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FIXED ASSETS OPERATION MANAGEMENT IN ENTERPRISE IN CONDITIONS OF THE XXI CENTURY ECONOMY

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Abstract
In the paper there are presented on the basis of literature and author's own researches the changes that have occurred in the management of enterprise's fixed assets due to changes in management of enterprise as a complex system located in a turbulent environment. Achieving the objectives of the enterprise is more and more difficult due to increased risk of activity in fast moving and difficult to predict changes in the global economy. In such conditions of enterprises functioning a special role is played by knowledge of a staff and ability to using it.
KEY WORDS: management; operation; knowledge; risk.

Introduction

Enterprise is an organization in material sense, therefore the most universal is its overall model of organization by HJ Leavitt, according to which the organization is a structured system, that is ordered in a certain way system (entirety) consisting of four basic elements (subsystems):

- objectives being realized by organization and resulting of it specific tasks,
- people with their individual and collective strivings and patterns of behavior,
- material and technical as well as technological equipment and specific rules of handling,
- formal structure, that is accepted principles of distribution tasks and responsibilities as well as information.

Enterprise as organized entity (system) must determine a purpose or purposes of its activity, simultaneously taking into account both closer and further changes in the environment and also must take into account and adapt itself to internal conditions.

The internal conditions are first of all human resources (including intellectual capital), financial resources and physical resources (including fixed assets).

All elements of the entity called enterprise are integrated by the objectives for which the enterprise was created and functions.

Purpose of enterprise

Traditionally, a model of private enterprise is based on assumption that the purpose of its business is maximizing a profit.

A. D. Chandler's definition defining a strategy as „... determination of long-term goals and tasks of the enterprise, the choice of courses of action and the allocation of resources necessary to achieve these goals" (Moszkowicz, 2005, p. 47), is a tool for highlighting setting goals in the analysis of the key elements of the strategy.

Depending on accepted strategy of the enterprise, one can notice a dominance of specific goals in a bundle of goals.

Analyzing relations „strategy - goals" one must answer the question who sets the objectives of the enterprise, since they can be determined by the owners (shareholders), but also by managers.

The owners realizing themselves the situations in which it may be a conflict between preferred by them objectives, and the objectives of managers, often strive to co-ownership of managers. This causes blurring the differences of both groups in the approach to the formulation of the strategic goals of the enterprise.

A bundle of goals one can build striving to basic objectives - survival and growth (Koźmiński, Piotrowski, 1998, p. 130) – with objectives arising from different partial criteria being realized on the base of strategic, tactical and operational plans of the enterprise.

In strategic management there are presented different base patterns, out of which result the different ways to achieve the primary objectives, which is „survival".

In most of concepts of enterprise's objectives a survival and development is absolute condition. There are situations when one needs withdraw from realization the „survival and development" goal, that is when it is not possible to improve the very poor situation of the enterprise, regardless of a phase of branch life cycle and then one should proceed to controlled liquidation or curtailment of activity.

The twenty-first century challenges for managers of enterprises

The twenty-first century is a post-industrial era, frequently called civilization of information, in which the primary resource creating competitive advantage is to have the knowledge and ability to use it.

Managers of an enterprise must take into account the characteristic changes in the world economy, such as:

- Turbulent environment,
- Increasing globalization,
- Competition between mega political and economic systems,
- Searching for a more flexible system.
- New vision of an enterprise.

In discussions over the requirements, what a new organization of enterprise should be, one can mention the most often occurring features:

- Flexibility,
- Dynamism,
- Multitasking - economic, political, social, moral, ethical goals,
- Orientation on science,
- Ability to manage a knowledge,
- Serving customers,
- Openness and ability to changes (ability to using opportunities and avoiding threats).

Flexible adaptation to continuous and turbulent changes in environment and ability to functioning in conditions of chaos and crisis – this is a concept of tomorrow enterprise - „sustainable enterprises". For those sustainable enterprises one can accept defined targets of control systems and supervision of the corporation, whose expression are principles of organizational culture of „corporate governance":

- harmonizing interests of entities that are involved in functioning of the corporation,
- providing owners and stakeholders effective procedures and institutions of monitoring the management and correcting its mistakes,
- gradual increasing a goodwill from viewpoint of owners and other stakeholders,
- creating an investment attractiveness and ensuring an inflow of financial funds necessary for development of the enterprise (Grudzewski, 2010, pp. 17, 199, 300).

