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Internal Client and Efficiency in the Mining Process

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Abstract. A sequence of intentional actions carried out within a fixed period of time by means of a specific set of machinery and equipment and with specific resources (materials, energy, human labour and financial and information resources) creates an industrial process. Sometimes the definition also includes the fact that industrial processes should be repeatable. An industrial process is often mistakenly classified as being synonymous with a production process. Many authors, including mining specialists, perceive the basic process in the mine without much consideration, as being a specific type of production process. The fundamental process in the mine (regardless of the method of mineral extraction) is not a production process owing to the lack of manufacturing processes within it, and the product research and development processes typical of manufacturing companies do not occur here, as the deposit - the natural accumulation of a particular mineral exists prior to the decision-making process regarding the start of the extraction. In the article, the authors analyse the efficiency of the extraction process from the perspective of processes within a mining company and working time efficiency and effectivity of longwall shearers. Presented are the current working diagrams of a longwall shearer and changes in its speed as shown in the E-mine reports, as well as changes in the shearers effectivity (working time with cutting) of the same longwall shearer in the time available (month) in one of one hard coal mines following the implementation of pro-efficiency adjustments. The authors indicate that the adoption of a process approach in hard coal mining has great potential for the improvement of the work efficiency of this equipment.

1. Introduction

The concept of the internal client emerged along with the popularization of the process approach to the management of organizations, including industrial enterprises, towards the end of the 20th century.

The concept of a process, currently defined in connection with economic activity, was originally only a very general idea: ***A process*** *is a sequence of events or activities connected by a common goal or effect* [1]. The development of the idea of a process approach to the management of industrial enterprises has resulted in many different, often divergent notions of processes implemented in enterprises [2]. For the purpose of this article, one of these definitions was adopted, as follows: ***A process*** *is a series (sequence) of logically ordered activities that results in a specific effect (result) of an action (product, service) used by the client (external or internal)* [1]. This definition includes an internal client and an external client.

The basic underlying premise of using the process approach to managing organizations is that [3]:

- Each organization (enterprise, institution) is a set of processes;
- The processes within an organization (enterprise, institution), overlap and intertwine;
- Identification allows for a better understanding of value creation in an enterprise;

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- Improvement and constant advancement of processes increase the efficiency of an organization, thus resulting in the satisfaction of both internal and external clients.

The use of a process approach to increase the efficiency of manufacturing enterprises and other organizations has resulted in practical benefits. It is therefore necessary to check: ***is there any potential to improve the efficiency in mining processes by introducing a process approach?*** One of the areas of analysis and the search for solutions should include observing costs and the cost of lost profits caused by the inappropriate organization of a mine's system of processes and the implementation of processes without taking into account the overriding purpose.

2. Processes in business organizations

The aforementioned definitions of a process have a wide range in terms of meaning. In enterprises, economic processes are performed, i.e. the constant repetition of a series of human activities based on the production of goods and providing services in order to meet human needs and to achieve set goals (e.g. to gain new markets, increase production) and thus to create added value as a surplus [4].

A sequence of intentional actions carried out within a fixed period of time by means of a specific set of machinery and equipment and with specific resources (materials, energy, human labour and financial and information resources) creates an industrial process [5]. Sometimes the definition also includes the fact that industrial processes should be repeatable [6]. An industrial process is often mistakenly classified as being synonymous with a production process [3]. A characteristic feature of a production process is the fact that manufacturing processes exist within it (both discrete and continuous - e.g. apparatus) as do the processes of product research and development. Today, there are economic processes possessing the characteristics of industrial processes, which at the same time are not industrial processes.

There is a significant compatibility of views with regard to the basic structure of processes performed within an enterprise, as shown in figure 1.

