

THE INFORMATION SYSTEM IN THE MACHINE EXPLOITATION MANAGEMENT

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Summary: The aim of this article is to present the importance and the influence of the exploiting system management in the enterprise. The Maximo system, its modules and wide range of applications has been described. The general view of the technical object exploitation is described. There are benefits presented resulting in the use of system and the problems which need be faced in order to make the system functioning correctly in the enterprise.

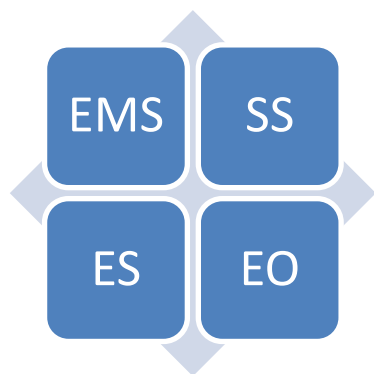
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INTRODUCTION

The most general definition of exploitation is included in PN – 82/N – 04001 norm, which describes the term as *a set of intentional activities organizational-technical and economic of people with the technical object as well as the interaction between them appearing from the moment of receiving the object to use in accordance with its purpose to the moment of the liquidation. (Norm PN – 82/N – 04001).*

The necessary condition of the exploitation execution is the existence of four basic elements:

- the exploitation object (EO),
- the exploitation stations (ES),
- the service stations (SS),
- the exploitation managing stations (EMS).



Pic. 1 Elementary exploitation system

Source: Legutko S. The machine exploitation, Poznań Univeristy of Technology, Poznań 2007.

Whereas the management of the exploitation of technical object in the enterprise is divided into two elements:

- the management of the machine usage,
- the management of the machine maintenance.

Subject to the enterprise and its structures the exploitation management process can proceed differently from very complex and complicated to simple. The rational managing of the exploitation needs to integrate all company activities and lead up to a definite goal. This aim can be effective production of goods, lack of stoppages in warehouses etc. Analyzing the management exploitation system we can claim that the reason to make the decision of exploitation should be the account of costs including both the costs of machine maintenance and the costs of losses resulting in the stoppages of machines. The increase of costs of maintaining the machines over the basic use includes the oil, filters change, servicing causes reducing losses coming from unexpected stoppages. This tendency is observed only until some moment after reaching which the losses resulting in excessive stoppages of the machines in serving subsystem start to raise. Well, we can state that the optimal exploitation strategy is the one when the costs of maintaining the machines result in the lowest losses in the enterprise coming from the application of a certain strategy. The exploitation management of the machines and devices concerns the exploitation system resources (human, financial, material and information resources) and includes planning, decision making, organizing, managing and controlling of the realization with an intention to achieve the goals of the enterprise. Therefore, as the objective of a system we can state the rational exploitation (usage) of machines as well as maintaining them in the state of functional and performance suitability. The exploitation system can be managed in diversified ways. In the day of computerization in most companies dedicated information system are used. It should be noted that the system cannot manage the exploitation itself, the human factor is required. A man needs to introduce the data to the system in the way that we can say about complete and efficiently working system of management exploitation.

1. BASIC REQUIREMENTS OF THE INFORMATION SYSTEM

In the era of information, technology and fast progressing development the information systems are used in many disciplines of life. Their wide range of usage is observed in machine exploitation with the support of these systems. In the area of the machine exploitation there are many different possibilities of computer applications in the process of supporting the management. It is conditioned on the automation level of a certain unit. The information processes of the exploitation can involve following activities:

- collecting data,
- preparation and initial data treatment,
- transferring data,
- storing historical data,
- reporting necessary data,
- making statements.

Collecting data and analyzing them is essential, they are included in the organizational operations designed to:

- set the length of the adaptation period, the regular exploitation, the use and aging,
- comparing the quality of the exploitation of the same machines of different operators,
- defining the purpose of delegating the machine to a certain operator,
- estimating the intensity of certain machine damages (elements, units),
- finding the exploitation process critical points related to the usage of the machines and finding their possible structural mistakes,
- the cause analysis of occurred failures,
- the optimization exploiting loads in order to reduce the number of damages,
- developing critical points related to construction and transferring them for the needs of perfecting machine construction,
- defining the creation of rational sets of spare parts in company warehouse,
- establishing, implementing and controlling the dates of the preventative services and repairs,
- the identification of the employee responsibility for the machine.

