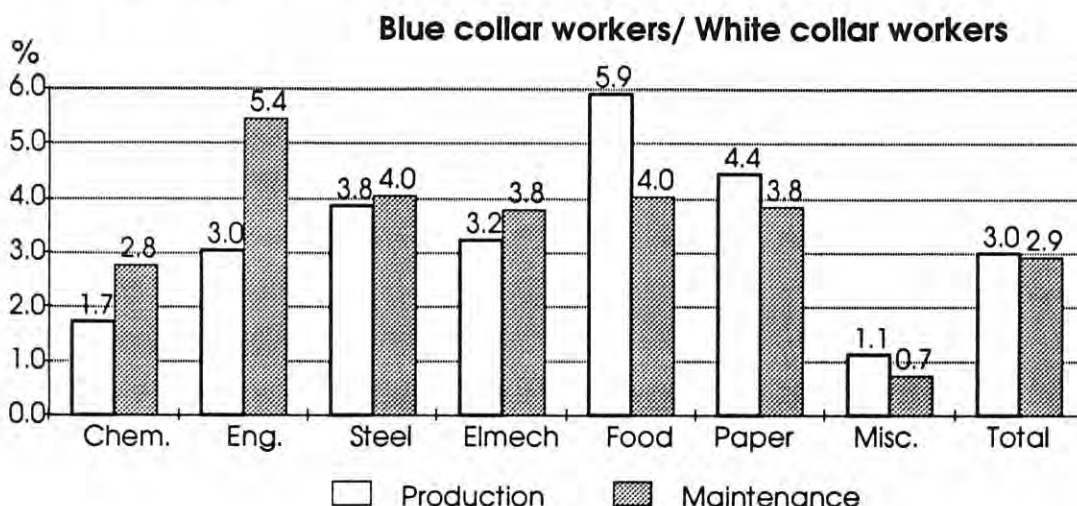


8.1.2.4 Ratio of blue collar workers to white collar workers



The average number of blue collar workers per white collar worker is very much the same, but the variations between branches of industry is greater on the production side. This is a consequence of the fact that maintenance work is much the same in most branches of industry while production work varies quite considerably. The figures for white collar workers include not only supervisors and managers but also other salaried employees.

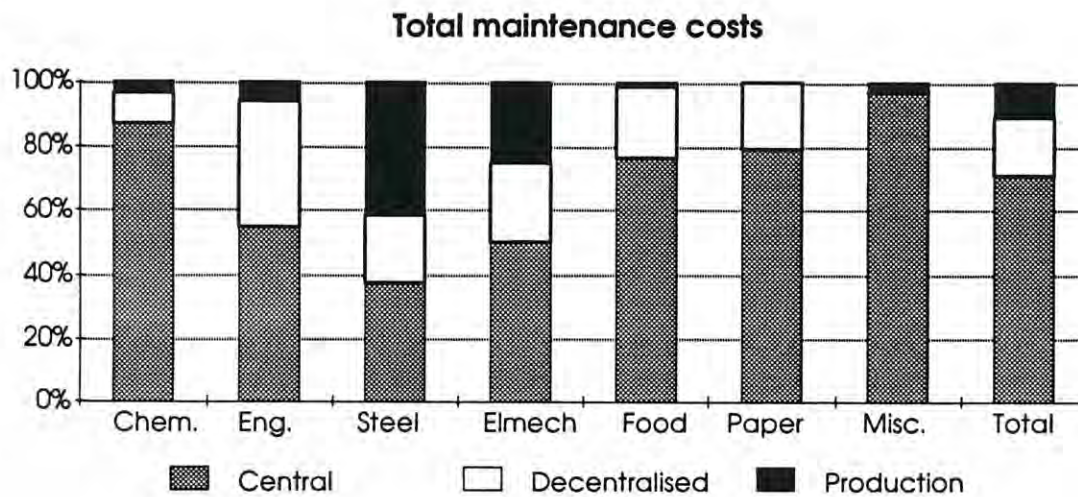
8.1.2.5 Decentralisation of maintenance resources

It is interesting to see the extent of decentralisation of maintenance resources in different branches of industry. We have therefore recorded how maintenance costs in the form of wages and salaries, materials, external services and miscellaneous are distributed between central and decentralised parts of the maintenance organisation and production.

Despite discussion on the need for decentralisation, it is quite clear that, in the participating organisations, the majority of maintenance resources used (approx. 70%) are organised centrally. Production's own maintenance resources are currently only of marginal significance.

