappears when the volume of work-related illness is reduced.

The fixed administration costs or costs of occupational health services belongs to the prevention cost component. A few studies have added such costs to the “total costs of illness”. This obscures the basic distinction between prevention costs and benefits from prevention, and reduces the user value of the figures for cost-benefit assessments, as they do no longer indicate costs that can be eliminated by prevention.

Prevention costs

While the prevention costs related to a specific OHS problem, an intervention or a specific regulation may be defined with reasonable precision, no global definition could make the distinction between OHS investments and other investments¹.

Consequently the total, annual investment or the current expenditure on workplace OHS prevention is unknown. At the national level, data may be available on the costs of a specific preventive institution (e.g. the occupational health services), or costs have been calculated for a specific intervention (regulation).

Tables 3.2 and 3.6 describe the variables applied in the evaluation studies reviewed, but the relevance of each of the cost variables 2.1 to 2.9 in the checklist cannot be determined in general, it depends on the design and purpose of the study as well as the character of the OHS problem which is the subject of an economic analysis.

Two specific items have appeared in several of the studies reviewed, namely: in-house time used for workplace assessments; specific “paper” procedures, e.g. notifications to authorities etc.

Though variable 2.6 “in-house preventive services, administration etc.” is intended to cover these activities, it could be useful to add the specific variables to the checklist.

The specific problems of ex-ante and ex-post assessments of regulations are treated in detail in HSE/DWES 1995. However, one problem must be emphasised, namely that of defining the baseline against which the regulations should be assessed. The marginal costs for business or society due to a change in regulations differ considerably from the necessary cost to reach compliance for the average company,

¹ Similar problems are found in attempts to measure the total environmental investments/expenditure, which usually cover “end-of-pipe” technology only.

not because the subsequent preventive activities differ, but because the baselines differ. It is a general experience that companies do not distinguish between "additional costs from our own current level" and "additional costs compared to the current obligations" when responding to industry surveys. This must be built into the survey methodology, through a detailed legal and technical analysis of the problem.

Additional costs and benefits

This part of the checklist covers various effects of an intervention on production. They are labelled "additional", as the direct goal of an OSH intervention is to influence health and safety, and these first-order prevention costs are registered elsewhere. As they are effects of interventions, they are relative measures, which can only be registered as a change compared to the ex ante situation, and found only in evaluation studies. The additional effects may be both positive and negative: for example, new, safer procedures may take time that decrease work productivity, but in the longer term reduce errors and customer complaints.

The hypothesis that improved workplace safety, health and welfare will lead to improvements in the competitiveness of the industry is often proposed in conference keynotes, but only few studies testing this hypothesis quantitatively have been found.

In the two ex post evaluation studies where these variables are measured, the scale used is a simple yes/no scale (for example: number of companies experiencing increased productivity versus no such effect indicated), and these judgments by informers (companies) are not transformed into a monetary value.

The characteristics of the evidence in these two UK studies is largely similar to the results of the scientific studies of the (medium or long-term) impact of regulations on technological development (see section 3.3), from the view that "technology" studies record some economically relevant variables with a positive sign, but abstain from monetarization of the benefits.

In conclusion, the second-order effects are highly relevant as a checklist for design of ex post evaluations, longitudinal analysis of industry and technology development or job development studies at the national or industry level. This part of the checklist should not be included in the monetary evaluation, but constitute an addition using some kind of scaling.

It is less certain that the list is useful for ex ante impact assessments of regulations. HSE & DWES (1995) reproduce a methodology for regulatory impact assessment from OSHA (US), which includes a range of second-order analyses. No evidence on the practical use of this part of the model have been found during the project. In a prospective analysis, second-order prevention costs or costs passed to consumers associated with very expensive regulatory proposals seems to be manageable.

International comparison and EU-wide cost assessments

Though a strict comparison of the quantitative results have not been performed as a part of our analysis, it is quite evident that all the cost-of-illness studies - which relate to the *benefits* from prevention - show some national bias which originates from the basic quantification of work-related sickness occurrence. The data used - both in socio-economic and financial cost estimates - reflects a national perception of work injuries and work-related disease, and the importance assigned to these phenomena.

In a strict sense, estimates of the costs of work-related sickness can only be added cross-nationally if the work-related sickness occurrence is quantified by the same method. In the short or medium term, such data cannot be produced for all EU countries, nor for all major relevant diagnoses. It is necessary to rely on national data. What can be done, however, is to increase the transparency of the data used for cross-national comparison and analysis. This calls for the establishment of a reporting format which highlights both the economic parameters applied, ensures reporting of basic volumes of work-related sickness occurrence and establishes some comparison points where work-related sickness occurrence is compared to basic national statistics (e.g. work-related sickness related to total sickness in a country, absence days per work active person etc.).

With respect to the prevention cost side, the scope for judgement is much narrower, and there are no inherent problems in adding data across country. However, both ex ante and ex post impact assessments are crucially dependent on the baseline applied, i.e. the measurements or assumptions made to describe the situation before implementation of a preventive programme (implementation of a Directive etc.).

The primary data supplier - either at the company level or a national rapporteur in an EU-wide study, obscures the baseline used if only aggregate prevention costs are reported. As with the benefit side, comparability can only be ensured by a parallel analysis of economic data and the basic quantities.

3.5.2 Recommendable variables and methods at the company level.

The conclusions concerning the economic models for company level are based on three basic types of studies:

Intervention studies, (section 3.5.1) which analyse the effects of health and safety prevention activities as compared to the situation before intervention. The studies reviewed describe both workplace prevention and health promotion programmes with both workplace and individually oriented interventions.

Accident costing studies, (section 3.5.2) which estimate the costs at a point in time, adding the costs occurring after (as a consequence of) registered work accidents.

Accounting and controlling models (section 3.5.3), which cover models designed primarily to monitor the state of OSH in the company at points in time. These models are used for supplementary accounting (as seen from the primary economic accounts of the company), and are comparable to the so-called "satellite accounts" for the external environment.

However, when the available references are analysed, the number of papers introducing "methods" rather than reporting empirical results is relatively high, while the number of convincing empirical studies is low. Our reservations are based on the fact that relevant background parameters are too often neither reported nor discussed - let alone controlled for.

The international perspective is almost absent, and only one study is truly cross-national in its design and methodology. The literature survey does not provide much information on the problems involved in building a general model which can also be adjusted to the specific conditions in each of the EU countries.

Health and safety problems covered

Most of the intervention studies use the volume of general sickness occurrence as the main health variable. Only some of them include additional measurement of the incidence of specific, work-related diagnoses. This trend is even more marked if the

experience from single-company programmes are included. The same pattern is apparent in the controlling models reviewed.

The accident costing studies focus on accidents only. All injury accidents, including accidents leading to absence for less than three/one days, are included in the data base. One study also includes non-injury accidents. While this may be justified by the specific hazards in some industries or by the prevention strategy chosen in a project, the "cost-per-accident" estimate published should distinguish clearly between the two types of accidents.

Health and safety effect variables

The volume of sickness absence (1.1.2) in the company is the core data set in all studies - in fact, many studies use general sickness absence as the only variable to describe health effects of interventions. The transformation of absence spells to costs is far more ambiguous.

When references not entered in tables 3.8 to 3.12 are considered, the most common method is also the simplest: assuming that the value of one work hour lost is the average hour wage for the worker or the company's sick payment contribution per worker.

The theoretical considerations in chapter 2 question this approach, and the more sophisticated models reviewed (tables 3.8, 3.9. and 3.12) reflect this by various strategies, which do not point to any consensus on methods. Some studies argue that the costs of work-related sickness absence are higher than the wage level, as various overheads are added to the flat wage rate. Some references reduce the rate due to slack in the organisation, i.e. assuming that workers can be taken off other tasks to perform the job of the victim. A few studies assign opportunity costs on re-assigned workers (i.e. the value of the tasks they have left in order to replace the victim). Some studies count only direct financial outlays for replacement workers employed.

A conclusion which is supported by two of the model/review references, is that the exact estimation procedures depend on company characteristics (e.g. Johansson 1996, Arbejdstilsynet 1996). However, this is not very helpful for the construction of a general model, and it is not evident from all empirical studies that the particular choices are made due to characteristics of the study data.

If the requirement to make simple models for the companies prevails, then a cost principle using the wage level as a proxy for both opportunity costs of replacing workers and for marginal production per day could be defended theoretically, though it may seem artificial in actual companies. An important problem is the sick payment arrangements - if companies are compensated by public or sick insurance funds to a large degree, the net effect of one person sick may even be positive in extreme situations.

If the requirement of precision and flexibility for companies with different characteristics prevail, then a calculation model is much more complicated. Firstly, the net effect of financial transfers must be entered (sick payments, wages saved, refunds from public or insurance funds). These elements are determined at the national level, but may also vary due to the length of absence and the work contract of the victim. Secondly, the choice of strategies to compensate for the absence of the worker must be determined from the actual situation of the company. The response to absence must be quantitatively distributed for the variables: internal and external replacement workers, and reduction of customer service (delays, services not delivered), and costs must be assigned to all the variables. Finally, the

interrelations of these variables must be modelled, allowing for company characteristics to determine the outcome. It is evident that it is misleading to add both positive costs of the injured worker and the costs to replace him/her, as only one of the two costs can be saved when he/she returns to work.

Cost of personnel turnover (1.1.3) is almost exclusively considered in Nordic studies. Though companies may not contribute to the subsistence of persons in early retirement, excess personnel turnover may lead to significant costs in the company for training and introduction of new employees. The technical estimation of this variable is expected to be manageable, and it is recommended to include it in a EU model.

Identification of general well being or specific health complaints (1.1.6, 1.1.7) is included frequently in controlling models, and these variables are also used as effect indicators of intervention studies. No attempt of monetarizing these variables has been identified.

Non-health correction costs

These variables are used to describe responses by the company to individual incidents that are not directly related to the health or injury of the victim.

The identification of variables like investigation time, management time, transport of victims to hospital etc. is rather detailed in accident costing studies. Most accident costing studies seems to be precise with respect to identifying the marginal costs of an accident, though problematic examples using average per worker costs (e.g. of OHS services, insurance fees) as a contribution to "accident costs" are also found.

The variables "variable insurance premiums" (1.2.5) and liability, penalties (1.2.6) are only relevant for accidents, and they seem to be of limited importance.

When the perspective of studies and models are broadened to *all* work-related health problems in intervention, accounting and controlling models, these variables are much more difficult to identify, and they are only sporadically included.

Prevention costs

Judged by the purpose of the various types of models, prevention costs should be identified in all intervention studies and in controlling/accounting models, but not in the accident costing studies, as the latter category should focus on marginal costs due to the accident. It is surprising that a significant proportion of the intervention studies treat the prevention costs rather superficially, both in descriptive terms and with respect to quantification. The explanation may be that marginal prevention activities are difficult to distinguish from general decisions, investments or work procedures.

Accounting and controlling studies may treat the prevention costs differently, as it is not less necessary for the establishment of accounts to define the marginal cost of specific activities precisely.

Some accident costing studies define "the costs of accidents in a company" as corrective costs (the consequences of accidents) plus total prevention costs. This is misleading - when the results are used for prioritizing preventive actions, these items are at opposite sides of the equation.

The relevance of each of the variables classified in our checklist depends on the specific problem addressed. The review did not reveal any additional proposals. The national-level review indicated that workplace assessments and paper

procedures are relatively important and should be highlighted in a practical checklist, which is recommended for company-level models as well.

Additional benefits and costs

The variables classified as "additional" are not specific for analysis of occupational health and safety - they consist of general production variables which would be used to evaluate the impact of any major change in production technology, work organisation etc.

The additional variables are relative measures, i.e. they can only be quantified as the change between two measurement points. They are therefore relevant only to intervention studies and in continuous accounting studies.

Though the effects of changes may be both positive and negative for some variables, no reference to productivity losses and quality deterioration, caused by OHS interventions have been recorded in our basic material, and the conceptual models seems to also take the positive sign ahead of the variable for granted. In a superficial evaluation, these variables are mentioned in more than half of the studies reviewed (table 3.7). A closer inspection reveal that variables like worker productivity, product quality and product quality are mentioned frequently in conceptual references and models, while there are few specific estimation procedures proposed. When it comes to empirical studies, work productivity (3.1) the number of complaints/scrapped products (quality, 3.2) and throughput time are the only variables quantified in terms that could be transformed into "costs".

While the first-order health-related costs and preventive costs are identified in conjunction with some well-defined events (e.g. a sickness absence period), the second-order effects are measured as a development in time at a more aggregate level in the company. There is therefore a risk of double counting, e.g. if the "productivity" is measured as yearly output per worker instead of per effective work hour. In the former case, a decrease in sickness absence increases the average worktime per worker, and presumably the output. If the saving from sickness absence is included in our model, the value of an increase in the per worker productivity cannot be added to this figure without an adjustment for the volume of work hours. Neither the conceptual models nor the empirical studies have reported adjustment procedures to account for these problems.

Confounder control

The possibility that the measured effects are caused or influenced by confounders is mentioned only in a few studies, and scientific methods such as multivariate regression analysis is found in fewer still. Control for confounders cannot be dismissed as an ideal, scientific requirement which is irrelevant to practical models. Outside influence from, for example, the labour market situation has been identified by enterprises in practice (Arbejdstilsynet, 1996), and disregarding this factor may lead to serious misinterpretations of the results.

Scientific methods for confounder control cannot be recommended as a part of practical enterprise-level models, but a short-list of confounder variables which must be considered and discussed by the enterprise when results are interpreted should be included in the model.

This list should include at the least:

- the general trend in sickness absence;
- the demand for labour (relative to the personnel turnover variable);
- all major organisational changes (apart from the OSH project) in the enterprise.

4. Variables and parameters in use in the EU

4.1 Introduction

This chapter sets out to provide an overview of the data sets in use by official bodies and the social partners at the national and company level which might be used as a basis for the evaluation of the socio-economic impact of occupational accidents and ill-health in thirteen member states of the EU (for Luxembourg and Portugal insufficient information was available). In addition there is some brief consideration given to assessment of the impact of occupational accidents and ill-health upon the individual. Appropriate reference has been made to the social security systems in place in the member states.

In addition to the overview of these statistics, consideration is given to the issue of comparability of these statistics across the thirteen Member States. This discussion addresses the range of variables, definitions and coverage and costing principles. Comparability is a key issue for the selection of variables and development of a framework for evaluating the socio-economic impacts of occupational accidents and ill-health at the company level.

The material presented in the chapter is based upon the information provided in the thirteen country reports on interview surveys produced by the SHAPE project national representatives.

4.2 Overview of statistics in use by official bodies and social partners at the national level

Table 4.1 presents a range of possible variables available at the national level in the thirteen participating Member States. The table is divided into categories: corrective costs (health related), corrective costs (non-health related), pricing principles, preventive costs and benefits. Within each category there are a number of variables. Variables used or gathered in each country are identified by an alpha-numeric code, e.g. B1 indicates variables used or gathered by private insurance companies in Belgium. A key identifies the source of the code and gives a short description in annex 1.

The presence of a code in the matrix below signifies that a specific variable has been used in the calculation of costs and benefits, not that the variable is habitually used in this way. For example, specific variables may not be used by national agencies, but scientific studies of costs and benefits may have used the variable on a one-off basis. In addition, it should be noted that some variables may not be routinely collected at national level, rather they have been derived or calculated from other variables for purposes of specific studies.

Data on basic health effects at national level

It is clear from Table 4.1 that a wide range of variables are collected at national level in the 13 Member States included in the study. At a general level, data sets were available at the level of basic health effects in all or most countries. However, there were a number of gaps in relation to the 7 variables enquired of. For

example, data on non-medical costs were available in only 7 of the 13 countries, while only 7 countries reported the availability of data on other health effects.

Costing or pricing principles at national level

For the 12 countries which reported information on pricing or costing principles in relation to accidents and ill health, it appeared that the majority of countries used either financial costs or economic transfers as the basis for calculating costs of occupational accidents and ill health. Very few countries reported either human costs or loss of potential output being used as the basis for costing.

Corrective costs at national level

Only six countries reported corrective costs being available at national level. In general terms, 4 countries had data on administrative costs, and only 2 countries had data on damaged equipment, and 2 had information on other workplace categories of costs.

Preventive costs at national level

Only seven countries reported data sets relating to preventive costs being available at national level (Austria, Finland, France, Germany, Ireland, Italy, and the Netherlands). However, even in these countries, with the exception of Finland, the number of variables upon which data was collected was very limited.

National level data on benefits

It appears that there is no systematic data collected at national level of the benefits of undertaking health and safety. Only Italy reported any such data set.

Table 4.1. Possible variables/measures at the national level

National level													
1.1 Corrective costs (health-related)													
Basic health effects or outcomes:													
1.1.1 Hospitalisation (bed-days)	A2 A4	B1	DK5 DK6 DK7		F1 F2	D1 D2 D11 D13 D18	G1 G3 G4	IR5	I3	N7 N8	E3	S2	UK1 UK2 UK3
1.1.2 Other medical care, e.g. non hospital treatment, medicines	A4	B1	DK5 DK6 DK7		F1 F2	D2 D11	G1 G3 G4	IR3 IR5	I1	N7 N8	E3	S2 S4	UK1
1.1.3 Non medical (e.g.vocational), rehabilitation, house conversions	A4		DK5			D2 D9 D18 D20				N7 N8	E3	S3	UK2
1.1.4 Sickness absence spells (days or weeks)	A1 A2 A4	B2	DK1 DK2 DK4 DK5 DK6	FN1 FN2	F1 F2	D1 D2 D3 D4 D6 D11	G1 G2 G3 G4	IR1 IR2 IR5	I1 I2	N1 N5 N7 N8	E3	S3 S5	UK1 UK2
1.1.5 Permanent disability (numbers, age of patient)	A4		DK1 DK2 DK3 DK5 DK6	FN1 FN2	F1 F2	D1 D3 D4 D5 D6 D8 D11 D18 D19	G1 G2 G3 G4	IR1 IR3 IR5	I2	N5 N7 N8 N9	E3		UK1 UK2
1.1.6 Fatalities (numbers, age of patient)	A4		DK1 DK2 DK5 DK6	FN1	F1 F2	D1 D5 D12	G1 G2	IR1 IR2 IR3 IR5	I1 I2 I3	N7 N8	E1	S5	UK1 UK2
1.1.7 Other health effects				FN3	F1 F2	D4 D5 D6 D8 D9	G2				E1	S5	UK1
Costing or pricing-principles:													
1.a Financial costs (expenditures for an economic actor/agent/institution)	A3	B1 B2 B3	DK5 DK7	FN1	F1 F2	D7 D9 D11 D15	G1 G2 G3 G4	IR1 IR3 IR4 IR5	I1	N10			UK2
1.b Loss of potential output, opportunity costs			DK3 DK5					IR5					UK1
1.c Human costs (willingness to pay for avoidance of grief, suffering, ill health, risk)													UK1
1.d Transfers, such as compensations		B3	DK5 DK7	FN1	F1 F2	D2 D8	G1 G2 G5	IR1 IR3 IR4	I1		E3		
1.2 Corrective costs (not health-related or damages)													
1.2.1 Administration of sickness absence etc.							G3 G4		I1		E3		UK1 UK2
1.2.2 Damaged equipment (by accidents)								IR5					UK1
1.2.3 Other workplace cost categories										N2 N3			UK1
1.2.4 Other, non health-related, costs or savings													UK1

Table 4.1. Possible variables/measures at the national level (continued)

National level	A	B	C	CH	F	D	HA	HE	I	HI	F	C	HI
2 Preventive costs ('expenditures for preventive action')													
2.1 Investment in retrofit, equipment, exhaustion systems etc.					F1								
2.2 Additional investment in capital goods, equipment and buildings					F1								
2.3 Additional costs of substitution products (per year)													
2.4 Purchase of personal protective equipment (per year)					F1								
2.5 Additional costs for changed working procedures and maintenance (per year)													
2.6 In-house preventive services, administration, meetings, OHS training				FN2	F1					N7 N8			
2.7 External services (e.g. occupational health services)	A4			FN2	F1	D8				N6			
2.8 Other workplace level costs													
2.9 National level infrastructure, inspection, registers etc.	A3				F1			IR1	I2				
3 Benefits (second order costs):													
3.1 Productivity													
3.2 Quality of products													
3.3 Market penetration of certain (low-risk) products													
3.4 Technology development (process and products)									I3				
3.5 Human resources													
3.6 Competitiveness of regulated industry relative to other countries													
3.7 Other secondary effects													

4.3

Overview of statistics in use by official bodies and social partners at the company level

Table 4.2 presents a range of possible variables available at the company level in the thirteen participating member states. The table is divided into categories: health-related effects, corrective costs (non-health related), preventive costs and benefits. Within each category there are a number of variables. Variables used or gathered in each country are identified by an alpha-numeric code as in Table 4.1. A key in annex 2 identifies the source of the code.

As before, the presence of a code in the matrix below signifies that a specific variable has been used in the calculation of costs and benefits, not that the variable is habitually used in this way. In addition, it should be noted that some variables may not be routinely collected at national level, rather they have been derived or calculated from other variables for purposes of specific studies.

Data on basic health effects at company level

All countries with the exception of Denmark reported that some data on the basic health-related effects of health and safety outcomes were available at the company level. In Finland and Austria, data was available for each of the seven variables in this category. However, Belgium reported data being available on only one variable (reduced well-being) while Ireland and Spain reported data being available for only two variables.

Data on absenteeism, sick leave, registered accidents and occupational diseases were most commonly available at company level.

Corrective costs at company level

The availability of data in relation to the corrective costs of health and safety appeared to be widely available, with 9 of the 13 countries reporting some level of data (the exceptions being Austria, Denmark, Spain, and Sweden). Finland reported all 7 variables being available, while the most commonly available variables concerned the effects on variable parts of insurance premiums, administrative costs, damaged equipment costs and legal liabilities costs.

Preventive costs at company level

The availability of data on the preventive costs of health and safety activity at company level also appeared to be quite widespread, with 9 of the 13 countries reporting at least some level of availability (the exceptions were Denmark, Greece, Ireland and Spain). The most commonly available data sets concerned the costs of extra working time and the costs of internal or external OSH services.

Company level data on benefits

There appeared to be little systematic data available in relation to the benefits of undertaking health and safety. Only four countries reported any data in this regard (Belgium, Germany, Italy and the Netherlands). The most commonly available data set concerned benefits for productivity and quality of products and services.

Table 4.2. Possible variables/measures at the company level

Company level	A	B	DK	FIN	F	D	GR	IRL	I	NL	E	S	UK
1.1 Health related effects (without cost calculation):													
Basic health effects or outcomes:													
1.1.1 Deaths, fatalities	A4			FN4	F1		G6		I4 I5		E4 E5 E6 E7 E8		UK4 UK5
1.1.2 Absenteeism or sick leave (worktime lost, costs)	A4			FN4 FN6	F1	D21 D22 D23 D24 D25	G6	IR6	I4 I5	N11 N12 N13 N14	E4 E5 E6 E7 E8	S5 S6 S7 S8	UK4 UK6
1.1.3 Personnel turnover, including early retirement and permanent (partial) disability	A4			FN4	F1	D23 D24 D25			I4 I5	N13 N14		S6 S7 S8	UK4 UK5 UK6
1.1.4 Non-medical rehabilitation (except transfers to patients)	A4			FN4		D24 D25			I4				
1.1.5 Registered accidents, occupational diseases	A4			FN4 FN6 FN7	F1 F3	D21 D22 D23 D24 D25	G6	IR6	I4 I5	N13	E4 E5 E6 E7 E8		UK5 UK7 UK8
1.1.6 Reduced well being, job satisfaction and poor working climate	A4	B4		FN6	F3	D21 D22 D23 D24 D25				N13			
1.1.7 Complaints about health and well being (without sick leave)	A4			FN6	F3	D21 D24 D25			I4				
1.2 Corrective costs (non-health related costs or damages, costs incurred to maintain production level):													
1.2.1 Administration of sickness absence, accidents etc. (worktime, costs)		B4		FN4 FN5 FN6 FN7	F1 F4				I4 I5	N12 N13 N14			UK4 UK6
1.2.2 Damaged equipment (accidents)				FN4 FN5 FN6 FN7	F1	D24			I4 I5	N13			UK4 UK5
1.2.3 Lost production time, services not delivered		B4		FN4 FN5 FN6 FN7	F4				I4	N12 N13 N14			
1.2.4 Other, non-health related costs (e.g. investigations, management time, external costs)				FN4 FN5 FN6 FN7					I4 I5				UK4 UK6
1.2.5 Effects on variable parts of insurance premiums, high risk insurance premiums		B1		FN4 FN5 FN6 FN7	F1 F3	D21 D22 D23 D24 D25	G6	IR6	I4 I5	N12 N13 N14			UK4 UK5
1.2.6 Liabilities, legal costs; penalties				FN4 FN5 FN6 FN7	F1	D23 D24		IR6	I4 I5				UK5
1.2.7 Extra wages, danger money (if the company has choice)		B4		FN4 FN5 FN6 FN7	F4		G6	IR6					

Table 4.2. Possible variables/measures at the company level

Company level	A	B	DK	FIN	F	D	G	IRL	I	NL	E	S	UK
2 Preventive costs (first order costs or expenditures for preventive action):													
2.1 Investment in Safety and health equipment such as exhaustion systems		B4		FN4 FN5	F3	D21 D22 D23 D24 D25			I4	N13			
2.2 Additional investments in capital goods, equipment and buildings		B4		FN4 FN5	F3	D22 D25							
2.3 Additional costs of substitution products (per year)				FN4 FN5						N13			
2.4 Purchase of personal protective equipment (per year)		B4		FN4 FN5	F3	D21 D22 D23 D24 D25				N13			
2.5 Additional costs for changed working procedures and maintenance (per year)		B4		FN4 FN5	F3 F4								
2.6 Extra worktime of direct personnel: meetings, training, participatory developments		B4		FN4 FN5	F3	D23 D25			I4	N13		S7 S8	
2.7 Costs of internal or external OSH services, other preventive services	A1	B4		FN4 FN5 FN6	F3	D22 D23 D24 D25			I4	N11 N12 N13			
2.8 Compensations received from insurances		B4		FN4 FN5 FN7									UK5 UK6 UK8
2.9 In-company activities: human resource management, health promotion, OSH policy		B4		FN4 FN5 FN6		D23			I4 I5				
2.10 Other workplace costs		B4		FN4 FN5	F3	D23							
3 Benefits (second order costs):													
3.1 Productivity		B4				D21 D23			I4 I5	N13 N14			
3.2 Quality of products and services						D21			I5	N13 N14			
3.3 Innovative capacity of the firm						D21 D22 D23 D24 D25			I4				
3.4 Opportunity costs (orders lost or gained, competitiveness in specific markets)										N13			
3.5 Other operational effects (reduced costs for facilities, energy, materials)		B4							I5				
3.6 Company image effects						D21 D23							
3.7 Impact on non economic company values													

4.4 Individual level

The national correspondents had great difficulty in identifying any data sets available at the level of the individual. In all, the only data reported came from Italy.

This failure to find individual level data does not signify that real costs don't exist for individuals, rather it signifies that there are no official agencies interested in calculating these costs. In effect, where costs are externalised to the individual, insurance agencies, health and safety agencies, or social welfare agencies see no grounds to concern themselves about these costs - hence little or no data is collected.

Table 4. 3. Possible variables/measures at the level of the individual

Individual level	
1 Health and quality of life:	I
1.1 grief, suffering	
1.2 healthy life expectancy	
1.3 reduction of quality of life or welfare	
1.4 grief and suffering of relatives and friends	
2 Costs and damages:	
2.1 income losses, loss of potential earnings;	II
2.2 expenses and costs that are not covered by insurances or compensations	

4.5 Analysis of comparability at the national level

4.5.1 Country descriptions

This section provides an account of the data sets which are available in each country. It focuses on describing the data sets, their strengths and weaknesses and looks at some definitional issues and pricing and costing principles, where information was available. In addition, it describes, where relevant, aspects of the social security system in each country. Finally, it provides an analysis of how comparable the data sets are in each country, both at national level and at company level.

Austria

There are only a few data sets available in Austria at both the national and company level. At the national level the examples of data sets provided focus on the corrective costs (health-related) with limited information on preventive costs.