The information systems during the completion of delegated tasks are aimed at effective supporting of certain problem groups which can be defined as:

- establishing the need of operating the machine exploitation taking into account the rules of optimal planning the machine usage,
- preparing the technical service and repair schedule including the program of the load facilities and back-shop workers,
- defining the data collecting system for the needs of rational operating of the machine exploitation process,
- indicating the data processing system (previously collected),
- defining the exploitative potential recovery of utility base,
- modelling and observing the schedules of intensity usage of certain machines,

- the optimization organizational structures of exploitation system understood as the operating system structures adjustment to the usage system,

- matching the structure of the exploiting system back-shop facilities to specific (character) conditions of the company performance,

- establishing the rules of the service control (time, place, conditions),

- determining the frequency and range of the technical service,

- choosing durability measures of machines and the ways of increasing it without introducing construction changes,

- the assessment of the machine reliability, the methods of studying and increasing it.

In order to solve mentioned problems it is necessary to do adequately organized exploitative research of machines and their systems. It is crucial to create decision models, which need to be based on current data (exploitative), which consequently enable to choose the most optimal solution. The accomplishment of formulated tasks is possible only with the appropriate application of correctly organized and functioning information system. The information system, therefore, can be defined as a set of specialized software, which overall objective is to support the decision-making process in terms of the assessment of the machine condition as well as its working environment.

Currently the market offers many informatics tools specialized in the exploitation, some of them are ready products, other however, are dedicated to the selected user. One of the solutions this class is CMMS system (Computer Maintenance Management System), its main task is to support industry enterprises in maintaining the highest machine reliability which effects in the economic, technical and organizational profit.

The exploitative reality description is possible with the usage of functional models, durability-reliable, diagnostic, controlling, circulation and subordination, which can be implemented in different applications CMMS class. The correct maintenance of the technological machine park and the installation also depends on the effective and working suitability maintaining systems.

2. THE MACHINE OPERATING SUBSYSTEM

The subsystem of operating the machine covers the exploitation facilities models including the basic exploitation of the supporting system modules. The most optimal operating actions are classified as, among others, diagnosing, element renovation (units) in the shape of following action variants:

- repair/change of the element for another fixed or regenerated (not new),

-repair/regeneration on the spot, without the necessity of transporting to the service (installation and dismantling required) resulting in shortening the time of the action performance and more efficient bringing back the machine to working state,

- quick repair (short repair time) during the renovation, overcoming the necessity of change for the new/fixed/regenerated element.

Joining the subsystems of diagnosing and repairing into one holds a range of advantages. It offers the possibility to compare the diagnose with the actual state, accurate definition of the size value describing the technical state before the launching of the exploitation and before and after the repair.

Defining the technological process of repairing machines and devices should be preceded by describing the repair process term- it is understood as all actions related to the repair of a machine or a device. It consists of the technological repair process, supportive, logistics and management processes. However the technological repair process includes the sequence of technical actions with the objective of bringing the machines and devices back the required usage suitability. Because of the ways, means and the process work organization its phases can be distinguished. They account for main stages of repair actions.

Within the technological repair process operations and procedures are differentiated. The operation is a separated, closed part of a technological process performed on one, certain work position by one worker on one renovated device or machine, on one unit, subunit or on one spare part, without brakes for other works[2]. However, a procedure is a part of the operation explained as (during the installation/dismantling) performing in a certain place a combination that is connected/disconnected with the same machine element using the same tools or equipment and unchangeable way of performance. It can be divided into elementary activities. The beginning of the whole process is found with the acceptance of machines and devices to renovate, qualified basing on the criteria stated in the approved by the enterprise strategy or in the situation of failure. Later the external and internal surface cleaning is done which very often results in the use and mechanism damages quickening, corrosion and the deterioration of external look [3]. The next level is the dismantling. Correctly performed dismantling process should leave the spare parts in the same state of use as they were before the disconnection (avoiding dents, rends, bolt rips etc.). After this stage comes the verification of units and parts of the machine. The detailed verification is done during the dismantling , measuring the elements of the machine, comparing received results with the technical documentation. The next step that should be taken are methods indicating the usage, damages

and hidden defects. There are many quantitative methods indicating the usage in workshop conditions, but the most commonly used are the following three:

- linear – is based on defining the usage by changing the linear dimension,
- weight – is based on weighing a sample before and after a certain working, but the difference in the sample mass gives the information about the value of the use,
- volume – analogical to the previous methods, the measure of the use is the sample change of volume before and after the use.

The appropriate verification of the current state of the machine gives the possibility to define damages or hidden defects. The damages are often the results of machine overworking or inadequate usage, sometimes they result in hidden defects. In terms of the enterprise it is significant to determine the source of damage. The last stage of subunit operating is the regeneration and the exchange of parts of the machine and devices. After completing the verification of all stages mentioned above the repair of the faulty element/units follows or if it is possible their regeneration. The range of the element regeneration indicates the level of repair technique and the quality of production of the repaired objects.

3. THE MACHINE MOVEMENT MAINTANANCE WITH THE USAGE OF INFORMATION SYSTEMS

The machine movement maintenance system is the main task for the enterprise. The most essential is matching appropriate strategy and following it. Opposite to all opinions this aspect can decide on the competitiveness of the enterprise on the market. In the literature there are many strategies of maintaining machines, there are some of them:

- to damaging,
- planning – preventing,
- according to technical state,
- the amount of the work performed etc.

In order to ensure the machine maintenance in desired functionality the enterprise uses the strategy of maintaining the machine movement with the use of informatics subsystems. In S. Niziński's and B. Żółtowski's books there are few types of informatics systems found, distinguished depending on the criteria of its function:

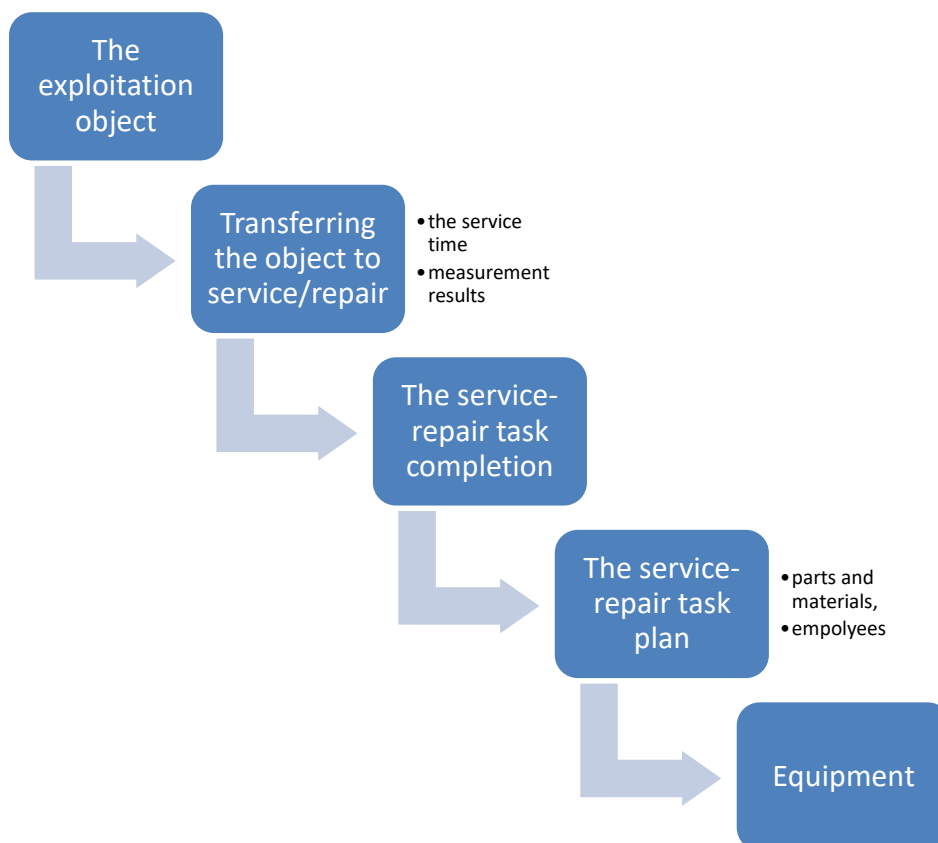
- evidential,
- informing the executives,
- decision supporting,
- advisory.