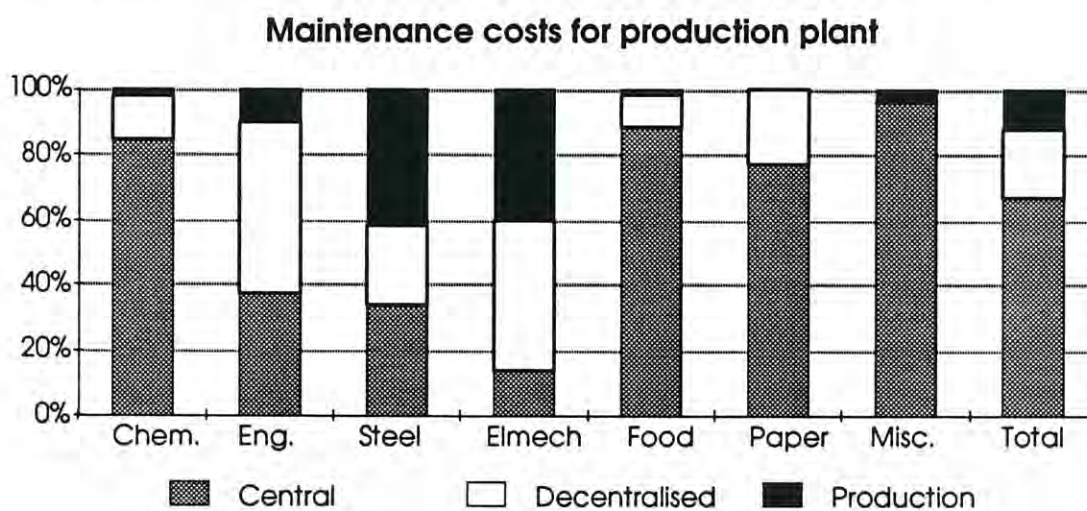
This conclusion remains valid even when considering distribution according to production plant, buildings and other plant.

Reporting by individual branches of industry may show considerable variations as a result of conditions within individual companies. The data are however too limited for these differences to be generalised and illustrate the differences between individual branches of industry. The data are more an expression of differences between different companies.



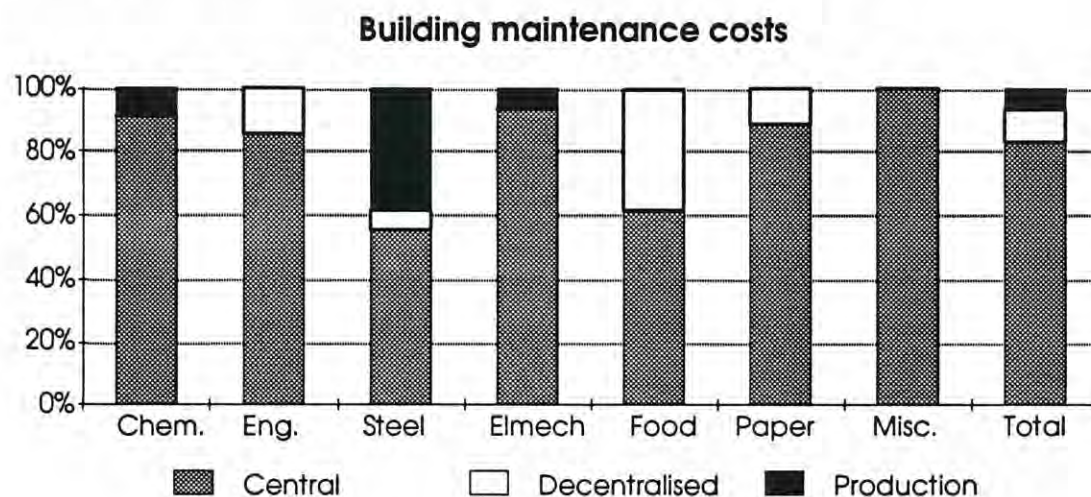
The diagram shows that Steel and Elmech have the greatest decentralisation when measured in this way.

8.1.2.6 Decentralisation of maintenance resources for production plant



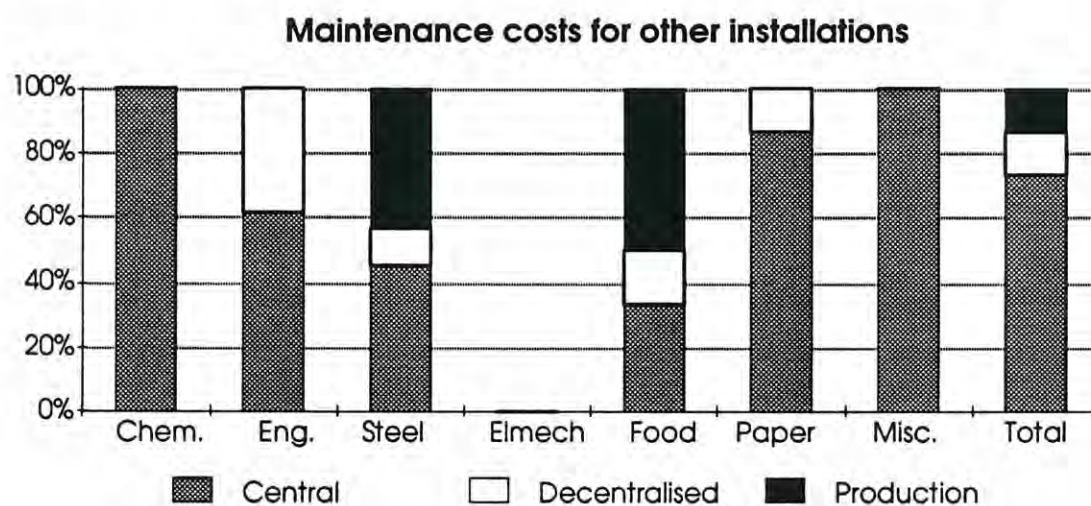
The maintenance of production plant is much more decentralised in Eng., Steel, and Elmech than other branches of industry.