Data about industrial accidents and occupational diseases are collected by the social-insurance companies, such as "Allgemeine Unfallversicherungsanstalt" (AUVA), "Versicherungsanstalt öffentlich Bediensteter" (BVA), "Sozialversicherungsanstalt der Bauern" (SVB) and "Versicherungsanstalt der österreichischen Eisenbahnen" (VAdöE). A very extensive data set is generated by "Hauptverband der Österreichischen Sozialversicherungsträger" (could be translated as "Federation of Austrian social-insurance-companies"). The "Bundesministerium für Arbeit, Gesundheit und Soziales, Zentralarbeitsinspektorat" (BMfAGS, ZAI) (Ministry of Labour, Health and Social Welfare, Central Labour Inspectorate) also collects its own data sets.

The social system is divided into the three sectors of health, pension and accident insurance. In general all this insurance is compulsory for every worker. Accident insurance (which is the most relevant for the SHAPE project) is run by 4 companies. There are three smaller companies (for farmers, railwaymen and officials) and one big company for all other professions (AUVA with 4.05 million insured workers (blue collar), employees (white collar), self-employed and pupils and students). In comparison, Austria has about 7.6 million inhabitants altogether. The insurance premiums for accident insurance are paid in full by employers. The insurance rate of 1.4% of gross salaries is the same for every company (no employee contribution).

An accident is labelled an industrial accident, when there is a factual and temporal coherence and causality with the workplace. Registration is obligatory for every industrial accident involving sick-leave of more than three days. There is no data on industrial accidents with sick-leave of three days or less.

If an illness occurs, it is classified as an occupational disease if it can be found in the 47 illness "list of occupational diseases". This list has a statutory basis and can be found in Annex 1 of the "Allgemeine Sozialversicherungsgesetz" (ASVG) (General Social-Insurance-Law). There is no data about work related illnesses, which are not in the list.

At the national level, costing of accidents and occupational diseases is limited to the direct costs only. Costing for administration of sickness absence and damaged equipment can only be estimated. There are no reliable data for preventive costs and benefits at the national level. Insurance companies pay for the direct costs of accidents and occupational diseases, i.e. medical treatment, medical and non-medical rehabilitation and compensation to those who have a permanent disability (from a certain degree up to 100%). These payments are supported by the accident insurance premiums which are paid by employers at the rate of 1.4% of the gross salaries.

Belgium

The private insurance companies' data set and the social security system data set are used by government, companies, trade unions. There is a lack of and well structured data. The best available data are those on occupational accidents and diseases. No research has been done to make an estimate of the indirect costs of these occupational accidents. Occupational diseases are dealt with under the social security system, and the direct economic cost of these is calculated at 15 billion francs a year. The real cost is much higher, one reason being that the definition of occupational diseases is very restrictive. It is estimated that some 10% of all sick leave granted for long term illness (more than 30 days) is related to purely psychosocial problems. This represents a cost of 10 billion francs to the Belgian social security system. This does not include symptoms which can not be clearly identified as psychosomatic in origin. If these were included, this figure would have to be tripled or quadrupled.

The most interesting data available at this moment are data which are gathered at company level. Although these data are not inventorised in a structured way, there has been some reporting on specific projects which have been undertaken in different companies. At this moment, some 50 case studies on cost and benefits of specific prevention projects have been carried out. Direct costs have been quantified here. Indirect costs are more difficult to calculate.

Occupational accidents are declared to the private insurance companies to which companies belong. Occupational diseases are registered with social security and compensations are paid from the occupational disease fund which is funded by employer contributions. Direct costs of accidents are covered by the insurance company, for example, part of the salary of the victim, medical costs and hospitalisation costs. The employer has to take care of the part of the salary costs which are not covered by the insurance company. The insurance company will pay 90% of the average daily salary of the victim. The average daily salary is calculated by dividing the yearly salary by 365; the yearly salary is limited to a fixed amount. The insurance company does not cover the social security costs which have to be paid by the employer during the period of guaranteed salary.

Insurance companies are responsible for the direct costs of accidents in companies. Thus companies do not deal with accidents case by case, but report accidents to their insurance companies, and pay an annual insurance premium. Indirect costs are not covered by insurance companies and are difficult to locate and quantify. In this situation, companies make use of a mini-maxi approach.

Denmark

The general availability of social and health statistics is good, and because of the central person register, multiprogramming of registers (i.e. health data and occupation) is technically possible. However, because of the structure of Danish sickness benefit arrangements, general absence statistics do not exist. In addition, there are no available data bases which record the socio-economic costs of work-related diseases directly, but some databases with partial data on social consequences (i.e. length of sickness spells, percentage of victims retiring due to disease etc.) do exist. With respect to Table 4.1 these statistics are limited to corrective costs (health related).

The following points should be noted with regard to Danish data sets:

- Registers of occupational accidents record absence spells of more or less than one week, not the absolute number of days of absence.
- General sickness absence is low, around 4% but increased during 1997 due to the rise in employment.
- Early retirement by various public pension schemes is relatively high.
- Sickness absence is compensated by different regulations according to the employer. Private employers pay full wages for the first 2 weeks, after which a tax-financed public fund pays sick benefits of up to 330 ECU per week (60% of average wages). A large percentage of those privately employed receive further compensation according to collective agreements. Public employers (i.e. not the public funds) pay full wages during the entire absence period.
- Persons may be fired after 120 work days of absence.

Finland

While a range of health statistics are available e.g. hospital bed-days, there is limited direct information available that is work related. Work related sickness absence information is not available and needs to be estimated, although statistics on certain occupational accidents and diseases can provide this information for specific instances, likewise with disability statistics. Generally, statistics available are limited to corrective costs (health-related).

The coverage of Finnish accident statistics is considered to be good because the data are gathered from accident insurance companies. Insurance schemes for occupational health and safety belong to the social insurance scheme in Finland. The Social Insurance Institution compensates to some extent for the costs of occupational health services and sick leave of workers. A special feature in the Finnish occupational accident insurance system is that, although the system is obligatory and statutory, private insurance companies under public supervision are responsible for accident insurance. All employed workers are included in the scheme for accident and work-related diseases. The system has significant economic incentives because it is constructed so that only the smallest enterprises belong to a fixed premium system while the bigger ones belong to a special tariff premium system. The special tariff system makes it possible to allocate the costs of accidents individually, so that effective occupational health and safety measures and a low accident situation are returned to enterprises' profit in the form of lower premiums.

Entrepreneurs and their family members are not covered by the statutory obligatory insurance scheme, but they can take out voluntary insurance. An exemption is made for farmers, who are insured according to the Accident Insurance for Farmers Act. The state pays accident compensation to the persons who work for the state.

France

The French social insurance is in four hands:

1. The general system which covers 80 % (> 46 millions persons) of the population for illness,
2. maternity, death, disability, occupational accidents and diseases
3. The system for people of the agricultural sector (8,8%)
4. The system for people in free activity (not employed) (5,7%)
5. Specific systems (SNCF) (4,2%)

The general system (the most important one) is divided in autonomous branches such as : the "sickness insurance body for the salaried people" (covering also the members of the family who do not have an income), the "pension insurance body", the "family allowances body" and the "central agency of tax collecting".

The income of this general insurance system comes from the contributions paid by all the salaried people according to their wages (between 20% and 25% of the wages) and from employers' contributions (about 30% of the wages). As the expenses usually exceed the income (especially in periods of high unemployment), the State has to intervene.

Within the "sickness insurance body for the salaried people" an autonomous branch has been created for occupational accidents and diseases, managed by a commission of social partners. This branch covers (for occupational accidents and diseases) around 15 millions employees. Its budget is drawn from the employers' contributions. The national body for sickness insurance has 16 regional offices. Each of these offices includes a person in charge of occupational accidents, and a work doctor. Furthermore, the commission works with 15 "technical committees" corresponding to the professional sectors.

The amount of employers' contributions to insurance for occupational accidents and diseases is calculated as follows:

Annual contributions are calculated by one of 3 methods:

- companies with less than 10 employees pay a contribution according to a collective rate calculated at the national level
- companies which have between 10 and 250 employees pay according to a “mixed” rate (mixed between collective and individual)
- companies with more than 250 employees pay according to the real costs of accidents they declare.

When an accident happens in a firm, the employer fills out a declaration form which is then sent to the regional office. If an employee can not prove that an illness is work-related, the case will not be paid as occupational “damage” but transferred to the general insurance system.

Every year, each company has to fill out a sheet called “the employer’s account report” indicating : name, risk code (according to activity sector), total wages, average workforce, urgency care, name of victim, date; and first payment for temporary disability (< 10% or > 10%); payment by general insurance sickness office: medical care, medicine, hospital costs, sickness absence, payments in capital). These declarations are centralised at the national level and are used for the statistics elaborated by the department of occupational risks of the national sickness insurance office.

These statistics deal only with corrective costs. Furthermore, it is largely said that they do not reflect reality (under declaration by the employers, transfer to general insurance, no integration of the specific systems, absence of registration for civil servants). At the company level there are some attempts to calculate the real costs of accidents and diseases (direct costs + indirect costs), but useful tools are lacking.

Germany

Germany has a dual system of occupational safety and health. Two more or less independent branches coexist: public labour inspection and a largely independent (compulsory) accident insurance system which is run on a mutual basis (“Berufsgenossenschaften”) and runs a self inspection service. While the public labour inspection operates *regionally*, the mutual accident insurance is organised by *industrial* sectors (plus a regional organisation in some branches).

There are:

- 35 mutual accident insurance organisations for the industry sector (“Berufsgenossenschaften”)
- 20 mutual accident insurance organisations for the agricultural sector
- 51 self sustained accident insurance institutions for the public sector (on municipality, district, county and federal basis and for certain public institutions like fire brigades, railway company, post office, etc.)

For the industrial part of the system, to which the following description will be confined, there is a central federation with no “legislative” power but with considerable co-ordination activities.

The mutual accident insurance organisations (“Berufsgenossenschaften”) for industry and for the agricultural sector are based on federal legislation but are independent, except for a certain amount of supervision by the Ministry of Labour. Like all branches of German social security they are autonomous bodies ruled by self-administrated boards, in accordance with German co-determination practice. The “Berufsgenossenschaft” is a compulsory insurance scheme for all employees

and people in similar position (trainees, etc.), sometimes also for the employers of the sector. In all other cases, employers can be insured voluntarily.

The types of risks covered are:

- Occupational accidents,
- Occupational diseases,
- Accidents on the way to or from work.

Insurance premiums are paid by the employers in a "pay-as-you-go" system. The premium amounts to about 1 to 2 percent of wages, depending on the tariff of the respective "Berufsgenossenschaft". Of the whole budget more than two thirds are spent on pensions and other benefits. Less than 5% is dedicated to accident prevention. The level of occupational safety reached in Germany is quite good - only about 0.2 to 0.3 % of the work force are absent due to accidents.

Greece

The Social Insurance Institute (IKA) data-set, the corresponding of the Ministry of Labour and Social Insurance and the National Statistical Service data-set constitute the available data sources in Greece.

The first data-set covers occupational accident statistics for its entire insured labour force (44,32% of the total number of people directly insured on 1996 in Greece). It includes data on the number of occupational accidents (these are accidents necessitating more than three days out of work, of which IKA cover the first 50% while the employer is responsible for the second 50%), fatal occupational accidents, work incapacity days (only the compensated ones, i.e. after three days absence), compensation cost, and the cost of pensions due to occupational accidents (does not include the cost of pensions due to fatal accidents).

IKA has (since 1-1-1998) introduced a new improved form for Accident Reporting to be used by its local branches all over the country. Although this constitutes a significant improvement, it is still far from collecting data adequate for a realistic socio-economic assessment. Some of the new data which this form asks for in relation to each individual accident may relate to a socio-economic assessment, and include: (a) whether first aid was provided and transportation means used for the victim (b) whether or not the victim was admitted to a hospital for treatment.

The second data-set is the one which the Ministry of Labour and Social Insurance used to collect and it was included in the annual report of the activities of the Labour Inspectorate. Although the total number of accidents reported lagged substantially (about 1/3) from those reported to IKA, the number of fatal accidents reported to the Inspectorate was more reliable because it included persons insured in organisations other than IKA. This report of the activities of the Labour Inspectorate has not been published since 1994, a year marked by the establishment of the elected Prefecture Government which resulted to the fragmentation of the Labour Inspectorate. Just recently (September 1998) a central Labour Inspection Organisation was introduced by law under the direct responsibility of the Minister of Labour, rectifying the adverse outcome of the generally approved Prefecture local administration. For the year 1999, it is anticipated that the previously mentioned data-set will again be collected through a new improved method. Another figure available at national level and published yearly by the same Ministry, is the forecast of the compensation cost due to accident (for the year 1997 it was estimated at 4,504,700,000 Drs = 12,62 MECU, 1ECU=357Drs).

The third data-set gives annual data on occupational accidents for the entire labour force. Data available includes total number of accidents (the reliability of this figure is questionable), fatal accidents, work incapacity days, temporary disability cases, permanent disability and pensioning, and physical injuries that do not affect work capacity. It is doubtful whether the data available has the minimum reliability required for use in any type of assessment of the socio-economic impact of occupational accidents.

The definition of occupational accidents in Greece includes those occurring during commuting to work. However, no separate figure is available for them.

The Social Insurance Institute has compiled a prescribed register of occupational diseases. Occupational diseases are rarely reported and therefore no useful data exist.

Although there are no methodologies at national level which are systematically used for impact assessments of the OSH regulatory process, the cost of occupational accidents for the national economy is estimated to exceed the amount of 42 billion Drs, whereas the cost of occupational diseases the amount of 350 billion Drs.

Some studies have looked at the national financial cost of occupational accidents in Greece. The first study was based on statistical data of the Social Security Institute. It looked at data on the number of occupational accidents, percentage of the ratio of the number of occupational accidents in the labour force directly insured by the Social Security Institute, the number of compensated days and amount of compensation paid by this Institute for occupational accidents and the amount paid for disability pensions due to occupational accidents. It made some assumptions:

- One fourth (1/4) of the compensated days are spent in a hospital (thus being able to estimate hospitalisation costs).
- Companies need to pay one extra full time worker to carry out the job of the injured person during his/her absence from work.
- One non productive man-hour is paid by the enterprise for each accident (for assisting the victim, providing information for completing the accident statement to the authorities, etc.).
- Two out of three of the accident victims need to have 2 medical or laboratory examinations each as well as 2 prescriptions each (other medical care and medicines).

The calculations make use of the fact that employers cover 50% of the compensation cost. The author reached the conclusion that the total cost for the Social Security Institute and the enterprises due to occupational accidents amounted to 10,6 billion drachmas for the year 1984.

The second study made similar use of Social Security Institute data for the years 1992 to 1996 and estimates the total cost of those accidents as in the first study. The three assumptions remain the same and only the cost of non productive time is assumed to be 6,5 man-hours (instead of one) for each accident (for assisting the victim, providing information for completing the accident statement to the authorities etc.). In the third case only the insured cost of occupational accidents was estimated. For the remaining cost, which is difficult to calculate, empirical data for its ratio to the insured cost were used. Three different values were used. These were 1/8, 1/12 (both based on a study carried out by the HSE in 5 enterprises of UK during 1990-91) and finally 1/4 (based on the work of H. W. Heinrich for the

relationship between direct and indirect cost). The total cost can be seen by addition. Finally the estimated total costs were weighted to constant prices of 1996 and compared to the budgets of various ministries.

The third study examined the data for the number of occupational accidents provided by the Social Security Institute in relation to those provided by the Ministry of Labour and explains the differences observed between them. The study used the occupational accidents data of the Social Security Institute and it examines the diachronic progression of labour accidents in relation to the total number of people insured by the Social Security Institute and the Gross National Product of Greece for the period 1970-1986. It analysed the costs of labour accidents and estimates the total expenditure required for the treatment of the victims, based on the compensation cost of occupational accidents per sector, the average industrial wages (to calculate the loss of wages). The researchers assumed that $\frac{1}{4}$ of the compensated days are spent in hospital (to calculate the medical care expenditure) and that the administrative expenditure is 0.1 % of the sum of compensation plus pension expenditure. Finally the study formulated proposals estimating their implementation cost in relation to the expected savings re the cost of accidents.

The fourth study was based on detailed data collected by a large company regarding occupational accidents of permanent employees. These data give figures for days of absence, type of accident and injury, injured part of the body, cause of the accident, duration of previous service and age of victim and cost for their medical care and medicines. The study calculated the direct financial cost for the company caused by the accidents for the years 1990 and 1991 at current prices based on the following figures: number of accidents by age, duties and previous service of victims, wages in the company according to duties and experience, and days of absence. The study was also based on the assumptions that: the company pays one extra full time employee of similar qualifications and experience to replace each injured person, that the number of non productive man-hours paid by the enterprise for each accident varied from one to five according to the severity (days of absence) of the accidents, and that pensions had to be paid for a period until 1/6/93. The total financial cost was calculated as five times of the direct cost (cf Heinrich). The study also compared the costs by type and cause of accidents, by type of injury and by injured part of the body.

Ireland

The Health and Safety Authority, the Labour Force survey, the Department of Social Welfare, the Insurance Federation (private sector insurers) and the Survey of Health and Safety on Farms data sets are used by the Health and Safety Authority, social partners and Construction Industry Federation. The Health and Safety Authority produces an annual report which includes the compilation of data on:

- accidents (injuries and fatalities) reported to the HSA (it is a legal requirement that accidents necessitating employees' absence for more than 3 days to be reported to the HSA)
- occupational data on diseases from the Department of Health, the National Cancer Registry, the Irish Medicines Board
- Physician based voluntary reporting schemes such as RODD (Reporting of Occupational Dermatological Diseases), SWORD (Surveillance of Work and Occupational Respiratory Diseases) and ROPI (Reporting of Occupational (Pathology) Illnesses).

These figures are not aggregated. The Labour Force Survey gathers information on time off due to occupation related illnesses (when time exceeds three days), the number of days taken and the number of such occurrences by work sector from over 47,665 households annually. The Department of Social Welfare publishes an annual report that includes data in relation to state expenditure on occupational illnesses and the number of recipients of occupational injury benefits such as injury benefit, disablement benefit, death benefit, workers' compensation benefit and medical care costs. This data does not give the full picture regarding other costs such as state expenditure on medical attention, hospital stays, insurance costs of the employer and taxes and wages loss for the employee.

The Irish Insurance Federation supplies information on gross written premiums, gross incurred claims, new claims notified and underwritten compensation in relation to employers' liability insurance. The Survey of Safety and Health on Irish Farms provides data on the number and type of farm accidents and fatalities, medical treatment received (surgery and non surgery), the length of hospital stay, farm days lost and the overall economic loss due to farm injuries and fatalities. These data sets are varied, but are very difficult to relate to one another. Unfortunately, there is no single source of national statistics on costs of injuries and diseases at work, the related work sector and number of people. Moreover, all of the data sources mentioned above suffer from underreporting. For example, a data from a recent Labour Force survey suggest that the rate of occupational accidents is underestimated by approximately 90%.

The Health and Safety Authority in Ireland records occupational accident and disease statistics, which include any injuries or fatalities that occur during work, and dermatological diseases, respiratory diseases and pathological illnesses. The Department of Social Welfare is responsible for social welfare payments, details of claimload, appeals and payment methods. Occupational Injury Benefit is payable to those off work as a result of a workplace accident or who have contracted an occupational prescribed disease. Occupational Injury Benefit is payable for six months following which a person may go on to disability payments, or if recovery within six months is unlikely they will go on to disability benefit from the start of payments. Applicants must get their employers to sign a declaration that the injury occurred in the course of their work. Disability payments are made when the injury results in permanent disablement, and a lump sum payment is made if disability is 20% or below while a permanent pension is payable if disability is above 20%.

Italy

The National Institute of Occupational Injuries and Occupational Diseases Insurance data set, the Institute of Prevention and Safety at Work data set and the National Institute of Statistics data set are used by the Ministry for Health and Insurance Institute for social insurance system administration and injury prevention and official statistics. The first data set is in relation to its insured 16 million workers. It presents comprehensive data on corrective health and non-health related costs and costing principles. This data is readily available and reliable. The second data set presents data on corrective health-related and preventive costs (managerial costs) for industrial workers. It is also considered reliable although not combined with the first data set to give an overall data set. The third Institute collects data on corrective health-related costs at national level and data on benefits such as technology development (enterprises that consider the improvement of the working

environment as an objective of technological development). This data is considered reliable, although data on technology development in enterprises will not be available until the end of the year.

The Italian compensation system for occupational injuries dates back to 1898, while that for occupational diseases was established in 1934, and is based on a list of prescribed occupational diseases. Since 1988 the system also envisages other diseases besides those already listed, as far as the worker is able to prove that the disease is due to occupational causes. The compensation system is based on the following principle: since work can be hazardous and workers are constantly exposed to accidents and diseases, employers must comply with the national compulsory insurance scheme and insure workers against these risks. The premium is determined by the extent of the estimated risk in each industrial activity and varies according to the number of injuries occurring at a corporate level (*bonus-malus* system). Injured or ill workers are entitled to receive health assistance from the National Health Service and compensation from the National Institute of Occupational Injuries and Occupational Diseases Insurance. Such compensation is provided both for the temporary absence from work, if longer than three days, and for an eventual permanent disability, in the case of a working capacity reduction of at least 11 %. In the case of fatality, the worker's family is entitled to a pension. The worker or his/her family are also entitled to insurance benefits, even if the employer did not previously pay any insurance premium.

The National Institute of Occupational Injuries and Occupational Diseases Insurance measures the number of compensated sickness days, frequency and severity indexes of different economic areas and activities (these are calculated on the number of working hours performed), the number of permanent disability cases per year (frequency and severity indexes), and compensation benefits per year (can be broken down into different categories related to economic activities, type of disability, etc.). The Institute of Prevention and Safety at Work prices the same variables as above for industrial workers.

Netherlands

The following points are worth mentioning with regard to the relevant aspects of the Dutch social security system. Firstly, since 1996, employers are obliged to pay 70% of the wage during the first year of sickness absence. Sickness benefits are not covered by a social security fund, as was customary until 1996 (with some exceptions such as maternity leave). Employers can and mostly do insure themselves against this risk. The (collective) disability insurance has recently been revised (1998), one of its purposes being to allow for more 'market' influence (which will hopefully lead to more efficiency) and more re-integration of (partially) disabled workers. Insurance can now be competitively offered by several organisations: not only re-organised and privatised 'old' organisations, but also 'classic' private insurers. However, one of the distinguishing features of the Dutch sickness and disability insurance still remains: it is irrelevant if the cause of illness or disability is to be found in the work situation or not (of course, for liability claims, it is still relevant).

The main findings of the Dutch survey on the availability of data can be summarised in the following points:

- Data on occupational accidents is notoriously unreliable. In order to estimate the costs of occupational accidents researchers use foreign data (mostly German data) and apply the relationships found between occupational accidents and e.g. number of working days and industries to the Dutch situation. However, for analysis of the development of accidents, it is possible to use the NIA accident registration; the methodology of this registration has basically remained the same (the level of registered accidents is considered too low, however, due to underreporting).
- The estimation of the part of occupational diseases that is due to working conditions is hampered by the fact, that no distinction is made between sickness absence due to work or due to other factors. The Netherlands does not have a *risque professionnelle* insurance.
- However, since 1995 data on (specific) occupational diseases is collected by the Centre for Occupational Diseases by order of the Ministry of Social Affairs and Employment. The first results showed some shortcomings, but these will hopefully be overcome in the near future.

Spain

The Ministry of Labour and Social Security, the National Institute of Safety and Hygiene, the Social Security System, and the National Institute of Statistics, among other institutions, generate data sets which are mainly used by Government.

An important first data set includes nationally-based data on work-related accidents and occupational diseases. The main purpose of this occupational health registry has been to indemnify or to compensate damages instead of preventing risks, so this data set does not reflect all the effects of occupational risk factors. Thus, only occupational accidents statistics are relatively reliable while the number of work-related diseases are clearly underestimated. However, even for accidents, a number of limitations make it difficult to obtain a valid picture of the country: a) many occupational accidents are aggregated into one large category called "non traumatic pathologies" in which it is not possible to separate specific causes of death; b) occupational accidents are not defined very precisely (i.e. an accurate description of their characteristics, type of injury, etc.) and causes are not coded in a standardised system; c) the legal definition of work-related accident does not count accidents that occur in the submerged economy and from workers who are not included in the Social Security System, and d) occupational accidents, notified as serious accident leading to death, may not be registered as fatal accidents since the surveillance system does not allow their follow up. It has been estimated that at least between 6 and 9% of fatal accidents could be missing.

Other important occupational data sets are the two national surveys on Working Conditions conducted in 1987 and 1993 by the National Institute of Safety and Hygiene. Those surveys include information on the frequency of occupational accidents, accidents with and without interruption, occupationally related diseases, morbidity attended and morbidity attributable.

The Spanish Social Security System provides protection to the population against economic distress connected with work-related accidents, occupational diseases, retirement and death. Workers, civil servants, students, foreigners, and other

groups of people as well as their families are included in different categories within this system. The Social Security System issues a budget in connection with work-related accidents. This includes information on economic expenditure, health care costs, social services, treasury and informatics, management expenditure, pensions and other economic expenditures.

The approval of the new Law 31/95 of Occupational Risks Prevention (Directive 89/369) has opened a new era in the field of Occupational Health at the company level increasing the interest in studying the health and economic impact of work-related accidents and diseases. However, current data on the magnitude or degree of health and safety hazards at work at the company level are disperse. A number of large companies gather occupational data on accidents but reports or studies are scarce or confidential. Although comprehensive studies and reports are rare, a number of descriptive and preliminary studies on both health and economic impact are already available at the local and company levels.

At both national and company levels, there is a clear need: 1) to improve and standardise occupational health systems establishing criteria for register occupational accidents and work-related diseases, and 2) to develop methods from which accurate assessments can be made on the economic impact of work-related accidents and diseases.

Sweden

Information has been drawn from the official statistics for industrial injuries, health insurance, figures for state of health and cause of death, to form the basis of an account of the costs of occupational accidents and diseases. This information has been supplemented by statistics regarding time utilisation, the labour market figures and the usage of medication.

Extensive changes to the social insurance system have been introduced in recent years. Changes to the rules governing health insurance, which involved the introduction of a waiting day (unpaid) in 1992, reduced absenteeism through sickness from 14.0 days per insured person, in 1992, to 9.7 in 1996. This development was confirmed by the Swedish Employers' Confederation's time utilisation statistics, where the percentage change in sickness absence during normal working hours decreased from 12 percent in 1992, to 7 percent in 1996. Prior to 1992, absence through sickness was compensated by a payment equivalent to 90-95 % of normal salary, compared to today's 75 %.

Changes in the rules governing industrial injury insurance affected the figures recorded for industrial injuries. At the same time as changes were made to the health insurance system, stricter rules were introduced governing the evaluation of reported industrial injuries. Previously it was sufficient to demonstrate a connection between factors contributing towards an industrial injury and a reduced work capacity; however, the new rules placed greater requirements on this demonstration. Already, it is possible to see the results of the new evaluation procedure in the figures for industrial injuries, which paint a picture of decreasing volumes of industrial injuries. However, this is not actually the case and it is actually the stricter rules and evaluation procedure that partially explain this development.

When considering sick-leave through industrial injury, it is important to note that a source of error arises through the lengthy waiting times encountered between notification of an injury, investigation of the course of events surrounding it, determination of cause, result and effect, as well as taking a decision about early retirement, or rejection of the claim. A large proportion of notified industrial injuries involve a case handling time, on the part of local social insurance offices, shorter than one year, but there are also long and difficult cases, taking a number of years to investigate (anything from between 2 and 5 years). During this period, the employees in question are on long-term sick-leave and receive a type of sick-pay, known as rehabilitation allowance. These lengthy case-handling times, which shouldn't really counted as sick-leave, increase the period of long-term sickness absence and should be referred to by their proper title of "case handling sick-leave".