In concepts of business management at the end of the twentieth century and early twenty-first century, in new economic situation in the world one is looking for help in new approaches such as:

- Situational approach, system approach,
- Customer orientation,
- Orientation on quality, orientation on innovation and know – how,
- Orientation on financial result, orientation on goodwill,
- Orientation on knowledge, orientation on human, resource approach,
- Concepts of learning, intelligent, virtual and network organizations,
- Process oriented paradigms, flexibility and changes in management concepts,
- Lean Management, clever organization.

Those concepts relate to enterprise management as a whole, but also influence the management of individual subsystems, including assets subsystem.

Fixed assets management

Assets of enterprise is identified with capital because financial capital invested in the enterprise is converted into assets of the enterprise, which consist of fixed and current assets. Depending on the purpose of capital for the financing the type of property we can distinguish fixed or current capital. A size and structure of material and financial capital decides on formation of enterprise, its operations and development. Rational using resources (capital) of the enterprise allows to its growth and development.

In process of business management the ability of making decisions in all areas of enterprise determines results. Synergy effect in decision-making processes is achieved if coherence of decision-making system is ensured, while lack of coherence in decision-making processes accelerates entropy of the system.

Subsystem of fixed assets is the most important in the tangible fixed assets.

Relations between a subsystem of fixed assets economy, and the goal of the enterprise (goodwill) are related to two areas: reproduction and widely understood exploitation.

Choosing a fixed assets economy subsystem for the analysis, results from the importance of this subsystem in a modern knowledge-based economy.

The increase in value is a goal of enterprise's activity, because „the goodwill is the appropriate criterion for any decision whose consequences are of a financial nature." (Czekaj, Dresler, 2005, p. 20). The goodwill, as opposed to the criterion of the amount of profit, takes into account the time factor and the risk factor, which is particularly important in conditions of turbulent changes in the economy.

An enterprise that exists (lasts) can increase its value and for the purpose of duration the enterprise must renew its fixed and current capitals and use of owned property.

Renewing can also be simultaneously a factor of development (broadened reproduction), only a maintenance of production capacity in the existing sizes (simple reproduction) or a reduction of production capacity (constricted reproduction).

Owned assets and its fixed assets, require implementation of the operation processes, which include sub-processes: maintenance, waiting and using, as well as liquidation. Operational processes have an impact on goodwill through optimal implementation of those sub-processes.

The process of use actively influences on increase of goodwill, because that sub-process determines the added value in manufacturing processes. The maintenance sub-process, as a typical secondary process, has a significant impact on possibility of using and enterprise's costs in the form of indirect costs despite the fact that it itself does not bring a new value.

Reproduction, especially broadened, increases potential capabilities of increasing the goodwill, however for the goodwill any kind of reproduction will have a positive significance, provided that the adjustment of fixed assets to the changing needs of the production program will be an effect of the reproduction. An increase

in value of fixed assets without an increase in productivity of fixed assets will not increase the goodwill.

Means of work including fixed assets (tangible fixed assets) as one of the components of the business assets should affect an increase of goodwill and should be a factor of boosting the enterprise development.

Means of work is also accumulated work of society in the past years (national property), constituting objectified expenditure of human labor (physical and mental). For efficiency of means of work, except the production fixed assets, the use of intellectual capital has special significance.

Means of work improvement is one of the basic elements of technological progress, which have an impact on the growth of labor productivity.

However, in many cases one can observe a phenomenon, that the fixed assets becomes a ballast aggravating costs without multiplying the added value.

Fixed assets operation management

In English language literature an operation as „maintenance" comes down to the issue of handling or exploitation (Gulati, 2009, p. 18, Levitt, 2009, p. 9). Functions of exploitation or maintenance are treated by practitioners of enterprise management as functions of ensuring the continuity of work process of technical equipment at the lowest possible cost.

The best proof of it is the fact that popular *Maintenance Management* term equated with the process of management of handling the machinery and technical equipment is more and more often equated with an integrated system of fixed assets management and manufacturing process in the concepts of *Total Productive Maintenance* (TPM).