8.1.2.7 Decentralisation of maintenance resources for buildings



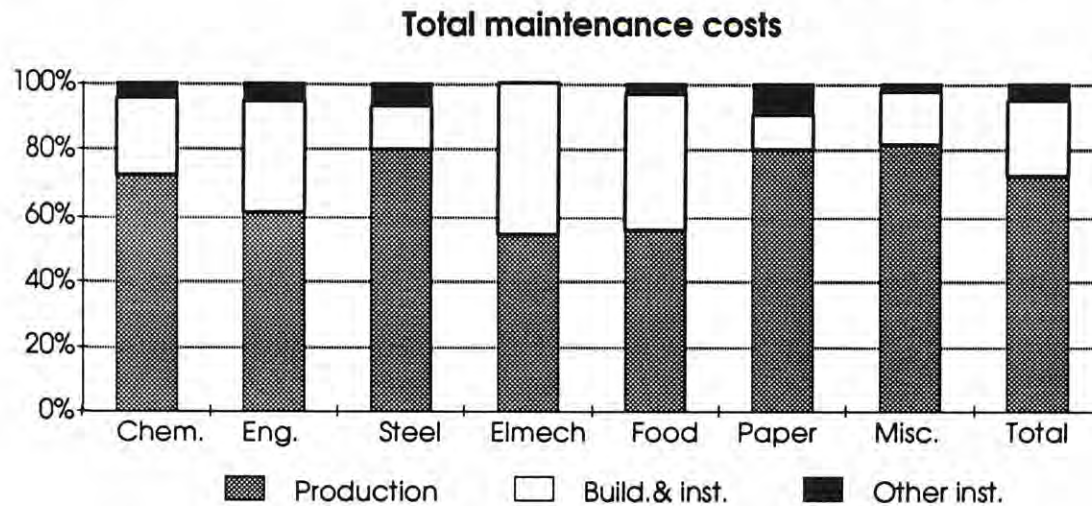
There is a clear degree of centralisation of maintenance resources for buildings in all branches of industry, perhaps with the exception of Steel and Food.

8.1.2.8 Decentralisation of maintenance resources for other installations



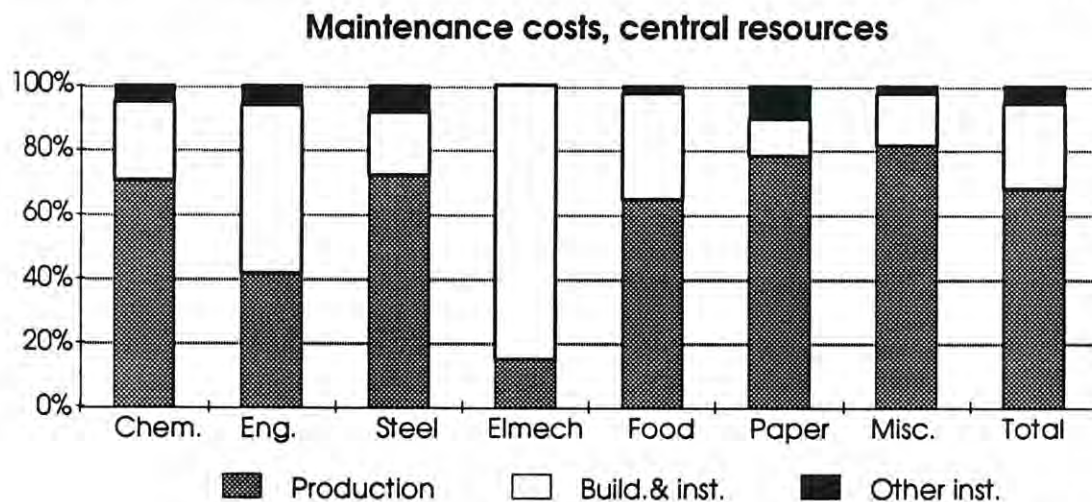
To a great extent, Steel and Food have delegated maintenance of other plant to production.

