MAINTENANCE OF VEHICLES, MACHINES AND EQUIPMENT IN VIEW OF THE ISO9001 REQUIREMENTS.

The paper describes the ISO 9001:2001 requirements related to machine operation. These are general requirements concerning the process-related approach, infrastructure, staff competence and product execution. Examples of real life approaches to the issue are presented.

Keywords: maintenance of vehicles, process approach, ISO 9001.

1. Introduction

The number of companies managed according to the ISO 9001 requirements is growing. A significant portion of them are those whose activities are closely linked to operating machines, devices and vehicles. When implementing, and then maintaining, a Quality Management System (QMS), they face a dilemma: should they treat the use of technical objects as a process which should be monitored, analyzed and improved, or should it be reduced to a procedure which describes the principles of handling technical objects (which usually means conducting planned maintenance, replacements, greasing, etc.). A question arises whether it is acceptable from the point of view of a certified QSM to apply other common operation strategies, like use of a machine until it breaks down.

2. Strategies of vehicle and machine

There have been numerous reports in the literature of systems and strategies of machine operation and maintenance [1, 2, 3, 6], starting with the simplest ones (operation until a machine breaks down, routine and preventive maintenance) through strategies based on the technical condition, reliability, amount of work performed, etc.

An informed choice of strategy is made mainly by large companies, having at their disposal sufficient human, financial and technical resources. In small and medium businesses (SMB), the choice is frequently without realization and is usually reduced to adopting one or several of the following models [4]:

- production-oriented strategy (operation until a machine breaks down);
- according to the operation manual, technical documentation and legal requirements;
- outsourcing of services related to machine maintenance;
- philosophical approach strategies (5S, Kaizen, TPM, etc. in modern, not necessarily big companies);
- strategies stemming from ISO procedures.

2.1. Production-oriented strategy (operation until a machine breaks down)

The choice of this kind of strategy is usually equal to the lack of any strategy of machine operation. Machines and devices are operated until failure or its first symptoms appear; after that, they are repaired and used further.

This strategy is used in two cases. If it was an informed choice of this manner of machine operation, the choice was preceded by an economic analysis (possibly including safety and health issues), which showed its profitability. Any investments in surveys or diagnostics are unprofitable in view of the achieved benefits, such as reduced failure frequency, stoppage planning, etc. Machines operated according to this strategy are doubled and easy to repair; any failure of such machines and resulting stoppages are not critical to the company activities. In the other, not as frequent, case adopting this strategy is a result of a shortsighted, wasteful production policy of the company.

2.2. According to the instruction manual, technical documentation and legal requirements

Many companies adopt a machine maintenance strategy which conforms to the instruction manual and technical documentation supplied with machines. These documents contain information about the required replacement (oil, belts, bearings) and surveys (e.g. warranty survey, after 10 000 km, after 500 months). The strategy is therefore planned and preventive in character and in the case of some machines (e.g. cranes and pressure containers) certain regulations issued by the Office of Technical Supervision apply, concerning the necessity to perform surveys (inspections) mainly related to the safety issues.

The Office of Technical Supervision is a legal entity which performs tasks related to technical supervision within the scope laid down in the law of technical supervision and executive regulations to it [7].

2.3. Outsourcing of services related to machine maintenance

Outsourcing is a management strategy which consists in performing tasks, unrelated directly to the main scope of the company activity, by an external partner. This enables the company to focus its resources on the areas crucial to its basic activities, in which it achieves a competitive edge. The company outsources the operation of such processes which are considered auxiliary, e.g. IT (Information Technology), transport, accountancy or machine maintenance.

The companies which opt for such a model of machine maintenance should consider the following issues:

- the contracts should be long-term, enabling an assessment of the service performance;
- the service provider should be regarded as a competitive entity for the internal machine maintenance service – if the service provider is not competitive, outsourcing is not a good solution;
- a contract should focus on achieving results and not on delivering services. Apart from the price, the following should be taken into account: evaluation of the proposed principles.
of machine maintenance, processes to be implemented, how the results will be assessed, how the decisions concerning prevention and prediction will be taken, etc.

2.3. Philosophical approach strategies (Total Productive Maintenance)

The TPM program is an approach to machine maintenance management of Japanese origin. Maintenance management based on the TPM approach consists mainly in preventing quality defects, preventing machine failures and their regulation. It is a program of permanent improvement based on the cooperation of the maintenance and production workers. This model is more and more frequently adopted by Polish companies, mainly by large, international ones; it can also be found in efficiently-managed SMBs. One of the system features is that a machine operator performs daily maintenance-related tasks, which results in elimination of failures caused by the lack of daily maintenance, and service specialists can devote their time to other activities. Thus, a conflict of operation system managers is avoided; a machine operator and its service team act together and account for their actions together.

