On the necessity of organizational transformations in the system of repairing the mining equipment

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Abstract. This article considers the methodological approach to the reorganization of the repair department of a mining enterprise (ME) into an independent structural unit, which provides the technical services (maintenance of the mining equipment) for the primary production of a mining enterprise. We consider the main reasons of inefficient activities of the repair department, justify the necessity of organizational transformations into one of the forms, which allows for a repair department to develop economic relationships with other units of an enterprise on the basis of mutual benefits. Also we describe the factors which are necessary to be taken into account when reforming the organizational structure of the repair department and provide a brief analysis of the preferability of directions of the technological specialization and the structure of main functions of the repair department. This approach will allow to make a well-grounded choice for the managers of an enterprise – either to repair the equipment with the help of a third party or to arrange the maintenance on its territory on the basis of providing a service and mutual benefits.

The basis of this article is the long-term author researches of the organizational structure of repair departments of mining enterprises. The accumulated experience allows to claim the following: the redirection of production of many coal producing companies (CPC) to business activities in conditions of competition, the increase of the importance of resources for enterprise owners and the availability of the new foreign equipment and the old equipment, which has been manufactured at Russian machine-building factories, at CPCs justifies the necessity to apply the principally other mechanism for providing the working efficiency of the mining equipment.

In conditions of competition, the enterprises, which use mining machines, faced with the problem of providing the economically reasonable level of working capability of the equipment, the part of which (60 – 70%) is the machinery with excessive working life and without any remaining carrying value.[1]

It becomes more difficult for a mining enterprise to provide the maintenance and repair of this machinery. The increase of capital investments, which are connected with the development of the repair and technical base and the warehouse of spare parts, the increase of the cost of training the personnel, who maintains the mining machines, negatively influences the cost of production. The development of the policy in the sphere of using the methods of the maintenance and fulfilment of repairs at a mining enterprise is of a subjective character and it does not always coincides with the...
recommendations of equipment manufacturers, and this fact finally leads to the decrease of the working efficiency of machines, periods of their operation and sufficient expenses of their maintenance.

As a result of researches, it has been found out that the system of providing the working capability of the mining equipment of open-pit coal mines is characterized with 3-4-fold excess of manufacturing capacities, 5-7-fold excess of material and labour resources. Besides, the throughput time of work of the equipment is twice or three times less than the time of its operation. (Figure 1)

![Equipment provision and Labour input]

| Duration of the equipment maintenance: 0.6 - 2.0 h./mach.-h |
|------------------------------------------------------------|
| Labour input: 1.8 - 5.0 man.h./mach.-h                      |
| Expenses on maintenance and repair: 120 - 132 conv.un./mach.-h |
| Equipment provision: 7.8 m³/min. m³                        |
| By 3.1 times                                              |
| By 6 times                                                |
| By 6 - 10 times                                           |

**Figure 1.** Specific indices of functioning the system of providing the working capability of the mining equipment of foreign (a) and national (b) enterprises

Below there is an excerpt from the letter of the master mechanic of a large mining enterprise of Russia, where he describes the incompliance of applied methods of organization and planning the repair activities with the conditions of effective development of an enterprise and provision of the required working capabilities of the mining machines:

«Under current conditions of developing the mining industry there appears an urgent need in optimizing the expenses on the primary production, which naturally influences the funding of the repair activities of enterprises. To the full extent this process covers the activities of units of coal producing companies and enterprises of ferrous and non-ferrous metallurgy.

Also the thing which does not promote the solution of this task is the unsystematic character of accounting and reporting, allocation and recovery of costs, absence of an orderly mechanism to control the execution of repairs and the expenditures, and also of stimulating factors. All these things take place within the Decree on Preventive Maintenance, which appeared and has not been revised since 1990, where, as it is well-known, the planning is based on the obsolete method of periodicity of repairs for operation time of mechanisms».

The abovementioned problem has put the following task to the management of mining enterprises – to provide the working capability of mining machines at the right price and with the guarantee of high quality of maintenance.