8.1.2.9 Distribution of maintenance resources according to type of plant



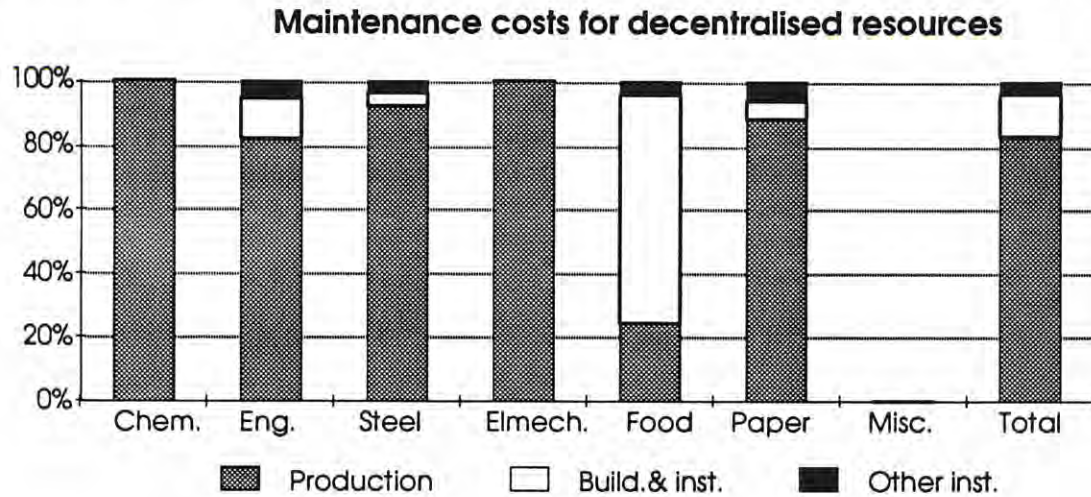
50-60% of the total maintenance costs in typical engineering branches of industry, Eng. and Elmech, are spent on the maintenance of buildings. Food also incurs a large proportion of maintenance costs for buildings.

8.1.2.10 Distribution of central maintenance resources according to type of plant



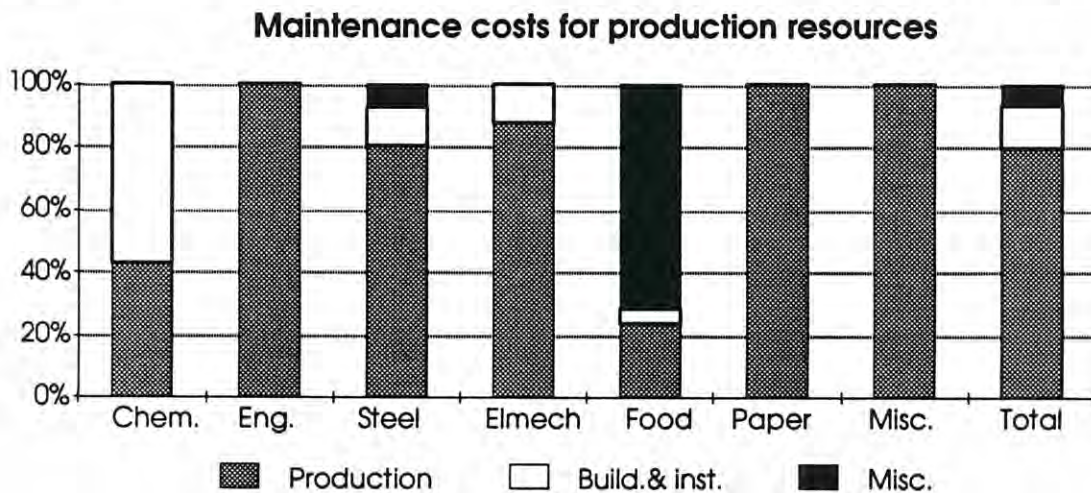
In comparison with the average of 73 %, Eng. and Elmech allocate significantly more of the centrally administered maintenance resources to buildings.

8.1.2.11 Distribution of decentralised maintenance resources according to type of plant



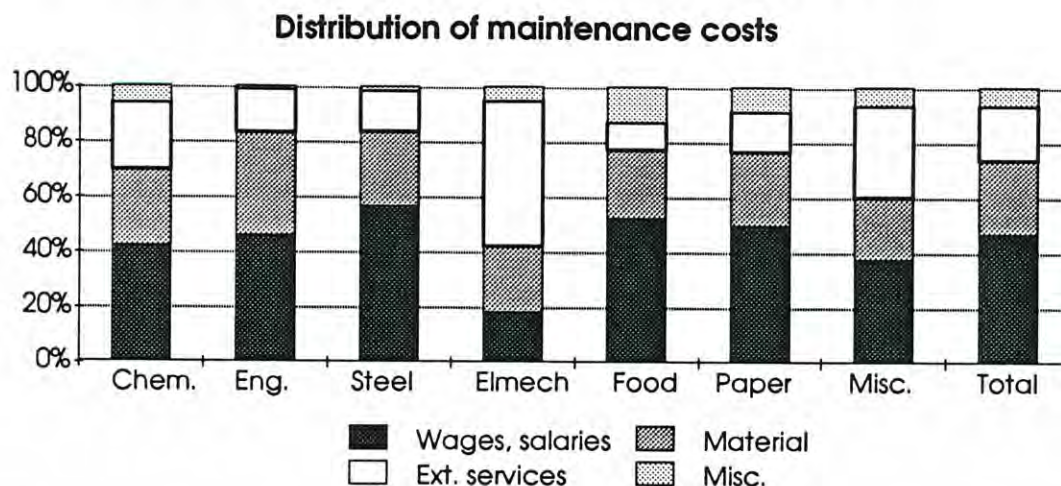
It is interesting to note that Elmech, where the maintenance costs are quite strongly decentralised, allocate 100% of the decentralised resources to production plant.