When making international comparisons, it is important to be aware of these differences in case handling and waiting times and whether or not these periods are included in overall figures for sickness absence. In comparison with other Nordic countries, e.g. Finland, Swedish long-term sick-leave was disproportionately high at the start of the 1990s. It is possible to find part of the reason for this in "case handling and waiting times". The planning of rehabilitation work can also be influential at the point where it is decided how long, or short, long-term sick-leave is allowed to be before rehabilitation commences. In a social insurance system where employers have a direct financial responsibility for early retirement pensions, or where the level of injury affects the insurance premium, the speed at which the need for rehabilitation is recognised, and with which measures are taken, is increased.

United Kingdom

The availability of data sets specifically relating to *occupational* accidents and ill-health are limited. The main source of data and most relevant data set is provided by the UK Health and Safety Executive (HSE). The Statistical Unit of the UK HSE interprets the data that are reported to the HSE under the statutory requirements on Reporting of Industrial Injuries, Diseases and Dangerous Occurrences Regulations 1995 (RIDDOR). These statistics are summarised in a statistical supplement to the Health and Safety Commission Annual Report. These data are based on statutory reporting requirements and are not necessarily comprehensive since there is no requirement to report injury accidents which do not result in at least three days absence from work. However, they represent the only data set specifically dealing with *occupational* accidents and ill-health.

While the UK HSE data provide an overview of the extent of accidents and ill-health instances across all work environments, other national level organisations can provide some information related to their particular interests. For example, the Department of Social Security who administer, for example, the Industrial Injuries Disablement Benefit Scheme (IIDS), are able to provide information on the number of people claiming this type of benefit and therefore a cost of the occupational disablement. As in the case of the HSE data, the data from the IIDS scheme does not provide a comprehensive picture as the benefit is only payable for certain prescribed illnesses and accidents and industries. Furthermore, the data is only derived from a limited (10%) sample. Claimants may also receive other benefits through the social security system as a result of their disablement and

therefore calculation of the economic impact of their accident or illness is complex. Further details on documents produced by the Department of Social Security regarding benefits are detailed in Chapter 3.

The Department of Health (Central Health Monitoring Unit) also uses a range of statistics gathered by other organisations, some of which can provide information on occupational accidents and ill-health, although this is not the primary purpose. Examples of these statistics are the mortality statistics produced by the Office for National Statistics, the Annual Health Survey for England which occasionally includes questions on occupational accidents and ill-health.

4.5.2 Analysis of comparability of data sets at national level

There are many clear problems relating to the data sets gathered at national level which may be used for calculating the costs and benefits of occupational accidents and diseases interventions. These problems not only make it more or less difficult to generate useful calculations within many countries; they also make it almost impossible to undertake valid and reliable international comparisons of costs and benefits. Among the most important problems with these data sets to emerge from the surveys are:

- Different sets of data are collected. In some countries relatively little is collected, while in others there are many potential sources of data
- There are few data sets collected which are common across all countries
- The coverage of data tends to seriously under-represent the reality of the costs and benefits of accidents and disease prevention
- Data reliability is a problem - the data which are collected are in many cases not accurate with regard to the accidents which are notified
- There are few data sets which are concerned with occupational diseases. Those which are available severely under-represent the true situation
- Data sets on occupational diseases appear to have different bases, i.e. the definition of occupational disease varies between countries
- Data sets tend not to be integrated with one another, thereby making it extremely difficult in most countries to relate, for example, the costs of accidents with their occurrence.
- Social insurance systems differ widely in the provisions made for compensating for occupational accidents or diseases. Some of the more relevant dimensions of difference include:
 - provisions for the distribution of costs between social insurance agencies and employers;
 - the period of liability for payments; and
 - the presence or absence of incentives within the system.
- The definitions of variables in the data sets available vary from country to country.
- With regard to absence statistics and disability statistics, differences in the length of time taken to resolve legal aspects may contribute to spurious elevations of time off.
- Many of the variables reported as being available are not directly so. These can only be derived from scientific studies.

It is clear from the above summary of the main findings from the survey of data sets, that the issue of generating international comparisons is enormously complicated. Countries differ in the type of data collected, the purposes for which it is collected, the definitions used, their social security systems and the policy objectives and approaches taken to dealing with occupational accidents and diseases. Moreover, an apparently universal experience is that there are problems with the reliability, coverage and validity of some of the data sets collected.

The implications of these constraints on data for purposes of undertaking comparability analyses are also clear. These include:

- At the national level the greatest concentration of data sets is in the 1.1 Corrective costs (health related) so any 'approach' to assessment should try to use the variables that are highly likely to exist.
- If there is a need for transnational comparisons, there is a need to develop complementary approaches to socio-economic assessment dependent of the data sets available. One way forward is to develop a minimum data set which might be collected or already available in all countries.
- In the interim, it may be possible within the limits of reliability and validity constraints to conduct longitudinal analyses of the costs health and safety and disease within countries, thereby enabling trends in costs to be monitored.

Table 4.4 summarises the comparability with regard to:

- the variable and criteria;
- definitions, interpretation and coverage;
- pricing and costing principles applied.

Table 4.4 Analysis of comparability of data sets at national level

Variables and Criteria	Definitions, Interpretation and Coverage	Pricing and Costing Principles
Austria There are four data sets generated by the Chamber of Commerce, the Federation of Social Insurance Companies, the annual report from the Labour Inspectorate and the Workers' Compensation Board. They cover most of the health related corrective costs. There is only data in relation to financial costs at national level for the costing principles. They have information on external services and national level infrastructure for preventive costs, and no data in relation to benefit costs.	These data sets give information on sickness absence and all absence days for blue and white collar workers. It has data on the no. of beddays, no. of ambulant cases and sickness absence days for all employees in the social insurance system in relation to occupational accidents and diseases. It has data on the financial costs to the national labour inspectorate.	The national labour inspectorate publishes data on the financial costs. It details information on fines, no. of charges brought, sum of proposed fines, no. of completed procedures, sum of fines imposed and commission charges.
Belgium There are three data sets generated by private insurance companies and the social security system. They cover some of the health related corrective costs. Data is available on financial costs and compensation re costing principles. There is no data available re preventive costs or benefit costs.	These data sets give information relating to the costs of accidents to insurance companies such as part of the victim's salary (90% of average daily salary), medical and hospitalisation costs. Sick leave costs approximately 10 billion francs to the social security system. The cost of occupational diseases is estimated at 15 billion francs.	The occupational disease fund is financed by employers' contributions, at 1.1% of salaries. It is estimated that 10% of all sick leave is due to long terms illness (more than 30 days) related only to psycho-social problems, it does not include other symptoms which would triple or quadruple the 10 billion current cost of sick leave.
Denmark There are seven data sets generated by the occupational accident and disease registers, National Board of Industrial Injuries, the Employers' Confederation, and national studies. These give extensive coverage of health corrective costs, and costing principles but no data on preventive or benefit costs.	These data sets provide data on beddays, medical treatment, transfers for non medical rehabilitation, sickness absence, permanent disability and fatalities. They also provide information re financial costs as sick benefits plus wages paid by public employers, loss of potential output, and compensation.	One national study priced the costs of sickness absence, permanent disability and deaths by loss of output where the average wage level was used as a proxy for output. For disability and deaths, potential output until the year of retirement was added, adjusted by the average probability of survival. The calculation was made with a 4% discount rate and a zero rate.
Finland There are three data sets generated by the Federation of Accident Insurance Institutions, Social Insurance Institution and Institute of Occupational Health. They give good coverage of information relating to health corrective costs, and some data on preventive costs and costing principles but no data re benefit costs.	These data sets give information on sick leave absence due to occupational accidents and diseases, whether sick leave is work-related and the number of permanent disability cases due to occupational accidents and diseases, fatalities due to accidents and occupational diseases and the number of occupational diseases. They also provide information on in-house preventive services and occupational health services.	Data is available re accident compensation calculated as the direct costs of occupational accidents and diseases.

Variables and Criteria	Definitions, Interpretation and Coverage	Pricing and Costing Principles
France There are two data sets generated by the National Sickness Insurance Office and its counterpart for the agricultural sector only. These give very good coverage of health corrective costs, costing principles and preventive costs but no benefit costs.	The data sets give data on beddays in hospital, medical care and medicine, sickness absence, temporary/permanent disability, and fatalities in relation to accidents and occupational diseases. It also has data on the contribution of companies to the Sickness Insurance Office, and compensation to victims.	The financial statistics are established from number of accidents and diseases and indicators such as average cost of an accident with sick leave and permanent disability (IP), ratio of IP number to the number of accidents with sick leave and temporary disability, the ratio amount in capital/allowances for temporary disability, the gross risk rate of permanent disability (< 10% or > 10%) and the gross annual risk rate.
Germany There are twenty data sets generated by the Ministry of Health, Ministry of Labour and Social Affairs, and a variety of other institutes. These give extensive coverage of data relating to health corrective costs, costing principles, some data on preventive costs and none on benefit costs.	These data sets give extensive data on hospitalisation (no. of cases and days), medical treatment, rehabilitation, sickness absence (no. of cases and days lost), permanent disability, fatalities and occupational accidents, injuries and diseases, and external services for the injured and sick as transitional arrangements. They also give information on financial costs to a national body, and compensation.	Social health insurance expenditure per case of sickness is calculated as expenditure per day in hospital and the ratio of sickness among the compulsory members of the system. The Federal Statistics Agency calculated the total cost of hospitals.
Greece There are five datasets generated by Social Insurance Institute, National Statistical Service, the Ministry of Labour and Social Insurance and national studies. These give good coverage of data on health related corrective costs and costing principles, but no data on preventive costs or benefit costs.	These data sets provide data on hospital admittance and costs, first aid, medicine costs, absence due to accidents which is compensated, temporary and permanent disability cases, and fatal occupational accidents. They also have information on the costs to the Social Insurance Institute, and compensation costs of accidents and pension costs in relation to permanent disability. Other data relates to the cost of administrating sickness absence.	The Social Insurance Institute cover the first 50% cost of wages for people absent due to accidents while employers cover the second 50%. One study estimated the costs of sickness absence as including paying one extra full time worker to do the injured person's job, the administration of sickness absence as one non productive hour paid by the enterprise for each accident, for assisting the victim and providing information for completing the accident statement to authorities.
Ireland There are six data sets generated by the Health and Safety Authority, Labour Force Survey, Social Welfare Department Insurance Federation, Employers' Confederation and a national study. These give good coverage of information pertaining to health related corrective costs, costing principles, very little data on	These data sets have data on beddays, medical care costs, sickness absence spells, disability benefit, and fatalities relating to occupational accidents. They also have information on costs to the national health and safety body, state expenditure on occupational illnesses and disability and the	In terms of social welfare, occupational injury benefits are payable for six months following which a person may go onto disablement payments or if they are unlikely to recover within six months go on these payments at the start of the payments. Disability payments are made when the injury results in permanent disability, and a lump sum

Variables and Criteria	Definitions, Interpretation and Coverage	Pricing and Costing Principles
preventive costs and none on benefit costs.	costs of employer liability insurance to cover companies against claims. Compensation data is available for social welfare benefits and the national insurance body. Other preventive costs include damaged equipment due to accidents.	payment is made if disability is 20% or below of incapacity while a permanent pension is payable if the disability is above 20%.

Variables and Criteria	Definitions, Interpretation and Coverage	Pricing and Costing Principles
Italy There are three data sets generated by the National Institute of Occupational Injuries and Diseases Insurance, the Institute of Prevention and Safety at Work and the National Institute of Statistics. These give some information on health related corrective costs, and pricing principles, but little on preventive and benefit costs.	These data sets provide details of hospitalisation (beddays and number of discharged patients), medical care (high tech prosthesis), sickness absence days compensated and a frequency and severity index for different sectors, permanent disability (annual no. of cases, age, sex and severity, and frequency and severity index for industrial sector), and fatalities (no. of cases annually, age, sex and severity). They also provide data on financial expenditure for the National Insurance Institute and compensation benefits annually and administration of sickness absence. Data is available for managerial costs at the national level and data on the benefits of technological development for 10,000 enterprises.	The National Insurance Institute collects data from individuals re costs and damages in relation to income losses (compensation for loss of job, capability calculated according to the inability percentage and dependent on the salary not on age).
Netherlands There are ten data sets generated by the Labour Force Survey, Ministry of Health, organisations on behalf of other Ministries and the National Institute of Social Insurance. They give good coverage of health corrective costs, some data on pricing principles and preventive costs but none on benefit costs.	These data sets provide information on hospitalisation, medical care, non medical care, sickness absence (percentages and days across sex, age and industry), permanent disability (no. of cases, costs, premiums) and fatalities. Other data includes cost of illness information for each disease to the state, and costs of production losses (enterprise and workforce in general level). Preventive costs information relates to OSH policies of companies and the costs and outlays of the health sector.	Production losses at the enterprise and household survey level are calculated at hourly wage rates, costs per industry, and number of hours worked per year per industry. Calculation of costs per disease use the 'year cost method', i.e. all outlays occurring in a year are attributed to diseases (diagnoses) in the same year.
Spain There are three data sets generated by the Ministry of Labour and Social Security and a national working conditions survey.	These data sets give information on hospitalisation, medical care costs, non medical care costs, sickness absence, permanent	The Social Security System issues a budget in connection with work related accidents, this system decides on compensation, pensions and other

Variables and Criteria	Definitions, Interpretation and Coverage	Pricing and Costing Principles
They give good coverage of health related corrective costs, some data on costing principles, but none on preventive or benefit costs.	disability, and occupational accident information. They also have data on compensation from the Social Security system and administration of sickness absence costs.	economic expenditure factors.
Sweden There are five data sets generated by the National Labour Market Board, the National Board of Health and Welfare, the National Social Insurance Board, the Pharmaceutical Company, and the Board of Occupational Safety and Health. They give very good coverage of corrective health costs but no other data.	These data sets give information on hospitalisation, medical care and medication sales figures, costs of rehabilitation, sick leave figures, fatalities and occupational accidents and diseases.	

Variables and Criteria	Definitions, Interpretation and Coverage	Pricing and Costing Principles
UK There are three data sets generated by the Health and Safety Executive, Department of Social Security and the Department of Health. They give good coverage of corrective health costs and costing principles, but no other data relating to preventive and benefit costs.	These data sets give information in relation to hospitalisation (beddays, admissions, type of operation), medical care, non medical, sickness absence spells, permanent disability and fatalities. Other data includes benefit expenditure of the Social Security Department, loss of potential output, human costs, administration of sickness absence, and damaged equipment, other workplace cost categories and other non health related costs.	

4.6 Analysis of comparability at the company level

4.6.1 Characteristics of the data sets in use

This section presents an account of some of the findings relevant for comparability at the company level. In particular, it seeks to draw attention to areas where comparisons between companies in different countries can be legitimately made.

The following notes draw attention to peculiarities of the company level data sets available in the participating countries:

- In Austria, company level data sets are limited to basic health effects without cost calculations.
- In Finland limited data sets are available at the company level. Information on registered accidents and occupational diseases is available. Other corrective costs (non-health related) and preventive costs must be estimated. Specific methods have been devised for calculation of the cost-benefit of specific OSH intervention and also impact costs of specific accidents.
- In France, company level data sets have extensive information on all variables but benefits. Information on all items but non medical rehabilitation is available for basic health effects. Data is available for all items but other non health related costs for corrective costs. Data in relation to preventive costs is also available with the exception of additional costs of substitution products, compensation received from insurance and in-company activities.
- In the Netherlands, the officially registered sickness absence figures are less reliable since 1995; many employers do not report sickness absence of short duration, because they do not have a financial interest in reporting sickness absence (until 1994 employers got financial compensation for paying wages during sickness absence). Since 1994 the only more or less reliable information are data from sample surveys; these are data based on samples of employers and employees. Only limited examples available of variables used at company level and these are limited to specific studies. In these cases mainly basic health outcomes and some corrective costs have been recorded.
- In Sweden, time utilisation statistics are used to measure sick-leave at the company level. These are produced by the Swedish Employers' Confederation. All Nordic employers use this statistical model. However, the figures are only based upon a small proportion of private Swedish companies. Of a total of approx. 1.2 million private company employees, only around 230,000 are included in the report. The reason for this is that a large proportion (around 75-80 percent) of private Swedish companies are small businesses, with less than 25 employees. Inclusion in the time utilisation statistics is voluntary and these small businesses don't find it necessary to be included in them, as they track attendance and absenteeism manually. The volume of sick-leave per collective bargaining group and the distribution of sick-leave according to its length, frequency, and as a proportion of normal working hours, are provided in the statistics.
- Since 1997 in Sweden, the time utilisation statistics have been supplemented by a scheme for the accounting of a company's labour force costs through sick-leave. All private companies have access to this service and it is provided free-of-charge as a part of the Swedish Employers' Confederation service to its member companies.

Equivalent time utilisation statistics are not available to the same extent for the public sector and neither is there access to the same sort of computation service. The following statistics are available at a company level:

- Time utilisation statistics, in one form or another
 - Sick leave, major inadequacies in the statistics
 - Personnel mobility, partially recorded
 - Personnel statistics, incomplete
 - Training statistics, incomplete
 - Key personnel figures
- Statistics are lacking for
 - Sick leave categorised according to remuneration period, showing whether the absence was, short, long, or work-related
 - Personnel mobility, complete account
 - Industrial injury figures are not extensively used
 - Major deficiencies in the formulation of personnel statistics
 - Training statistics
 - Competence utilisation
- With regard to the statistical reliability and validity of Swedish Company level statistics, if the job in hand were to answer the question of whether or not statistics existed at a company level, the answer would often be yes, or partially. But if the question of whether or not the statistics stood up to a scientific scrutiny of their validity and reliability were raised, the answer would often be negative. The statistics exist, but wouldn't stand up to a critical examination. Generally, the things causing problems are that: the variables are not defined uniformly, sometimes variables are not defined at all and it is not always evident how percentages have been calculated from the statistics. Furthermore, ratios which can be manipulated have been used as measurements. The measurements of sick-leave and personnel mobility are examples of such. Further problems relate to hidden sick leave and the verifiability of data at company level.
 - In the UK, organisations appear to be currently assessing impact in terms of health related effects and corrective costs at the company level. In particular at the company level, impact is assessed routinely in terms of a number of reactive measures e.g. number of serious injuries, number of RIDDOR reportable accidents rather than in terms of cost. Even in large companies, the costing of accidents is not routinely undertaken.

4.6.2 Analysis of comparability of data sets at company level

Most of the data available at company level is concentrated in the area of the health related effects of occupational accidents and illness with a special focus on absenteeism data, registered accidents and illness data and personnel turnover data. In addition, there is a relatively high concentration of data sets on some of the corrective costs for illness and accidents, especially in relation to administration costs, damaged equipment, lost production time, insurance premiums and legal liabilities. However, data sets relating to preventive costs and especially the benefits of prevention were much less widespread.

From the point of view of making comparisons between company levels costs, especially on a transnational basis, the relative availability of data needs to be balanced against the following issues:

- Legislative changes in some countries have reduced the incentives for companies to maintain data on short-term absences due to accidents and occupational ill health
- The impact which social security legislation and regulations have on definitional issues and on the apparent rates of accidents, illness and absenteeism (The Swedish report gives a particularly good insight into these issues)
- The issues of the validity and reliability of data are also of relevance at the company level

The problems of comparability of data sets at company level are somewhat less than those at national level. Even if there are definitional problems, there is a greater potential availability of data when compared to national level. However, the limitations on currently available data sets are not the only ones to be faced by a methodology for calculating costs and benefits of health and safety activity. Other issues include:

- The failure of many companies to maintain accurate records on absenteeism
- The difficulty of measuring assessing productivity effects of illness
- The difficulties of assessing the benefits of prevention

Table 4.5 gives an overview of comparability of datasets.

These issues need to be and 6 in the context of developing the company level methodology. Chapter 5 outlines the approach to developing the methodology which is being taken by the SHAPE project.

Table 4.5 Analysis of comparability of data sets at company level

Variables and Criteria	Definitions, Interpretation and Coverage	Pricing and Costing Principles
Austria There is one data set generated by the Workers' Compensation Board. It gives good coverage of health related outcomes only.	This data set provides information on deaths, absenteeism, personnel turnover, non medical rehabilitation, registered accidents and occupational diseases, reduced well being, job satisfaction and poor working climate and complaints about health and well being.	
Belgium There are two data sets generated by private insurance companies and company projects. They give good coverage of health related outcomes, corrective costs, preventive costs information and some benefit cost information.	These data sets provide data on reduced well being, administration of sickness absence, lost production time, effects on insurance premiums, and extra wages. They also provide information on investment in H&S equipment, extra investment, purchase of personal protective equipment, extra costs for changed working procedures, extra worktime of direct personnel, costs of internal or external OSH services, insurance compensation, in-company activities, and other workplace costs. Benefit cost information includes productivity and operational effects.	The direct costs of accidents to companies are quantified simply as the insurance premium they pay they pay, this is dependent on the number of accidents for which they claim from their insurance.
Denmark No company data sets reported.		
Finland There are four data sets generated by four methods. These give excellent coverage of information on health related outcomes and preventive costs.	These methods give information on all categories of health related outcomes. One of these methods was developed specially for SMEs, while another has been used within small enterprises.	The first method was developed for the calculation of the costs due to poor working environment. It uses "consequence costs" and the cost of OSH activities "preventive costs". It has been tested in 30 companies and the classification of cost items seems reasonable. The second method (TERVUS) is a computer-aided calculation software for c/b analysis of a specific OSH measure. The problem with using both these methods is to obtain the necessary data. The third method - Human resource accounting (HRA), is aims to provide more specific information on a company's personnel. The fourth method - Consequence Accident Tree (ACT), aims to develop a reliable cost calculation method and to apply this method in the workplace.

Variables and Criteria	Definitions, Interpretation and Coverage	Pricing and Costing Principles
France There are two data sets generated by two companies, an SME with less than 50 employees and a large company with over 500 employees. These data sets give information on the health related outcomes, corrective costs and prevention costs data.	The SME data set gives specific information in relation to registered accidents and occupational diseases, reduced well being, job satisfaction and poor working climate, complaints about health and well being, and effects on insurance premium. The SME has data on prevention costs in terms of investment in safety and health equipment, additional investments in capital goods, purchase of personal protective equipment, additional costs for changed working procedures, extra worktime of direct personnel, costs of internal or external OSH services and other workplace costs. The large company data set provides data on administration of sickness absence, lost production time, and extra wages. Information on preventive costs related to additional costs for changed working procedures.	The average cost of an occupational accident is calculated as the total cost of accidents divided by the number of accidents.
Germany There are five company data sets. The first three enterprise are in the metal working industry with 300, 600, and 1400 employees. Enterprise 4 was in public traffic and supply with 3000 employees. Enterprise 5 was in the chemical industry, with 8900 employees. These data sets have information on the health related outcomes, corrective costs, preventive costs and benefits.	All enterprises had available data on absenteeism, registered accidents and occupational diseases, reduced well being, job satisfaction and poor working climate, effects on insurance premium. All had information on prevention costs specifically relating to investment in H&S equipment, purchase of personal protective equipment, and innovative capacity of the firm. Three of the companies had personnel turnover figures, and data on complaints about health and well being. Two of these had information on non medical rehabilitation and liabilities/legal costs, while only one of these also had data on damaged equipment due to accidents. Four companies had information on the costs of internal/external OSH services, two had data on additional investments in capital goods, while a different two companies had data on productivity. One company had information on in-company activities and other workplace costs, while another company had data on the quality of its products and services.	

Variables and Criteria	Definitions, Interpretation and Coverage	Pricing and Costing Principles
Greece There is one data set from a company called the Public Power Corporation. It employs approximately 35,000 people. It gives data on health related outcomes and corrective costs only.	The data gives figures for deaths, absenteeism, registered accidents and occupational diseases, and effects on insurance premium and extra wages.	The study calculated the direct financial costs of accidents in the company for 1991 and 1992, based on the figures: number of accidents by age duties and previous service of victims wages according to duties and experience days of absence The study was based on the assumptions that: the company pays one extra full time employee of similar qualifications and experience to replace each injured person the number of non productive hours paid by company for each accident vary from one to five according to the severity (days of absence) of the accidents and that the pensions had to be paid up to a certain date.
Ireland Data was available from a survey of 300 member companies of the Employers' Confederation. The survey related to employer/public liability claims for personal injury. The data provided information on some health related outcomes and corrective costs.	The data provided information on absenteeism, registered accidents, effects on insurance premium, legal costs, and extra wages.	
Italy Two data sets from two companies are reported. The first company was in the energy sector with 11,000 workers and the second was in the packaging sector with 250 workers. Data available related to health related outcomes, corrective costs, preventive and benefit costs.	Data related to deaths, absenteeism, personnel turnover, registered accidents and occupational diseases, administration of sickness absence, damaged equipment due to accidents, other non health related costs, effects on insurance premium, and liabilities. The large company also had data on non medical rehabilitation, complaints about health and well being and lost production time. Both companies had data in relation to in-company activities and productivity. The large company had data for investment in H&S equipment, extra worktime of direct personnel (training costs), costs of internal/external OSH services, and the innovative capacity of the firm (auditing costs for constant auditing). The smaller company had data on the quality of products and services (costs of work hygiene and sanitary control) and other operational effects such as expenditure on energy materials.	

Variables and Criteria	Definitions, Interpretation and Coverage	Pricing and Costing Principles
Netherlands There are four data sets reported, generated by four studies involving companies. The data provided information on health related outcomes, corrective costs, preventive costs and benefits costs. The first study involved a comparison of targets for a programme to prevent low back pain complaints and their realisation. The second study involved the development of a model to calculate the costs and benefits of a policy on sickness absence for an individual company. This model was applied to six companies. The third study involved the development of an instrument to assess the costs and benefits of investments to improve working conditions (applied to six enterprises). The fourth data set was an award winning essay on the costs of sickness absence and the factors influencing sickness.	The data captured information on absenteeism from all studies. Companies from three of the data sets had data on administration costs of sickness absence, lost production time, and effects on insurance premium. Two of the data sets had information on personnel turnover, while one had data on registered accidents and occupational diseases and reduced well being, job satisfaction and poor working climate. Three data sets had figures for costs of internal/external OSH services. Two of these data sets also had data on productivity and quality of products and services. One of these data sets also had information on investment in H&S equipment, additional cost of substitution products, purchase of personal protective equipment, extra worktime of direct personnel and opportunity costs.	
Spain There are five data sets generated by companies. The first company is in the transport sector with 5,200 workers. The second company is a hospital with 3,300 workers. The third company is in the industrial sector with 2,150 workers. The fourth company is also in the industrial sector with 500 workers. The fifth company covers over 42,000 workers in Catalonia and has 150,000 workers in Spain. The data captures information on health related outcomes only.	All five companies had data on deaths, absenteeism, and registered accidents and occupational diseases.	
Sweden There are data sets from four institutes. They are the Board of Occupational Safety and Health, the Employers' Confederation, the Association of Local Authorities and the Federation of County Councils. These data sets provide information on health related outcomes and some data on preventive costs.	Four of the organisations had information on absenteeism. Three of these also had figures for personnel turnover. Only two of these had data on preventive costs; these were in relation to extra worktime costs of direct personnel.	

Variables and Criteria	Definitions, Interpretation and Coverage	Pricing and Costing Principles
UK There are data sets from five very large organisations. These are Norwich Union, Willis Coroon Insurance Brokers, GMB Union, Chemical Industries Association and the Association of British Insurers. The data sets provide information relating to health related effects, corrective costs, and preventive costs.	The data sets specifically relate to deaths, sickness absenteeism (days), personnel turnover (permanent disability), registered accidents and occupational diseases for health related outcomes. There is also some information in relation to corrective costs re administration of sickness absence, damaged equipment, costs of investigations, effects on insurance premium and legal costs. Three of the organisations also recorded information on compensation received from insurance.	Damaged equipment is included as a lump sum for claim plus costs of investigation; loss of future earnings and the number of claims are taken as a measure of risk.

This section outlines the conclusions from the survey of national and company level data sets.

