AN EXPANDED CALCULATION METHOD OF COST EFFECTIVE ANALYSIS TO VALUE OCCUPATIONAL HEALTH AND SAFETY MEASURES

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ABSTRACT

In Europe the operating authorities of recycling factories have to fulfil requirements and guideline laws of the European Community laws as well as meet the local and national standards in each member country. The employers of any company should not only see the legislative standards protecting the employees but also the economic aspects of implementing health and safety measures. Preventive measures to this end are actually not a liability (loss) but an asset (investment) and the cash backflow is realized in human resources and productivity. Last but not least every employer has a social responsibility. In face of all technological progress, people should be regarded as a human resource, actually a production input which is a part for every product.

1. INTRODUCTION

Occupational health and safety belongs nowadays to the daily organization of a company. A lot of laws and regulation standards have to be fulfilled not only by the employers but also by the employees. By law the employee is protected. He is not anymore seen as an instrument. Much more he is a human resource.

On one hand the employer has to provide safe and healthy working conditions, on the other hand the employee has to apply the health and safety measures which are provided. But with the discussion of occupational health and safety measures and their target the question of economical aspects become significant. A lot of employers only have the costs of the precautions in mind and not the money which can be saved avoiding accidents or sick employees become. Especially in the young section of waste processing it is paid very little attention to occupational health and safety.

This paper points out that occupational health and safety measures are more then only costs. First a short excursion to the history and the current international and national (Germany) legislation is given before the current situation in waste processing plants is shown.

Further the paper describes the use and problems of economical calculation and presents an example of expanded economical calculation, the cost effective analysis. With an example of a work-place this method is extended. In the end it can be said that occupational health and safety means much more than costs.
2. BASICS

2.1 History
During the last few years the occupational health and safety has grown more and more important for all employers. Nearly every month new regulations are implemented on international and national level. All these laws are made to protect the employees. The protection of employees is not a new idea of our century. As one of the first known literature source the bible can be named: “When thou buildest a new house, then thou shalt make a battlement for thy roof, that thou bring not blood upon thine house, if any man fall from thence.” (Deuteronomy 22;8). In the notes of Hippokrates from the year 400 B.C. descriptions of occupational diseases can be found, too. Especially in the mining history in Germany for example a lot of regulations and descriptions over health and safety are known. Names like Paracelsius or Agricola can be associated with occupational health and safety. However the invention of protective equipment already started many years before. For example in 1746 a Dutch goldsmith invented the thimble. The target was and has always been and still is to save the human resource because in spite of all technical developments and rationalisations work can never be done without human beings.

2.2 Current legal foundation
With a joint international legal foundation the countries of the European Community move closer together. The international trade between the different member countries becomes much easier and hindrances can be reduced. It seems possible to reach the target of international standardized occupational health and safety on a high level. But at the same time the jungle of international and national laws and regulations becomes more and more confusing for all parties. Here a small overview of laws and regulations on international and national level is presented which are affecting the occupational health and safety.

2.2.1 International legislation
The basis for the international and national legislation is the treaty of Amsterdam from 1997. For the occupational health and safety two articles should be specified. The article 95 is the basis for the edict of guide lines which refer to the technical safety of work equipment. Guide lines like 89/686/EC (guide line for personal safety equipment) or 98/37/EC (machine guide line) were developed from this article. The article 137 is the basis for the edict of guide lines for using products and for conditions at workplaces. An example for a guide line developed from this article is the 89/391/EC (guide line for measures to improve the occupational health and safety). The just mentioned guide lines are only a small selection of regulations which have to be converted into national law. Further on, the German legislation shall exemplify how international law is converted into national law.