8.1.2.12 Production maintenance resources distributed according to type of plant



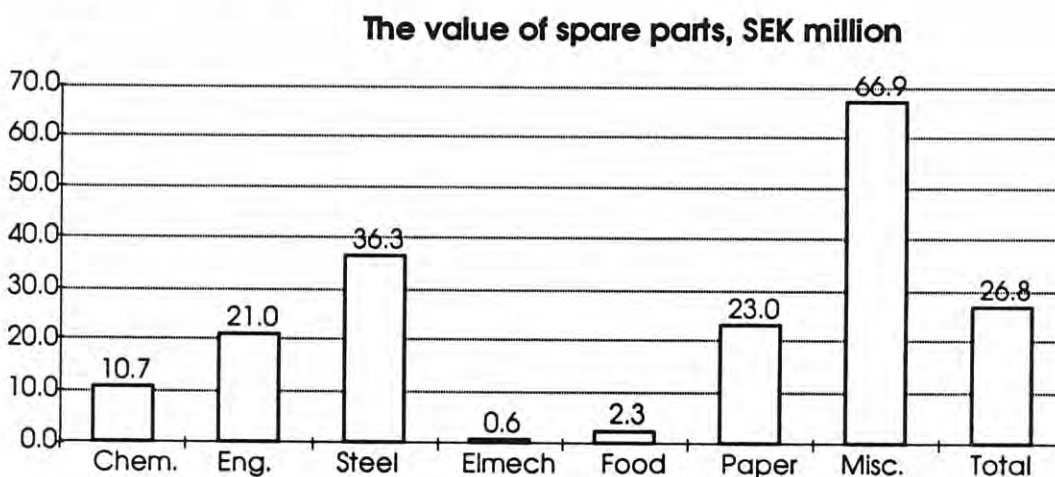
The maintenance resources available to production are in the region of 10%. With the exception of Food, and as can be expected, these resources are concentrated on production plant.

8.1.2.13 Distribution of maintenance costs according to type of cost



The labour-intensive nature of maintenance is shown by the payroll costs of 47%, and "External services" of 20%. "External services" for Elmech is up at 53%, but this is because only three companies replied to the question and one had very high "External services".

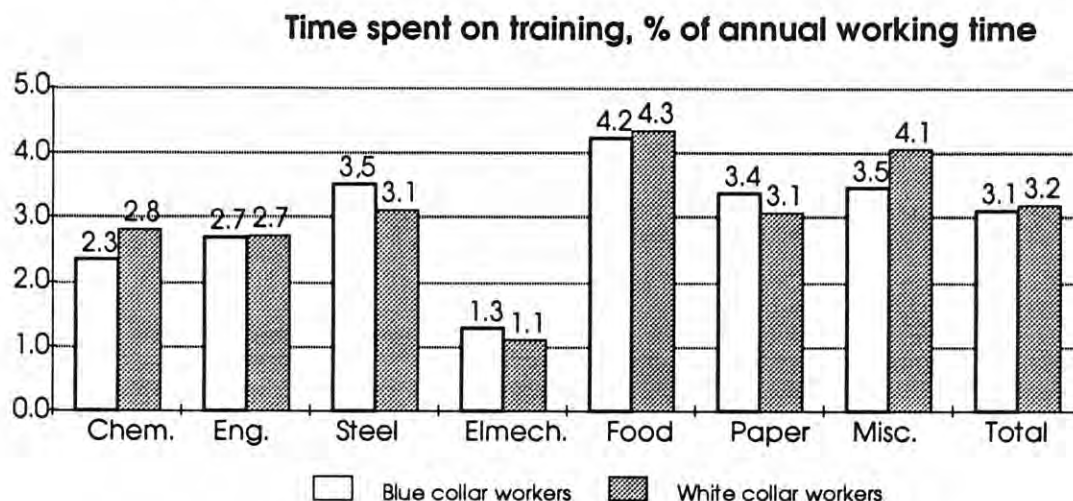
8.1.2.14 The value of spare parts



The value of spare parts is, of course, strongly dependent on the size of the company and sensitivity to breakdowns, and the different requirements for stocking strategic spare parts.

8.1.3 Organisation

8.1.3.1 Time spent on training



The proportion of annual working time spent on training is approximately 3%. During the survey, it was found that companies are relatively satisfied with the skills level despite the low figure for the time spent on training.

Training appears to be split equally between blue and white collar workers.

8.1.3.2 Number of companies with a written policy on maintenance

- The number of companies who responded to the question of whether they had a written policy with "Yes" was 44.
- The number of companies who replied "No" was 24.
- The number of companies who gave no answer was 3.