Analysis of the systems of fixed assets operation management should be preceded by an analysis of paradigm shifts in operation management.

The paradigm shift in operation management by J. Moulbray (Moulbray, 2009) is based on the analysis of processes of fixed assets maintenance, mainly of machinery and technical equipment in connection with the general objectives of the enterprise, rather than focusing only on autonomous goal of maintenance, what often was only ensuring a suitability for using.

According to the old paradigm, development of the concept of *Preventive Maintenance* was based on the belief that maintenance has to entirely preserve reliability or built-in utility potential of each fixed asset. According to the new paradigm based on a deeper understanding the role of fixed assets in building the goodwill (business role) it is important, what the asset makes it possible to realize according to the required standards, and not, what that asset is.

L. Fedele notes that the term of maintenance is identified with the policy and strategy. The policy of maintenance indicates that established by the firm the general attitude to the problems of maintenance may be in practice related to the subjects: organizational units, work stations (organizational level 0), as well as to a single technical object (eg. machines) in different strategies (Fedele, 2011, p 33).

In the literature on maintenance some authors define three basic strategies of maintenance (Wireman, 2008, Levitt, 2009, pp. 219-258):

- *Breakdown Maintenance,*
- *Preventive Maintenance,*
- *Predictive Maintenance*.

Also appears extended understanding of the predictive strategy: *Proactive Maintenance* (Fefele, 2011, p. 41).

In the publications and in practice one can note mixing of concepts and interchangeably use of policies, strategies and methods of maintenance.

Simply put, most generally one can divide the strategies into two opposing strategies:

- *Breakdown Maintenance*,
- *Preventive Maintenance*.

In the *Preventive Maintenance* we can use different methods, whose common feature is the action of preventing accidents.

R. Gulati does not include the *Breakdown Maintenance* to the strategy, treating this type of maintenance as a case not resulting of the choice of decision-maker.

In practice, a strategy of *Breakdown Maintenance* is used with respect to some objects for economic reasons. In every case one must make an account what is more profitable: so called individual *Breakdown Maintenance* or group maintenance of some cheap elements as a preventive replacement. When it is necessary to maintain a group of objects in an up state it can be more profitable to replace the entire group, even if some elements continue to work properly, than replace individual objects after diagnosis their damage.

Regardless of the classification, an objective of maintenance services activity is to reduce reactive breakdowns and adapt or increase respectively works of *Preventive Maintenance* (PM) and *Condition Based Maintenance* (CBM).

Preventive Maintenance (PM)

Preventive Maintenance refers to a series of actions that are taken on the resources in accordance with the schedule. This schedule can be based on both the time and the machine running time or the number of machine cycles. These actions are designed to discover, prevent or mitigate the degradation of the system and its components.

Preventive Maintenance carried out at predetermined intervals, based on the number of operations (for example mileage, number of made details, etc.), based on the using of data on reliability (MTBF, Rate of Failure, mean time between failures, the rate of damages, etc.) (Wireman, 2008b, pp. 11-15).

PM is a scheduled conservation of resources, designed to enhance life of resources and to avoid unplanned conservation activities. PM includes cleaning, adjustment, lubrication, and smaller replacement of spare parts, in order to extend the life of resources and expand its capabilities.

The aim of PM is minimizing the failures. One should not be allowed to reach a critical point both by property and equipment, unless strategy *run-to-failure* (action until

the failure) is accepted for specific parts of resources. In its simplest form, *Preventive Maintenance* can be compared to a car service schedule. The scope of the necessary procedures undertaken within the PM is very different. It can include a range from visiting of property and equipment to measuring the backlashes, checking settings of pumps and engines, simultaneously noticing other deficiencies for later improvement.

According to L. Fedele, *Preventive Maintenance* was often used as dogmatic as planned revisions at fixed intervals regardless of the possible comparison with the data obtained in the previous experiments. At the beginning of the 60s of the twentieth century, when it was decided to carry out deep researches on the effectiveness, *Preventive Maintenance*, and on other hand development of RCM (*Reliability Centered Maintenance* – maintenance focused on reliability) method aimed at combination the reliability of the project with complex analyzes, which required a number of significant activities (staff training, information gathering, identification and distribution the system, strategy, cost effectiveness, etc.) led to fully defining a new strategy *Predictive Maintenance* (predictive - *Predictive Maintenance* as a logical evolution of *Preventive Maintenance*).