2.2.2 National legislation
A lot of different laws, regulations and guide lines can be found in Germany which all regulate the occupational health and safety. The German Constitution already states that every citizen has the right of life and health. In 1974 the “Work safety law” (Arbeitssicherheitsgesetz) was established followed by the “Work protecting law” (Arbeitsschutzgesetz) in 1996. Next to these laws there are a lot of regulations as for building, working places or on-screen work. Working with the material waste a new regulation became very important. In April 1999 the “Biological materials waste
regulation” (Biostoffverordnung) was implemented. In this regulation biological material is named as a material which can cause infections, sensitisation or poisoning [1]. The biological material is divided up into four different classes of dangerousness. The material waste collected from the households can be placed between class 2 and 3. That means for example that the operator authorities of waste processing plants have to take precautions to protect the employees and citizens from health defects and accidents in a special way.

2.3 Situation in waste processing plants
With the implementation of the “circulatory economy and waste law” (Kreislaufwirtschafts- und Abfallgesetz) in 1984 more and more waste processing plants were built in Germany. In this law an order of ranking is given how waste has to be treated. It is said that waste first has to be avoided, then be exploited before being cleared away [2]. The target of waste processing plants is the production of a material which can be exploited. Mostly the product consists of a high caloric value and can be used as substitute fuel.

Waste consists of all kind of materials like paper, plastics, clothing and organic waste which includes a lot of biological material. These days it is still not apparent how much the health of the employees might be effected by dealing with waste. All kind of viruses and bacteria can be found in waste. Diseases like hepatitis or diseases of the lungs are possible. Therefore the protection of all employees is very important. With the technical possibilities of today it is no problem to cover the whole plant so that no biological materials can escape. But during maintenance of the machines the employee is in contact with the waste. Then only personal safety equipment can protect the person. Very often exactly this fact is not observed. The figure 1 shows such a situation.

![FIGURE 1: Repairing a machine in a waste processing plant](image)

Concrete operating instructions should be given and a documentation is necessary. The problem of biological material is that mostly it is invisible and thus it is very easy to say that the material can not effect anybody. These kinds of plants are very young and so far experiences are falling far short. A lot of employers only fulfil the bare necessary regulations. They consider investments on occupational health and safety only as costs.
3. ECONOMICAL CALCULATION

3.1 General overview
The field of occupational health and safety gains more and more importance. Just some years ago no connection was drawn between a good working situation for the employees and the productivity of the company. The employees were regarded as instruments, as objects for the purpose of reaching the product target. The economical result was of first importance, the needs of the persons was minor.

This situation changed slowly. Nowadays the personal well-being is strongly connected to his efficiency. Only an employee who is highly motivated and who finds good working climate will work effective with optimal results. It is important to accept the employee as an individual and to include him in factory developments.

On the part of employers the employees become more a human resource which has to be preserved. It is important to save the human labour not only for the time being but also for the next years. With the improvement of medical diagnosis it is possible to specify all kinds of new occupational diseases. This means high costs for the companies which have to be avoided. It is inevitable for an employer to take into consideration preventative measures.

A measure to avoid an occupational disease which can appear, is very difficult to assess. It is easier to assess a failure, as for example an accident. The question is how can an employer be convinced to spend more money on occupational health and safety then he has to.

There is not only the fact that occupational health and safety cannot only be seen as purely monetary that means one-dimensionally, but the soft skills like motivation of the employees, personal well-being or personal capabilities have to be included in the economical assessment. The target of all measures is to avoid an interruption in the production process. Occupational health and safety has to be regarded as an investment and not as pure costs [3]. Only then it is possible to name an exact target and to plan the course. The advantage and success of an occupational health and safety measure can be recorded only after a longer period. The question of efficiency comes up much earlier on the part of the management. In this moment an economical calculation is necessary which can be used for multi-dimensional assessment. Different kinds of analysis methods are known but most of them cannot be applied here. The expanded economical calculation makes it possible already in the planning period to expose weak points, to include non-monetary aspects and to assess investment alternatives. With a weighed point grading it is possible to compare different measures and their grade of reaching the target [4].