8.1.3.3 Quality certification of companies

Companies which have some form of quality certification or which intend applying for certification are shown in the following.

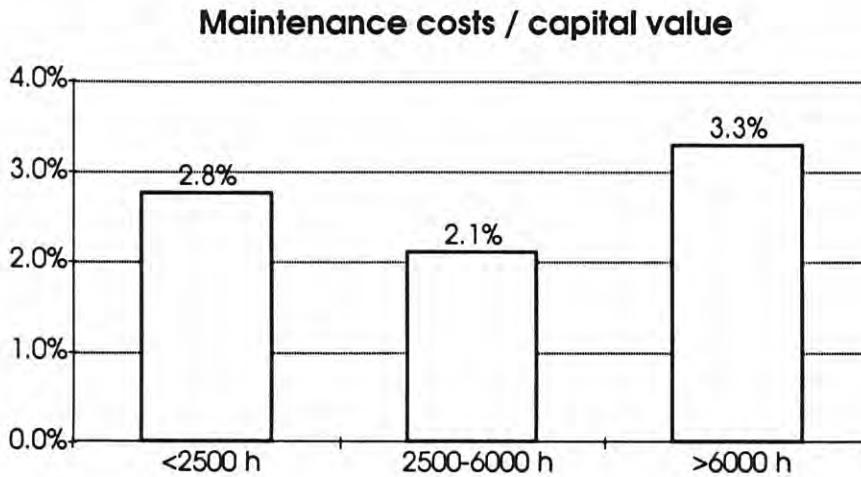
ISO 9000	34 companies
ISO 9000 in progress	8 companies
Other certification	4 companies
Other certification in progress	1 companies
No reply	24 companies

8.1.4 Supplementary analysis basis, operating time groups

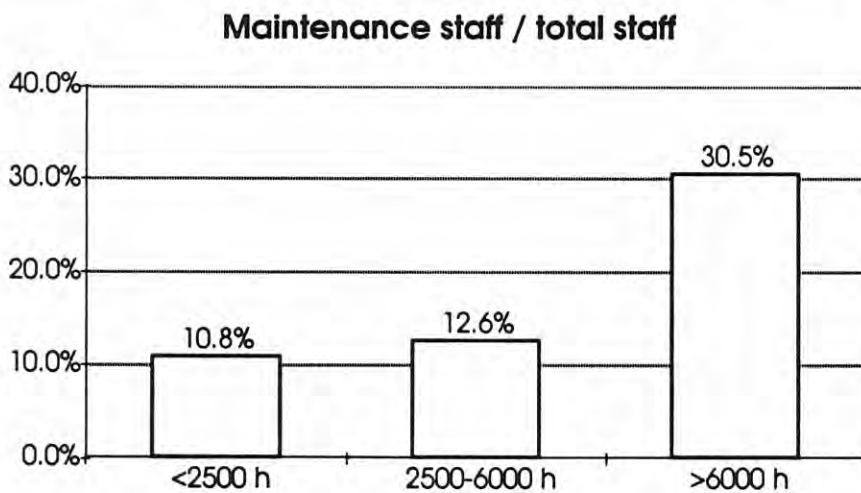
We traditionally use branches of industry as the classifying principle. We have found reason to believe, however, that other principles could be interesting, e.g. similar production technology, production time used, size of maintenance organisation or maintenance costs per capital value.

To ensure consistent reporting of results, we have within the framework of the EBSOM project, primarily studied the results using branches of industry as the classifying principle. During the project we have found that we should have illustrated an alternative classifying principle and have therefore chosen production time. We have selected three groups with operating hours of < 2500 hours per annum, 2500 - 6000 hours per annum and > 6000 hours per annum. This produced the following results.

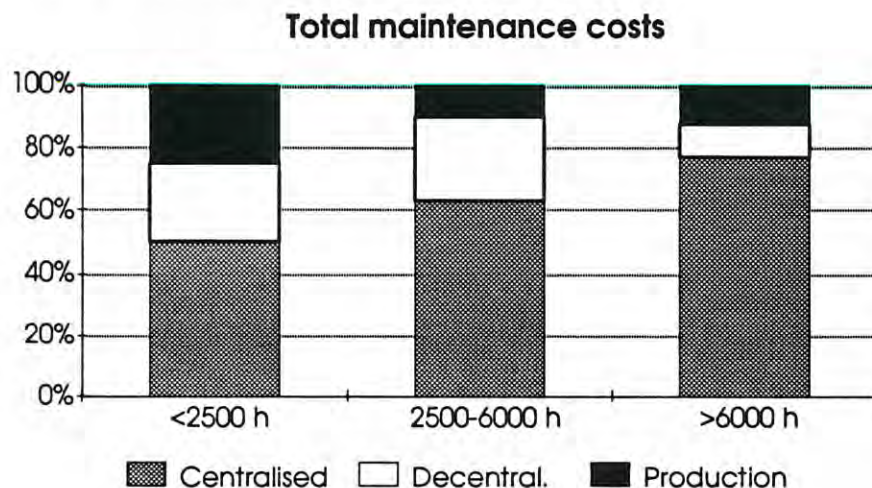
8.1.4.1 Maintenance costs / capital value