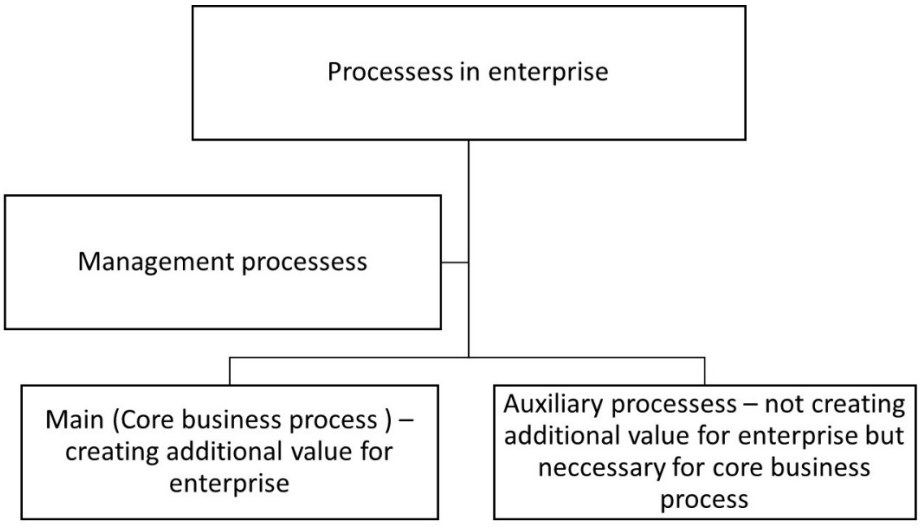

Figure 1. The general structure of processes in an enterprise according to I. Durlik [7].

Indication an enterprise or an industrial plant performs processes that are necessary for the purpose of the enterprise, but do not bring revenue from outside the company, makes it necessary to indicate the internal recipients of activities in this enterprise, i.e. internal clients. Of course, there are internal suppliers of tangible goods, information or services that do not bring revenue to the enterprise, but are necessary for the implementation of the basic fundamental process, the purpose of which is to meet the needs of the external client and obtain income that adds value, or is a surplus.

In addition, it must be noted that the purpose of the company's activity is to create, for the external client, a certain service for which the client is willing to pay. There are three basic types of economic utility:

- Utility of form – being the result of fundamental production process;
- Utility of place;
- Utility of time.

The two latter forms of utility are attributed to being the result of logistic processes.

3. Mining activity and production processes.

Focusing on the mining aspect of the fundamental process in a mine, that is the mining process (works), mining (exploitation works and transport), leads to the definition of the mining process as being:
Discharging a storage of minerals previously accumulated in natural processes and supplying this mineral to the user (external customer).

This definition shows that the basic process in a mine creates the external utility of place and time for the client - this process is therefore in this respect closer to logistic processes [6].

In each mine, processes are a complex series of actions, operations and activities performed for the implementation of a specific economic goal. When describing the system of processes carried out in each mine (regardless of the type of mineral extracted, the method and manner of extracting this mineral), it is necessary to include this system of processes in industrial economic processes [8, 9]. Owing to the scale, repeatability of processes and operations as well as the complex system of technical means, the processes in a mine form a system of industrial processes. An important element complicating this generalized model of the process network in a mine is the presence of people who must be assured the ability to get to their place of work, as well as ensuring their return, as well as appropriate living and working conditions.

Extraction process comprises the process of excavation and the transport of excavated material as a basic process requiring earlier measures in order to facilitate its implementation (diagnosis, design, access to the bed, and preparation it for use its designed manner) or implementation of fundamental actions (processes). The implementation of the basic (core business, main processes in the mine requires the reliable implementation of necessary activities related to the supply and maintenance of the socio-technical system of the mine – important group of existential processes.

The efficiency of the mining process consists of the relationship between the effect and the resources consumed in the process (figure 2). There was an idea in the recent past, of designing and instituting highly efficient walls – faces. This, however, did not mean that the plant - the mine in which such a wall was exploited, would automatically become efficient. This was determined by the total commitment of resources in the settlement period in all activities carried out in this mine that would create a network of processes for itself.