The rationale for the use of predictive methods (CBM) is the fact that 82% of the components does not exhibit wearing-up (frequency of failures does not increase over time), and 72% show an increased frequency of failure immediately after installation.

In economic practice one can find cases, where badly (failure) fixed assets operate, and production services put pressure on increasing purchases of new resources to ensure the timely completion of production tasks.

Increasing state of assets ownership can lead to its excess, which is justified by high rate of failure. It may turn out, that if the maintained system would increase the reliability of existing fixed assets, additional purchases would be superfluous and thereby the effectiveness of the invested fixed capital would be higher, and thus ROI (Return on Investment) indicator would increase.

In natural way the next step after PM based on the time, is carrying out a maintenance based on work cycles or on the time course. Resources do not need to be checked repeatedly, if they were not used. Generally, the actual operation of resource exhausts them, so it makes sense to check them after a certain time of work, in which they could be partially worn out.

Condition Based Maintenance (CBM)

Condition Based Maintenance (CBM), also known as *Predictive Maintenance* (PdM), attempts to assess the state of resources by periodically or continuously monitoring them. The ultimate goal of CBM is to carry out the maintenance in the scheduled time point, when the action is costly the most effective and simultaneously at the time before the failure. „Predictive" component is derived from the goal, which is prediction of future trends regarding the state of resources. This approach uses principles of statistical process control and trend analysis to determine, at which point in the future the carrying out the maintenance will be appropriate and most effective in terms of cost reduction.

CBM inspections are usually carried out during servicing, so that a break in normal operation of the system are minimized. The results of the acceptance of CBM/PdM are significant cost savings and higher system reliability.

Advantage of *Condition Based Maintenance* by R. Gulati (Gulati, 2009, p. 56) is that the proceeding can:

- warn on time against the majority of mechanical problems to minimize unexpected damages, risk and consequences of additional damages and adverse influence on safety, operation and environment. This will reduce a quantity of forestall corrective actions,
- increase the use and lifetime of equipment, minimize disruptions in fulfilling their mission and schedule. It will reduce periods of exclusion of resources and processes, which will result in increased availability,
- reduce maintenance costs - both spare parts and labor,
- reduce significant number of inspections and *Preventive Maintenance* inspections based on calendar/mileage,
- minimize the costs and threats relating to resources, which are the result of necessary carried out inspections, dismantling and PM inspections,
- increase the probability of optimal lifetime of operating components.

Operator Based Maintenance (OBM)

An operator is actually the most important member of the maintenance team. Well informed, trained and responsible operators are guarantors of maintaining the resources in the functional efficiency.

The operators are on the first line of defense carried out against the periods of excluding the fixed asset from operation. OBM assumes that operators, who are in daily contact with the resources, can use their knowledge and skills to predict and prevent the accidents and other losses.

The main objective of the program *Operator's Maintenance* also called *Autonomous Maintenance Program* is to provide operators with the following skills related to resources:

1. The ability to detect abnormalities;
2. The ability to correct - as far as possible - smaller abnormalities and restoring function;
3. Ability to determine the optimum conditions of resources;
4. The ability to maintain optimal conditions of the equipment.

Autonomous maintenance is one of the basic pillars of *Total Productive Maintenance* (TPM). TPM is a Japanese philosophy of maintenance, which involves operators performing some basic maintenance activities. The operators acquire maintenance skills through a training program. In some cases in the processes running in automated lines, due to the nature of these processes the positions of operators do not occur, and only maintenance posts, which perform only one operator function, i.e. initiating the process.

Corrective Maintenance (CM)

CM, sometimes called a repair, is carried out to improve the deficiencies found in the evaluation of PM and CBM; it restores good conditions of the resource after their breakdown or work stopping. CM is an activity initiated as a result of observed or measured conditions of resources before or after functional failure. CM action can then be classified in three categories:

Scheduled CM

CM – Scheduled is a corrective action being performed in order to ease potential failures of resources or to improve the deficiencies found during PM and CBM tasks. It leads the resources to capability, what were designed for them, or to level, which is expected to be acceptable.

