1. The Current Position of Maintenance

During the ‘80s, industry world-wide experienced profound changes as the result, on the one hand, of technological changes (automation) and, on the other, of an ever more widespread and integrated use of information technology.

This trend will continue to develop during the '90s, producing a position with the following characteristics:
- strong market instability
- ever-shorter product life-cycles
- quality-based work systems
- growing intensity of innovation, with competitiveness, productivity and, above all, survival key factors for capital-intensive companies
- greater attention to the environment, both within the factory (problems of security) and outside (ecology)

In line with these developments, the role of maintenance will continue to evolve from one of a service seen as a generator of costs to one of a “guarantor” of continual productivity, in other words, of ever more reliable plant and of the quality of the product it creates.

The evolutionary path which maintenance will have to follow in order to realize the above-mentioned objectives will lead principally towards an improvement of the following:
- planning of preventive maintenance on the basis of sound data on reliability and maintainability
- the re-distribution of responsibility for repetitive and low-level technical tasks, such as cleaning, adjustments and minor preventive checks. All these tasks will gradually pass to the machine operators, giving maintenance personnel greater room for specialization.

It is against this background, then, that the current position of maintenance in Italian industry will be presented and possible trends for the '90s suggested.

2. Demand in the Industrial Sector

As Italy is a member of the European Community (EC), it was felt appropriate to refer to a study carried out in 1989 by the French consultants SINORG, who are specialists in the maintenance sector.

The study looked at the availability of industrial maintenance in Europe, with particular reference to French, British, German, Spanish and Italian companies.

In addition to this data, further information was taken from reports by ISTAT (Italian Statistical Institute) and CENSIS (Centre for Social Investment Studies), so as to provide the most comprehensive picture possible.

The economic dimension of the maintenance system for Italian companies as a whole can be summarized in the following figures (1988 values):
- Total sales: $ 544 000 10$ 
- Maintenance costs: $ 24 500$
- Operative results: $ 36 000$
- Maintenance costs/Total sales 4.5%

In this context, maintenance plays the following dual role:
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—lowering maintenance costs and with this their ratio to total sales. On this measure, as is evident from the table below, Italy must make up some ground on its leading European partners, whose ratios are lower:

The ratio of maintenance costs to total sales in European Industry in 1988

- U. K. 3.8%
- F. R. G. 4.0%
- Spain 4.15%
- France 4.2%
- Italy 4.5%

—improving operative results, or better the difference between revenue and costs (variable and fixed), with a more efficient maintenance policy, able to counter the losses caused by faults.

The priority of one objective with respect to the other is a function of the type of production, whereby policy in companies working with a continual production cycle will seek to improve operating results (reducing faults and therefore production loss), while in manufacturing companies with a non-continual production cycle, emphasis will be on a more careful employment of resources and thus of sustained costs.

### 3. Types of Demand for Maintenance in Italy

The primary objectives of maintenance must be, then, to contain maintenance costs and improve operative results. Our analyses of results reported to date in various industrial sectors, and our hypotheses for future developments are, therefore, based on these two parameters.

We looked first at the ratio of maintenance costs to total sales, considering this high if it was greater than or equal to 5% and divided to distinguish companies who employ advanced maintenance policies and organizational structures for maintenance, from those still using out-dated policies and organizational models.

The following four sectors were thus identified:

<table>
<thead>
<tr>
<th>Sector</th>
<th>Ratio of maintenance costs to total sales</th>
<th>Level of maintenance rationalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>high (≥5%)</td>
<td>low</td>
</tr>
<tr>
<td>B</td>
<td>high</td>
<td>high</td>
</tr>
<tr>
<td>C</td>
<td>low (&lt;5%)</td>
<td>low</td>
</tr>
<tr>
<td>D</td>
<td>low</td>
<td>high</td>
</tr>
</tbody>
</table>

Table 1 shows total sales, maintenance costs and operative results in each of the four sectors for Italian industry as a whole.

Tables 2-5 show figures for individual industries in the four sectors, so as to underline the different behaviour in various industries with respect to the problem of maintenance.

The parameters used to assess the different behaviour are organizational criteria, maintenance policy, plant availability and the information system.