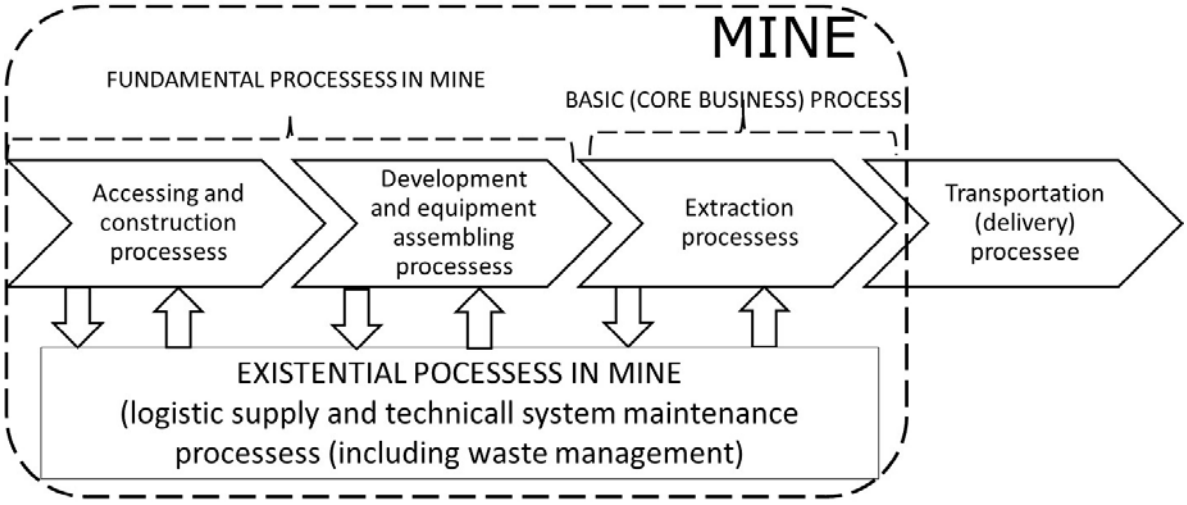

Figure 2. The structure of processes conditioning the implementation of the basic process [Individual study]

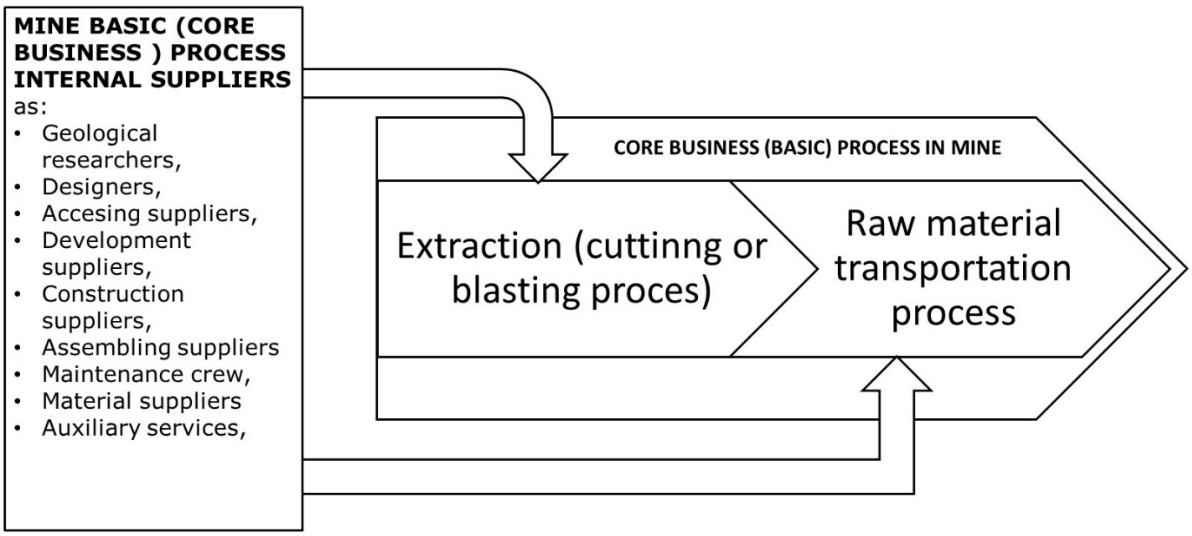

Figure 3. Internal clients and external suppliers in the mining process [individual study].

The producers of the mining process are the internal clients of other processes produced within a mine (figure 3), whose results (quantity, quality and time) may significantly influence the efficiency of the mining processes.

4. Potential to improve efficiency as a result of adopting a process approach in hard coal mining

The productivity of a mining wall is, in a sense, the product of the technical potential of equipment and the degree to which this potential is utilized within existing conditions and constraints. The existence of a large potential for improvement in efficiency in hard coal mining through the use of a process approach is indicated by both long-term analyses of the results obtained by this industry and a random analysis of

records of machine and equipment monitoring systems as developed as part of the FAMUR S.A. E-mine system or similar systems from other manufacturers.

The information made available in the graphs developed as part of FAMUR S.A. E-mine system of workplaces of the longwall shearer can be used to indicate other areas of potential improvement in the efficiency of the mining process (figure 4).

The information from the mine that was analysed showed there was a need to limit the speed of mining with a longwall shearer, owing to the possibility of methane poisoning. At the same time, a lot of available time of the mining machine was lost for technical shutdowns connected with the transfer of the reverse drive of the longwall conveyor due to:

- Improper design of the intersection wall-ventilation shaft (internal supplier);
- Incorrect execution of the ventilation shaft;
- Leaving unnecessary elements and equipment, as well as the spoil after drilling the ventilation shaft.