The accumulated experience of transformations and issues of arranging the effective production at coal producing companies, which have been considered in papers of A.S. Astakhov, V.I. Ganitskiy, N.V. Melnikov, E.V. Petrenko, L.A. Puchkov and other scientists, have become the basis for further investigation of this issue.

In connection with this, the development of a methodological approach to the reorganization of the repair department is of more importance because it allows to make investments into the development of an enterprise more efficiently and to provide for the working capabilities of machines on preferential terms.
It is well-known that in the repair department there are standards for differentiation according to the equipment groups depending on its purpose, category of repair complexity, age groups, types of repair and character of works. These methods are effective at enterprises of heavy machine building, power engineering industry and transport machine building. This approach is necessary in order to make the planning of expenses on equipment repair not significantly different from actual expenses on the performed repair,[2].

At mining enterprises there is often another method available. Senior services take decisions, allocate the funds («determine the limits») on performing the repairs, and then bind the onsite executors to justify the purposefulness of this or that decision made by them and to confirm the sufficiency of allocated funds. But … not to exceed the fixed limits in any way.

The significant part of expenses on the equipment maintenance are the expenses on purchasing the spare parts (Figure 2)

![Figure 2. Structure of expenses of the energy and mechanical service for coal mines of CPC.](image)

The availability of necessary spare parts significantly increases the period of operating the machines and equipment, reduces time, which is spent on repairs, and makes the work of maintenance employees easier. But as a rule, the high cost of spare parts for companies is a limiting factor during the process of purchasing the necessary original spare parts, and, as a consequence, the equipment is idle and the period of repairs increases.

The missing spare parts are quite often manufactured at the site. As a result, these parts do not serve for planned hours, therefore, increasing the number of irregular repairs. This situation takes place due to the fact that these parts are usually manufactured from materials, which have been selected at random, as the manufacturer does not give any information in relation to materials, which have been used for manufacturing these details initially.

The repair of the mining and conveyor equipment (MCE) is a time-consuming and expensive process and the expenses, which are connected with the maintenance and service of mining machines, are 28-40% in the structure of the production cost of the coal. In addition to that, the actual productivity of MCE is lower than its technical capabilities, the time of the productive work of the main technological equipment is, as a rule, just 3800-4500 h. of the annual calendar working time fund.[3].

It is obvious that the main reason of the existing situation is the existing economic mechanism, inefficient organization of the repair system, disunity of the production and technical operation of MCE, their different economic interests, and imperfect methods for calculating the standards of resource consumption.

There is a way out of this situation. In the whole world little and large mining enterprises are engaged in the primary production, i.e., extraction of mineral resources, and “secondary works”,

![Figure 2. Structure of expenses of the energy and mechanical service for coal mines of CPC.](image)
which also include the high quality maintenance and repair of mining machines, are provided by specialized companies or services, which have qualified specialists and experience of these works.

In the recent past Russian mining enterprises were proud of the fact that they can independently arrange the maintenance of machines and their repair, having the appropriate repairing capabilities and workforce for all types of maintenance. At present the majority of them come to the conclusion that it is more advantageous to concentrate their efforts and resources on mining works and to transfer the repair of machines to servicing companies.

Operators of mining machines aim at purchasing not just a machine. They need a function, which will allow to achieve certain economic purposes, in particular, the production of the necessary amount of products at lower costs. Therefore, from manufacturers of machines miners require guarantees that the improved properties of machines (reliability level, cost of operating hour, material expenses, quality of spare parts, etc.) will provide their working capabilities. However, the reliability of machine operation mainly depends on the level of their maintenance but the process of its management as a sphere of production services is underdeveloped.

A set of measures of the organizational, technical and legal character, which maintains the equipment in good technical condition, i.e., in condition of its constant readiness for operation, is understood as a system of the technical service. Abroad the technical service is provided directly by the manufacturer or by its branches and also by associations of suppliers of parts for machines and equipment and specialized companies on a contractual basis.