CM – Major Repairs/Projects (Planned & scheduled**)**

In many organizations all major repairs or improving works which are valued above a certain threshold - eg. general reviews and major projects, are treated as taxable capital projects. If those projects are to bring the resources back to the abilities that were designed for them, without adding additional capabilities, they should be seen as C*orrective Maintenance*. In this case, they should be planned and schedules.

CM - Reactive (Unscheduled), also known as Breakdowns/Emergency (reactive unscheduled).

Corrective Maintenance - Reactive (Unscheduled) first of all is repairing of resources after being damaged. This action is also known as an emergency or failure repairing action. In most of cases the implementation of this activity is mixed with the realization of the regular weekly planned activities. The activities outside the schedule cost much more than planned and included in the schedule.

A lot of researches/studies presented at the *International Maintenance Conferences*, at the annual *Society for Maintenance & Reliability Professionals' Conferences* and on *Reliabilityweb* indicate, that *Reactive Maintenance* is still the most widely used method of maintenance. The average results of the researches on the methods so far used in enterprises in the United States are as follows (Gulati, 2009, p.61):

- 55% reactive - (CM unscheduled),
- 30% preventive - calendar and running time,
- 15% CBM/PdM.

Note that those studies indicate, that 55% of maintenance of resources and activity is still reactive nature

- maintenance prevents failures of resources or their parts and repairs them in the case of occurring.

However, a new paradigm of maintenance is capacity assurance, what means that maintenance assurances the resource capacities on planned or acceptable level.

Costs of maintenance and resource availability can be improved by optimizing the operating tasks and through the effective execution of tasks using available tools. Tasks of maintenance, such as operating instructions of PM, CBM and repair plans must cover everything, what requires performing. These tasks can be optimized by the use of tools and techniques such as RCM, FMA, predictive technologies and *Six Sigma*. These tools and techniques help optimizing range of operating tasks, which are to be realized. Execution of maintenance tasks can also be optimized by the use of other tools and techniques, such as planning and scheduling. These tools and techniques can help you effectively use resources use.

The selection of appropriate indicators to measure the performance of maintenance tasks is an important element in the implementation of best practices. Indicators should encourage appropriate behavior; they should be difficult to handle, leading to results that allow „feel good". And finally, it should be easy to collect and make up reports.

The evolution of operating techniques (maintenance) is a result of growing expectations of management, increasing the efficiency of the whole system - an enterprise - as synergistic effect resulting from co-contribution of the individual subsystems, including maintenance subsystem to achieve the strategic goals of the enterprise.

Each maintenance causes unavailability of equipment for the processes of using in time of residence the device in handling.

Ensuring continuity of exploitation of the devices requires, that a number of operating devices is greater by average number of devices residing in handling in relation to number of operating devices with full load of production or service processes. This additional equipment is called the repair fund, and applies only to homogeneous or devices, that are not homogeneous, but can replace each other. This fund is used to fill up the group of devices being used in the case, that any devices must be taken out of service to perform maintenance.

Exploitation politics

L. Fedele at policy level distinguishes (Fedele, 2011, p. 14):

TPM - *Total Productive Maintenance* - comprehensive maintaining the productivity,

RCM - *Reliability Centered Maintenance* – the maintenance focused on reliability,

Total Productive Maintenance (TPM) is a method (Masaki, 2007, p. 178) of management the resources, which puts pressure on cooperation between divisions: operational and maintenance, aimed at zero defect, zero failures, zero accidents at work (effective workplace) (Gulati, 2009, p. 167).

„The method of achieving these objectives is, among others, stimulating the initiatives of the operational staff, who can submit proposals of improvements, group solving the problems." (Urbaniak, 2004, p. 200).

TPM aims to activation of all employees at various levels of the organization with their different functions, in order to unite efforts to maximize the overall efficiency of production resources.