To the main and the most important informatics system tasks include the registration of all actions resulted in the machine exploitation, preparing basic statements concerning- from the enterprise performance point of view- the areas of exploitation system functioning.

Depending on the number of possessing machines in the enterprise The Machine Movement Maintenance Organization is instituted. This unit copes with the in the general term, the state of the machine suitability and readiness. At the same time this organization needs to develop consistently and fit to current requirements and to be inseparably connect with the informatics subsystem supporting its performance. The cooperation of these two links depends on certain characteristics, as follow:

- maintaining the suitability state the machines and devices in particular time and conditions,
- the appropriate choice newly purchased devices depending on the company needs,
- preparing the correct schedule- cooperating with the company performance- concerning the trainings of the operators, term ,term review , current repairs, supervision and conservation, preventing unexpected failures and ways of removing them, proper supply, the checking the suitability in order to rational usage etc.

With the aim of the efficient organizing all activities related to the machine movement maintenance different computer systems are used. There are modules like CMM and Maximo among them which support thanks to their performance, the movement maintenance management and exploitation. Maximo in its functionality also has got the possibility of storing, transferring and analyzing data. These activities lead to the efficient and intentional exploitation management of the technical means. The core rule of functioning the information system is basing on the technology client/server, generally speaking it is the hierarchic system of coding the objects of the exploitation. The picture below presents the scheme of system functioning.



Picture 2 The general scheme of the functions performed in CMM Maximo system
Source: own elaboration

The Maximo system consists of many modules, each enterprise before buying, decides how many and what modules will use. The important advantage is the possibility of the system expansion at any moment. The functioning of certain modules should have the possibility of full and congeneric exploitation management of the machine park combining the management with organization and physical works. Among modules we can differentiate; works module, preventing maintenance, inventory, equipment, shopping, employment, working schedules, calendars, resources. The works module is primarily dedicated to inspectors, they can prepare the schedule of inspections, however, after performer activities they introduce the information describing the state of the object to the system and close the job. If there is a need of the repair or the renovation they make appropriate jobs in the module. The working schedule module is different, the planner gets the possibility of planning all the activities which will be performer in terms of the repair or renovation taking into account the necessity of parts and tools needs. Thanks to the inventory module the up-to-date state of possessed tools and parts can be checked. In situation of lacking elements in the shopping module, there is the demand which is transferred to the trade department. The systems consists of many extended modules, it is not possible to describe all, much less to use in one enterprise. This system is designed in the way that by its functionality and performance supports every sector of the enterprise and in order to