In Russian coal producing companies (CPC) the material basis of maintaining the mining equipment is the repair and technical base, which has been created and has been functioning practically without any participation of manufacturing plants as a part of the coal producing complex.[4]

In addition to that, the process of creating the technical service as a system of services is going on at some mining enterprises of JSC “SUEK”. It is justified by the necessity to change the relation of the personnel to the resources which are consumed in the repair department; to provide a mutually beneficial and efficient interaction of enterprise units; to increase the level of financial, technological and organizational discipline.

Transition of the repair department to new economic relationships can have three forms:

• preservation of the traditional organizational structure and the administrative mechanism of relationships with an enterprise, which is accompanied with the opening a separate account of technical services as a whole or centralized departments (or both of them) in order to transfer the repair funds (budget) to it. This variant presupposes the advance payments for different types of expenses with or without any control or the control of the reporting parameter, i.e., the reliability of the serviced equipment.

• Establishment of the specialized structural unit on the basis of the available units of the repair department (creation of the in-house technical service).

• separation (detachment, outsourcing) of structural units from the enterprise and establishment of independent repair departments – joint-stock companies (with a different degree of specialization), which are focused on the efficient business activities.

The creation of the in-house service on the basis of the repair department requires some changes in relationships inside the energy and mechanical service and between it and other structural units of the enterprise. When choosing the adequate type of organization of the repair department there is an opportunity to detach the repair department into a specialized structural unit, which will cooperate with the enterprise units on a mutually beneficial basis. [5]

Separation (reorganization) of the repair department presupposes the reformation of the organizational structure, which includes the transformation of the department staff and official persons, their subordination and interaction.

The main condition for transforming the organizational structure is the provision of the economically justified level of operating reliability of technical objects and the transition to the economic mechanism of management. The reorganization is limited to the following consequent
actions: increasing the level of personnel centralization in specialized (according to business processes) intraproductive functional units and the phased transition of these units to the independence and economic relationships with other departments of the enterprise (Figure 3).

![Diagram of detaching the repair department into a specialized unit](image)

**Figure 3.** Block scheme of detaching the repair department into a specialized structural unit.

The transition to new economic relationships is performed after the justification of possibility on the basis of analyzing the main business processes, taking into account the specificity of types of technical objects and their corresponding services (mechanical, energy and electrical repair). Main business processes are: preparation for repair; arrangement and fulfillment of repairs; maintenance; elimination of defects during the turnaround time.

When reforming the organizational structure of the repair department it is necessary to take into account the following factors:

- technical level of the technological equipment and its corresponding level of basic and operating reliability;
- technical level of the maintenance system at an enterprise, technical infrastructure, personnel qualification, et al.;
- contents and structure of main functions of the specialized repair department.

Making the decision in relation to the degree of “freedom” of services must be preceded by economic calculations of reorganization variants and choice of technological specializations of repair departments.[6]

In order to select the technological specialization of the repair department it is necessary to evaluate every structural unit (workshop, section) according to the characteristics of the technological level and production potential and to refer to one of the matrix items, which should be made using the MCKinsey model (MCKinsey Model is a multifactor model for analyzing and determining the strategic positions of a certain business and its capabilities.) (Table 1).
Table 1. Matrix of preferences of directions of technological specialization.

| Production potential | High | Medium | Low |
|----------------------|------|--------|-----|
|                      | 1    | 2      | 3   |
| High                 |      |        |     |
| Medium               | 2    |        |     |
| Low                  | 3    |        |     |
| High Medium Low      |      |        |     |

When evaluating the technological level of production one should use the following characteristics: availability of the modern equipment; availability of necessary technologies; personnel qualification.

When evaluating the production potential one should use the following characteristics: production capacities; production area; possibility to increase the production capacity; availability of strong management; ability of the personnel to train, etc.