- Epidemiological analytical articles and accurate economic assessments on occupational accidents and work-related diseases are almost non existent
- There are no methodologies at national level which are systematically used for impact assessments during the OSH regulatory process
- Occupational accidents underreported
- The definition for occupational diseases appears to vary between countries, with some using a list system of registered diseases, while others allow for the linking of potentially any disease with the workplace
- The data sets which are collected at national level are very difficult to compare because of the facts that different data sets are collected, and reliability and validity tend to be poor
- The data sets which are collected at company level may be more comparable, but reliability and validity also tend to be problematic here
- There are many missing areas of data at both national and company level which would be needed to perform a sophisticated cost or cost benefit analysis
- There is almost no data collected at the individual level
- Occupational diseases are drastically underreported. This may be due to the complexity of the procedure in being able to register a disease as related to occupation (France) or due to collection systems of data not being integrated (Ireland)
- There is a lack of centralisation and integration of all data collected
- There is a low awareness of the need for methodologies for socio-economic assessment of occupational accidents and diseases in companies
- A mechanism linking insurance premiums paid by enterprises and their performance in OSH prevention may offer financial incentives to enterprises for OSH prevention. This occurs only in some countries, for example, France, Greece.

5. Requirements and development of a economic evaluation methodology for OSH in companies

5.1 Background, goals and development of the methodology

In this chapter an overview is given of the requirements and development of a methodology for economic evaluation of costs and benefits in the field of OSH (Occupational Safety and Health), intended to be used in companies. The methodology will assist a user to prepare and perform an assessment resulting in calculation or estimation of costs and benefits to the company of :

- health and safety management and investments at the company level;
- occupational accidents, diseases and work related illnesses;
- its effects on company performance.

This draft methodology is based on the information gathered in the first year of the SHAPE-project and the discussions of the Amsterdam Seminar, then finalised by the project team. The methodology to be practically applied and evaluated in the second and third year of the SHAPE-project in a number of European companies.

This chapter is introduced by a sketch of the background, the goals and the development process of the methodology. Section 5.2 gives a description of the basic concepts of costs and benefits as applied in the methodology. In the next section (5.3) the practical requirements on the methodology are worked out, which is followed by the suggested format of the methodology (section 5.4). Finally the process of further development is sketched (section 5.5).

5.1.1 Background

It is believed (European Agency, 1998) that there is a need for adequate instruments for economic evaluation analysis at the company level. These instruments will be important for the company's economic position with regard to the improvement of working conditions. An accepted economic evaluation will support decision making on safety and health management, as it clearly indicates both the costs and the economic returns that may be expected. Better information on the economic returns of attention to safety and health at work is likely to prompt action in enterprises.

In practice users in companies are confronted with a wide range of situations in which an economic assessment is useful. Until now, various instruments have been developed, but its reported use is limited so far. Reasons are current problems with the complexity of the methods, the limited support in practical application and also the difficulties users experience in collecting adequate data.

5.1.2 General goals of the methodology

The general aim of the methodology is to provide users in companies with a set of instruments (applications) to be used to perform various kinds of economic analyses with regard to all aspects of management that are related to occupational safety and health, occupational accidents and work related illnesses.

The methodology will have an open structure, so that it supports various kinds of specific needs and context of the future user. The methodology will not be a

prescriptive recipe, but will have an open structure that guides the users towards valid economic assessments.

The methodology will contain various procedures and calculation schemes so that it suits users in differently sized companies in all EU Member States.

Determination of specific requirements and user needs is seen as a part of the methodology development.

It is recognized that these goals are very wide and need to be elaborated and specified. This is best done in an iterative way. Section 5.3. further elaborates on the requirements.

5.1.3 The methodology development process

Before reporting on the requirements themselves, it is worthwhile to outline the development process which will take place and to comment on the nature and role of requirements within the development process.

The development of the methodology will follow these stages:

1. exploration of the problem to be addressed (phase 1 of SHAPE project, literature surveys, inventory of parameters);
2. user requirements analysis (phase 1, survey among professionals, representatives of employers, employees and governments);
3. development of a prototype methodology (phase 2);
4. user feedback (phase 3, testing in 90 companies);
5. amendment of the prototype (phase 4, analysis of the effectiveness);
6. development and testing of a final version of the methodology (phase 5);
7. application and evaluation (phase 6, application in 30 companies)

The development of the methodology begins with an exploration of the problem to be addressed - in this case an examination of the issues surrounding the assessment of the costs and benefits of occupational health and safety practice. This phase of development has been undertaken within the first year of the project and the results from this activity are contained in this report.

The second phase of development - user requirements analysis is generally organised in two stages. The first of these consists of asking a representative user group for their opinions on what they believe the methodology should do and what should be its functionality and structure. However, a common problem in asking for requirements is that they only have a poor understanding of both the nature of the problem to be addressed, and more commonly, that they do not clearly understand the solution being proposed. A further related issue which often occurs at the requirements specification stage is when a tool with new functionality is being proposed, they have difficulty in imagining their potential usage of the tool.

These problems with requirements specification lead to the need for a second stage of requirements gathering at a point in the development process where they are more able to understand what is being proposed. This can most usefully take place when the prototype tool has been developed, and within the context of the SHAPE project, this has taken place in September 1998 when the first project workshop took place. An important feature of the prototype at this point of development is that it need not be complete or even bear a strong resemblance to the final version of the methodology. Its function is to enable users to understand the nature of the

solution being developed, and to facilitate the generation of more specific and accurate requirements, rather than to anticipate in detail the final structure and function of the finished methodology.

The first phase of requirements gathering has taken place, the results of which are reported upon in this report (section 5.3.). In addition, the results from first project workshop, where requirements were gathered from approximately 50 experts in the field, are incorporated into this report.

The third phase of development consists of the development of a prototype of the tool. This task is currently underway, and the initial developments in this regard are reported upon in this report chapter 6. The fourth phase of development - user feedback - will partly take place in September as already indicated. In this activity, participants in the project workshop were asked to comment in detail on the prototype methodology.

The remaining phases of the methodology development process will take place during the second and third years of the project, and these involve extensive testing of the methodology and its amendment on the basis of the testing programme.

5.2 What are possible OSH-costs and benefits?

The methodology starts from the notion that preventive activities and safety and health management at the company level has effects on the incidence of illnesses and accidents as well as effects on the productive performance of companies (see Figure 5.1).

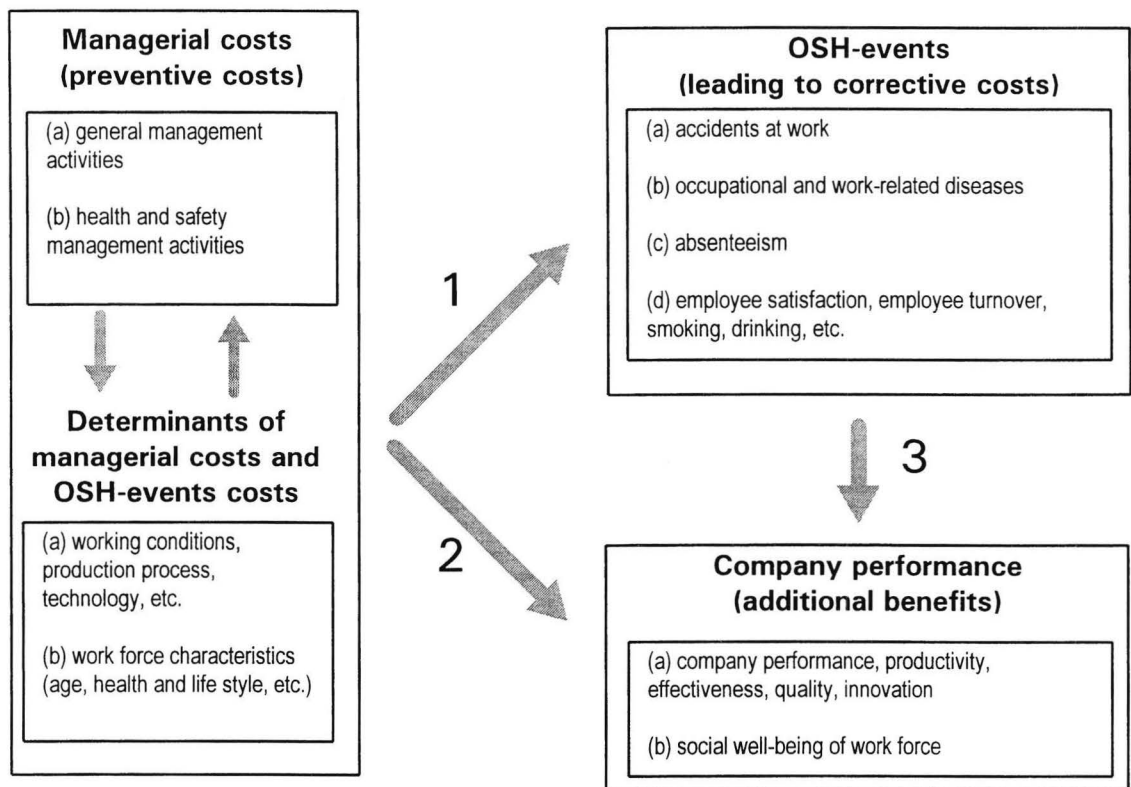


Figure 5.1 General model of the relation between conditions at work, occupational accidents and diseases, work related illnesses and company performance.

A distinction is made between a number of causal variables describing the situation at work and its effects. The causal variables reflect organisational and managerial activities, the actual working conditions and characteristics of the work force. These include all preventive activities. Usually the activities lead to costs to the company. The effect variables comprise the direct results such as accidents, diseases and employee behaviour like absenteeism and turnover. These effects usually lead to damages or costs to the company. Note that prevention will reduce the number of accidents and occupational diseases leading to lost savings (benefits). Furthermore these effects can in their turn give rise to effects on company performance.

It should be noted that preventive activities influence company performance indirectly (e.g. less sick leave, which in turn leads to less production losses) and directly (the measure leads directly to an improvement in production or a safety measure impedes normal production practices). Many safety measures and ergonomic improvements have both direct and indirect effects on productivity and quality at the same time. Also the effects of preventive actions are hard to isolate. For instance, good house keeping in a workshop can be seen as a specific safety improving action, resulting in less accidents. It can, however, also be regarded as a normal activity that results in better quality and productivity.

Occupational safety and health is more and more an integral aspect of day to day company management. As a consequence it becomes increasingly difficult to distinguish actions and practices that have a safety and health goal from other operations and management activities.

The concepts of costs and benefits should be handled with care. Costs are defined as cash flows away from the actor or reduced income. Benefits are savings on costs that should have occurred otherwise or additional cash flows towards the actor.

From this definitions it follows that:

- costs to one party can be a benefit to another party at the same time;
- absenteeism leads to costs to the company, because absenteeism leads to the company spending extra money or having less income;
- reduction of sick leave (due to prevention) is a benefit to the company as prevention leads to less expenditures (saving or cost reduction).

The methodology will address all aspects of occupational safety and health management and its effects. The economic influence of the prevent situation in companies and the work force are acknowledged, however, the methodology does not take this into account.

5.3 Practical requirements of the methodology

5.3.1 Requirements on the methodology - 1st phase, national respondents

The survey asked respondents in 14 countries a number of questions concerning their requirements on the methodology to be developed in the SHAPE project. A summary of their responses is shown in table 5.1.

Table 5.1 Requirements on the methodology - national correspondents

Requirements	Level	Requirements	Level
Practical use		accuracy and basis	
easy to use	1	accurate enough	
not time consuming	2	scientifically based	3
user friendly	2	reliable	2
simple		valid	2
cheap	2	precision	1
expense in relation to task	1	transparent (make clear what is done)	3
participatory	1		
efficient	2	Content	
basic in first instance	1	focus on core problems	2
self instructing		include externalities	1
		address productivity and quality, make link	
Relation to company practices		comprehensive	3
support of info systems in the company	1	also address social impact	1
integrate into company accountancy	4	give meaningful information for decision making	2
integration into works council data collection		maintain non-monetary parameters	2
serve as an information system	2	link cause and effect	1
easy to gather information	1		
known data sources		Application, functionality	
flexibility, adaptability	1	acceptable across a range of industries	1
flexible, allow for rough estimates mix with judgements	1	must be seen as having value	
detailed, allow disaggregate analysis	1	fit to SME characteristics	2
different levels of detail		improve on existing data	2
		support social partners	2
		allow for benchmarking	

Table 5.1 organises the requirements which were elicited from respondents into five main categories - practical usage of the methodology, the relationship of the methodology to company practices, the level of accuracy and the basis for the methodology, the content of the methodology and its applications or functionality. These categories are not necessarily exclusive, but they provide an starting point for analysing the requirements and for constructing the methodology.

It should be borne in mind prior to this analysis that the respondents to the survey were unlikely to be direct users of the methodology, and that they only represented workplaces by proxy rather than coming from workplaces themselves. This feature of the respondent group often leads to requirements being stated at a general level, and in terms which may conflict with each other.

The requirements of users were spread relatively evenly among these five categories, indicating that users wanted a balanced methodology, which is both practical and soundly based and which integrates well with existing company practices.

Some of the more important requirements, in terms of the numbers of respondents who thought them worth mentioning, concerned the need to integrate the methodology into existing company practice, the need for it to be scientifically based, the need for it to be transparent, and that it should be comprehensive. Other important requirements concerned user-friendliness, efficiency, the effort and cost of usage, reliability and validity, its focus on core problems, that it should provide support for decision making, it should include non-monetary issues that it should support the social partners, it should build on existing data and that it should be capable of application to SMEs. (The numbers of respondents citing specific requirements is not so important here, as the small numbers only provide a rough guide to the importance of specific requirements. Of more importance is the fact that requirements were mentioned at all.

Also of importance here is the fact that some requirements were not mentioned. Most notable of these concerned potential requirements on simplicity, accuracy and the need for the methodology to be self-instructing. However, too much should not be read into this finding at this stage of development, as it would seem more than possible that potential users would value these features in a methodology.

A preliminary analysis of these requirements indicates that some of them are likely to be in conflict. Specifically, the requirements that the methodology should be scientifically based and should be consistent with company accounting practices may be in conflict, since company accounts rarely provide sufficient detail for scientific studies to be conducted. Further elements of this potential conflict are evident in the requirements for comprehensiveness, cheapness and that it should not take too much effort to apply.

In summary, the requirements as currently stated give only a general guide to the features which the methodology must have. Even at this general level, it is clear that the methodology must have a clear practical focus and yet be accurate and soundly based

5.3.2 Requirements on the Methodology - 2nd Phase, project workshop

Within the context of the one and half day project workshop, which was held in Amsterdam in September 1998, more than half a day was devoted to generating requirements on the methodology. The following procedure was adopted to generate requirements:

- Presentations were made to the workshop on:
 - Current requirements on the methodology
 - The prototype methodology
- A 'Sticker Parade' was held which addressed three central questions:
 - What obstacles exist to developing and implementing the methodology
 - What should the methodology be able to do
 - What are your requirements on the methodology

Note: A Sticker Parade is a version of the Delphi technique, which allows participants to identify the most important answers to the questions asked, and for the responses to be sorted into meaningful categories.

The results from the Sticker Parade have been analysed following the workshop and these are reported on below.

What obstacles exist to developing and implementing the methodology ?

Table 5.2 summarises the main responses to this question. These answers may be considered as being an indirect method of generating requirements since it does not ask about the methodology per se, but asks about the problems it may encounter in either its design, marketing or implementation.

The obstacles to developing and implementing the methodology are organised into six main categories on the basis of a content analysis. By far the most important category was the 'Motivation and Marketing' category which accounted for 24 of the 86 obstacles which were cited. Here the main concern was with issues of persuading stakeholders to use the methodology, especially when they had low motivation to do so. In addition, there were concerns about the overall marketing strategy which might be adopted. However, it should be noted that there appeared to be an assumption that the methodology should be capable of being applied to all enterprises, regardless of their motivation or interest. This is an unrealistic expectation to place on any method, since there is no means of obliging enterprises to use the finished product. The best that can be achieved is to develop a product which is capable of being used in as wide a range of enterprises as possible and to develop an appropriate marketing strategy for its dissemination.

Table 5.2 Obstacles to methodology development

Obstacle	Count	Obstacle	Count
The mechanics of calculation	4	Motivation and marketing	24
Accuracy of calculation	1	Low motivation among stakeholders	8
Underestimation of human labour costs	1	Marketing and selling of the methodology	4
No realistic views on effectiveness	1	Usage will be limited to OSH professionals	2
At company level, only a small part of costs are visible	1	It may deal only with marginal matters, not OSH promotion	2
Benefits	13	Needs to emphasise positive, creative thinking	1
Benefits are hard to quantify	8	The quantification of 'human' consequences	1
Wrong estimates of costs and benefits lead to bad decisions	2	Dissemination of the methodology	1
Benefits are usually long-term	2	Perception (denial) by companies of OHS risks	1
Benefits occur outside the company	1	Who will the users be ?	1
Data	14	Lack of interest in piloting the methodology	1
Lack of knowledge of cause and effect	4	Establishing regular usage of the methodology	1
The methodology will collect only quantifiable data	3	Understanding each others work methods and showing respect for those methods	1
Difficulty with soft variables	2	Not generally accepted by all concerned	1
Relevance of data collected	1	Opposition of interests	1
Difficult to gather data in companies	1	Complexity	12
Comparability of data between countries	1	There is a danger of becoming too complex	12
Difficulty of obtaining relevant data		Other problems and barriers	10
'Wrong' usage of results	9	Too open a method, lack of specific aims	4
It may encourage narrow thinking	6	Insufficient information on prevention alternatives	2
Lack of global thinking instead of economic analysis	1	Discretionary OSH expenditure may be less than what is legally required	1
Misuse of the results	1	Setting the objectives for CBA	1
It may give employers the chance to argue for reduced OSH	1	Amending the methodology on the basis of field trials	1
		Inadequate funding for OSH actions in the company	1

The next most important category concerned the data to be used within the methodology. Here the concerns were related to issues of availability and reliability of data within the company. In addition, there were concerns expressed about using relevant and available data. These concerns are realistic, as if data aren't available, then the methodology cannot be used. The methodology will provide guidance on what kinds of data might be used and how it might be generated.

The category of 'Benefits' was also important, especially in relation to the difficulties of calculating either short-term or long-term benefits health and safety interventions. It is clear that the methodology should make every effort to address these concerns, as their quantification or inclusion within the methodology is essential to ensure that a balanced view is taken of the effects of OSH interventions.

Another potential obstacle concerns the issue of the complexity of the product which emerges from the project. There was a very clear directive from the workshop participants that the methodology should not be too complex, though if it is to be accurate, reliable and applicable in a number of contexts, great care must be taken to ensure that the complexities of its operation must be kept hidden from the user.

Workshop participants also gave a very clear message in relation to the scope of the methodology, both in general discussion and as part of the results from the Sticker Parade. In general terms, it was felt that the methodology must focus on much more narrow cost benefit analyses, as it was felt that such a focus would not necessarily lead to either accurate results, or serve the function of promoting OSH activity. In addition, it was felt that there is a great need to incorporate 'softer' issues into the methodology, in order to ensure that a balanced view was taken. As a result of these concerns, many participants expressed fears that the methodology might be misused within enterprises, either to produce 'incorrect' estimates of costs and benefits or as a means to suppress OSH activity. This strong feeling among participants will be given due weight in methodology design, and while it is impractical to 'design out' misuse of the methodology, every support will be provided to users to incorporate non-quantitative elements into the usage of the methodology.

There were surprisingly few concerns about the accuracy of the calculations generated by the methodology. In part, this may have been due to a recognition that accuracy depend in large measure on the quality of the data available, and perhaps also because of the concerns that the methodology itself should be broadened beyond narrow cost-benefit calculations. The full meaning of this issue is further explored below in the discussion of requirements on the methodology.

What should the methodology be able to do ? / What are the requirements on the methodology ?

Table 5.3 below details the responses to the questions on requirements and the operation of the methodology. The responses to these questions have been amalgamated, as they cover similar areas.

Table 5.3 Requirements on the methodology - workshop participants

Requirement	Count	Requirement	Count
Awareness raising/education/marketing	33	Simplicity	21
Should raise the priority of H&S/encourage long term investment	9	Easy to use but accurate	13
Generate increased knowledge of OHS	6	Simple to understand	4
Comprehensive regulation labour participation	4	Simple	1
Global sensibilisation/raise awareness	3	Accessible language and concepts	1
Should help convince that prevention is better than correction	2	Stand alone usage	1
Highlight the importance of health to company performance	2	Company friendly	1
Show what is important and/or profitable	1	Transparency	4
Show how important measures can be	1	Use clear and concise language and concepts	2
Agreement at company level about the relevance of variables	1	Makes clear what is done	1
Encourage innovation and a wider awareness of the benefits of OSH	1	Clarity to end users/consumers	1
Generate new information	1	Flexibility	8
Show the complex nature of cause and effect	1	Different for/tailored to large companies and SMEs	4
Give guidelines	1	Usable by different groups of users	3
Have a wide concept of health	8	Supports many usage scenarios	1
Focus on health not just safety	5	Accuracy	27
Include human costs	2	Accurate enough and reliable/comparable	17
Should be comprehensive	1	Consistent - comparability across companies and EU	7
Goal setting	18	Efficient	1
Should help companies to be cost effective with H&S	12	Scientifically sound	1
Provide a choice of possible answers	2	Avoid double counting	
Provide information for problem solving	1	Fit with company practice	37
Deal with important matters only (user defined)	1	Should be consistent with company decision making practice (financial)	12
Define specific aims	1	Must enable integration with global decision making	5
Should provide information on investment decisions	1	Integrate with company accounting	5
Moral requirements	12	The methodology must point directly to practice	3
Should not justify unsafe decisions	4	Should focus on compliance with risk assessment	2
Should support 'socially correct' decisions	4	Should be acceptable in pilot companies	2
Should focus on work environment change	2	Practicality	1
Should help in identifying hidden costs and benefits	1	Include only relevant and realistic variables	1
Should fit with H&S objectives	1	Utility to H&S practitioners	1
Decision support	19	Reduce choice of variables for companies	1
Support for decision making	14	Issues and variables must be recognisable and useful	1
Help prioritise OSH interventions	2	Capable of being integrated with existing company software	1
Give meaningful information for decision making	1	Should not need major data collection	1
Provide support on finding the relevant variables	1	Should address real user needs	1
Select indicators and methods of analysis	1	Process issues	12
Methods	5	Generate discussion	5
Take account of legislation and social security differences between countries	2	Involvement of workers and representatives	4
Show short term benefits to companies	1	Secure support of line managers and workers	3
Quantify rather than count money values	1	Other requirements	5
Be available in all languages	1	Help improve productivity and wellbeing	1
		Add a few new variables to standard calculations	1
		Calculate the cost of accidents	1
		Include externalities	1
		Take account of existing national data	1

In general terms, the most significant requirements to emerge from the workshop marked a shift in emphasis for the direction of methodology development. Specifically, workshop participants wanted the methodology to expand in scope, away from what was perceived as a narrow focus on traditional cost-benefit analysis, towards a broader analysis which would include a wider range of qualitative variables. In addition, the methodology should provide much more support for the process of undertaking analyses and should have a significant educative function, a marketing or promotion role in relation to OSH interventions and should support a participative process of analysis which involves all workplace stakeholders. This change in emphasis arose because of the widely held belief that traditional cost-benefit analysis CBA has significant weaknesses, especially in relation to the assessment of benefits, which led to the conclusion that quantitative analysis needed to be set in a broader context than traditional CBA would allow.

This shift in perspective is reflected in Table 5.3, where the second most prevalent category of requirements were expressed in relation to an awareness raising or educative function (33 out of 219 requirements). Important requirements here concerned the need for the methodology to raise the priority of OSH investment within the company and the need to increase the knowledge base of the company in relation to OHS. Also reflecting this shift in perspective were the categories of providing decision support to the user (19 requirements), moral requirements (12 requirements), process issues (12 requirements), embracing a wider definition of health (8 requirements) and methods (5 requirements).

The most prevalent category of requirements concerned the need to ensure that the methodology integrated well with company practice (37 requirements). Two aspects were especially important here - the need to integrate with decision making within the company and the need to integrate with company accounting practice.

The next most prevalent sets of requirements concerned the need for the methodology to be kept simple in relation to its usage (21 requirements) and accurate (27 requirements). Though there was some overlap between these categories, the message for methodology development is clear - it must be both simple to use and accurate and reliable enough to enable valid conclusions to be drawn. To some extent these requirements may be in conflict, as simplicity might seem to imply that rigour should be compromised. However, the use of 'confidence boundaries' may help to overcome criticisms of accuracy and reliability, and these can be produced within the context of a simple and transparent procedure.

One final significant category of requirements concerned the need for the methodology to assist in the process of goal setting (18 requirements). This category refers to the ability of the methodology to set realistic OSH goals and also to the capacity of the methodology to assist in making cost-effectiveness decisions. There were other relatively minor categories reported in relation to transparency and flexibility, with a residual small number of unclassifiable requirements.

One final issue to emerge from the workshop (of which the project team was already aware) concerned the need for this requirements generation process to be extended to include end users of the methodology. This extension of the process will now take place in Year 2 of the project.

5.4 Format of the methodology

There are a number of possible formats which can be used to deliver the methodology. Traditionally, a paper based, manual type format is used for these kinds of methodologies. However, as the methodology will have at its core a 'calculation engine' (see Paragraph 5.2), it is appropriate to consider electronic formats for presenting the methodology. At minimum, it will be desirable to present the calculation engine in electronic format, as this will considerably ease the load both on the user of the methodology and on the developers, who will not then need to present laborious calculation routines in paper format.

Furthermore, electronic formats offer far better opportunities to meet the requirements with regard to hiding the complexity of the methodology to the user and the electronic format is superior to the paper format in supporting (in a context or task sensitive way) the user by presenting examples, data sources, case studies and the like.

5.5 Conclusions and implications

In addition to the initial goals of a methodology that can be applied in companies (in particular SMEs) throughout the European Union, the analysis of requirements and obstacles has the following implications:

- the methodology should have a wide scope, not just a narrow (financial) cost/benefit; also more qualitative variables are to be included;
- the methodology should offer the user considerable process support;
- in the methodology educative functions should be included; these will also allow for a larger variation in users' experience and will enhance the proper interpretation and use of the results;
- emphasis on estimation of benefits;
- integration with or link to common company practices; this includes three aspects: decision making procedures, accountancy practice and registration of relevant data;
- simple in use; this does not mean that the methodology should be simple as a whole, its structure and the way calculations are performed may be complicated, as long as this is hidden to the user;
- the methodology should be accurate and reliable enough to allow for conclusions to be made and to for moving to action;

the utility and usability of the methodology in itself should be enough to anticipate problems related to scepticism and marketing.

6. Outline of the methodology

6.1 How to read this chapter

This chapter gives an overview of the proposed methodology and elaborates on a number of parts of the methodology. The aim of the chapter is to describe the fundamentals, basic approach and content of the methodology and to present some details of assessments and calculations. It is *not* the intention in this chapter to present a ready for use procedure.

Section 6.2 describes the general approach, which is translated into the functional structure of the methodology in section 6.3. In the subsequent sections (6.4 to 6.8) the contents of the methodology are detailed. The text of these sections is organised according to the basic components of the methodology. The presented order is logical in the sense that the results of each step are used or further elaborated in the next steps. However, when the methodology has an electronic format, this need not be the order in which the methodology presents itself to the user.

6.2 General approach

The requirements for the methodology, as set out in section 5.5, have a number of consequences for the architecture of the methodology:

the adopted general approach can in principle meet the requirements. For the general approach, three issues are particular important:

- user needs;
- orientation towards the process of assessment of socio-economic costs;
- support by explanatory and educational functions.

User needs

The difficulty of using a method for economic impact assessment is usually not only the calculation itself, but also choosing adequate indicators, finding appropriate data and interpreting the outcomes of a calculation. It is the aim of the methodology to give support also in this respect, by

- offering an open and non-prescriptive structure, so that the methodology can successfully be applied in a multitude of situations;
- offering help on selecting the appropriate techniques for the questions at hand;
- assisting in the selection of relevant variables and collecting (or constructing) adequate data;
- providing a sound, valid and country (or even sector) specific calculation scheme, in which recent insights on the economics of the working environment, on the relation between occupational accidents, diseases and work related illnesses and their economic effects are incorporated.

The starting point of the methodology is the task, need or specific question a user in a company may have, such as:

- how much money are we loosing as a result of work related illnesses and occupational accidents?
- will the investment in new protective equipment or training programmes pay off?
- which of the alternatives for workplace improvement is financially the most attractive?
- what is the most cost effective way to reduce noise to acceptable levels?