3. A strategy which stems from the adopted ISO9001 procedures

Growing competition and customer requirements are forcing companies to implement and maintain quality management systems (QMS). Such systems are usually certified based on the ISO9001 standard. It is very important that the standard does not specify the requirements concerning the product (or service) provided by a company, but refers to the organization of all business processes (from marketing to invoicing) which are vital to its production. The standard is adequate to each type of production (service) being the outcome of each business activity, regardless of the geographical or cultural location of a company. It sets down the principles of planning, execution and supervision of particular activities [5].

3.1. Identification of the standard’s requirements

In terms of the machine and device operation in the company, the following points of the standard directly apply to this issue: 4.1 – General requirements, 6.2 – Human resources, 6.3 – Infrastructure, and 7. – Product manufacture. Obviously, other standard requirements concerning corrective or preventive actions, or data analysis, may also apply, or do apply to operation; however, if they do not apply directly, they will not be discussed in this paper.

3.1.1. Identification of the standard requirements “4.1 General requirements”

Organizations are obliged to apply a so-called “process approach” in quality management, which means the necessity to identify the processes necessary in QMS, determine their sequence and interrelations, determine the criteria of effectiveness, monitor, measure and analyze. A process is understood to denote each action which transforms input (input data) to output (output data) with the use of resources. A definition of a process is contained in the ISO 9000:2000, point 3.4.1.

The process approach required by the standard causes the companies, which identify processes within themselves and present them as a so-called “process map”, to define – apart from the main processes (e.g. production) leading to the final product – the processes of machine operation in the overall scope of activities leading to the final product. An example of a process map with an identified process of machine maintenance (understood as their operation) in an example SMB is shown in Fig. 1.

An important consequence of adopting machine and device operation as process is the necessity to identify it according to the standard requirements. The identification includes the process objectives, its owner, input and output data, criteria of effectiveness as well as ways of monitoring; in practice it is usually found in the Process Charter, whose example is shown in Table 1.

Another requirement of the standard (4.1 f) makes it necessary to improve processes. For machine and device operation it means that the process owner (usually the chief mechanic, the chief of the machine maintenance department) is required to monitor the process and measure it with adopted indicators and measures and to take corrective actions if the limiting values are exceeded.

Fig. 1. A process map in an SMB with an identified process maintenance

Tab. 1. An example Process Charter “Process maintenance” in a water supply and sewage removal company

<table>
<thead>
<tr>
<th>1. Process objective:</th>
<th>Achieving the optimum state of readiness of the equipment that the company has at its disposal to perform its tasks and to ensure the continuity of the order execution process</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Process owner:</td>
<td>company owner</td>
</tr>
<tr>
<td>3. Process input:</td>
<td>service requirements (based on the technical documentation), current requirements (based on the current technical condition), employees’ skills and authorizations to perform certain tasks, safety and health requirements, plan and scope of surveys and repairs, reported failures, new machine/device</td>
</tr>
<tr>
<td>4. Process output:</td>
<td>machines and devices in working order, list of machines and devices, records of failure repair, needs in terms of repair/survey planning, needs in terms of new machines and devices, invoices for a service,</td>
</tr>
<tr>
<td>5. Process participants:</td>
<td>company employees – mechanics as well as machine and device operators</td>
</tr>
<tr>
<td>6. Manner of monitoring</td>
<td>analysis of a machine operation card, analysis of fuel consumption, analysis of failure cost</td>
</tr>
<tr>
<td>7. Effectiveness indicator</td>
<td>the number of hours of stoppage resulting from failure of machines/devices, not greater than 5% of the work time</td>
</tr>
</tbody>
</table>
3.1.2. Identification of the standard requirements “6.2 Human resources”

This item of the standard imposes the obligation to ensure competent personnel. The company should identify the needs in terms of personnel responsible for machine maintenance; the term “competence” is understood to denote the necessary education, experience, training, etc. If the competence is insufficient (e.g. lack of appropriate education), the company is obliged to satisfy the needs (e.g. by providing the necessary training) and, additionally, assess the effectiveness of the actions taken.

3.1.3. Identification of the standard requirements “6.3 Infrastructure”

The standard requirements in terms of infrastructure include such resources as the company buildings, working space, tools, machines, devices, information techniques, communication, etc. If machine operation is not identified as a process, the principles of supervision over machines and devices should be set forth so as to ensure the conformity of the product with the requirements, i.e. meeting the obligations, both in terms of deadlines and quality, towards the customer. Note that in this case there are no direct requirements concerning the measurement of effectiveness of machine operation, and the approach is purely procedure-related.