For economical assessing of ergonomic measures in a medium-sized rubber producing company in Germany the cost effective analysis developed by Zangemeister and Nolting was used [3], [5]. The method can be used for ergonomic measures and occupational health and safety measures in the same way. The advantage of this method is that measures can already be assessed in the planning period. Statements can be put up before the measures are established. Then the statements from the planning period can be compared with the practice. This method described in detail the next part of this paper.

3.2 Cost effective analysis
The analysis starts with that moment the management decides to establish occupational health and safety measures. First the current situation in a company has to be documented. Here it is very important to split the company in different small parts and to get an objective overview over
different work-places. It has to become clear where the weak points of a work-place are, which people are using the place and which occupational diseases are known. Taking a survey with the employees is also very important because their opinion should be included.

When planning an investment on a machine, it should be calculated how much money can be saved with the new machine and how the productivity can rise. For planning occupational health and safety measures the same procedure should be kept. In the planning period it should be fixed which amount of money can flow back when the planned measure achieves its purpose. For example how many pieces more the employee will be able to produce with an ergonomic all better styled table. This amount represents the basis for the analysis.

The analysis starts. Four steps including all kind of aspects such as economics, image of the company, the opinion of the employees, diseases, different measures, current situation and the situation being are weighed. After the last step the analysis shows the measure which is the most cost-saving and effective one to be still economical. A ranking can be fixed pointing out the measure which should be established first. After establishing the measures a controlling is indispensable.

After this theoretical report an example shows that occupational health and safety measures do not mean only bare costs but can have a cash backflow.

4. EXAMPLE FOR COST EFFECTIVE ANALYSIS

In a medium-sized rubber producing company in Germany they had the problem of a very high number of illness and at some work-places a high number of error products. After assessing the current situation it could be shown that the ergonomic standards were not best. The employees suffered from diseases of the muscles, skeleton, stomach and eyes. All notifications of illness cost the company a lot of money. In co-operation with the Service Centre for occupational health and safety / Ruhrkohle AG in Saarbrücken / Germany an ergonomic project was started in 1999. The work-places were assessed and a survey with the employees was held [6]. Further a cost effective analysis was executed from two different parts in the company [5].

As example, the cost effective analysis is represented by the analysis from a work-place where the table was replaced by a new ergonomic table. The old table can be seen in figure 2. Only women are working at this work-place. They have to control the incoming pieces and treat them with a chemical substance. The substance is applied with a pistol which weighs 2,8 kilograms. Height and slant of the table could not be changed and the lighting above the table was insufficient. This situation resulted in diseases of the muscles, skeleton and eyes. Also a lot of error pieces were produced.

The following calculation shows how much money could be saved when only one piece per shift would be produced more at this work-place.

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value of one piece</td>
<td>17,50 €</td>
</tr>
<tr>
<td>Two shifts</td>
<td>2 x 220 / year = 440 shifts / year</td>
</tr>
<tr>
<td>Raising of the number of pieces</td>
<td>1 / shift</td>
</tr>
<tr>
<td><strong>Value in total</strong></td>
<td>440 Shifts x 17,50 € = 7700,00 € / year</td>
</tr>
</tbody>
</table>
FIGURE 2: Old work-place

FIGURE 3: New work-place
Figure 3 shows the new table. Now the height and slant can be changed and the light is much better. The pistol is much lighter. The employees are very satisfied with their new work-place. But still the question has to be answered for seen if really more pieces are controlled. Last step of the analysis is a comparison between the use which developed in four steps and the connected costs [5].

Table 1 shows the use-cost-comparison with one additional piece per shift. The points are developed in the four steps and are standardized on 1.000 points of use. This is done to make a comparison possible to the costs. Then the points are converted into money. The calculated 7.700,00 € are the basis for this conversion. The new working table should not cost more then 3.465,00 € to be efficient. In fact the table costs 4.750,00 € which means with producing one piece more per shift the table would not be efficient after one year. Table 2 shows the same comparison with two more pieces per shift. The basis are 15.400,00 €. Now the new table would be efficient after one year.