- how can we prioritise actions in our safety and health management, keeping in mind the costs and the potential benefits?
- what damage resulted from last accident?
- how are our OSH costs compared to other companies?
- how can the added value of a medical or safety and health department be shown to general management?

The requirements for the methodology, as set out in chapter 5 have a number of consequences for the architecture of the methodology.

- it must be process oriented.
- it must contain educational functions.
- it must have adequate accuracy and reliability.

Different applications exist for each of these questions. An important notion in this regard is that the basic approach is very much the same. Furthermore all applications rely on the same principles of quantifying and pricing the effects of OSH management or interventions. This allows a methodology with a limited number of basic steps while still covering a wide range of user needs and potential applications.

Process of assessments

The methodology will support the user regardless of the way of working adopted. The user may have a mixture of approaches, such as:

- Concentric approach: the first results are obtained on basis of a fairly small number of variables (not worked out in much detail) and based on rough estimates. Based on this first assessment choices are made for further elaboration, the use of more accurate data sources, more sophisticated estimation techniques or more detail in variables.
- Linear approach: the calculation is made by performing a number of subsequent steps. In practice this approach is useful to less experienced users.
- Ad hoc approach: The assessment is constructed in a way that is fully determined by the user needs and the possibilities available to perform parts of the assessment. The order is neither linear, nor concentric. The first assessment may be made based on incomplete information. However this may give an idea how to proceed in the assessment.

The methodology does not prescribe a fixed order of activities. Nevertheless, the order presented in this chapter presents a logical way of working. It is most efficient when some attention is paid to each of the presented steps. A first, quick, assessment at the start can be performed with relatively little effort. In general experienced users benefit from this approach as they can quickly pick out relevant issues.

Essential in the methodology is that it is always possible to take shortcuts and to make an assessment in a quick and easy way.

Educational functions

There are large differences in the level of experiences potential users have with regard to economic aspects of occupational safety and health.

The value of the information generated by the methodology depends on the knowledge and experience users have. To maximise the usability and utility, the methodology is largely self-explanatory and contains examples, definitions, frequently asked questions and the like.

6.3 Overview of the structure of the methodology

There are a number of different situations in which an assessment of socio-economic costs of occupational accidents and diseases and work-related illnesses in companies can be useful. Therefore a number of variations for methodologies exist. To the user it is not always clear which kind of assessment is best suited, which is particularly true for the inexperienced user. The methodology will therefore not only support the user in performing calculations, but also in selecting and detailing the most appropriate way for the economic assessment and in the interpretation of the results. Whatever the topic taken at hand, the principles of the economic assessment are comparable: a set of quantifiable indicators is constructed and next a money value is assigned to the indicators (as much as possible). The data input comes from available statistics, is constructed or estimated in an indirect way.

The construction of an assessment process from the needs of the user requires four basic steps, each step further detailing and performing the economic assessment (see figure 6.1):

1. which application(s) best reflect the question at hand?, which economic assessment technique is adequate for the situation? what kind of results are required?
2. what variables or indicators are needed and are possible?
3. where can data be obtained, or - if data is not available - how can estimations be made?
4. how should calculations be performed and how are the results to be interpreted and used?

The methodology includes a support system that helps the user in constructing a useful economic evaluation in a number of steps, starting with the actual need of the user. It also provides help for the interpretation of results.

In each of the steps a number of elements of the assessment are determined by the user. Once the construction of the assessment is complete, a calculation of costs, benefits and economic indicators can be performed, starting from the data (or data strategies) specified by the user.

Figure 6.1 and table 6.1 give an overview of the functional structure and some details on the actual content respectively.

The result of applying the methodology will be an economic assessment together with explanation of what the assessment means and how it can be used.

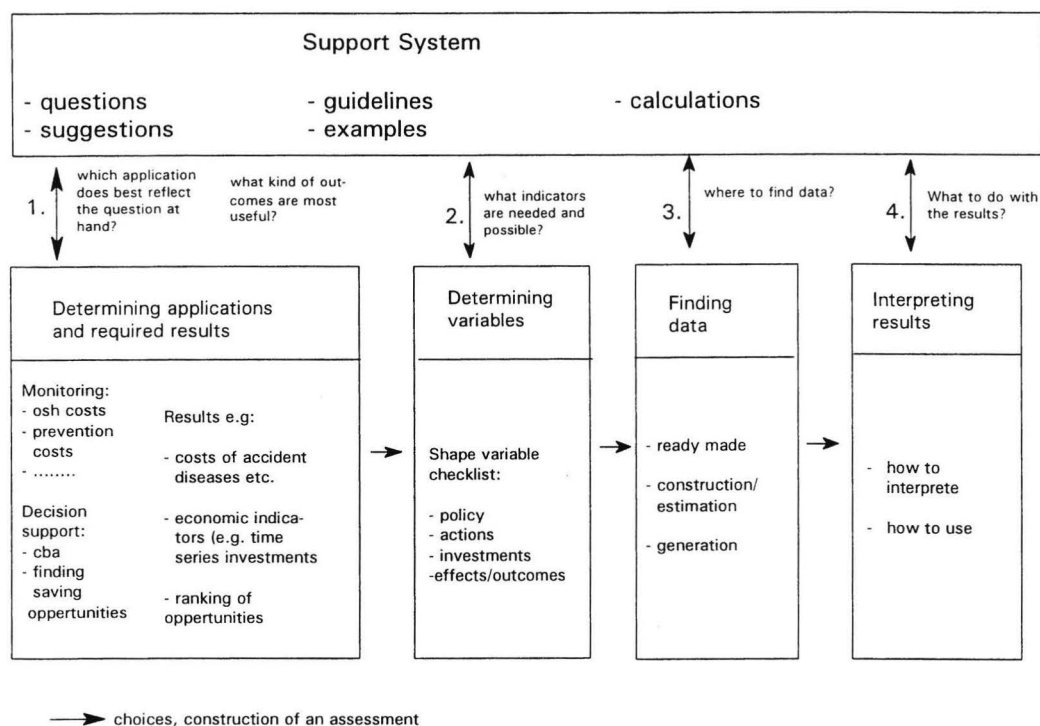


Figure 6.1 Functional overview of the methodology, four basic steps in conducting an assessment of socio-economic costs at the company level.

Table 6.1 Content of the methodology

Item	Goals	Examples of tools
Introductory module description of the methodology	- Overview of the methodology's structure and goal - Overview of the problem areas the methodology addresses	- Case studies of cost benefit analysis and other procedures - Frequently asked questions about economic appraisal
Step 1 Choosing an application and required results for the methodology	- Choice of an appropriate application - Determination of criteria against which evaluations are performed	- Inventory of types of analysis - Minimum requirements of each type of analysis - Strengths and weaknesses of each type of analysis - Selection support
Step 2 Conducting the analysis: selection of variables	Selection of variables to be included in the assessment	- Checklist and description of relevant variables - Selection guidelines
Step 3 Conducting an analysis: finding data or making estimations	- Identification of data sources - Generating data - Inputting data	- Possible data sources - Guidelines on data quality - Guidelines on how to generate useful data - Common pitfalls in data - Suggestions for estimation or approximation techniques
Step 4 Performing calculations and interpreting results	- Calculation of economic effects - Clarification of meaning of results	- Guidelines for interpreting results - How to move from results to action

6.4 Introductory module and support system

Support system

The support system gives guidelines during the construction of the assessment and assists in the process, for instance by asking questions, outlining options, suggesting optional courses of action, providing explanations and definitions, giving examples, referring to data sources and the like.

Once the goals, process and variables included in the assessment are clear, the methodology supports the actual calculation of the result indicators. In this calculations the different situations in the EU Member States is taken into account. As set out in chapter 2, from country to country big differences can exist in the way costs to companies should be calculated because of differences in social security and the national infrastructure on occupational safety and health.

The support system consists of a number databases and decision rules that have as a purpose to support the user in performing the steps of an assessment of socio-economic costs. In its final form the support system may contain:

- support system that will present the user an introductory module in which the methodology is presented and explained to the user database of relevant literature (as discussed in chapter 3)
 - database of statistics currently in use in the EU (as presented in chapter 4, annex 1 and annex 2);
 - database of frequently asked questions (to be constructed);
 - guidelines for selection of applications, variables, indicators or;
 - suggestions for approaches to socio-economic cost and benefit assessment;
 - (electronic, context sensitive) search functions;
 - calculation engine for e.g. cost calculations, including country specific parameters;
 - examples of good practice, cases;
 - process support, actions to be taken in each step, suggestions for next steps.
- Of course, an electronic format allows the functionality to be extended at will.

6.5 Step 1: Applications and required results

As outlined in the previous section, there are different results available an assessment. For instance, it is possible to restrict output to monetary results, such as the costs of an accident or the expenditures for preventive policies in a certain year. But another possibility is to include also result-indicators that cannot be expressed in terms of money, such as improvement in health. For the comparison of alternatives for interventions, a ranking could be a useful method.

So, one of the first activities is to determine what kind of results are required. In large measure, these result reflect the questions a user may have. As a consequence, the application required is chosen on basis of the user needs, but also the context in which economic evaluations are conducted plays a role. For instance, a small company that has little information available would require a different kind of economic evaluation than a large company with an extensive registration on health data.

Step 1 of the methodology deals with three questions:

1. which application is the most appropriate and will give results that best answers to the user's questions?
2. what criteria will be used to evaluate the results of an assessment?
3. What are the goals of the monitoring system or intervention in question; the results of the assessment of socio-economic costs should be in line with these goals.

Selecting an application

There are a number of variations in economic assessments which should be used for specific purposes. Generally two kinds of applications may be distinguished: (1) monitoring and (2) direct decision support (see table 6.2). In addition, some extensions are possible to both of these applications.

For applications of a monitoring nature a set of variables is selected as indicators and these are measured and monetary values are assigned to them as much as possible. Measurement can take place once (for instance a calculation of the costs of accidents or occupational diseases), or can comprise several measurements and result in a time series. The variables may include indicators for preventive action to be taken, such as yearly expenditures for personal protective equipment) and effect-indicators (e.g. the amount of sick leave due to work related illnesses). The choice of the indicators to be measured is open and can depend on the actual needs of the user or stakeholders and the possibilities for obtaining quantitative input. It is quite possible to follow both indicators for actions taken and effects at the same time without assuming a causal relation between the two.

Applications for decision making support normally include choices and making comparisons between various alternatives. Also the decision making deals with projections into the future, whereas monitoring applications are about the present and past. So, forecasting is an essential part in applications that support decision making. In applications for decision making support both variables that indicate the effort or cost of a (preventive) action and its effects are to be included. It is important to have some insight in the causal relation between actions and the effects. Table 6.2 presents an overview of various applications.

Table 6.2 Examples of applications of assessments of (socio-)economic costs. Typical questions that can be answered are shown in *italics*.

Application	Practical use, typical questions the application can answer	Remarks Strengths and weaknesses
I. Monitoring		
OSH costs monitoring	Constructing a time series of one or more variables that reflect safety and health performance and its financial effects. • <i>how is OSH performance developing?</i> • <i>how are prevention costs developing in relation to costs of accidents and occupational diseases?</i>	Needs careful selection of variables and a reporting system in the company. There is no need to assume a causal relationship between interventions and effects, both can be monitored independently
Accident costs	Summary of all costs related to an accident or accidents within a certain period of time • <i>what is the total damage that resulted from last accident?</i>	Gives a focused assessment of costs
Ex post evaluations	Did a particular intervention pay out, demonstration, examples	Especially useful in demonstration projects. Company management is not always interested in ex-post evaluations

Application	Practical use, typical questions the application can answer	Remarks Strengths and weaknesses
Costs of occupational illnesses	Summary of all costs of occupational diseases during a certain period of time (e.g. one year) <i>How much money are we losing because of occupational illnesses and work-related diseases</i>	Focus on formal registered occupational diseases only is likely to give an underestimation of real burden of work related health problems
Benchmarking	Comparison of (financial) safety and health performance indicators with external sources, such as other companies or aggregated sector or national statistics <i>How are our OSH costs compared to other (similar) companies?</i>	So far, little standards for comparison between companies are known. Benchmarking against sector or national statistics may be possible.
II. Decision support		
Cost-benefit analysis of interventions	Comparing expenditures related to an intervention with the (projected) revenues (within a defined period of time) <i>will the investment in new protective equipment or training programmes pay out?</i> <i>how can the added value of a OSH or medical department be shown to general management?</i>	Needs careful consideration of the variables to be included and the time over which benefits are attributed to the intervention.
Choosing between alternatives	Simultaneous cost-benefit analysis of different alternatives to reach the same (or comparable) goals	as above
Finding cost saving opportunities	Where are we losing money, pinpointing opportunities	Breakdown of monitoring data into cost components, find the cost component that has the greatest contribution to the total costs
Cost effectiveness analysis	Comparing costs and effects. Finding the cheapest way to reach a certain effect <i>what is the cheapest way to reduce workload to an acceptable level</i>	The effects need not be expressed in terms of money
Pareto analysis	Ranking a number of alternatives in order of cost-effect (or cost-benefit) ratios <i>what are priorities in a OSH programme (from a viewpoint of costs and effectiveness)?</i>	Gives a financial ordering of attractiveness of alternatives
Analysis of marginal costs and benefits	Does an extra unit of money result in extra benefits	Abstracted form of cost-benefit analysis of cost-effectiveness analysis. Not much applied at the micro level
III Extensions on applications		
Sensitivity analysis	What is the (relative) effect of changes in the assumptions made, which assumptions have a large impact on the results	Advised for every economic analysis.
What-if analysis	What is the effect of (assumed) value changes in some of the variables	Useful if economic return of projects is doubtful: what results should the project give in order to be economically attractive
Scenario analysis	What will be the outcomes given a specific set of variables and assumptions	as above
Technology options analysis	Which alternative technologies are available to solve OSH problems	Finding alternative ways to reach the same goal.
Multi-criteria analysis	Which alternative solution is most attractive, taking all criteria (also non-financial criteria) into account.	Many techniques are available in order to rationalise choice in decision making

Criteria

One important step, especially for applications involving decision support is the clarification of criteria against which the outcomes are evaluated. Two different ways to establish criteria are open. One can follow an analytical approach or one can decide on criteria in a participative way.

In the analytical approach, criteria can be derived from the company's competitive strategy, business goals, company values or norms (see table 6.3). Larger companies often have documents or statements one can refer to. In small companies however, most strategies, goals and values are not made explicit. In small companies it can be useful to explore tacit strategies, goals and values by means of for instance interviews, for example.

Often the selection of criteria leads to discussion between stakeholders within or sometimes even outside the company. In the participative approach different stakeholders are invited into a discussion on the criteria to be applied. General management may emphasise the business goals or financial criteria, whereas lower management may give more importance to more operational goals. Employees or their representatives are more likely to stress criteria like human or social costs

Table 6.3 Analytical approach to the definition of criteria. This overview gives some examples, but companies can have other criteria.

Source of criteria	Explanation	Examples of criteria	Formal sources of information
Competitive strategy	The strategy through which a company seeks to establish a (durable) competitive advantage	• innovative power • price, costs • flexibility • customer satisfaction • quality	• business and strategy analysis • business plans • mission statement
Business goals	Business goals are often expressed in quantitative terms	• price, costs • flexibility • customer satisfaction • quality • market share	• business plans • operationalisation of mission statement
Company values	Most (in particular larger) companies operate from values, which can be of an ethical nature	• employee health and well being • environmental care • human and social costs	• mission statements
Financial goals & standards	Some (most) large) companies have guidelines for the financial performance	• total production costs per unit of goods or services • pay back period, return on investment, net present value, cost-benefit ratios	• financial information system • project evaluation procedures
Operational goals	Implicit or explicit goals for lower management or production departments	• production costs, overheads • uninterrupted production hours • absenteeism and accident rates • budgets	• procedures

Of course one can limit the evaluation to a single or just a few criteria. However it is important that the criteria used are endorsed throughout the company (and in particular the decision makers and stakeholders in question).

Description of goals of monitoring and interventions

Before entering an assessment of socio-economic costs it is useful to describe the goals of a monitoring application, or - in case of decision support - the goals of the intervention. These goals should be integrated into the criteria.

Most important are the activities within the intervention and the objectives and anticipated outcomes of the intervention, preferably in quantitative terms.

Table 6.4 Outcomes of step 1

Topic	basic options	advanced options
Choice of applications	• single application	• combination of applications • extensions (such as sensitivity analysis)
Determination of criteria	• limited list of financial criteria (e.g. costs, payback periods)	• explicit link to company's competitive strategy • extensive list of criteria • mixture of criteria reflecting financial goals, competitive strategy, health and well being • involvement of multiple stakeholders in a participative approach
Goals of monitoring systems or safety and health interventions	• overview of activities & nature of investments • anticipated health outcomes of interventions	• intervention plan, specifying staffing, amount of work, investments • specific quantitative objectives with regard to accidents, illnesses, health, productivity

Usually, only cost and benefits to the company are calculated, but one can choose to include costs incurred outside the company as well (externalities), for instance costs to individual workers.

6.6 Step 2: Selecting variables and indicators

This step deals with the selection of appropriate variables. This selection deserves some attention as several considerations play a role. The results of step 1 have a large impact on the choice of the variables:

- what are important criteria to the user, the company or other stakeholders, the choice of criteria from step 1 need to be translated into (preferably quantifiable) variables and indicators;
- what are the objectives of a monitoring system, these objectives should be reflected in the variables and indicators used;
- what are the goals of safety and health management in the company, which indicators give information about the performance;
- what are the goals interventions, these goals can be reflected in the choice of variables.

In addition one can add:

- (expected or anticipated) availability of data sources;
- (expected or anticipated) possibilities for adequate pricing.

In deciding upon the scope and coverage (i.e. which variables are going to be included) one should strike a balance between the actual needs and usage of the assessment, the interests of stakeholders, the data and resources available.

In the calculation the checklists as presented in tables 6.5, 6.6 and 6.7 serve as a basis. Cost components should be included as much as possible. Ideally, one would (from a standpoint of accuracy and scientific validity) want to include a complete set of variables. However, the inclusion of specific cost components also depends on the needs of the user and the practical possibilities.

At the company level three groups of effect variables may be important:

- corrective costs or costs which are incurred to maintain levels of production and quality; here a distinction is made between health related effects without cost calculation and effects that can readily be expressed in monetary terms (such as damaged equipment);
- prevention costs, all expenditures for preventive action;
- other effects on company performance, e.g. productivity, quality, operational effects and impact on non-economic company values.

As the checklists (see tables 6.5, 6.6 and 6.7) provide general headings, one can quickly decide whether a certain variable is relevant. For the subsequent practical application it may be useful to make a further decomposition into variables of which the value can readily be determined in the company.

Table 6.5 Variables concerning health related effects

nr	Variable	Description
1.1	Health related effects (without cost calculation):	
1.1.1	Deaths, fatalities	Number of fatalities within a period of time
1.1.2	Absenteeism or sick leave (work time lost, costs)	Amount of worktime lost due to absenteeism, may be expressed as a percentage or as number of hours or days
1.1.3	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
1.1.4	Non-medical rehabilitation (except transfers to patients)	money spent by the employer to facilitate returning to work
1.1.5	Registered accidents, occupational diseases	Number of formal recognised occupational illnesses and accidents.
1.1.6	Reduced well being, job satisfaction and poor working climate	
1.1.7	Complaints about health and well being (without sick leave)	
1.2	Corrective costs (non-health related costs or damages, costs incurred to maintain production levels):	
1.2.1	Administration of sickness absence, accidents etc. (work time, costs)	(Managerial) activities that have to be performed by the company following to sick- leave
1.2.2	Damaged equipment (accidents)	Damages or repair costs of machines, premises, materials or products related to occupational accidents
1.2.3	Lost production time, services not delivered	Production time lost as a consequence of an accident (e.g because it takes time to replace machines, or production has to be stopped during investigation)
1.2.4	Other, non-health related costs (e.g. investigations, management time, external costs)	Time and money spent for accident investigation, workplace assessments (resulting from occurrence of illnesses)
1.2.5	Effects on variable parts of insurance premiums, high risk insurance premiums	Changes in premiums due to the incidence of accidents and occupational illnesses
1.2.6	Liabilities, legal costs; penalties	
1.2.7	Extra wages, danger money (if the company has a choice)	Extra spending on higher wages for dangerous or inconvenient work

Table 6.6 Variables concerning prevention costs

2	Prevention costs (expenditures for preventive actions):	
2.1	Investment in safety and health equipment such as exhaustion systems	Costs of specific 'OSH' equipment or additional costs of other investments related to OSH
2.2	Additional investments in capital goods, equipment and buildings	changes in non-OSH related capital goods to facilitate functioning of OSH equipment (e.g. reconstruction of buildings)
2.3	Additional costs of substitution products (per year)	Price difference (e.g. for non-toxic chemicals, lighter product)
2.4	Purchase of personal protective equipment (per year)	
2.5	Additional costs for changed working procedures and maintenance (per year)	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)
2.6	Extra work time of direct personnel: meetings, training, participatory developments	
2.7	Costs of internal or external OSH services, other preventive services	
2.8	Compensations received from insurances	Support for prevention only, compensations received for sick leave or disability are to be excluded
2.9	In-company activities: human resource management, health promotion, OSH policy	
2.10	Other workplace costs	anything that is not covered in the previous headings

Table 6.7 Variables concerning organisational performance

3	Benefits (additional effects):	
3.1	Productivity	Changes in costs to produce the same amount of product or value of extra production with the same resources
3.2	Quality of products and services	Changes in quality. Value depends on company strategy. Cost of quality and productivity are linked
3.3	Innovative capacity of the firm	Ability to innovate in products and production processes
3.4	Opportunity costs (orders lost or gained, competitiveness in specific markets)	
3.4	Other operational effects (reduced costs for facilities, energy, materials)	As far as not included in variable 2.5
3.5	Company image effects	
3.6	Impact on non economic company values	to be derived from mission statements and the like

It should be noted that the selection and elaboration of variables is not a one-off activity. First, it is perfectly acceptable to revise the choice of variables during the whole process of assessment of socio-economic costs. According to increasing knowledge, changing wishes and practical considerations one can add or omit certain variables. Second, one can further detail variables at later stages in the assessment process.

In the process of selecting variable, it should be kept in mind that variables are not completely independent. For instance, an establishing the costs of sick leave, should also include the managerial activities in the company that arise from every case of sick leave. Table 6.8 gives an overview of recommended variables to be included in different applications.

Table 6.8 Overview of recommended minimum set of variables for selected applications. The set of variable can be expanded according to the goals of the assessment and the needs of users and stakeholders.

Application	Recommended variables to be included (minimal)
I. Monitoring	
OSH costs monitoring	selection including both health variables and prevention costs
Accident costs	• deaths, fatalities • sick leave • material damage • liabilities • administrative overhead • lost production time • non health related costs
Ex post evaluations of interventions	• all preventive activities • sick leave & related administrative overhead • non health related costs • productivity and quality (if data allows)
Costs of occupational illnesses	• registered occupational diseases • sick leave • administrative overhead
Benchmarking	choose any of the variables
II. Decision support	
Cost-benefit analysis of interventions	• all preventive activities • sick leave & related administrative overhead • non health related costs • productivity and quality (if data allows)
Finding cost saving opportunities	• sick leave & related administrative overhead • non health related costs • productivity and quality (if data allows) • preventive activities
Cost effectiveness analysis	• preventive activities

6.7 Step 3: Quantification, finding data, pricing principles

The actual determination of socio-economic costs of health effects, but also for productivity or quality effects, involves two activities: first quantifying the selected variables and, second, the estimation of a monetary value (see figure 2.2). Several pricing principles are available and will be used in the methodology, depending on the cost item, available data, needs of the user and the like.

This section deals with the first activity: finding data for the quantification of variables. Three topics are addressed:

- finding data (6.7.1);
- attribution to safety and health at work (6.7.2);
- cause and effect relationships (6.7.3).

Note that the accuracy and reliability of the data usually is the limiting factor in the accuracy of assessments of costs and benefits. Estimation or approximation techniques that are applied to overcome missing data also have limitations with regard to accuracy. Therefore, the use of data deserves some extra attention. The techniques for estimation offered in this section are meant as suggestions to overcome lack of data, but should be handled with care. The techniques offer a practical approach to the data problem, however there is not always a sound scientific basis.

6.7.1 Finding data

The basic data required can be obtained in basically three ways:

1. The data is available and can readily be used in the socio-economic assessment. For instance the costs of equipment for health protection or salaries of professionals are normally included in the company's accounting system. The number of accidents or incidence of occupational diseases can be recorded by routine, many companies have registers of sick leave.
2. The data required is not readily available, but it is possible to make an estimation. For instance, the number of work-related illnesses can be estimated from the sick leave data of the company, epidemiological data and literature (work-relatedness of illnesses), or absenteeism is estimated from sector or national statistics.

In most decision making applications, it is necessary to have an indication of the effectiveness of the intervention, which usually requires some kind of expert estimate on the cause-effect relation. Sometimes data from similar situations in other companies can be used as an estimate.

3. The third option is to generate data specifically for the assessment. For instance, at the company level one can decide to make a registrations, for instance of costs of preventive actions, work related illnesses and the like.

Available data

It is advisable to form an opinion on the quality of the data used, even where the data is readily available. In particular the definitions used and the method and incentives of recording may influence the usability of the data for assessments of socio-economic costs. As discussed in chapter 4, underreporting is a common problem.

Estimation

Estimation is particularly important in forecasting as used in cost-benefit analysis. In general, estimation of missing data is useful when large effects on a particular variable are expected and little or no (reliable and accurate) data is available. In general estimation is difficult. Table 6.9 presents some suggestions. Of course it is possible to construct other estimation methods.

Table 6.9 Overview of some techniques for estimating data when accurate or reliable datasources are not present (adapted from Mossink, 1996)

Variable	Examples of methods for estimations
sick leave, work-related part	• estimation of work-relatedness based on epidemiologic studies • fraction of registered occupational diseases and accidents of total sick leave • extrapolation from external databases • analysis of complaints and diagnosis
productivity effects	• analysis of work processes, analysis of impact of intervention • productivity studies, task analysis • comparable cases and evaluation studies (e.g. from literature) • learning curves
quality effects	• analysis of work processes, analysis of impact of intervention on quality • analysis of relation between working conditions and quality

Generating data

The best way to obtain relevant data is to generate the data within the company.

Several options are open:

- conducting surveys among employees;
- additions to existing information systems;
- implementing a dedicated information system.

Note however that data generation is in general expensive and needs much attention from various part of the organisation. Commitment of higher management is a prerequisite.

6.7.2 Attribution to safety and health at work

A very important step in finding or estimating data is to determine which part of the effects or activities are related to occupational safety and health and the management thereof. With regard to attribution several decisions may be needed:

- 1 The part of the activities or investments or management activities (prevention costs) that are to be attributed to safety and health. A practical approach is to include:
 - those management activities, interventions or investments that have safety and health as a primary goal;
 - the extra activities or investments that have been done on top of other for the purpose of safety and health improvement.

Then of course there are many activities which have improvement of safety and health as an embedded goal. In these cases one can best include all activities and all sorts of outcomes into one assessment of costs and benefits.

- 2 Which part of the effects like sick-leave, turnover and productivity is related to occupational safety and health in the company.

Options to get some indications on the work-relatedness are:

- use of epidemiologic data;
- registration of occupational diseases, accident registration;
- from literature or comparable cases;
- analysis on the impact of labour on productivity and quality.

6.7.3 Cause and effect relationships

In particular for applications for decision making (such as cost-benefit analysis), the quantification involves making estimates or assumptions on the effects of the intervention. In the field of occupational safety and health interventions there are no firmly established cause (or intervention) - effect relationships. So educated guesses, estimations or approximations have to be made in order to obtain some idea about possible benefits of interventions. Several routes (or combinations thereof) may be followed:

- use of information from similar cases and literature;
- high-low, 'what-if' or scenario calculations;
- estimations based on company information;
- information from project or intervention descriptions;
- analysis on the impact of labour on productivity and quality.

Information from similar cases

The same intervention may have taken place in a similar company. Though no two cases are the same, the comparison can give useful information.