TPM (Gulati, 2009, pp.169-176) is based on the following principles:

- improving the efficiency of resources and equipment,
- *Autonomous Maintenance* carried out by the operators,
- serviceability, adjustment and minor repairs,

- planning the handling by exploitation division,
- training of improvement the operations and skills in a scope of maintenance,
- better designing of workplaces, including taking into account the standardization of procedures.

According to R. Gulati, TPM consists of eight pillars of activities, that affect all areas of the organization, with three basics, that are immutable and always should take effect:

1. The involvement of all employees;
2. Teamwork;
3. 5 ”S” (Japanese version: seiri - selection, seiton - systematics, seiso - cleaning, seiketsu - maintaining cleanliness, shitsuke – selfdiscipline).

J. Levitt believes that pillars are specific strategies of transforming the *Lean Maintenance* and can be changed and accept TPM as a building with 4 plinths, which are the bases and can not be changed (Levitt, 2010, pp.61-62):

1. Safety, health and environment,
2. Training,
3. 5 „S” (a modified version compared to the Japanese version - separate, organize, clean the place of work, standardize, self-discipline)
4. TPM office,

and 6-columns:

1. Autonomous Maintenance,
2. Synchronized Maintenance,
3. Proactive Maintenance,
4. Quality of a product,
5. Continuous improvement of both equipment and processes,
6. Management of a new equipment.

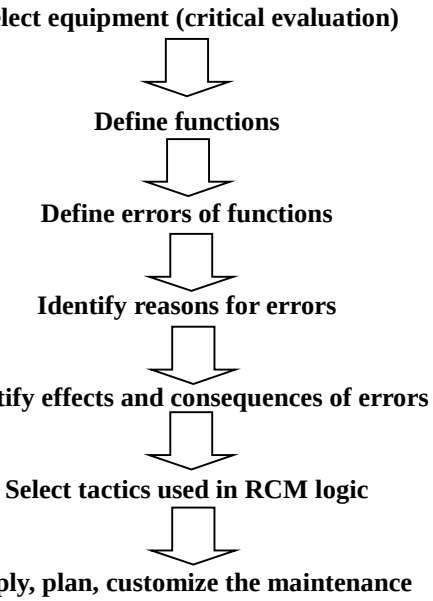

Fig. 1. Steps of RCM by J. Moubray (Campbell, 2001, p. 45)

Reliability Centered Maintenance (RCM) - maintenance focused on reliability is a historical process that led to the development of reliability issue of dependability (reliability).

RCM was created as an attempt to find answers to questions, that were partially ignored:

- What does equipment do?
- What type of functional failure are possible?
- What are possible consequences?
- What can be done to prevent them?

Implementation of RCM by J. Moubray should be in accordance with diagram shown in Figure No.1.

RCM is a set of rules, methods and procedures for management of maintenance and their rules aim to rapidly increase and sustain growth of availability and safety in the enterprise. RCM uses the theory of reliability as its basis.

J. Moubray draws attention to the use of RCM in *Proactive Maintenance*, because of the study of „P-F” interval (potential failure - functional failure) (Moubray, 2002, pp.144-168).

Model of analysis the causes of damages, which allows the personnel to determine plans and procedures for management of interventions, is achieved by incorporating the principles of RCM on three levels:

- assessment of the consequences of damages to the decision-making process, which takes into account the criteria of safety, economic parameters and maintenance costs;
- developing the researches over models of complex systems damages, to determine a new approach in choosing the most appropriate policies of preventive or alternative actions;
- binding of these activities in a process which guarantees making optimal choices.

RCM must be implemented throughout entire facility’s life cycle, if it is to achieve maximum efficiency (Gulati, 2009, p. 214)

R. Gulati believes that decision of introducing RCM in relation to the technical facility, including monitoring the conditions under which the facility will be used, will have a greater impact on cost of life cycle of the object. This decision is best to take during planning and designing phase. Since decisions about RCM are often made later in the life cycle, it becomes more difficult to achieve the maximum possible benefit from RCM program.

However maintenance absorbs a relatively small part of total life cycle costs, the program of balanced RCM is still available to achieve 10-30% savings in annual maintenance budget of the facility during phase O & M (Operations and Maintenance.).

Currently the most popular variant of this method (policy) is version RCM II developed by J. Moubray and constantly improved.