Typical decisions when choosing the direction of the technological specialization in accordance with the positions according to the matrix areas:

- **High production potential and low technological level** (area 1). The production is used for individual requirements of an enterprise in case if the technological level is enough for manufacturing the products and providing the services. It is possible to attract investments in order to increase the technological level for the purpose of transferring the department to areas 4 or 7 of the matrix;

- **Medium production potential and low technological level** (area 2). The production can be used for individual requirements of an enterprise, if the technological level and the production capacity are enough for manufacturing the products and providing the services. It is possible to gradually shut down the production and to employ third parties to perform this type of works;

- **Low production potential and low technological level** (area 3). The production is liquidated. If there is necessity in this type of works, then third parties are employed;

- **High production potential and medium technological level** (area 4). The production is used for individual requirements of an enterprise. Free production capacities can be used for executing the orders of third parties. It is possible to attract investments in order to increase the technological level for the purpose of transferring the department to the area 7 of the matrix;

- **Medium production potential and medium technological level** (area 5). The production is used for individual requirements of an enterprise, if the technological level and the production capacity are enough for manufacturing the products and providing the services;

- **Low production potential and medium technological level** (area 6). The production is liquidated. If there is necessity in this type of works, then third parties are employed;

- **High production potential and high technological level** (area 7). The production is used for individual requirements of an enterprise. Free production capacities can be used for executing the orders of third parties. Diversification;

- **Medium production potential and high technological level** (area 8). The production is used for individual requirements of an enterprise;

- **Low production potential and high technological level** (area 9). The production is used for individual requirements of an enterprise. When the production capacities are not enough, it is possible to increase the production potential by way of expanding the production areas as a result of liquidated production areas et al.
The structure of main functions with the purpose of efficient formation of the specialized structural unit is based on the development of necessary acts, provisions, methodics, instructions and other documents, which regulate the activities of the unit (Figure 4).

| COAL PRODUCING COMPANY |
|-------------------------|
| **1. Production arrangement** |
| 1.1 Standards of processes and personnel functions. |
| 1.2 Provision on scheduled preventive maintenance of mining and conveyour equipment (repair and maintenance). |
| 1.3 Creation of competence and its acquisition by the personnel. |
| 1.4 System of interaction and resource provision. |
| 1.5 Creation of optimal production chains in order to provide a technical service. |
| **2. Manufacturing of services/products** |
| 2.1 Production capacities and their utilization. |
| 2.2 Preparation of areas of maintenance, specialization of the production. |
| 2.3 Technology for recovering the consumer properties of mining machines. |
| 2.4 System for controlling the quality of a service and a product, processing the order in structural units. |
| **3. Production management** |
| 3.1 Management accounting (process and operational). |
| 3.2 Planning the current activities and development. |
| 3.3 System of economic relations of structural units. |
| 3.4 System of personnel motivation. |
| 3.5 Monitoring the system of management. |
| **4. Financial provision** |

**Figure 4.** Structure of main functions when transforming the repair department into a specialized structural unit.

The main method for the transformation of the repair department is the development of the efficient interaction between structural units on the basis of the technology of budget management, which allows to determine the target indicators, to establish limits for expenses in order to provide the required level of working capability of the mining and conveyour equipment, taking into account the economically reasonable cost of its maintenance.[7]

Generalizing the results of the research, it is important to note that in order to arrange the efficient interaction it is necessary: to clearly determine the area of mutual responsibility and obligations of department managers, the mechanism of economic control of results of activities, and, the most important, the concerted position of the top managers and specialists in structural units of a mining enterprise.

Transformational processes in the repair department, which are aimed at providing the competitiveness and investment potentials of mining enterprises, become not only a real necessity but also determine the actuality of resolving the issue of determining the optimal number of production units, level of their specialization and cooperation.

The creation of the in-house technical service at the mining enterprise will allow managers of the repair department to develop and to make decisions on the basis of analyzing the factors which influence the efficiency of the main production. It is achieved during the process of implementing the unified service policy of a coal producing company, which combines the capabilities of a manufacturer, a machine operator and departments of technical and production operation.
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