avoid the necessity to use more than one system. Besides the current functions the system possesses the archive of the continuous access. In this archive the information about past failures and damages can be found. The information included in this module may turn out to be very useful because on their bases the repair plans can be created. By analyzing the historical data the repair frequency and failures can be searched. The system also holds the analytical function. That kind of proceeding results in harmonious and balanced managing of resources in the enterprise. The module of damage record directly informs to planning of servicing works. The repairs planned respectively early allow the rational managing the employees working time and the early purchase of needed change elements as well as respectively early retreating the product from the use and transferring for the time of repair to appropriate services. The module supporting these actions is defining the usage of resources. The employee generates the job and then there the proper materials, parts, workers reservation takes place which allow to perform the specified task within the planed period of time. Defining the use of resources is possible thanks to the planning of maintenance works. The planning of seasonal renovations – similarly to planning the maintenance works. The planning of the renovation budget is a very important element. In this case it is worth to pay attention to the importance of introducing data to the system because as historical data it creates the base of many calculations in the future. Having the previous information about the costs related to the renovations the calculation for the future can be made. However, if the data information is just being created, some amounts can be assumed in consultation with the experts in this field. This kind of planning gives the opportunity to keep proper funds for appropriate needs and avoid unexpected situations. Ordering the parts and materials- this module is extremely practical in situations when a planner plans renovations or repairs. Knowing what kind of resources will be needed, prepares the list and makes reservations of needed goods or if the needed goods are currently out of stock, makes their reservation. That sort of system shortens the time spend on planning and improves the information flow. Setting the costs of works is essential from the viewpoint of the company finances. Each order needs to be valuated, the valuation includes; the cost of materials, the cost of labor, the cost of parts. When the manager has got the information about the overall cost, approves it or rejects certain order. The rejection of the order is related with too high costs, sometimes these kind of situations occurs when the repair cost significantly exceeds the profitability of maintaining the machine in further use. In this situation the decision of retreating the object from the use and buying a new one is made. The costs of orders are components of company expenses. The work safety requirements are vital elements of work which are overlooked in everyday life. When the planner plans work he needs to take into

consideration the conditions of the performance of the certain order. It can happen that the order will require additional licenses e.g. working on heights. In these cases it needs to be marked in the order and provide proper work security conditions so the data should be written in the system. Creating the record of contractors- if for some order it is necessary to hire subcontractor company. In the future it gives the possibility to find quickly the company which will do the task, therefore it shortens the time of performing the task. Queuing faults to remove- in Maximo system there is an option to prioritize faults dividing them into 5 priorities. This function allows doing first the tasks of the greatest influence on the process of the enterprise functioning. The system owns many more functions and modules. In practice not all its functions are used in the company. Usually that modules are bought, which in the opinion of the board members will have the greatest influence on the effectiveness of the exploitation management process. For the effective and efficient use of the possibilities of the system, the staff needs to be trained and the advantages of introducing the system should be outlined. The main advantages are:

- more effective information flow between workers and in the relations worker-manager,
- shortening the repair time planning and easing that process by possessing all necessary information in one system,
- shortening the stoppages by shortening the repair planning time,
- the improvement of the machine effectiveness thanks to respectively early preventing activities,
- no possibility to exceed the dates of inspection, the system reminds daily.

It is worth to mention not only about advantages but also about disadvantages of that system.

There are some of them:

- the cost of the software purchase,
- the necessity of training the staff,
- causing the staff to up-date all the information in the system, in order to avoid lacks of information,
- at the beginning reduced employee work efficiency caused by working with the new system,
- mistakes in introducing the information to the system by employees
- placing all the information in one place etc.

In many enterprises the strategy to maintain the machine movement is used, resulted in the manual and technical-movement documentation. However it needs to be consulted that in that companies there is a great risk of unexpected stoppages and failures. It mainly follows from, that in this case the essential role plays a man and one's skills, not the system which abilities are very wide.

CONCLUSION

The exploitation system of technical objects is one of the important areas of the enterprise management. Properly managed will be an effect of cost reduction resulted in many factors. Creating the machine exploitation system for the use of certain enterprise offers the opportunity to identify basic elements of its environment. The way it will be built depends on the needs of the enterprise. However, it is indisputable to claim that this system should aim to maximizing profits with the minimizing costs. Considering the aspect of costs in terms of machine and device exploitation is by minimizing/levelling its stoppages resulted in unplanned failures. This effect can be reached by systematic and rational performance of services/repairs. Rational in time and cost terms that means not to perform them neither too rarely nor too often to not to take too much time of service. In the light of existing new technologies supporting the system of exploitation by dedicated information system becomes a rule. A human is a fallible being and possible to be replaced, became a danger for effectively performing enterprise. The tools that the market offers currently give the sense of security. Nevertheless it is essential to not to forget about the human factor because the system can be purely and simply the supportive, not the managing element.

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