RCM II is a process used to meet expectations of users, enabling determination the functional interdependence of groups, which are composed by the users and employees, to design programs enabling reliability of technical objects.

It was assumed in the concept of RCM II, that new production technologies require new solutions in the scope of handling.

Business approach to managing the operation

In the theories of operation management, in the West limited to Maintenance Management, it appears the concept of thinking about maintenance in business terms. In this approach, it is analyzed the impact of maintenance on the profitability of the enterprise.

Maintenance should be managed just like any business organization. T. Wireman notes that „if manager of maintenance makes one or two bad decisions in any business part, the profitability of the entire plant can be threatened", and also believes that for maintenance organizations „it is important the setting business goals, objects, policies and procedures for maintenance and dependability departments, as far as one really establishes the business " (Wireman, 2008a, p.1).

Business approach requires determination the measures of achieving the objectives, and it is important the adoption of acceptable deviations from the accepted indicators. Such a measurement system known as KPI (*key performance indicators*) should constantly make measurements of these indicators and study deviations and in case of deviations not falling within the limits set as acceptable, causes of their occurrence must be established.

As soon as the causes are identified, one must determine the appropriate corrective actions to fix the problem. Along with the determination of corrective actions, it is important to plan how to implement this action; it often requires communication with other units or internally with individual employees of exploitation unit.

Corrective actions should be included in schedule; before the beginning of implementation, the schedule should be known and understood by all participants of corrective actions implementation. After finishing implementation of corrective action one should periodically evaluate the effect of this action and answer the question whether the correction has solved the problem; if the problem has not been solved, further corrective actions are necessary until the problem is corrected. Corrective actions may take a form of a loop of continuous improvement, where KPI are constantly monitored, to ensure focus on business of maintenance and dependability.

By T. Wireman such system of business control ensures that maintenance and dependability unit is managed in efficient way and it ensures generating a profit.

The author of the trilogy on *Maintenance Strategy Management*, Terry Wireman believes, that business approach to maintenance requires the successive implementations of strategies.

Adopted by the author's philosophy of development of fixed assets maintenance systems is based on the assumption: as long as *Preventive Maintenance* is not effective, every consecutive strategy will be more costly and inefficient. It is a starting point to improvement handling systems and it is necessary to master this strategy before implementation the next-generation maintenance strategy. Similarly Nakajima Seiichi believes that the PM (*Preventive Maintenance*) is a core of handling processes strategies (Nakajima, 2008, pp.12-29).

The second series of „maintenance" strategies is a continuation of the first series, but under condition of effective functioning the first series modules.

The second series of „maintenance" strategies improvement begins from the module of planning and scheduling of handling processes through the module CMMS/EAM (Computerized Maintenance Management Systems / Enterprise Asset Management), until training employees in a scope of acquisition the „maintenance" skills.

Planning and scheduling „maintenance" processes aims to optimize the cost of service life, assuming minimizing interruptions of operation of the device.

Criterion of choosing the optimal variant of projects implementation in the scope of operation, especially in the field of maintenance, is often minimizing of time of device exclusion; however not always is so, because in some cases it can be efficient use of operated technical means, under the given constraints, eg. financial. Therefore there is a need of building mathematical model, which would be a base for formulating, appropriate to the situation, tasks of optimization.

Computerized Maintenance Management Systems

Computerized Maintenance Management Systems is an essential tool for all maintenance units. It helps maintenance divisions to improve efficiency and effectiveness, and - ultimately - to gain more of the fixed assets by improvement of critical „work streams", planning, scheduling and reporting. Two types of systems are available. One type is regarding the entire enterprise set of modular applications, such as fixed asset management, material resource planning, finance and human resources. These applications can work effectively in many places and plants. Most of these systems, developed in the mid-90s and at the beginning of this decade, is known as *Enterprise Asset Management* (EAM). Their installation is costly.

Another type of systems are autonomous applications of maintenance management. They can have an area of joint action with other enterprise systems such as systems for Finance and Human Resources. These systems are called *Computerized Maintenance Management Systems* (CMMS). The name CMMS was introduced in the 70s and 80s, when programs PM (*Preventive Maintenance*) were automated using computers. Basically, at present there are no major differences between the methods of functioning the systems of both types, so the notions CMMS and EAM are often used interchangeably.