'High-low', 'what if' and scenario calculations

When the exact effect of an intervention is not known, it may be possible to give a range in which the effect is likely to be. For instance: absenteeism as a result of an intervention will be 0 to 2% lower. The calculation is then performed for both the upper and the lower limit. The result is a range in which the costs and benefits will probably be.

Alternatively one can make a series of calculations on different assumed effects.

Example: what will be the financial effect if absenteeism drops by 1%, and what at 1.5% or 2%. As an extension, it is possible to construct different sets of assumptions (scenarios) and calculate the effects for each of these sets.

Estimations based on company information

Sometimes it is possible to use (tacit) knowledge or information from several departments in the company. For instance the medical department of safety and health professional may indicate many complaints or injuries may be related to safety and health at work. The quality or production manager can have some clues whether safety and health give rise to quality or productivity problems.

Information from descriptions of projects or interventions

Descriptions of projects and interventions often give useful information for assessments of socio-economic costs. A good description gives information about the goals of the intervention. This is generally the case for engineering projects.

Impact analysis

The consequences of improved safety and health at work on productivity and quality can be estimated by an impact analysis. This analysis should give answers to questions like:

- what are common incidents that disrupt production that can be related to working conditions?
- what aspects of work are of critical importance to productivity and quality; how are these affected by the working conditions?

6.8 Step 4: Calculation and interpreting results

6.8.1 Introduction

Starting from the data and keeping the kind of application and its use in mind, calculations are performed to put a monetary value to a number of variables. During the calculation the specific situation in each of the EU Member States (with regard to e.g. the social security and national infrastructure on OSH) are included.

The general idea is to complete a table in which (selected) variables and monetised values are listed and totals are calculated. In order to obtain meaningful results, some technical issues have to be resolved, such as the period of time that is considered.

The results can be presented to the user in a number of ways. The tabular format, in which all cost components are summarised and an addition is made, is the most common. This form is useful for accident costing, but can also be used in cost-benefit analysis of interventions. In a cash-flow table, this format is extended to

specify costs and benefits over a number of years (useful for ex-ante and ex-post evaluations of specific interventions).

In addition to the presentation of a cost calculation one can choose to present the results as from a different perspective, for instance by presenting scores on effects that cannot be expressed in terms of money (such as company image). In general it concerns the same results, but presented from an other angle.

Current calculation schemes offer various ways to calculate the costs and benefits of occupational safety and health. Most of these schemes, for instance for assessing the costs of accidents or cost-benefit analysis of investments are structured according to current economic standards.

A framework for the economic appraisal of health and safety in the individual enterprise is described by Davies et al. (1995) in a report to the European Commission. Other existing models for economic assessments (Oxenburgh, 1991; Zangemeister 1999; Ministry of Social Affairs and Health (FIN), 1997; Mossink, 1996; Alofs, 1998; Gröjer & Johanson, 1996)) grossly operated within this framework.

The proposed methodology will generally adhere to these principles. However, some extensions and alterations are also proposed.

6.8.2 Principles and assumptions

In the assessment of (socio-)economic costs some assumptions and principles have to be specified:

- the calculation is made at the company level, or a part of the organisation that has budget responsibility for all cost components. In other words: there are no external effects to other parts of the same company (unless specified). Decision making and monitoring takes place in this context;
- effects are expressed in terms of money as much as possible but should always be acceptable to the user and to stakeholders. When monetisation is not feasible, quantification or ranking can be used.
- cost calculation schemes follow accepted pricing systems as much as possible.

Avoidance of double counting

The current list of variables may lead to double counting of costs, for instance sick leave may have productivity effects. Sometimes double counting can be hard to trace. Therefore an indication of causality of effects may be required.

6.8.3 Costs of absenteeism, sick leave (variable 1.1.2)

In this section an approach to the calculation of sick leave, starting from a known sickness rate, is described. Basically the calculation results in the expenditures or reduced income for a company for every day that an employee is absent from work due to occupational accidents, occupational diseases and work-related illnesses.

For the calculation of the costs of sick leave, only the real expenditures or lost incomes to the company are included. In general, taking full wages for the work hours is not very accurate, but may be well suited to make a first assessment to establish the order of magnitude.

The approach to establishing costs of absenteeism is based on what the company does when an employee is on sick leave. This includes the following steps:

1. analysis of the effects of absenteeism to the company, what actions are taken to maintain productive capacity or to minimise the burden of absenteeism;

2. identify (indirect) effects on other variables, such as administrative overhead, rehabilitation and productivity.
3. quantify and assign monetary values, using the appropriate pricing principle.

Actions taken by the company to cope with absenteeism

The actual costs to the company depend on the action the company takes to cope with incidences of sick leave. Also the nature of the company (profit/non-profit, subsidised, governmental etc.) influence the actual costs of absenteeism and the value of lost production time. Furthermore the characteristics of the social security (or insurance) system have an effect on the costs.

Table 6.10 Strategies for employers to deal with absenteeism and direct cost effects

Action taken	general cost effect	examples of application	remarks	calculation scheme
No action, production loss is accepted and is not recoverable	reduced income: value of lost production time	• non routine office work • professional work	• in case the value of production is not adequately represented by wages, it is better to use added value or actual fees (e.g. for professional work)	• lost time * wages • lost time * price
No action, production loss is made up by worker later or by colleagues during their normal working hours (no overtime)	none, production is maintained at original quantity and quality	• short term (e.g. few days) sick-leave in many situations	• in general there is an extra organisational burden • may affect company's ability to deal with disturbances • may lead to temporary increase in workload	none
Production is maintained at original level (as much as possible) by working overtime	extra costs for overtime productivity effects (3.1 to 3.6)	whenever sick leave results in overtime, usually in case of short time sick leave	• generally overtime is paid at higher wage rates	additional costs for overtime (compared to normal wages)
Production is maintained at original level (as much as possible) by hiring temporary staff	extra hiring costs productivity effects (3.1 to 3.6)		not applicable for specialist work or when labour market is tight	difference in wage level * time
Production is maintained at original level by using reserves or over-employment	costs of maintaining reserves	where guaranteed production or service levels have to be maintained (public transport, critical services)	if no absenteeism occurred, reserves could be smaller it may not be possible to reduce labour force without costs	sick leave rates * wages + costs of laying off workers
Production level is maintained by contracting work out to third parties	costs of work contracted out	well defined jobs (e.g. in construction of metal working)	some companies (e.g. "jobbers") have a routine practice in contracting out work	price of work contracted out

note: (calculation schemes are all relative to normal situation, assuming employer pays full wages of absent person; corrections for wages not paid or compensated are made later)

Effect on other variables

Sick-leave may indirectly incur a number of other costs. In general these are:

- administrative overhead (1.2.1)
- other non-health costs (1.2.4), such as additional costs of medical services
- indirect effects on productivity (3.1)
- indirect effects on quality of products and services (3.2)

Calculation

The calculation of the costs of absenteeism includes different pricing principles (as also described by Davies et al., 1995), dependent on the situation at hand.

Table 6.11 Basic calculation scheme for the costs of sick leave

	Cost component	Currency	Amount
1	Extra expenditures for labour or costs of lost production time <i>Choose strategy form table 6.10</i>		
2	Wages not paid <i>Varies per country, sector or company</i>		
3	Received compensations <i>Varies per country and/or per sector</i>		
4	Net costs of lost working time <i>Calculate: 1 - (2+3)</i>		

After the extra expenditures for labour costs or lost production time have been established, corrections should be made for wages that are not paid and for received compensations. The amounts involved are dependent on the system of social security, insurance, and for instance on collective labour agreements. These will differ per country, per sector or may depend on the size of the company.

Note:

The methodology may supply country specific regulations and agreements on this respect.

6.8.4 Excessive labour turnover (variable 1.1.3)

Once is know how much of the labour turnover can be related to occupational safety and health, one can calculate the costs. The costs are divided into five categories:

1. costs related to separation (employees leaving the company);
2. recruitment costs for new employees;
3. additional effects on productivity and quality;
4. costs of understaffing (during period between the old employee leaving and the new one starting);
5. other financial effects.

Calculation schemes are largely based on work of the Finnish Ministry of Social Affairs and Health (1997), Gröjer & Johanson (1996), Davies et al. (1995) and Wells & Liukkonen (1991).

Separation costs

Employees leaving the company for reasons related to occupational safety and health, but not due to (partial) disability, may incur some costs.

Table 6.12 Calculation of separation costs, cases of disability not included. An x-mark indicates required data.

Activity	Direct costs	Number of hours	Cost per hour	Total
Administrative overhead (including line management)		x	x	
Exit interview, discussions		x	x	
TOTAL separation costs				

Recruitment costs

The costs of recruitment of new personnel can be estimated according to table 6.13.

Table 6.13 Calculation of recruitment costs

Activity	Direct costs	Number of hours	Cost per hour	Total
Determining job requirements		x	x	
Advertising	x			
Job interviews		x	x	
Administrative overhead (including line management)		x	x	
Introduction & training		x	x	
Personal equipment	x			
TOTAL recruitment costs				

An x-mark indicates required data.

Effects on productivity

Personnel turnover is likely to have additional effects on productivity and quality (variable 3.1 and 3.2).

In general it can be expected that leaving employees have lower motivation and have lower productivity as a consequence. These effects are very hard to predict, but may sometimes be reconstructed from production records.

New employees generally lack the skill and expertise of experienced workers. In addition, the fall in productivity and quality is hard to predict. However some indications can be obtained from experience of line managers, an analysis of the complexity of the job or from known learning curves.

Costs of understaffing

Understaffing may lead to extra costs (of course depending on the actions taken by the company). These costs are comparable to the costs of absenteeism (see section 6.7.3). The difference is that the period of understaffing is usually known, no wages have to be paid and specific regulations for sick leave do not apply. Extra overtime or hiring or lost production may give rise to extra costs.

Other

Labour turnover is not necessarily an unwanted phenomenon in companies. A limited rate of turnover may even be beneficial to the company, for instance because of the acquisition of new skills and recent insights. Furthermore, the new employees may have lower wages than the leaving persons.

6.8.5 Administrative overhead

Sick leave, occupational diseases, accidents and work related disability give rise to a number of managerial activities in the company. Often procedures have to be started to make registrations and ensure that compensations are being paid. These procedures differ from country to country and from sector to sector.

Furthermore the company may undertake actions for medical care or actions to speed up the employee's return to work.

Costs can be calculated from the amount of time the extra work takes. In some cases services are contracted out. In this case market prices should be used.

6.8.6 Prevention costs

The prevention costs refer to all activities and expenditures incurred by safety and health management in the company.

In the determination of the expenditures and activities it is important to fix a reference point. Expenditures of safety and health management and improvements of safety and health at work are measured against this reference point.

For monitoring applications the reference point is usually the situation with no safety and health activities at all.

As applications for decision making are usually performed to estimate the costs and benefits of an intervention, the reference point will be the situation before the intervention. Expenditures incurred by the intervention are calculated as the difference before and after the intervention. Note that expenditures can be positive or negative (saving on previous expenditures). For instance, an exhaustion system may reduce the need for personal protective equipment (saving), but it will also increase energy consumption and maintenance (additional expenditures).

Each of the variables should be further elaborated depending on the situation at hand. This can be done by exploring what the consequences of an activity or investment are for each of the variables.

Costing is generally easy (market prices, invoices or the cost of labour).

6.8.7 Productivity and quality effects

The calculation of effects on productivity deserves some special attention.

Depending on the application one may want to include productivity effects in two different ways. One can assess the indirect productivity effects of sick-leave, but one can also assess the direct productivity effects of interventions.

In case of monitoring, health effects and sick leave are considered to be the main variables. These health effects may in turn have an effect productivity or quality levels as an indirect effect. Several mechanisms for this productivity drop are plausible, such as:

- ill or tired people have lower productive capacity and are likely to have more problems maintaining adequate quality;
- people returning from a period of sick leave are less productive for some period;
- workers that replace absent colleagues are less efficient at the job (leading to lower productivity and quality).

The estimation of productivity effects is usually difficult. However from experience within the company some information may be obtained. In particular lower levels of management generally has good insights in the performance of workers.

Pricing or cost estimation of productivity effects can be done in several ways:

- value of lost production time (time * wages);
- value of reduced output (number of products * price);
- wages of additional personnel that have to be employed to cover lower productivity of others.

The costs of quality deficiencies depend on the companies policy:

1. In companies for which quality is a key factor in competition, poor quality usually results in more production time required for the same amount of output (e.g. because of rework and repairs).

The costs are equal to the costs of the extra production time required or the value of the products not produced.

2. A second option for a company is to sell products of lower quality for lower prices.

In this case the costs is the difference in value.

3. In some cases companies can get away with poor quality (e.g. when quality is ill defined or in case of monopoly such as government services).

Furthermore in all options costs can arise because of:

- internal control systems of quality management;
- additional service to customers.

When economic assessments are used in decision making support, it is more realistic to assume that every intervention has an effect on safety and health and, at the same time, an (independent) effect on productivity or quality. In addition to this, the above mentioned additional effects occur. For instance good house keeping in a messy workshop will not only improve safety (which will lead to less accidents and injuries), but will also improve the work process leading to better quality and productivity. The additional effect is that an injured employee will most probably have a lower productivity.

Many ergonomic interventions are designed to achieve both a productivity goal and a health and safety goal at the same time.

In the calculation both direct and the additional effects on productivity are to be included.

7. Conclusions

This chapter gives an overview of the conclusions from the national surveys, the analysis of comparability of variables in use in the EU Member States, the development of an appropriate set of variables and the development of a methodology to be applied in companies.

7.1 General conclusions

The issue of socio-economic costs of occupational accidents, occupational diseases and work-related illnesses (both at national and company level) is topical in virtually all member States of the European Union.

For a number of countries, national cost-of-illness studies or cost-benefit analyses are available. The scope of these studies varies between estimation of full socio-economic costs, costs of accidents and the total amount of compensations in social insurance. Studies at the company level have been reported from all Member States. At the individual level, no studies were found. Almost all studies are one-off evaluations.

From a scientific point of view, an assessment of socio-economics costs of safety and health at work would include all activities and effects related to safety and health at work. This would be: health effects, non-health related effects, preventive activities, effects on company performance (e.g. productivity and quality). In practice no studies have been found that cover this full range of variables.

Some theoretical issues remain unsolved. Especially problems with the attribution of health effects to work, unclear relations between intervention and (health) effects, and the issue of time pose problems in assessments of socio-economic costs. An issue with a political dimension which influences costs levels (especially at the company level) is the extent to which costs can be internalised.

The measurement of economic effects is generally limited to direct monetary consequences. At national level, effect indicators like welfare, employment rates and national competitiveness are related to occupational safety and health in a few studies only. At the company level, performance measurement with a wider scope than the monetary effects are emerging but only a few examples of application in the field of safety and health at work are available.

7.2 National level

In the assessment of socio-economic costs at the national level a three step approach is adopted: (1) collection of health data, (2) construction of relevant indicators, which includes the attribution of health effects to work and (3) assigning a monetary value. Each of these three steps problems have an influence on the quality of the assessments and the comparability between countries.

Available datasets on health effects

All reported studies strike a balance between the results that are required from the study, the data that is available or can be estimated and the scientific basis. Most studies use the prevalence principle in the data strategy. Calculations using incidence data are found in some ex-ante economic impact assessments.

In most countries datasets on health effects are available. Well covered are hospitalisation, medical care, sickness absence, permanent disability and fatalities. Little information is available on non-medical rehabilitation. There are no centralised datasets, data is used by different institutions, resulting in difficult integration for cost estimates within a country.

Most data is derived from notification data in social insurance and national statistics. Data from occupational safety and health surveys is used in a few studies only. Epidemiological analytical articles and accurate economic assessments on occupational accidents and work-related diseases are almost non-existent. There are many missing areas of data at both national and company level which would be needed to perform a sophisticated cost or cost benefit analysis. The availability of adequate data and difficulties in making estimates for missing data are a limiting factor in the number of variables that are included in studies.

Quality of available data

Both occupational accidents and occupational diseases are underreported. For occupational diseases this may be due to the complexity of the procedure in being able to register a disease as related to occupation or to collection systems of data not being integrated.

The definition for occupational diseases appears to vary between countries, with some using a list system of registered diseases, while others allow for the linking of potentially any disease with the workplace.

Applied costing and pricing systems

Commonly applied pricing systems are financial costs and money transfers such as compensations. Human costs (by willingness to pay methods) and estimations of lost output are available in a few countries only. In addition, estimations of human costs and lost (future) output are controversial.

Comparability between countries

The datasets which are collected at national level are very difficult to compare because of the facts that different data sets are collected, and reliability and validity are uncertain in a number of countries.

Variables included in studies at national level

The costs of health effects are included in practically all studies at the national level, though there is some variation in the cost components that are actually included. For the calculation of the costs of sickness absence and also for the calculation of costs of disability, various techniques are used. All resulting in different outcomes. The interpretation and definitions of occupational accidents (e.g. inclusion of accidents during commuting) and diseases (recognised and non recognised occupational diseases) and work related illnesses vary widely.

The costs of preventive actions have been estimated in a single case only. Including costs of prevention (especially investments) is likely to give rise to methodological

problems (which part of investments is to be attributed to OSH). Also little is reported on the costs of the national occupational safety and health infrastructure (e.g. costs of labour inspection).

Productivity effects prove to be hard to include in assessments as aggregation of company data is possible only under certain conditions. Furthermore there is a serious risk for double counting as the costs of sick leave also include productivity losses for some part. Productivity effects directly related improvement in OSH are not measured.

Consequences for assessment of socio-economic costs

The greatest concentration of datasets is available on health related costs. Due to differences in characteristics in data sets, making EU-wide comparable assessments will be highly difficult. For assessments (both costs-of illness studies and ex-ante evaluations) existing datasets should be supplemented in order to cover the whole set of variables.

7.3 Company level

Corrective costs for companies

Datasets on corrective and preventive costs for companies are scarce. Only in countries that have specific programme on OSH investments or national research projects, aggregate company data is available.

At the company level a wide range of variables in the field of health effects and preventive costs are included in the various studies. Also a few examples are described for assessment of productivity effects.

For the calculation of costs of sickness and disability to the company, the results are highly dependent on the system of social security.

With regard to additional costs and benefits (such as productivity and quality effects) virtually no datasets are available.

Comparability of variables

The comparability of data is reduced by differences in definitions, scope and differences in the quality. Only with respect to health related effects there is adequate coverage in all Member States (Portugal unknown).

For socio-economic assessments at the company level, reduced comparability between countries need not be a problem. Nevertheless, the data sets which are collected at company level may be more comparable, than datasets at the national level, but reliability and validity also tend to problematic here.

7.4 Individual level

Costs to individuals receive little attention in assessments of socio-economic costs.

Studies

In current studies on costs and benefits of occupational safety and health, too little attention is paid to the costs and benefits at the individual level. Explicit attention to costs to individuals is given in a few studies only. However, in some national studies the macro effects of costs to individuals, such as lost house hold production, is taken into account.

Datasets

There is almost no data collected at the individual level. In one country only (Italy) some data is available, regarding income losses and losses of potential earnings.

7.5 Methodology

This report sets out the basic framework of a methodology for the assessment of socio-economic costs in companies. The general aim of the methodology is to provide users in companies with a set of instruments (applications) to be used to perform various kinds of economic analyses. The methodology will have an open structure, so that it supports various kinds of specific needs and context of the future user. It contains various procedures and calculation schemes so that it suits users in differently sized companies in all EU Member States.

From an analysis of requirements and obstacles it can be concluded that the methodology should:

- have a wide scope, not just a narrow (financial) cost/benefit; also more qualitative variables are to be included;
- offer the user considerable process support;
- include educational functions;
- put emphasis on estimation of benefits;
- integrate with or link to common company practices;
- be simple in use, hide complexity to the user
- the methodology should be accurate and reliable enough to allow for conclusions to be made and to for moving to action.

A four step approach and a support module to assist users can accommodate the requirements and overcome the obstacles. The four steps are:

- Step 1 Choosing an application and required results for the methodology
- Step 2 Conducting the analysis: selection of variables
- Step 3 Conducting an analysis: finding data or making estimations
- Step 4 Performing calculations and interpreting results

The coming two years the methodology has to be further detailed and tested in companies in all Member States of the European Union.

An electronic format for the methodology has considerable advantages over the traditional paper format as it offers greater flexibility to the users, allows for easy searching in included databases and literature and calculations can be performed automatically.

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Annex 1

KEY To Table 4.1

Austria

A1 - Chamber of Commerce

This chamber of commerce data set is generated for its own purposes only. The data set is used as a basis for negotiations about wages and salaries, and about the legal rates for the accident insurance and for the law about continued payments. It compiles data on the number of sickness absence-days and the number of other absence-days. These data are categorized for blue and white collar workers and whether the company has to pay for them or not.

A2 - Federation of Austrian Social Insurance Companies

Statistics of the "Hauptverband der österr. Sozialversicherungsträger" (*Federation of Austrian social-insurance-companies*), are public and can be used by everybody. The Chamber of employees' welfare specified these statistics as one of its main sources of information. The data set contains health related data in relation to the number of beddays, the number of ambulant cases and sickness absence days. All this data is available in general and assigned to accidents and to occupational diseases.

A3 - Annual Report of the Central Labour Inspectorate

The Annual report of the Central Labour Inspectorate includes data about all labour inspectorates. The data contained in this report has not been used for the purposes concerned by the SHAPE-project so far. The Central Labour Inspectorate holds the budget for the entire labour inspectorates (i.e. national level infrastructure) to fund the costs for inspection at national level. Its annual report includes information on fines, number of charges brought, sum of proposed fines, number of completed procedures, sum of fines imposed and commission charges. This last piece of information relates to a labour inspector who has to participate in compulsory hearings about the industrial code. The report details the number and sums available for Austria as a whole and for every labour inspectorate separate (19 labour inspectorates, 1 additional labour inspectorate for construction works).

A4 - AUVA (Austrian Workers Compensation Board)

The AUVA is Austria's most important compensation board with 4.05 million insured persons (1,23 mio. workers (blue collar), 1,33 mio employees (white collar), 0,22 mio self-employed and 1,26 mio pupils and students). Statistics of the AUVA (Austrian workers compensation board) are compiled for its own purposes, the data is transmitted to the Central labour inspectorate and to the Federation of Austrian social-insurance-companies. It collects data on the number of bed-days, number of days in medical rehabilitation-centers, number of ambulant cases and ambulant treatments, contributions to costs for retraining and house conversions, sickness absence days (only calendar days, workdays just for random samples), percentage of disability, running time and total amount of compensation, fatalities (number, age of patient). AUVA also has a budget for prevention activities.

Belgium

B1 - Private Belgian insurance companies (covering occupational accidents)

In Belgium, accidents at work are covered by private insurance companies. Every year, some 200,000 accidents are reported; this represents some 34 billion francs for insurance companies. In addition one must add 7 billion francs of the FAO (National fund for occupational accidents) to this figure. The direct costs of accidents at national level in Belgium are relatively easy to quantify. These include costs to the insurance company such as part of the salary of the victim, medical costs and hospitalisation costs. No research has been undertaken to estimate the indirect costs of these occupational accidents. The direct costs of accidents at company level in Belgium are relatively easy to quantify. Direct costs are covered by insurance which includes part of the salary of the victim (90% of average daily salary and fixed amount for annual salary), medical costs and hospitalisation costs. The more accidents for which companies put in claims to their insurance companies the more effect this will have on their premium.

B2 - Belgian social security system

It is estimated that some 10% of all the sick leave granted for long term illness (more than 30 days) is related to purely psycho-sociological problems. This represents a cost of 10 billion francs to the Belgian social security system. It does not however include symptoms which can not be clearly identified as psychosomatic in origin. If these should be included, the above mentioned figure would have to be tripled or quadrupled.

B3 - Belgian social security system/FBZ (occupational disease fund)

Occupational diseases are dealt with under the social security system via the FBZ (the occupational disease fund is financed by contributions from employers; these contributions currently amount to 1.1 % of salaries). At the moment some 80,000 people receive compensation for a recognised occupational disease. Every year, 3,000 new cases are reported. The direct economic cost is about 15 billion francs a year. However, the real cost is much higher due to several reasons, one of them being the fact that the present definition of occupational diseases is very restrictive.

Denmark

DK1 - Register of occupational accidents (DWES)

The Danish Working Environment Service is responsible for the register of occupational accidents. The purpose of this register is to prevent accidents by planning and prioritising inspections. It deals with approximately 50,000 new cases per year. This register is used by DWES and the social partners. The register includes details such as age, sex, region, industry (NACE, 5-cipher), occupation, work process at the time of accident, absence - less/more than 1 week, fatalities and location/severity of injury.

DK2 - Register of occupational diseases (DWES)

The Danish Working Environment Service is responsible for the register of occupational accidents. The purpose of this register is the same as above. It deals with approximately 16,000 new cases per year. These are notified cases and the diagnoses are not systematically evaluated. This register is used by DWES and the social partners. The register includes details such as age, sex, region, industry, occupation, exposure factors, diagnosis ICD, 5-cipher level and no "consequence" data.

DK3 - Register of the Danish National Board of Industrial Injuries

The Danish National Board is responsible for the register of the Danish National Board of Industrial Injuries. The purpose of this register is to deal with industrial injury compensation for accidents and occupational diseases. This register is used by the National Board. It dealt with approximately 13,000 accidents and 16,000 diseases of which it was notified in 1994. Relevant accident notifications are exchanged between DWES and the National Board for Industrial Injuries. The register includes information on age, sex, diagnoses, type of injury, industry (according to insurance classes), the degree of invalidity (medical) and projected employment applicability.

DK4 - Danish Confederation of Employers

The Danish Employers' Confederation is responsible for producing absence statistics. Its purpose is to give a general overview of the private sector only. These statistics are based on approximately half a million of the one and a half million private employees. They are used by the Employers' Confederation of the Danish Statistical Bureau. The register includes information on age, sex, industry, sickness /other absence causes for white/blue collar workers and length of absence spells.

DK5 - National study A

A study on the costs of work-related diseases and work accidents in Denmark undertaken by DWES aimed at raising awareness on the importance of workplace health and safety; development of and documentation of basic data for cost-benefit assessment of regulation. The results indicated that the socio-economic costs of work-related diseases and work accidents occurring in the year 1992 was calculated to be 3000 Millions ECU, or approximately 15% of total sickness occurrence. The public costs for the same year/population of victims was 1700 Millions ECU. The report includes examples of c/b calculations from recent regulatory proposals. The study used general health and social statistics. The socio-economic calculation included the total costs of medical treatment (1.1.1, 1.1.2), while sickness absence (1.1.4), permanent disability (1.1.5) and deaths (1.1.6) were priced by loss of potential output (1.b). The average wage level was used as a proxy for output. For disability and deaths, potential output until the year of normal retirement was added, adjusted by average probability of survival. The calculation was made with a 4% discount rate (results above) and a zero rate. These results were calculated for each diagnosis. An illustrative estimate of loss of potential household output (components 1.1.4, 1.1.5, 1.1.6) was added. The financial calculation for the public sector added public financial costs (1a) from components 1.1.1, 1.1.2 plus transfers during non-medical rehabilitation (1.1.3); sick benefits plus wages paid by public employers during sickness (1d+1a); plus the sum of future disability pension payment (1.d) until the age of 67 for persons retiring in the base year.

DK6 - National study B

Another study looked at a model for assessing the costs of stressors - socio-economic costs of work stress in 2 EU Member States (Denmark and Sweden). It aimed at developing methods for benefit assessment for the European Union. It used general health and social statistics. The socio-economic calculation included the total costs of medical treatment (1.1.1, 1.1.2), while sickness absence (1.1.4), permanent disability (1.1.5) and deaths (1.1.6) were priced by loss of potential output (for which the average wage level was used as a proxy).

For disability and deaths, potential output from the year of retirement until the 65th year was added, adjusted by average probability of survival. The calculation was made with a 4% discount rate.

DK7 - National study C

This study examined the economic impact of the working environment on local government. It aimed at raising awareness of the costs of working environment problems for the local authorities, both as employers and as administrators of social benefit arrangements. It applied a cost-of-illness methodology, the total, current costs for the public sector in 1991 was estimated at 2300 million ECUs. It used general health and social statistics. It was assumed from secondary analysis of other sources that 20-25% of health problems (diseases and accidents) in the statistical population is work-related.