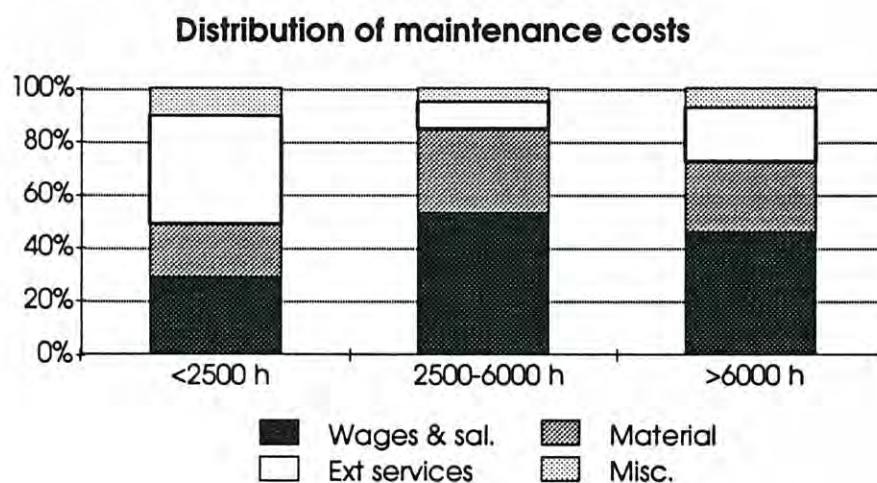
8.1.4.2 Maintenance staff/Production and maintenance staff



8.1.4.3 Decentralisation of maintenance resources



8.1.4.4 Distribution of maintenance costs by type of cost



8.2. The need for improvement

8.2.1 Introduction

A study of the replies to Questions / Statements / Areas 15-33 concerning controls applicable to maintenance activities indicates a considerable need for improvement. To determine in which areas there is the greatest need for improvement among those who participated in the survey, the total mean values of the replies to Questions 15-33 have been analysed by calculating a conversion factor, T , which illustrates the need.

Conversion factor

There is a considerable need for improvement in an area where the *current status* is *poor - low points* - and where the *need for improvement* is considered *high - high points*. To further strengthen the importance of the need to improve, the following expression has been created in the form of a *conversion factor, T*:

(Need for improvement - Present status) * Need for improvement = T

Example: 5.2 - 3.2 * 5.2 = 10.4

The Questions / Statements / Areas were then listed in descending order according to this conversion factor. See the table below. On this basis, the areas with the highest conversion factors should be given the greatest priority for improvement. These are seen at the top of the table.

The table shows that the following areas have the highest priority for improvement:

1. Maintenance skills of production staff.
2. Involvement of production staff in maintenance work.
3. Continuous use of key figures.
4. Knowledge of maintenance among company management.
5. Control of the effects of maintenance on production volume.

The need for improvement classified in other ways, such as by branch of industry or type of shifts, will be examined in more detail.

8.2.2 Ranking the need for improvements, total

Ranking of control areas gives the following:

RANK	STATEMENT*	DESCRIPTION	T
1	30	Production staff's maintenance skills	12.6
2	31	Production staff's involvement in maintenance	11.9
3	23	The use of key figures	6.1
4	15	Knowledge of maintenance among company management	5.5
5	21	Control of effects of maintenance on production volumes	4.3
6	27	Installation's maintainability	3.9
7	17	Clear goals for maintenance	3.7
8	25	Use of condition-based maintenance	3.6
9	16	Knowledge of maintenance among production management	3.5
10	28	Influence maintenance aspects during procurement	3.2
11	29	Development of skills among maintenance staff	2.8
12	26	Planning and preparation of maintenance work	2.7
13	18	Following-up downtime in production	2.4
14	33	Administrative computer systems in maintenance	2.2
15	22	Control of the value of spare parts	2.0
16	19	Control and management of costs	2.0
17	24	Use of preventive maintenance	1.7
18	20	Control of the effects on product quality	1.7
19	32	Purchase of maintenance services via an external specialist	-3.6

*) Statement number ...