The third series of maintenance strategies T. Wireman closes with the issue of implementation the training programs of operation and operators. He draws attention, that the issue of skills and increasing a scope of knowledge on operation (here understood as operator and handling personnel) is a critical point for the next steps to enter the higher levels of fixed assets management strategy.

The next step in improving the quality of maintenance processes is to go to *Predictive Maintenance* (PdM)

strategy. The basis of PdM is using the diagnostic techniques for evaluation state of fitness of equipment.

Business approach to operation management requires financial optimization through total costs of operation management. The following data are necessary to analyze the total costs:

- MTBF - medium time between failures,
- MTTR - mean time to repair,
- downtime costs and costs of lost production,
- ABC Pareto distribution of causes of equipment failure,
- the initial value of the equipment,
- costs of regeneration,
- history of operating the device.

It is necessary the continuous improvement of enterprise management system including the system of fixed assets operation management.

The last strategy of maintenance on the development path of management methods is a continuation of improving all aspects of operation management. This strategy is often called „Best Practices".

„Best Practices" is an idea that ensures that the technique, method or process that is more effective in supplying the desired results than any other technique, method or process.

It is usually documented practice being used by most of respected, competitive and able to generate profit organizations.

Best Practice, if properly implemented, should improve efficiency and effectiveness in specific area. Best Practice is a relative term, because some may be a routine or standard practice, but for others it may be the Best Practice, since the current practice or method is less effective than the practice of other organizations.

According to the American Productivity and Quality Center the three main barriers to the acceptance of Best Practice is lack of (Gulati, 2009, p.21):

- knowledge about current Best Practices,
- motivation to enforce the changes needed for its acceptance,
- knowledge and skills required for its acceptance.

„There is no single Best Practice, since what is considered as the best, is not the best for everyone. Each organization is different in its own way, when taking into account its mission, culture, environment and technology. By „the best" one should understand those practices, which showed, that they achieve the best results" (Gulati, 2009, p. 248).

The evolution of the strategy of exploitation process management is largely due to changes in approach to the role of resources, especially of fixed assets, in the creation of enterprise value.

Conclusion

Management of cycle of operating the fixed assets processes is a causing to that operational processes are carried out in accordance with a will of managing of the process. In different models of management of operation processes, it is important, regardless of the using the universal principles, also determination of specific methods in the operation management, which however must be subordinated to goals of business management.

If the enterprise accepted as the primary goal an increasing its goodwill, then all subsystems realizing their goals should get close the enterprise to increasing its goodwill.

The development of economic volume of activity of enterprises has led to ever deeper division of labor, increased specialization of work stations and organizational units of higher levels, and thus to the disintegration of the individual subsystems. In contrast, the development of technical and organizational progress manifests itself in the automation of manufacturing processes and the use of information technology to automate processes of information and decision-making, resulting in a closer integration of auxiliary activities, information and decision-making, the latter can be both a centralized, involving the entire system of manufacturing, and decentralized referring to the individual system components.

Turbulent changes in the environment of enterprise make it necessary to increase the flexibility of the organization, or the ability to adapt to the rapidly changing environment. This causes that both in production processes and service processes, withdrawing from deep specialization, one looks for an optimum of specialization.

According to the old paradigm, the development of the concept of *Preventive Maintenance* was based on the belief that maintenance is to a wholly behave the reliability or built-in utility potential of each fixed asset. According to the new paradigm, based on a deeper understanding the role of fixed assets in building a goodwill (business role) it is important, what the fixed asset enables to realize in accordance with required standards, and not, what this asset is.

In the process of improving asset management the strategy of *Preventive Maintenance* should eliminate the failures in order to eliminate unplanned downtime.

Increasing a state of fixed assets ownership may not be necessary, because if handling system increased dependability of existing fixed assets, it would be superfluous additional purchases, and thus the effectiveness of the invested fixed capital would be higher and it would be an increase of indicator ROI (Return On Investment).

The development of systems of maintenance processes management should proceed evolutionary through a shift away from reactive to preventive model, and then seek to „Best Practices" in the conditions of specific enterprise.

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