The study added public financial costs (1a) from components 1.1.1, 1.1.2; direct sick payment (1a/1d) due to sickness absence; plus the current expenditure on disability pensions (sum for all persons receiving) in the base year (1a/1d). The definition of long-term sickness absence was modified to include a percentage of persons who have health problems but who have received other social benefits (1d) for a prolonged period. These included unemployment benefits and the specific early retirement arrangement for persons aged 60-66. Additional, income-related transfers (1d) was added to the normal social benefit rates for the long-term sick and retirees (1.1.4 and 1.1.5). The individual level analysis illuminated public costs only, though personal income losses could be calculated from the base data.

Finland

FN1 - Statistics of occupational accidents and diseases

The Finnish Federation of Accident Insurance Institutions generates this data set. OSH administration, research institutes and companies use this data set. The statistics are published annually and are available in an electronic form called Sammio. This is an SAS database and advanced analysis can be carried out. The coverage of Finnish accident statistics is good because the data is gathered from accident insurance companies. They are used for the evaluation of prevention priorities, specific accident analysis, training and economic evaluations, though the data could be put to better use. Data on accident compensation costs is also available (i.e. direct costs of occupational accidents and diseases). Description of variables/measures included in the Checklist 1 are relevant here for the days of sick leave due to accidents and occupational diseases, the number of permanent disabilities due to accidents and occupational diseases, and the number of fatalities due to accidents and occupational diseases.

FN2 - Statistics of sick leave & early retirement and statistics of occupational health activities

The Social Insurance Institution generates this data set. State and health authorities and research institutes use this data for the evaluation of priorities, specific analysis of statistics and economic evaluations. Descriptions of variables included in Checklist 1 that are relevant here are the number of sick leave and early retirements, and data on occupational health services. Information is not available as to whether sick leave or early retirements are work-related or not.

FN3 - Statistics of occupational diseases

The Finnish Institute of Occupational Health generate this data set. State and health authorities, research institutes, and companies use this data set for the evaluation of priorities, specific analysis of statistics, and economic evaluations. The description of variables included in Checklist 1 that are relevant here is the number of occupational diseases.

France

F1 - National Sickness Insurance Office (CNAMTS) for salaried people

National statistics of accidents and occupational diseases are collected and presented by CNAMTS, the department of occupational risk, based on the information collected in the 15 technical committees. These statistics are presented as technological statistics (annual) and financial statistics (over a three years period). Quarterly statistics are published but they can't be compared with the technological ones as they do not take the same data into account (accidents paid in the year, accidents occurred in the year). The financial statistics include all accidents and occupational diseases with sick leave. This data set being practically the only one at the national level, is used by CNAM to calculate the contributions of companies of all the organisations concerned to follow the evolution of health and safety at work. The basic elements given by the employers to the regional office are presented on a sheet called employer's account report. This sheet includes information such as the name, risk code (according to activity sector), total wages, average workforce, urgency care, name of victim, date, 1st payment for temporary disability / permanent disability (< 10% or > 10%), payment by general insurance sickness office (medical care, medicines, hospital costs, sickness absence) (daily allowance) and payments in capital. The financial statistics are established on the basis of the results (number of accidents and occupational diseases, expenses, salaries) and indicators such as:

- > average cost of an accident with sick leave and accident with permanent disability (IP)
- > ratio of IP number with number of accidents with sick leave (temporary disability)
- > ratio amount in capital/allowances for temporary disability
- > gross risk rate of permanent disability (with distinction < 10% and > 10%)
- > gross annual risk rate.

These data are distributed over the 16 regional offices. They cover the gender of the victim, age, nationality, accident place, professional qualifications, nature of the injuries, place of the injuries, and the material element cause of the accident. Everybody using this data set is conscious of its limits (it does not cover the whole workforce, and registers only declared accidents and recognised diseases). The ministry of labour analyses the data to add to its annual Report on working conditions. An example of the calculation of the mixed tax rate is a three year sheet which is filled for each company with annual details of: wages, urgency care, accidents (temporary allowances, capital allowances) and the rate for travel accidents (x% per 100F wage), x% for service charges, x% for compensation per 100 F wages, all this being paid by every company.

This shows that these elements deal exclusively with direct corrective costs. The small companies, who pay the same contribution whether they have had accidents or not, are not motivated to undertake prevention (not from a financial perspective).

The big companies and medium ones can try to reduce their own part (by prevention, or any arrangements with the worker). At the national level, this information given by the CRAM are analysed for each activity registered under a risk code number.

The activities are classified under the 15 branches. The risk value is defined according to these statistics results. Example : figures for 1995

accidents	
Total workforce :	4 499 318
accidents with sick leave :	672 234
accidents with IP :	60 250
deaths	712
lost days for temp. dis.	26 021 266
total of IP rate	558 651
occupational diseases	
total workforce	14 499 318
paid diseases	7 152
diseases with IP (incl. death)	3 167
fatal diseases	32
lost days	907 121
total of IP rates	50 297
average rate of one IP	15,9

This allows analysis of the relation between risks and characteristics of the worker and the workplace. A report is published every 3 years by CNAM called the "Financial and technological statistics of occupational accidents and diseases"

F2 - National Sickness Insurance Office (CCMSA) for the agricultural sector only

A separate system is in place for the agricultural sector (CCMSA covers about 8.8% of people, other systems covering the rest including non-employed and specific systems (SNCF)), and this collects similar information as the CNAMTS but the two data sets are not combined.

Germany

D1 - Federal Ministry of Health (Data on public health)

This Ministry collects data on:

Hospitalisation (no. of cases and days spent in hospital) of the members of the public health insurance system by selected groups of diseases; ratio of persons reported sick among the compulsory members of public health insurance system; inability to work (no. of cases and days lost among the compulsory members of public health insurance system) by age and selected groups of diseases.

Rehabilitation, premature retirement and occupational diseases

Measures of rehabilitation by institution and type of measure; medical rehabilitation by type of handicap, result of measure; premature retirement due to occupational disability; the most frequent types of occupational diseases

Facts, patterns of behaviour and risks relevant to health

State of health of the population, sickness and accidents by age

Mortality

Mortality by selected reasons national figures and international comparison

Hospitals

Institutions, no. of beds available and patients; institutions of prevention and rehabilitation by region, beds, days of utilisation; patients in hospitals; treatment of

in-patients in hospitals, cost of medical treatment per day in hospital; cost per day by types of hospitals ; costs per case and type of hospital

Economic data, financing

taking and spending of public health insurance system; spending for health by types of service and institution; financial situation of public health insurance system; growth of spending for health (international comparison); indicators for the field of health; portion of GNP spent for health (international comparison); financing of health system (international comparison)

D2 - Federal Ministry of Health (Public health insurance system in FDR - Annual Report)

Summary of taking and spending

Persons insured

Spending for services

Members

Cases of service for members and their families, treatments (cases and days of incapacity to work, cases and days of sickness benefits, hospitalisation (cases and days), stays at health resorts (prevention and rehabilitation) medical treatment

Cases and days of service (per-capita-values; cases and days of incapacity to work per 100 members, hospitalisation (cases and days) per 100 members, ratio of persons reported sick among the compulsory members.

Compensation of spending by employers due to legal sickness payment regulations.

D3 - Federal Ministry of Health (Incapacity to work & hospital treatment by types of disease - Annual Report)

Persons insured and family members covered by insurance by age;

Incapacity to work (compulsory members only) by

age, sex and type of insurance

type of disease and sex,

type of disease and duration,

type of disease, age and sex,

Hospital treatment by

age, sex and type of insurance

type of disease and sex,

type of disease and duration,

type of disease, age and sex,

D4 - Federal Ministry of Labour and Social Affairs (Compulsory accident insurance in FDR - Annual Report)

Occupational accidents and diseases, Cases of insurance benefits; pensions,

Occupational diseases by type

D5 - Federal Ministry of Labour and Social Affairs (Labour safety - prevention report, annual)

Accidents (absolute figures)

accidents reported; new pensions; accidents leading to death

Accidents (frequency)

workers (converted into legal working hours), cases insured, working hours; accidents reported per 1000 workers (converted into legal working hours) / 1 million. working hours; new pensions per 1000 workers (converted into legal working hours) / 1 million. working hours

Occupational diseases

occupational diseases total number; occupational diseases reported, new pensions due to occupational diseases by types of diseases, Occupational diseases leading to death;

Costs, Pensions

spending of the compulsory accident insurance institutions; spending for accident prevention and first aid; pensions to the injured, the sick and surviving dependants

Development of number of accidents and new pensions occupational diseases since 1949; development of number of occupational diseases since 1978; development of five selected types of occupational diseases

D6 - Federal Ministry of Labour and Social Affairs (Statistics of labour & social affairs / social security)

Compulsory accident insurance

Pensions; cases of occupational disease (cases reported and cases compensated for the first time); no. of workers (converted into legal working hours), Occupational accidents and diseases by insurance institution; taking and spending by insurance institution;

The Public Health Insurance System

Cases and ratios of diseases; members, premium.

D7 - Association of the pharmaceutical industry

Spending of the health insurance institutions

D8 - Association of (compulsory) Industrial Accident Insurance Institutions (Annual Report)

Occupational accidents

accidents to be reported; new pensions; accidents leading to death

Occupational diseases

reported suspected cases of occupational disease; cases settled cases of death; most important developments in the field of occupational diseases

Pensions

number and development of pensions

Other services

services for the injured and sick; transitional arrangements

Spending

Compensation; spending for occupational diseases prevention

D9 - Association of (compulsory) Industrial Accident Insurance Institutions - Rehabilitations (Annual Report)

Cases of rehabilitation completed, by insurance institution and type of measures;

Cases of rehabilitation completed by type of event insured

Types of injuries by type of rehabilitation and type of event insured

Occupational diseases by type of rehabilitation

Occupational diseases by sex and age

Cases of rehabilitation by nationality, sex and age,

Cases of rehabilitation by result and age

D10 - Federal Agency of Statistics (reports on spending for health)

Summaries

- Spending for health by most important types of service

- Spending for health by types of service in detail

- Spending for health by institutions

Spending for health by institutions and types of service (annual tables)

Spending of public sector for health by types of service

Spending of social health insurance system for health by types of service

Spending of social security pension insurance for health by types of service

Spending of compulsory accident insurance for health by types of service

Spending of private health insurance system for health by types of service

Spending of employers for health by types of service

Spending of private subjects for health by types of service

D11 - Federal Agency of Statistics (reports on spending for health)

Hospitalisation

- institutions, no. of beds and patients (time series since 1960)

Hospitals

- Classification of costs of the hospitals

Mikrozensus - questions referring to health -

- Population, sick and injured by accident

- by duration of sickness, age and role within working population;

- by type of treatment, age and role within working population;

Interdisciplinary statistics

Social health insurance (expenditure per case of sickness - time series since 1982; expenditure per day in hospital - time series since 1982; ration of sick among the compulsory members of social health insurance - time series since 1970)

New pensions due to incapacity for work by age, reason, type of accident or disease (time series since 1950)

D12 - Agency of Statistics (reports on causes of death)

Deaths by accident by selected categories of accidents, age and sex

D13 - Federal Agency of Statistics (reports on health, basic data on hospitals & institutions of rehabilitation)

Hospitalisation

Institutions, beds and patients; average stay and utilisation of capacity in hospitals and institutions of rehabilitation by regions

Hospitals 1996

- Beds and patients, days of care

institutions of rehabilitation 1996

- Beds and patients, days of care by types of services and regions

D14 - Federal Agency of Statistics (reports on health, data of diagnosis of hospitalised patients)

Persons dismissed from hospital (including deaths, excluding cases of some hours duration) by types of diseases, selected diagnosis, age, number and duration;

Persons dismissed from hospital (cases of some hours duration including deaths) by selected diagnosis, age and number

D15 - Agency of Statistics (reports on spending for hospitals)

Total cost of hospitals

D16 - Federal Agency of Statistics (reports on social security)

Persons insured in the social health and pension insurances

D17 - Ministry of Labour, Health and Social Affairs of Nordrhein-Westfalen

Conditions for prevention at workplace

Influences on the working (indicators shop conditions)

Effects of strain and stress on the health of the working (indicators of strain and stress)

Preventive actions

D18 - Association of Industrial Health Insurance Institutions on Company Level

Incapacity for work

general development; results by branches; types of diseases in the different branches; occupational accidents; socio-demographic data; types of diagnosis

Hospitalisation

development of expenditure; general development in hospital treatment; morbidity by age and sex; hospitalisation by main types of diagnosis; medical rehabilitation

D19 - Association of Institutions for Social Pension Insurance (Annual statistical report)

(similar for new pensions, ceasing pensions and changing pensions)

Pensions (total)

Pensions because of diminished capacity of earning and age;

Pensions because of diminished capacity of earning

distribution of starting age and average age by diagnosis; distribution of types of pension/rehabilitation by diagnosis; pension of limited duration by types of diagnosis; distribution of criteria of labour market at starting time of the pension r

D20 - Association of Institutions for Social Pension Insurance (Annual statistical report on rehabilitation)

Summary

Medical and other services for rehabilitation by type of service, institution and expenditure and income for services

Completed medical and other services

Distribution of age and age groups by matrimonial status; distribution of sex and average age by diagnosis; distribution of age groups, average age and average no. of care days by diagnosis; distribution of age groups and average age by types of measures and causes of diseases

Greece

G1 - Social Insurance Institute (IKA)

The IKA (Social Insurance Institute) directly insures 1,846,868 people, or 44.32 % of the total number of people directly insured in Greece. Its data set consists of occupational accident statistics occurring to its directly insured labour force. These include data on the number of occupational accidents (these are accidents necessitating more than 3 days out of work, IKA cover the first 50% while the employers is responsible for the second 50%), fatal occupational accidents, work incapacity days (only the compensated ones, i.e. after 3 days absence),

compensation cost, and the cost of pensions due to occupational accidents (does not include the cost of pensions due to fatal accidents). IKA has (since 1-1-1998) introduced a new improved form for Accident Reporting to be used by its local branches all over the country. Although this constitutes a significant improvement, it is still far from collecting data adequate for a relevant socio-economic assessment.

Some of the new data which this form asks for in relation to each individual accident may relate to a socio-economic assessment, and include: (a) whether first aid was provided and transportation means used for the victim (b) whether or not the victim was admitted to a hospital for treatment.

G2 - National Statistical Service of Greece (ESYE)

Annual data on occupational accidents is available for the entire labour force from the National Statistical Service of Greece (EYSE). Data available includes total number of accidents (reliability of this figure is questionable), fatal accidents, work incapacity days, temporary disability cases, permanent disability and pensioning, and physical injuries that do not affect work capacity. It is doubtful whether the data presented by EYSE has the minimum reliability required for use in any type of assessment of the socio-economic impact of occupational accidents.

G3 - Study 1

A study carried out in 1989 estimated the total cost of occupational accidents to the national economy for the year 1984 at 10,6 billion Drs (current prices). The present corresponding cost is estimated to exceed the amount of 42 billion drs, whereas the cost of occupational diseases is 350 billion drs. The study is based on statistical data of the Social Security Institute (IKA). The study uses the following data for the year 1984: number of occupational accidents, percentage of the ratio of the number of occupational accidents to the labour force directly insured by IKA, number of compensated days and amount of compensation paid by IKA for occupational accidents, and amount paid for disability pensions due to occupational accidents. The study also makes assumptions which allows estimation of hospitalisation costs, costs of paying one extra full time worker to do the injured person's job during their absence, administration of sickness absence (one non productive man-hour is paid by the enterprise for each accident: for assisting the victim, providing information for completing the accident statement to the authorities, e.t.c.), and other medical care and medicines cost.

G4 - Study 2

This study is based on the statistical data of IKA for the years 1992 to 1996, which are the most recent available. It uses the same data as Study 1 and estimates the total cost of those accidents for three different cases.

In the first case the calculations are based on exactly the same assumptions as the study of Papadopoulos and the only difference is the use of updated data. In the second case the three assumptions remain the same and only the cost of non productive time is assumed to be 6,5 man-hours (instead of one) for each accident (for assisting the victim, providing information for completing the accident statement to the authorities e.t.c.). The assumption is based on the results of a study carried out by M. Aaltonen in the Finnish furniture industry in 1996. In the third case only the insured cost of occupational accidents is estimated. For the remaining cost, which is difficult to calculate it, empirical data for its ratio to the insured cost are used. Three different values are used. These are 1/8, 1/12 (both based on a study carried out by HSE in 5 enterprises of UK during 1990-91) and

finally $\frac{1}{4}$ (based on the work of H. W. Heinrich for the relationship between direct and indirect cost). The total cost results by addition.

G5 - Ministry of Labour and Social Insurance

Another figure available at national level, although only a forecast, from the Ministry of Labour and Social Insurance, Social Budget for year 1997, is the compensation cost due to accidents, which for the year 1997 was estimated to be 4,504,700 Drs (12,62 MECU, 1ECU=357 Drs).

Ireland

IR1 - National Authority for Occupational Health and Safety

The National Authority for Occupational Safety and Health (HSA) is a State-sponsored body responsible for administering and enforcing Ireland's laws on health and safety at work. It produces a report annually which includes the compilation of data on accidents (injuries and fatalities) reported to the HSA (it is a legal requirement that accidents necessitating employees' absence for more than 3 days must be reported to the HSA), a brief from the Labour Force Survey on accidents by work sector, an overview from the Department of Social Welfare on the number of occupational related injury benefit claims allowed, some details of employers' liability insurance claims allowed from the Irish Insurance Federation and occupational data on diseases from the Department of Social Welfare, the Department of Health, the National Cancer Registry, the Irish Medicines Board, and innovative physician based voluntary reporting schemes such as RODD (Reporting of Occupational Dermatological Diseases), SWORD (Surveillance of Work and Occupational Respiratory Diseases) and ROPI (Reporting of Occupational (Pathology) Illnesses).

IR2 - Labour Force Survey

The Labour Force survey is a representative sample survey carried out annually by the Central Statistics Office that surveys over 47,665 households. It gathers information regarding time taken off due to occupational related illnesses (when time exceeds three days), the number of days taken and the number of such occurrences. This report presents results of questionnaires completed by 47, 665 private households. In addition to demographic information such as age, sex and marital status, a comprehensive range of questions on employment, unemployment, search for work and injuries and ill health was asked. The results are presented as estimated totals rather than sample counts or percentage distributions of respondents. They are weighted by sex and age group within each region of Ireland to ensure agreement at national and regional level with independent population estimates.

IR3 - Department of Social Welfare

The Department of Social Welfare publishes an annual report that includes data in relation to state expenditure on occupational illnesses and the number of recipients of occupational injury benefits such as injury benefit, disablement benefit, death benefit, workers' compensation benefit and medical care costs. The Annual Statistical Information on Social Welfare Services 1996 report sets out comprehensive data relating to services provided by the Department of Social Welfare. The statistics set out relate to 1996 and previous years. They encompass the six areas of social welfare payments made by the Department and details of claimload, appeals and payment methods. Occupational Injury Benefit is payable to

those off work as a result of a workplace accident or who have contracted an occupational prescribed disease as laid down by document SW33 (HSA). Occupational Injury Benefit is payable for six months only following which a person may go on to disablement payments, or if recovery within six months is unlikely they will go on to disablement benefit from the start of payments. The number and sex of recipients, their number of dependants, and the number of disablement cases referred to medical assessors is included in the report. Applicants have to get their employers to sign a declaration that the injury occurred in the course of their work. Disability payments are made when the injury results in permanent disablement, and a lump sum payment is made if disability is 20% or below while a permanent pension is payable if disability is above 20%.

IR4 - Irish Insurance Federation

The Irish Insurance Federation supplies information on gross written premiums, gross incurred claims, new claims notified and underwritten compensation in relation to employers' liability insurance. The Insurance Federation supplies data on non-life premium and claims statistics, the most recent of which are from 1994 to 1996. Employer liability insurance is outlined in terms of the actual premium paid by companies; the total amount of claims made and the amount paid out by the insurers. In 1994 Irish companies paid out £106,737,000 in total premiums, £116,233,000 in 1995 and £118,297,000 in 1996. In 1994 companies put in claims for £107,597,000, £114,999,000 in 1995 and this increased to £142,828,000 by 1996. Insurance companies actually paid out £83,609,000 in 1994 on 7500 claims allowed, £89,320,000 on 8300 claims allowed in 1995 and this rose again to a payout of £94,686,000 on 8921 claims allowed in 1996.

IR5 - Irish Farms Safety and Health Survey

The Survey of Safety and Health on Irish Farms (survey undertaken and results published in 1997) was a study commissioned by the Health and Safety Authority and European Union structural funds and carried out by the State sponsored Farm Advisory Service. It provides data on the number and type of farm accidents and fatalities, medical treatment received (surgery and non surgery), the length of hospital stay, farm days lost and the overall economic loss due to farm injuries and fatalities. A similar study was conducted in 1991, allowing comparison over the past six years. This study was commissioned in order to investigate the causes and consequences of farm accidents in Ireland and farmers' attitudes to safety. The survey results show that about 5% of farms have full-time workers suffering from disability caused by farming as compared to 3.5% in 1991.

IR6 - Irish Business and Employers' Confederation Survey Report on Employer/Public Liability Claims for Personal Injury

An Irish Business and Employers' Confederation (IBEC) Survey Report on Employer/Public Liability Claims for Personal Injury in 1993 was based on a survey of over 300 member enterprises. The questionnaire focused on general statistics on experiences with accidents and claims and asked for detailed information on individual claims. Over 64% of companies experienced employer liability claims. The average number of employer liability claims per company was 10. The average award for an employer liability case heard in court was £16,513 as well as legal costs amounting to £4,672 on average. The figures were £10,621 and £3,208 for out of court settlement. The average employer liability insurance premium was 2% of the company payroll. The report also examined safety profiles and other

factors that may affect claims, e.g. gender, presence of sick pay scheme for injury incidents.

Italy

I1 - National Institute of Occupational Injuries and Occupational Diseases Insurance (INAIL)

INAIL is the National Institute of Occupational Injuries and Occupational Diseases Insurance. It insures nearly 16 million workers. According to its data, every year nearly 1 million workers suffer an injury. Its users include governmental institutions, health and safety agencies at every level, employers' organisations, trade unions and non governmental institutions. The data set is used for social insurance system administration and injury prevention. It generates data such as the cost of compulsory social insurance (premium) calculated on potential occupational hazards. The overall insurance income amounts to nearly 6 billion ECUs per year. It collects data on corrective health-related costs such as medical care (no. of high tech prosthesis); sickness absence spells (no. of compensated sickness days, frequency index of different economic activities and areas, and severity index of different economic activities and ages); permanent disability (no. of cases per year: age, sex, severity, frequency index of different economic activities and areas, fatalities (number of cases per year: age and sex, frequency index of different economic activities and areas, and severity index of different economic activities and areas); fatalities (no. of cases per year: age, sex, and frequency index of different economic activities and areas). It also collects data on costing principles such as financial costs (compensation benefits per year); and data on non health-related corrective costs such as administration of sickness absence (administration of injuries and occupational diseases). It collects data at the individual level such as costs and damages in relation to income losses (compensation for loss of job, capability calculated according to the inability percentage and dependent on the salary, not on age). All of this data is available, deemed reliable and applicable to injuries and occupational diseases.

I2 - Institute of Prevention and Safety at Work (ISPESL)

ISPESL, the Institute of Prevention and Safety at Work, is a technical-scientific body of the National Health Service and dependent on the Ministry of Health. The institute is the national focal point of the European Agency of Safety and Health at Work. Its users include governmental institutions, local health and safety agencies, employers' organisations, trade unions and non governmental institutions. It collects data on corrective health-related costs such as sickness absence spells (no. of compensated sickness days, frequency index for the industrial sector and severity index for the industrial sector); permanent disability (no. of cases per year: age, sex and severity, frequency index for the industrial sector and severity index for the industrial sector); and fatalities (no. of cases per year: age, sex, and frequency index for the industrial sector). It also collects data on preventive costs such as infrastructure, inspection, register at a national level (managerial costs). All of this data is available, deemed reliable and applicable to injuries and occupational diseases. The frequency and severity indexes are calculated on the number of industrial workers.

I3 - National Institute of Statistics (ISTAT)

ISTAT, the National Institute of Statistics, is a public agency that provides most of the official statistics for Italy. Its users include governmental institutions at any

level, non governmental institutions and scientific and research institutions. It collects data on corrective health-related costs such as hospitalisation (no. of discharged patients and days of hospitalisation); and fatalities (no. of cases per year: age, sex, etc.). It also collects data on benefits such as technological development (enterprises that consider the improvement of the working environment as an objective of technological development). This is a survey spanning the period 1994-1996, carried out on a sample of enterprises with 20 or more industrial workers (about 10,000 enterprises), currently underway with the first results available at the end of 1998. All of this data is available, deemed reliable and applicable to occupational and non-occupational injuries and diseases.

Netherlands

N1 - Sickness absence statistics

CBS generates statistics based on a sample of companies (approximately 10,000 in 1996). Time series from 1993 onwards. The time period before 1993 can be covered with data generated by administrative obligations for companies and collected by the former "Bedrijfsverenigingen". This data is now available from LISV and was published by the former Sociale Verzekerings Raad and, on a more aggregated level, by the CBS. The data is used to calculate absenteeism. Its variables include sickness absence: percentages and days, split for sex, age and industry. Data from LISV (National Institute Social Insurance) can give (for absenteeism of 13 weeks or longer) the cause of absence (diagnosis of disease, injury) (data up to 1995 could give a diagnosis for absenteeism of 6 weeks or longer).

N2 - Labour accounts

CBS brings together several statistics, collected at the enterprise level. They are used to calculate production losses. The variables include hourly wage rates, costs per industry, and number of hours worked per year per industry.

N3 - Dutch Labour Force Survey

CBS collects data from a large sample of the workforce. They use a proxy questionnaire. When the worker is not at home, answers may be given by someone else in the household. Lower validity is the cost in return for a large sample. It is used to give a complete overview of the Dutch workforce. With the Life Situation Survey and the Health Survey, the Labour Force Survey gives input to the so-called Arbomonitor (Monitor for Working Conditions). It measures hourly wages rate, costs per industry and the number of hours worked per year per industry.

N4 - Life Situation Survey

CBS collects data from a the workforce via a large sample of their households. This survey data is used to give an overview of the conditions of life for Dutch households, including aspects on working conditions. Together with the Labour Force Survey and the Health Survey this survey gives some input to the Arbomonitor. Its variables include a large variety of working condition variables (e.g. noise at work, heavy work, work hours, autonomy at work), labour relations, and opinions about wages and payment.

N5 - Dutch Health Survey

CBS collects data on the situation in relation to the health of Dutch people. This gives a complete overview of the Dutch workforce. Along with the data from the

Life Situation Survey and the Labour Force Survey, this survey gives input to the Arbomonitor. Its variables include the duration and number of times of sick leave per annum and disability figures.

N6 - Financial Overview Care

The Ministry of Health collects data on the financial costs and outlays of the health sector, together with data on hospitalisation etc. This data is used to calculate the costs of health care. Its variables include costs per institution and the medical profession.

N7 - ZARA employers panel

On behalf of the Ministry of Social Affairs, IVA from Tilburg and As/tri from Leiden collected from 1995-1996 information on sickness, disability and reintegration. The data was gathered from a sample of enterprises. This data set is used for monitoring the impact of several regulation measures regarding working conditions and social security. Its quantitative variables were similar to the health related effects in checklist 1 and its qualitative data related to the OSH policy of companies.

N8 - Monitor stress and physical strain

On behalf of the Ministry of Social Affairs, IVA from Tilburg and As/tri from Leiden collected from 1995-1996 information on sickness, disability and reintegration. The data was gathered from a sample of enterprises and employees. It is used for monitoring risk factors and the impact of stress and physical strain of companies' OSH policies. Its quantitative variables were similar to the health related effects in checklist 1 and its qualitative data related to the OSH policy of companies.

N9 - Disability statistics

LISV (National Institute Social Insurance) collects data from the UVIs (the organisations responsible for the operation of disability insurance). Until 1997, this data was collected and published by the CISV (Board for Supervision on Social Insurance) and its predecessor, the SVR (Social Insurance Council). Its variables include disability statistics (number of cases, costs, premiums), according to sector and diagnosis (ICD 9 classification). The sectors used cannot be translated one to one to an industry classification as used by the Central Bureau of Statistics.