3.1.4. Identification of the standard requirements “7. Product execution”

Product execution, i.e. its manufacture (or delivering a service) is the basic goal of a company existence. Except in the cases when machine and device operation is part of the direct execution of the goal (e.g. transport companies), the standard requirements related to the machine operation concern the following items:

a) 7.2.2 Review of the requirements concerning the product in sub-item c) the company is able to meet the relevant requirements,
b) 7.5.1 Supervising the manufacture and service delivery in sub-item c) applying the appropriate equipment,
c) 7.5.2 Validation of the production processes and service delivery in sub-item b) approval of the equipment and qualifying the staff.

Tab. 2. An example of operation tasks in infrastructure-related and process-related approach

<table>
<thead>
<tr>
<th>Operational tasks</th>
<th>Determination of the supervising tasks for the infrastructure</th>
<th>Determination of the tasks in the process-related approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodical technical surveys and routine repair.</td>
<td>Determination of the time and scope of the technical surveys and routine repair.</td>
<td>The same as on the left and: reporting the performed technical surveys and routine repairs, planning (frequently with the use of mathematical, prognostic and econometric models) and registering the actual amount of labour needed, consumption of the operational materials and costs. Assessment of the prognosis errors and promptness.</td>
</tr>
<tr>
<td>Damage repair</td>
<td>Establishing the principles of notifying failures. Sometimes reporting the performed damage repairs, taking into account the time, scope, cost and reasons of the damage.</td>
<td>Determination of the detailed principles of notifying failures, registering the time of failure stoppages, duration of damage repairs, cost, registering the repaired systems or parts, analyzing the causes of damage, earmarking the work time fund of the machine maintenance department – frequently with the use of statistical analysis. Assessment of the damage repair acceptability, e.g. by analysis: damage reaction time, time of machine restoration to the operational condition, financial loss.</td>
</tr>
<tr>
<td>Diagnostics</td>
<td>Frequently organoleptic, within its basic scope during operation, sometimes routine, with making comparisons of the measured values of diagnostic signals with the limiting values (warning and failure-indicating).</td>
<td>Routine diagnostics or condition monitoring. Registering the measured values of diagnostic signals, comparing with the limiting values (warning and failure-indicating). Forecasting the changes in technical condition.</td>
</tr>
</tbody>
</table>

3.2. ISO9001 requirements and the strategy of machine and device operation

The standard unambiguously indicates the necessity to apply the appropriate equipment in product execution, which is to be understood as the equipment which must be properly operated. However, the manner in which the requirement is to be met is the operator’s choice; this is shown in Fig. Achieving the objective is possible in two ways:

1 – application of the process approach, i.e. identifying machine operation as a process, which is usually auxiliary, yet independent, in character, with the obligation to monitor, analyze and improve, stemming from the approach,
2 – qualifying machines and devices as infrastructure and defining the supervision principles in a procedural manner.

4. Examples of operation tasks

In the example presented here, activities of machine maintenance in process-related and infrastructure-related approaches are compared. Table 2 lists the activities broken down into specific operation tasks. The example does not include consideration of the identification of particular legal requirements and training, as in each case they have to be taken into account.

If the process-related approach is adopted, the relationship should be identified between various activities (production, machine maintenance, servicing customers, etc.). Among the good sides of this approach there is the ensuring of the supervision over particular elements in the whole system of processes, as well as over their combination and interrelation. However, it seems that without the appropriate information processing system, such an approach cannot be effectively executed. The problem can be solved by introducing a system of the CMMS class (Computerized Maintenance Management) - (repair management, maintenance, investment, service), in which operation events are registered and reports are generated with the assessment indexes of the operation system [4].
5. Summary

ISO 9001:2000 is the most popular standard implemented in companies; it determines a model of planning, execution, and supervision over particular business models in order to achieve complete customer satisfaction (including the so-called “internal customer”). From the point of view of machine operation, it is important to ensure the application of the appropriate equipment for the production processes execution. This is understood to denote the application of appropriate machines and ensuring their proper technical condition, which affects the meeting of requirements in terms of production, quality, and deadlines.

The ISO 9001 standard, being a QMS, details only the requirements to be met, without imposing upon the company what methods it would choose to achieve it. For machine operation, meeting the requirements concerning the application of the appropriate equipment is possible in two ways:

1. – by adopting the process approach together with the measurements and analyses of the process;
2. – by adopting the procedural approach, defining more or less general principles of conducting surveys, maintenance, repairs, etc.

In each of these cases, the actions must be effective, i.e. they must ensure the meeting of a customer’s demands; however, adopting the process approach ensures the improvement of the process effectiveness. Note that the necessary competence of the maintenance personnel has to be ensured and the relevant legal regulations have to be taken into account, e.g. related to routine repairs, technical documentation or European Directives.

6. Reference


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