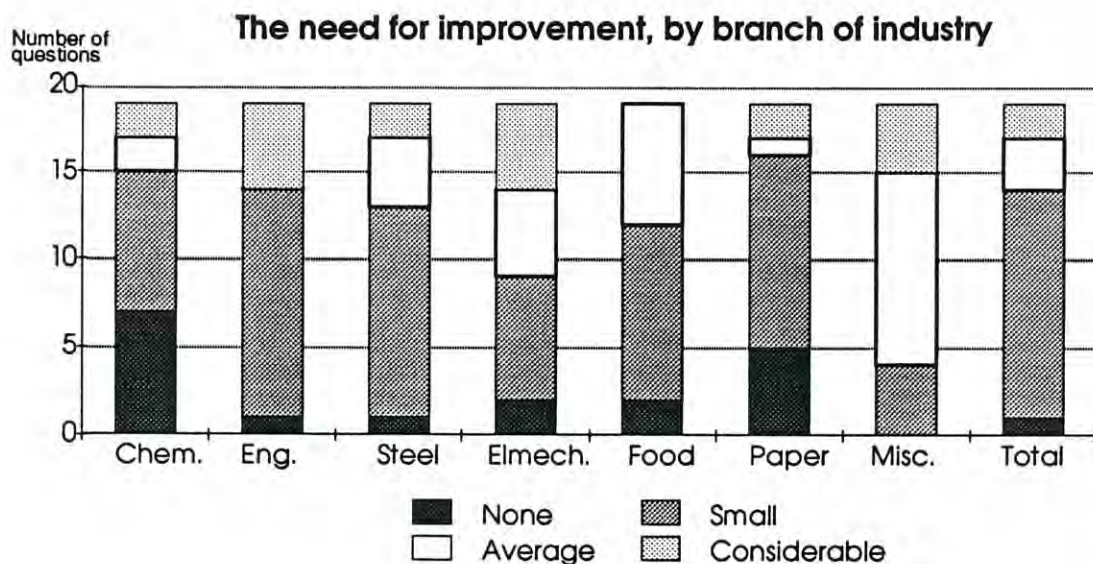
The organisational aspects, skills, goals, key figures etc., have generally been given high priority, while the administrative aspects such as planning, control, and follow-up have been given a relatively low priority.

8.2.3 The need for improvement according to branches of industry

We have used the need for improvement factor, T, to get an idea of how the need for improvement is considered in the different branches of industry. The table in Appendix 5 groups T as follows:

T Need for improvement

> 8	Considerable
4 - 8	Average
4 - 0	Small
< 0	None



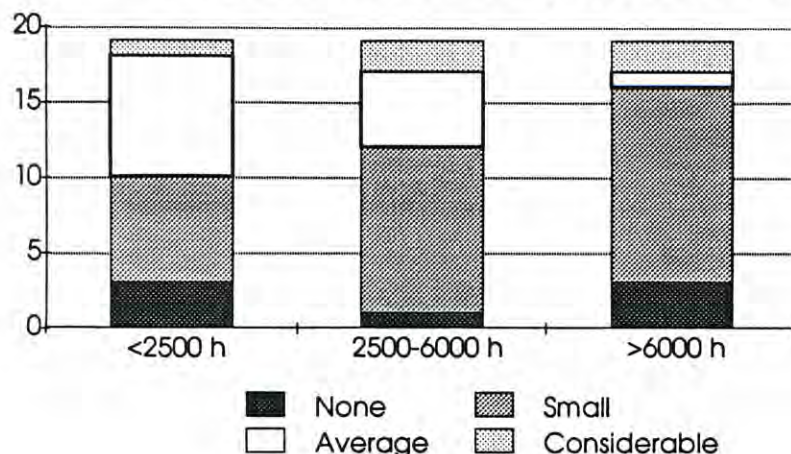
The table shows that Chem. has experienced the least need for improvement while other branches of industry have stated varying needs. Eng., Elmech and Misc. indicate the greatest perceived need.

8.2.4 The need for improvement according to production time groups

If the traditional analysis of companies by branch of industry (which reflects the companies' end products) is replaced by other groupings, it is possible to perceive other patterns and relationships. One such grouping is "production time". We have divided the material into three groups as follows:

< 2500 production hours per annum, usually single shift operation,	6 companies
2500 - 6000 hours, various mixed forms	18 companies
> 6000 hours, usually multi-shift operations	30 companies

The need for improvement, production time groups



The diagram shows a clear tendency. The shorter the production time - the fewer the shifts - the greater the need for improvement. Details are shown in Appendix 6.

9. The need for further research

When studying the key figures, it quickly becomes apparent that there is a problem caused by the lack of consistent definitions. Problems arise in comparing maintenance departments with each other and with themselves over time.

A research area that should be given priority should be to establish clearer principles on what should be considered maintenance costs and what should be considered operating or production costs.

A further problem that is closely related to the first problem is to establish a uniform method for determining the benefit of the maintenance that has been carried out. This is particularly important when considering the requirements in respect of availability, safety against accidents and emissions, quality requirements, flexibility etc. for the different branches.

The implementation of one or preferably both these projects would provide a very good basis for comparing different maintenance organisations and the development of individual maintenance organisations over time.

The foundations would also be laid for improving existing key figures and creating new ones with good validity and reliability. This is considered by many maintenance managers as vital in achieving better control of their activities in an effective manner.

We are aware that this study was directed at large and medium-sized companies. The legitimate interests of small companies in key figures has not been considered. Capacity limitations in dealing with the questionnaire on their part, and our reaching a representative number have also had an effect. It is therefore important to any future research that sufficient resources be provided to reach this type of company since they constitute an important component of business and commerce.