N10 - Study 10: Study of the costs of health per diagnosis

The Erasmus University in Rotterdam, Institute for Medical Technology and the Institute of Social Health Care were involved in this study. Two studies (1991 and 1994) were undertaken in relation to the costs of disease in the Netherlands. These two studies can be used as cost-of-illness studies for all diseases at the one time. Its variables include financial information used to calculate costs per disease. The 'year cost method' is used, i.e. all outlays occurring in a year are attributed to diseases (diagnoses) in the same year.

Spain

E1 - Ministry of Labour and Social Security

Statistics for accidents at work and occupational diseases are generated by the Spanish Ministry of Labour and Social Security and published annually.

The data is available to any citizen with the exception of confidential data protected by specific legislation, and is used for surveillance, public policy development and social debate. Its measures include occupational accidents with work interruption: outcome by province, economic sector and activity; health outcome by gravity, type of accident, material agent, type of injury and zone of injury; outcome by company size, age, sex, period of time spent in the company, period of time spent in the workplace, professional occupation and type of contract. Another measure is occupational accidents (serious or fatal) with work interruption: outcome by type of shift work, work incentive, day of the week and hour. Another measure is occupational accidents without work interruption: outcome by province, economic activity, type of accident, company size, sex and day of the week. A labour statistics bulletin is generated by the Spanish Ministry of Labour and Social Security and is published monthly. Its measures include economic expenditure, health care, social services and treasury and informatics.

E2 - Working Conditions National Survey

This survey was conducted in 1987 and 1993. The data is available to any citizen with the exception of confidential data protected by specific legislation, and is used for surveillance, public policy development and social debate. Its measures include: frequency of occupational accidents (last 2 years), accidents with work interruption (last 2 years), accidents without interruption (last 2 years), occupationally related diseases (frequency and types), morbidity attended (medical assistance in last year), morbidity attributable (medical assistance attributed to occupation in last year) and work shifts due to health causes.

E3 - Social Security System

The Social Security System issues a budget for the Social Security System in connection with work-related accidents. This includes information on economic expenditure, health care costs, social services, treasury and informatics, management expenditure, pensions and other economic expenditure.

Sweden

S1 - Labour statistics

The statistics report on the Swedish labour market is generated by The National Labour Market Board. The labour market statistics provide a description of the labour market's functioning. They are used as a basis for decisions regarding the country's economic policies. The figures include the results of labour force surveys, pay and employment statistics and information regarding the individual's conditions of employment, etc. Labour force surveys show the individual's mobility of status between being employed, unemployed, studying or elsewhere outside of the labour market.

S2 - Swedish Board of Health and Welfare (health statistics)

The health statistics are generated by the Swedish National Board of Health and Welfare and report on medical care figures, ill health, healthcare costs, health care provision, causes of death, as well as other health related figures.

S3 - Swedish National Social Insurance Board (social insurance statistics)

Social insurance statistics are generated by the Swedish National Social Insurance Board. The statistics report on the utilisation of social insurance. These include

sick leave figures, retirement figures, costs of rehabilitation, social insurance costs, etc.

S4 - Apoteksbolaget (medication sales)

Medication sales figures in Sweden are generated by Apoteksbolaget (*The Pharmaceutical Company*). The statistics report on sales of medication according to each of the larger groups of drugs. An account of the diagnosis and therapy survey, including information regarding diagnoses in open care, drug profiles and distribution of consultations, diagnoses profiles is also provided.

S5 - Swedish Board of Occ Safety and Health (Industrial injury statistics)

Industrial injury statistics are generated by the Swedish National Board of Occupational Safety and Health. Statistics regarding developments in industrial injuries are categorised into industrial accidents, diseases and deaths. Course of events, cause and sick-leave are reported upon according to occupational category.

United Kingdom

UK1 - Health and Safety Executive statistics

The HSE generates the data sets based on inputs from RIDDOR, the labour force survey, the dept. of health statistics on cost of medical treatment, the dept. of social security sick pay statistics, the dept. of employment and the office of national statistics. This data set is widely used by employers, the public, unions and h&s professionals. It is used for cost benefit analysis for prospective legislation; calculation of loss of output; calculation of loss of unit cost of fatal, major & minor injury and the production of reports, e.g. Annual Statistics, Case studies (HS(G)96), Davis & Teasdale. It has information that includes: fatalities (accurate estimate); sickness absence spells, permanent disability, loss of potential output, and administration of sickness absence (reliable estimates); hospitalisation, other medical care, human costs, damaged equipment, other workplace cost categories and other non-health related costs (rough estimates).

UK2 - Departments of Social Security

Various sections within the Department of Social Security generate the data set, which is made up of a number of sub data sets dependent on the various benefits. Users of the data are e.g. social policy researchers, pressure groups, and government ministers. The data set is used for the calculation of the costs of the various types of benefit, number of people claiming benefit and forecasting of benefit expenditure.. The variables used depend upon the particular benefit scheme, possible ones are: hospitalisation, non medical, sickness absence, permanent disability, and fatalities (of people on benefit), the cost of benefit administration and the financial costs of benefits, and a benefit forecast.

UK3 - Department of Health (Hospital Episode Statistics)

Hospital Episodes Statistics gather information on hospital admissions from hospital administration (not outpatients), e.g. bed-days, type of operation etc. Can include cause code which could help to identify whether admission is due to occupational accident/illness. There are a range of users of the data set (or parts of it), e.g. universities, medical companies, health care providers and other government departments. HES itself does not perform any assessments on the statistics

gathered, this may be carried out by other users of the data set (see above).
Hospital bed-days accurately recorded.

Annex 2

Key for Table 4.2

Austria

A4 - AUVA (Austrian Workers Compensation Board)

AUVA also compiles data for deaths, absenteeism or sick leave, personnel turnover, non-medical rehabilitation, registered accidents and occupational diseases, reduced well being, job satisfaction and poor working climate and complaints about health and wellbeing at company level. These cases can be assigned to the companies where they occurred, so that these data sets could be compiled for every company. Though this data is available it has not been used yet.

Belgium

B1 - Private Belgian insurance companies (covering occupational accidents)

In Belgium, accidents at work are covered by private insurance companies. Every year, some 200,000 accidents are reported; this represents some 34 billion francs for insurance companies. In addition one must add 7 billion francs of the FAO (National fund for occupational accidents) to this figure. The direct costs of accidents at national level in Belgium are relatively easy to quantify. These include costs to the insurance company such as part of the salary of the victim, medical costs and hospitalisation costs. No research has been undertaken to estimate the indirect costs of these occupational accidents. The direct costs of accidents at company level in Belgium are relatively easy to quantify. Direct costs are covered by insurance which includes part of the salary of the victim (90% of average daily salary and fixed amount for annual salary), medical costs and hospitalisation costs. The more accidents for which companies put in claims to their insurance companies the more effect this will have on their premium.

B4 - Company level methodology for case studies on costs and benefits of specific prevention projects carried out.

Some Belgian companies have carried out projects evaluating the costs and benefits of prevention policies for accidents and diseases. Their methodology includes costs divided into economical and non-economical factors.

Finland

FN4 - Method 1: A practical calculation method for costs of occupational safety and health

The method was developed for calculation of the costs due to poor working environment ("consequence costs") and the cost of OSH activities ("preventive costs"). The method was developed specially for SMEs. It was developed in close co-operation with trade unions and employer associations. It is very similar to the present methodology. The method includes all the variables as presented in Checklist 2, with the exceptions of 1.1.6, 1.1.7, and 3.1-3.6. It was tested in more than 30 companies. The result was that the classification of cost items is reasonable, but the problem is to obtain necessary data for calculation. The method has been published as a work book. Almost 1000 copies have been sold. It is also available on an Excel macro. Specific company consultations have been given.

FN5 - Method 2: A cost-benefit method called TERVUS

TERVUS is a computer-aided calculation software for cost/benefit analysis of a specific OSH measure. TERVUS was developed at the FIOH by Dr. G. Ahonen and it was based on the work of Dr. M. Oxenburgh and Dr. P. Liukkonen. In principle, TERVUS includes similar cost items as in checklist 2. The problem is to obtain relevant data for calculation. TERVUS has been applied in scientific studies with good results, e.g. in the Action Program on Small Scale Enterprises in Finland (see: http://www2.occuphealth.fi/u/pie_e.htm).

FN6 - Method 3: Human resource accounting (HRA) method

The HRA method aims to provide more specific information on the personnel of a company. Dr. G. Ahonen is the Finnish expert in this topic. In relation to the variables mentioned in Checklist 2, the HRA method includes information e.g. on sick leaves, accidents, working ability, working climate, costs of accidents and costs of sick leaves, costs of training and occupational health activities, and on productivity of personnel. In Finland, interest on the HRA method is growing, especially in large companies. Share holders wish to have more specific information on personnel and OSH situation of a company.

FN7 - Study 1: Costs of accidents in furniture companies

The aim of the study was to develop a reliable cost calculation method for accident costs and to apply this method in the furniture industry. Finland, Sweden and Norway participated this study in the late 80s. The Consequence Accident Tree (ACT) method was developed during this study. The doctoral thesis of M. Aaltonen was based on this study. The ACT method includes the following variables in Checklist 2: 1.1.5 (considers only accidents and diseases), 1.2.1-1.2.7 and 2.8.

France

F3 - Interview with Company 1 (SME with less than 50 employees)

This company is liable to the "mixed" rate of contributions. It collects information on the direct costs of declared accidents and occupational diseases (items 1.1.5 and 1.2.5 on Checklist 2), and information on reduced well-being and complaints (1.1.6, 1.1.7) through the Health and Safety Committee. In relation to prevention, this company calculates preventive costs in terms of the equipment of the company, individual protection, work station improvement, cost of security, and training as direct fixed costs (2.1, 2.2, 2.5, 2.6, 2.7, 2.10). In relation to benefits, there are no calculated costs, but an estimation of "security" (human resources aspect). The company is concerned with calculating the cost of each accident, this a wide acceptance of "prevention". Generally, about 1/10 of what the CHS-CT requires in this respect is done. The manager of this company wishes to do more, and is keen on getting evaluation tools, because they "don't know how to do it".

F4 - Interview with Company 2 (large company with over 500 employees)

This company uses the "account report" of CNAM which calculates the average cost of an accident from dividing the total cost by the number of accidents. This is undertaken on each shopfloor, for each plant and for the group and they analyse it for internal information. They also use "indirect costs" which they calculate as direct costs and additional costs for changed working procedures and maintenance. They integrate into indirect costs: salarial expenses (to the victims and others who were concerned), production loss (work interruption, absence, damaged products),

maintenance expenses (repair), administration (replacement, enquiry, reorganisation), commercial loss (delays, lost customers), penalties, social assistance (allowances) and prevention expenses (new measures). The costs of accidents without sick leave have been calculated to 2000 FF. Prevention is estimated through the "Bilan social", an official document obligatory for companies with more than 200 employees. The indicators refer to health, safety and working conditions; training; amount and nature of investments etc. According to the evolution of this cost, the company considers having good results or bad results and concludes whether their preventive measures are efficient or not. It was said that this calculation only makes sense for an important number of employees (>200). For 10 people, a serious accident falsifies the average. This ratio is given by experts.

The company decided to test the reality of all this, and carried out a study of 3 serious accidents with IP and 20 casual with sick leave. The results were that for the 3 accidents with IP:

$$TC = DC + IC (DCx4)$$

The results for the 20 casual accidents were:

$$TC = DC + IC (Dcx0,2) = 1,2$$

The decision was taken to go on calculating the total cost as:

$$TC = DC + IC (Dcx2,5)$$

However, this amount is not considered per se as incentive for prevention. Regarding cost of prevention, the position expressed here was that prevention has no cost, but an accident has some. The investments which serve exclusively the improvement of working conditions can be considered as prevention costs; not the ones for the purpose of being in conformity with the law. The training costs for security do not belong to prevention either - they are part of the general management of the company

Germany

D21 - Enterprise 1 (metal working industry; approximately 300 employees)

The personnel department of this organisation collects data on occupational accidents and diseases (presented in annual report and case by case evaluation for management); days lost due to sickness or injuries (monthly report to management); well-being, job satisfaction and the atmosphere at work (case by case evaluation); and objectives in detail in relation to working days lost, no ratios etc. Health circles in liaison with the manager responsible collect data on employee complaints referring to averse effects on health and well-being (case by case evaluation); and in co-operation with the social health insurance body collect data on the image of the enterprise (internal and external). The accountancy section collects data on insurance premiums (monthly report on costs); investment in safety and health protection installations (monthly report on investment); expenditure for personal protective equipment (monthly comparisons); and management objectives (monthly evaluations and department managers are questioned in respect of their reasons for objectives). The quality department collects information on changes in productivity and changes in the quality of goods and services for a monthly report. The manager of the training shop gathers information on proposals for improvement in order to evaluate health circles and write a quarterly report for management. Data on the objectives of the enterprise, concerning labour protection and/or health promotion is formulated by management.

D22 - Enterprise 2 (metal working industry; approximately 600 employees)

Within this enterprise the personnel department collects data on occupational accidents and diseases (quarterly and annual reports); objectives in detail (published at company level and monthly report); and management objectives (monthly report). The external company of this enterprise collected data (one time only) on well-being, job satisfaction and the atmosphere at work (case by case evaluation). The accounting department collects information on insurance premiums with respect to labour protection; investment in health and safety protection installations; additional (short-term) expenditure on installations or buildings and expenditure for personal protective equipment; and expenses for the internal safety department and/or external safety consultants (monthly and annual reports). Production management gathers data on proposals for improvement.

D23 - Enterprise 3 (metal working industry, approximately 1400 employees)

The labour protection department collects data on occupational accidents and diseases (annual report); damages and destruction due to accidents (recording purposes in accounting department); investment in safety and health protection installations (annual report); expenditure for personal protective equipment and working hours spent on safety-related discussions. The personnel department collects information on days lost due to sickness/injuries (annual report, case by case evaluation and evaluation at a cost level); labour turnover (annual, monthly and weekly reports); permanent (partial) disability; well-being, job satisfaction and the atmosphere at work (results are published at company level and case by case evaluation); operational activities such as person power planning and health promotion in co-operation with the social health insurance body (case by case evaluation); other preventive actions in conjunction with the company's sports and health circles (case by case evaluation); image of the enterprise (case by case evaluation); objectives in detail (annual and monthly reports), and management objectives that control (annual report, posted in company). The accounting department collects data for insurance premiums (annual report); compensation payment on pecuniary damages (case by case evaluation); and expenses for the internal safety department and/or external safety consultants (monthly and annual reports). Some departments collect data on changes in productivity (annual report).

The company agent (whose specific brief is proposals of improvement) collects proposals for improvements (annual report and evaluated case by case). Management formulates data in relation to the objectives of the company re labour protection and/or health promotion (monthly and annual reports and case by case evaluation).

D24 - Enterprise 4 (public traffic and supply; approximately 3000 employees)

The labour protection department gathers information on occupational accidents and diseases (annual report and case by case evaluation); additional factors (case by case evaluation); fines (annual report); and investment in safety and health protection installations (company annual report). The personnel department collects information on days lost due to sickness or injuries (annual report); information on permanent (partial) disability; and non-medical (occupational) rehabilitation (annual report). The works council in conjunction with the personnel department collects information on well-being, job satisfaction and the atmosphere at work (case by case evaluation); in conjunction with the labour protection department collects information on employee complaints referring to the adverse effects on health and well-being. The control post gathers information on damage and destruction due to

accidents (case by case evaluation). The insurance department collects data on insurance premiums (annual report); and information on compensation payments in relation to pecuniary damages (annual report). The accounting department collects data on expenditure for personal protective equipment, and passes on information re expenses for the internal safety department and/or external safety consultants to the labour protection department (annual report). The specific agents collect information on proposals for improvement which is then presented in the annual report. The chairperson formulates objectives of the company concerning labour protection and/or health promotion. The profit centres of the company gather data on the objectives in detail and management objectives (case by case evaluation).

D25 - Enterprise 5 (chemical industry, approximately 8900 employees)

In this company the works doctor keeps a record of occupational accidents and diseases (annual report, case by case evaluation); and collects details of employee complaints re adverse effects on health and well-being. The personnel department collects data on work days lost due to sickness or injuries (information used for personnel statistics on sickness ratios); labour turnover and premature pensions. The labour protection department (in conjunction with the works doctor) collects data on permanent (partial) disability; non-medical (occupational) rehabilitation; insurance premiums (case by case evaluation); expenditure for personal protective equipment; working hours spent on safety-related discussions; expenses for the internal safety department and/or external safety consultants (case by case evaluations); proposals for improvements; enterprise objectives; objectives in detail and management objectives. The external company collects data on well-being, job satisfaction and the atmosphere in the workplace; this information is evaluated case by case.

Greece

G6 - Study 4

This study is based on detailed data collected by a company regarding occupational accidents of its permanent employees. The Public Power Corporation of Greece employs about 35,000 people, 27,500 of whom belong to the permanent labour force of the Corporation and are insured by their own Insurance Fund, funded by the company. The data give figures for days of absence, type of accident and injury, injured part of the body, cause of the accident, duration of previous service and age of victim and cost for their medical care and medicines. The study calculates the direct financial cost for the company caused by the accidents for the years 1990 and 1991 at current prices based on the following figures: number of accidents by age, duties and previous service of victims, wages in the company according to duties and experience and days of absence. The study is also based on the assumptions that: the company pays one extra full time employee of similar qualifications and experience to replace each injured person, the number of non productive man-hours paid by the enterprise for each accident vary from one to five according to the severity (days of absence) of the accidents and that the pensions will have to be paid for a period until 1/6/93. The total financial cost is calculated as five times of the direct cost (theory of Heinrich). Finally the study compares the costs by type and cause of accidents, by type of injury and by injured part of the body.

Ireland

IR6 - Irish Business and Employers' Confederation Survey Report on Employer/Public Liability Claims for Personal Injury

An Irish Business and Employers' Confederation (IBEC) Survey Report on Employer/Public Liability Claims for Personal Injury in 1993 was based on a survey of over 300 member enterprises. The questionnaire focused on general statistics on experiences with accidents and claims and asked for detailed information on individual claims. Over 64% of companies experienced employer liability claims. The average number of employer liability claims per company was 10. The average award for an employer liability case heard in court was £16,513 as well as legal costs amounting to £4,672 on average. The figures were £10,621 and £3,208 for out of court settlement. The average employer liability insurance premium was 2% of the company payroll. The report also examined safety profiles and other factors that may affect claims, e.g. gender, presence of sick pay scheme for injury incidents.

Italy

I4 - Company 1 Survey

Surveys were carried out in two national companies. The first company (AGIP PETROLI) was in the energy sector with 11,000 workers. It had measures in relation to health-related corrective costs such as fatalities (no. of cases occurred); absenteeism (days of absence from work); turnover (turnover rate); non medical rehabilitation (non medical rehabilitation rate related to all employees); registered accidents and occupational diseases (frequency and severity rate related to the working hours performed); and complaints about health and well-being (hours devoted to assemblies and/or strikes). It also had measures on non health-related costs such as administration of sickness absence (annual expenditure); damaged equipment (annual expenditure); increased corporate insurance costs (differential expenditure); and liability (insurance costs for plant liability). It also has measures in relation to preventive costs such as investments in safety and health equipment (costs for health and safety investments); extra work-time (current expenditure for training costs); internal and external prevention services (current expenditure); and in-company preventive activities (current expenditure for preventive service costs). It also collects information on the benefits of prevention such as productivity (added value per worker); innovative capacity of the firm (auditing costs for constant auditing system). This data is used for risk assessment and health care. The ratio between health and safety costs as envisaged by the law and the actual expenditure borne by the company is 1 to 10. The company devotes special care to this issue and has set up a targeted preventive Service composed of 20 people and headed by a health and safety manager and a health care manager.

I5 - Company 2 Survey

The second company (CBM ITALCAPS) was in the packaging (engineering sector) with 250 workers. It had measures in relation to corrective health-related costs such as fatalities (no. of cases occurred); absenteeism (registered); turn-over (turn-over rate); non-medical rehabilitation (rehabilitation rate); and registered accidents and occupational diseases (frequency and severity indexes). It also had measures in relation to corrective non health-related costs such as administration of sickness absence (loss of working time and replacement costs); damaged equipment (expenditure); accident investigations; higher risk insurance premiums (premium rate fluctuations); and liability (insurance costs). It also had measures relating to

preventive costs such as investments in safety; extra work-time; internal and external preventive services and in-company preventive activities (current expenditure). Its measures in relation to benefits are productivity (working hours); quality of products and services (costs of work hygiene and sanitary control); and other operational effects such as expenditure on energy materials etc.

Netherlands

N11 - Study 11: Programme to prevent low back pain complaints at NAM (1995)

This study involved a comparison of targets for the programme and their realisation. Variables included sickness absence due to low back pain, and costs and benefits of the (low) back pain prevention programme.

N12 - Study 12: What costs policy on absenteeism? (1995)

This study involved the development of a model to calculate the costs and benefits of a policy on sickness absence for an individual company. It was applied to six companies. Variables included sickness absence (days), costs involved (checklist company level: absenteeism or sick leave, administration of sickness absence, lost production time, the effects on variable parts of insurance premiums and extra wages, danger money).

N13 - Study 13: Do the costs make profit? (1988)

This study involved the development of an instrument to assess the costs and benefits of investments to improve working conditions. This instrument has been applied to six metal processing enterprises. Variables include items from the company level checklist: absenteeism or sick leave, personnel turnover, registered accidents and occupational diseases, reduced well-being, administration of sickness absence, damaged equipment, lost production time, effects on variable parts of insurance premium, investment in safety and health equipment, additional investments, additional costs of substitution products, purchase of personal protective equipment, extra worktime, costs of internal or external OSH services, productivity, quality of products and services and opportunity costs.

N14 - Study 14: Absence, costs and company (1988)

This data set is from a prize winning essay on the costs of sickness absence and the factors influencing sickness. Its variables include the following items from the company level checklist: absenteeism or sick leave, personnel turnover, administration of sickness absence, lost production time, effects on variable parts of insurance premium, productivity and the quality of products and services.

Spain

Several case studies with companies selected from various economic sectors was shown. This information may be potentially useful to identify and quantify the human and economic costs of work-related accidents. However, it was not possible to establish how far the companies selected were representative of their sectors of industry.

E4 - Company 1 Metropolitan Barcelona's Transport

The first company was in the transport sector with 5,200 workers. It has collected data on occupational accidents. Information includes number of deaths, accidents with and without work interruption, minor injuries, injury location, and days lost by

absenteeism. A number of demographic and social variables are collected as well (age, sex, etc.). Data on occupational accidents looks at gravity, type of accident, zone of injury, day of the week, hour of the working day and the sector within the company. Descriptive reports are available and general prevention programmes have been implemented but no studies on the economic costs, health causes or prevention programmes have been conducted.

E5 - Company 2 Clinic Hospital of Barcelona

The second company was a hospital with 3,300 workers. The information it collects is in terms of occupational accidents and the numbers of deaths, accidents with and without work interruption, minor injuries, and injury location. A number of demographic and social variables are collected as well (age, sex, etc.). Data on occupational accidents looks at gravity, type of accident, zone of injury, day of the week, hour of the working day and place of the accident. Descriptive reports are available and general prevention programmes have been implemented but no studies on the economic costs, health causes or prevention programmes have been conducted.

E6 - Company 3 Roca Company

The third company was in the industrial sector with 2,150 workers. It mainly sells heating, lavatory and air conditioning products. The data it collected includes: data on accidents with and without work interruption, causes of accident, type of injury, zone of injury, period of the day when the accident occurred, period of the working day, day of the accident, age, period of time spent in the workplace and period of time without working. Descriptive reports are available and general prevention programmes have been implemented but no studies on the economic costs, health causes or prevention programmes have been conducted.

E7 - Company 4 CAMP S.A.

The fourth company had 500 workers and is in the industrial sector. Its main products are soaps and detergents. The information available via this company includes number of deaths, accidents with and without work interruption, minor injuries, injury location and days lost by absenteeism. A number of demographic and social variables are collected as well (age, sex, etc.). Data on occupational accidents looks at accidents with and without work interruption, causes of the accidents, type of accident, zone of injury, period of the day when the accident occurred, hour of the working day and day of the accident and sector within the company. Descriptive reports are available and general prevention programmes have been implemented but no studies on the economic costs, health causes or prevention programmes have been conducted.

E8 - Company 5 Montanesa Mutual Company

The fifth company covers over 42,000 workers in Catalonia and about 150,000 workers in Spain. Information in relation to occupational accidents is available, including: the number of deaths, accidents with and without work interruption, minor injuries, injury location, and days lost by absenteeism. A number of demographic and social variables are collected as well (age, sex, etc.). Data on occupational accidents looks at accidents with and without work interruption, causes of the accidents, type of accident, zone of injury, period of the day when the accident occurred, and day of the accident. Descriptive reports are available and

general prevention programmes have been implemented but no studies on the economic costs, health causes or prevention programmes have been conducted.

Sweden

S5 - Swedish Board of Occ Safety and Health (Industrial injury statistics)

Industrial injury figures are generated by the Swedish National Board of Occupational Safety and Health. The previously recorded industrial injury statistics also provide the opportunity to display the statistics at a company level. In this case, companies obtain information relating to industrial injuries and sick-leave arisen through this, in relation to industry trends for industrial injuries. The statistics include information regarding industrial injury related sick-leave, information about developments in industrial injuries per company, as well as the opportunity to report on the financial consequences of industrial injuries.

S6 - Swedish Employers Confederation (time utilisation statistics)

Time utilisation statistics are generated by the Swedish Employers' Confederation. The statistics include information regarding normal working hours, absence through statutory holidays, sick-leave, holidays, other absence, overtime, and personnel mobility. The statistics are categorised according to women, men, blue-collar workers, white-collar workers, and age group. Records are stated in hours. The statistics are generated quarterly and in an annual book. The statistics include information regarding Swedish Employers' Confederation's affiliated companies and their employees, approx. 230,000 employees in total.

S7 - Swedish Association of Local Authorities

This Association examines personnel mobility, sick-leave, employment, number of employees, and training.

S8 - Federation of County Councils

The Federation of County Councils collates data in relation to the number of employees, age, sex, employment grade, sick-leave, personnel mobility, leave of absence, and training.

United Kingdom

UK4 - Norwich Union

Data is provided by Norwich Union clients (policy holders). It is passed to the Association of British Insurers who produce annual statistics available to members. Its variables include: absenteeism / lost wages; fatalities; permanent disability; administration on absence, damaged equipment is included as a lump sum for claim plus costs of investigation; loss of future earnings (pricing principle) and the number of claims taken as a measure of risk.

UK5 - Willis Coroon Insurance Brokers

Data is provided by clients (companies) to insurance broker and entered into a database. Data set used to put a reserve on personal injuries/equipment loss. If over £100K then the case is sent to insurance company. Use of judicial guidelines for assessing compensation costs. Data for specific incidents provides the basis for reports to clients. Its variables include: fatalities, permanent disability, registered accidents / occupational diseases; damaged equipment, effects on insurance premiums, liabilities/legal costs; and compensation received from insurance.

UK6 - GMB Union

Data is provided by employers of union members, 1500 companies are members (60K individuals). Data is stored on database, able to generate sub data set for individual companies, specific incidents or national level profile. Information provided to the TUC. Its variables include: health related effects: hospitalisation (bed-days), other medical care (recuperation in convalescence), sickness absence (days), and turnover (permanent/partial disability). It also includes corrective costs: administration and investigation cost to union, and compensation costs. Data for accidents is more reliable than for ill-health.

UK7 - Chemical Industries Association

Data is provided by members companies using a standard proforma. Basic outcomes e.g. number of fatalities. Information used to produce reports to members on safety performance. Its variables include: fatalities, major injuries, reportable diseases (as defined by CIA), and dangerous occurrences. It also has limited information on occupational ill-health. It gathers information on the level of provision of occupational health resources. Reliability of the data set is dependent upon reliability of members' data.

UK8 - Association of British Insurers