#### 3.1 Sector A (see Table 2)

This sector includes primarily process industries which are major users of maintenance, such as mineral extraction, foundries, paper-making and
rubber. These companies can be classed as “conservative” type, that is to say the organizational structure of maintenance still does not include specialized staff, such as maintenance engineers for preventive maintenance (systematic and predictive), and in addition preparation and planning for corrective maintenance.

Maintenance works are primarily carried out only in cases of emergency, with the resultant penalization in plant downtime and costs.

The information system is computer-based, but current procedures are aimed primarily at controlling the costs of maintenance (internal and external labour and materials).

Budgets are usually not used to control maintenance management, consequently the responsibility of the head of maintenance is for the main part technical.

3.2 Sector B (see Table 3)

This is the sector with the highest ratio of maintenance costs to total sales (40%, see table 1). The sector includes process companies, such as energy production, iron and steel, chemicals and glass. In contrast to sector A, these companies are of the “innovative” type. The organizational structure includes specialized staff for the management of maintenance policy (preventive and corrective).

Maintenance policy aims to improve plant availability, values for which in a number of industrial sectors are reported in Table 6. In the iron and steel industry, use is also spreading of productive maintenance which follows in part concepts of the Japanese TPM.

As far as the information system is concerned, this is usually computer-based. In the more advanced cases (chemicals and energy production) the management system tends to be integrated with direct on-site data (continuous monitoring), so as to improve reliability and maintainability of components.

With respect to maintainability, in both the chemical and the energy production industries, experiments are under way with the use of expert systems for improving diagnostics.

Budgets are normally used for maintenance management, consequently the responsibility of the head of maintenance is both technical and managerial.

3.3 Sector C (see Table 4)

As is evident in Table 1, this sector has the highest total sales (49% of total Italian sales) and highest operating results (7.6% of total sales). On the other hand, companies in this sector, which are primarily in manufacturing, are principally of the “conservative” type, in which maintenance has exclusively technical functions. The organizational structure is traditional, comprising the operative functions of electrical and mechanical engineering, but without specialist staff for the management of
preventive and corrective maintenance.

Maintenance is generally carried out in cases of emergency, following stoppages or reports from the plant. Preventive maintenance, in particular on condition and predictive types are generally not planned.

The information system is exclusively made to feed the book-keeping system and in many companies still not automated.

Maintenance budgets are generally not drawn up.

3.4 Sector D (see Table 5)

This sector includes mechanical engineering and car production. Both industries have been classified as "conservative" type. If this is currently true for the mechanical engineering industry, it is much less so for the car industry, where the primary objective of companies is to reduce downtime in order to improve operating results.

Indeed, the high level of plant automation in the car industry requires the application of innovative maintenance techniques, capable of insuring maximum plant reliability. In this respect, the car industry has begun to use methodologies derived from FMEA systems which analyze the nature of the fault and its seriousness.

In the field of organization, there is a tendency to revise old structures, creating new positions, such as production line or area engineers, whose responsibility it is to implement wide-ranging processes of continuing improvement.

As far as the information system is concerned, there is still a gap between the continuous monitoring installed on the automatic plant and the management system which operates off-line without any link to the real time system available on the plant.

The mechanical engineering industry is also following, albeit with some delay, the automation policies adopted by the car industry, using, in the area generally called the work-island, ever more sophisticated and inter-linked digital control machines. These innovations will certainly lead to a revision of the maintenance policy, organizational structure and information systems at present used in this industry.

4. Conclusions

Returning to the current position of maintenance outlined at the beginning, it can be concluded that Italy still has a long way to go if it wants to maintain the position in Europe which the economic results of the last 10-15 years have granted it.

The pre-requisites are there, and, more importantly, the desire to innovate is no longer limited to the few leading sectors of the '70s and '80s. In the coming years, companies will require maintenance to guarantee high levels of plant availability and, at the same time, ensure quality levels (of the product, the image/service, and the internal life of the company) moving ever closer to excellence.

Maintenance will have, therefore, to play the role of a hinge between operational support of existing plant and the move to new technologies, new processes and new philosophies.