<table>
<thead>
<tr>
<th>Ergonomic measures</th>
<th>(points of use)</th>
<th>(€)</th>
<th>(€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>New table with new pistol</td>
<td>450</td>
<td>3.465</td>
<td>4.750</td>
</tr>
<tr>
<td>New lightening</td>
<td>350</td>
<td>2.695</td>
<td>500</td>
</tr>
<tr>
<td>Measure Holes</td>
<td>200</td>
<td>1.540</td>
<td></td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td><strong>1.000</strong></td>
<td><strong>7.700</strong></td>
<td><strong>5.250</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ergonomic measures</th>
<th>(points of use)</th>
<th>(€)</th>
<th>(€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>New table with new pistol</td>
<td>450</td>
<td>6.930</td>
<td>4.750</td>
</tr>
<tr>
<td>New lightening</td>
<td>350</td>
<td>5.390</td>
<td>500</td>
</tr>
<tr>
<td>Measure Holes</td>
<td>200</td>
<td>3.080</td>
<td></td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td><strong>1.000</strong></td>
<td><strong>15.400</strong></td>
<td><strong>5.250</strong></td>
</tr>
</tbody>
</table>

After one year the table was assessed. Figure 4 shows how the production rate of pieces at the table increased. Since establishing the new table the number of pieces raised from 93 to 135 per shift. This meant 42 pieces more then at the old table. But not only the table was changed at this work-place. Also new people started and a different work routine was established. During a discussion with the responsible people it was confirmed that around 15 % of the pieces produced more could be lead back to the new table. Converting this into money minus the costs for the table means that the cash backflow was approximately 40.000,00 €.
5. CONCLUSION

This example shows that spending money on occupational health and safety can not only be regarded as pure costs. More it is an investment which brings a cash backflow. With the saved money the company can undertake new investments. It is not enough to fulfil only the laws and regulation standards and only half of the obligation an employer has towards his employees.

The cost effecting analysis showed that occupational health and safety measures can raise the productivity and let money flow back into the company. A problem of the here described method is the fact that the developed result is based on assumptions and experiences of the responsible people. A controlling has to be added. The analysis is placed in the planning period and can not be taken for assessing the measures without sufficient time of establishing.

But laws, regulations and the economical arguments should not be the only ones in the discussion around occupational health and safety. Every employer has the obligation to take care of his employees. Money or legislation should not be the argument not to do the best for the people. Only motivated employees can reach the optimal results. The employees are not only a human resource which should be protected. They are individuals which are a part of the company and only together a company can run.

Even, when up to now no exact statements can be given if the work in a waste processing plant can cause occupational diseases or not, the employee has to be protected in the best way. Working under difficult conditions such as bad smells or knowledge of touching waste can put the employee under stress. Of course not all these stress factors can be eliminated but for the employee it is very important to know that he is not only an instrument.

The cost effective analysis presented in this paper can be used as an instrument to plan investments in occupational health and safety measures. Further it can include soft-skills in the assessment and show clearly the efficiency of occupational health and safety towards criticism. With the help of
such a cost effective analysis it can be shown that occupational health and safety measures can raise the motivation, productivity and quality of work and products.

6. SUMMARY

Occupational health and safety is no new subject. Nowadays a lot of laws and regulations standards have to be fulfilled. Legislation is one of the most important reasons for employers take care of the health of the employees. The management of a company has to follow the regulations but the question of economy has to be answered. Spending money on occupational health and safety lead to costs which the management wants to avoid. The problem is how the efficiency of measures can be demonstrated. Only an expanded calculation on a multi-dimensional level can include important soft-skills and can be used in the planning period.

This paper presents an expanded calculation method of cost effective analysis. It could be proved that established measures are not only costs but an investment with the result of a cash backflow which can be reinvested in the company.

Occupational health and safety measures are used for protecting the employees as well as saving money and last not but least to fulfil the social obligations towards the employees.

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