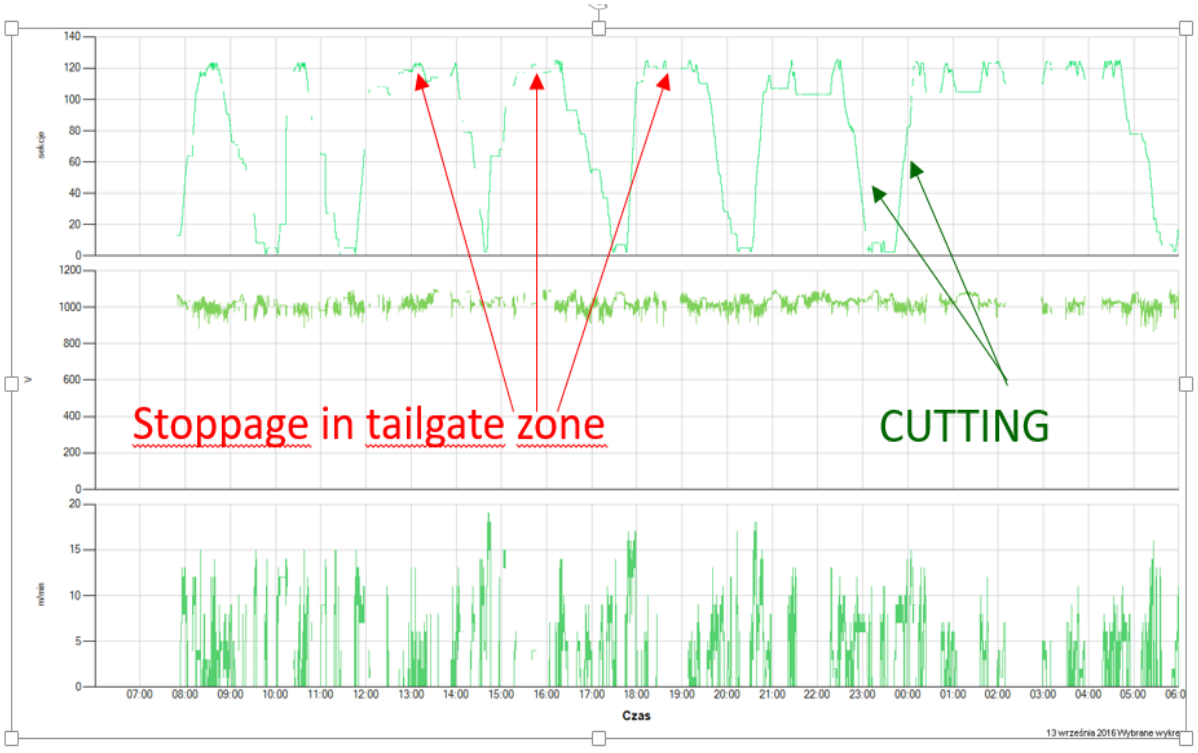

Figure 4. Screen shot showing actual charts of longwall shearer workflow and speed changes in the E-mine system report [Individual study basic on data FAMUR S.A.]

All the reasons for the excessive duration of breaks in the mining process related to the transfer of the reverse drive of the longwall conveyor resulted from transferring workers to the wall - one of the internal customer services of improper quality. Similarly, brigades drilling this ventilation walkway did not receive, as internal customers, a properly prepared drill project and specific tasks needing to be performed. In this case, a quantitative settlement of the pavement's progress was taken into account without considering the needs of the internal client - the user of the pavement. This situation allows us to assume that the information flow system is also not working properly. The system should integrate internal clients and all stakeholders of this process, in order for it to be optimally executed.

This example does not show the model of the deterioration of the mining process efficiency owing to the incorrect quantity or quality of the material or service provided resulting in an increase in the cost or productivity reduction of the mining wall (e.g. daily extraction), which results in a deterioration of the efficiency of the process.

To users of longwall coal shearers, FAMUR S.A. provides reports on the daily and monthly use of these machines based on data from the E-mine system. Figure 5 shows a practical example of how removing the "defects" the internal client received as a result of preceding processes or operational sub-processes can improve the efficiency of the fundamental coal mining process in a fully mechanized wall in one hard coal mine. As shown in figure 5 - the report from 2017, as a result of the activities described in comparison with the report from 2016 using the same longwall shearer, significant elongation in the same wall was the time of effective work (mining) of a longwall shearer, which confirms and justifies the thesis set out in this article.

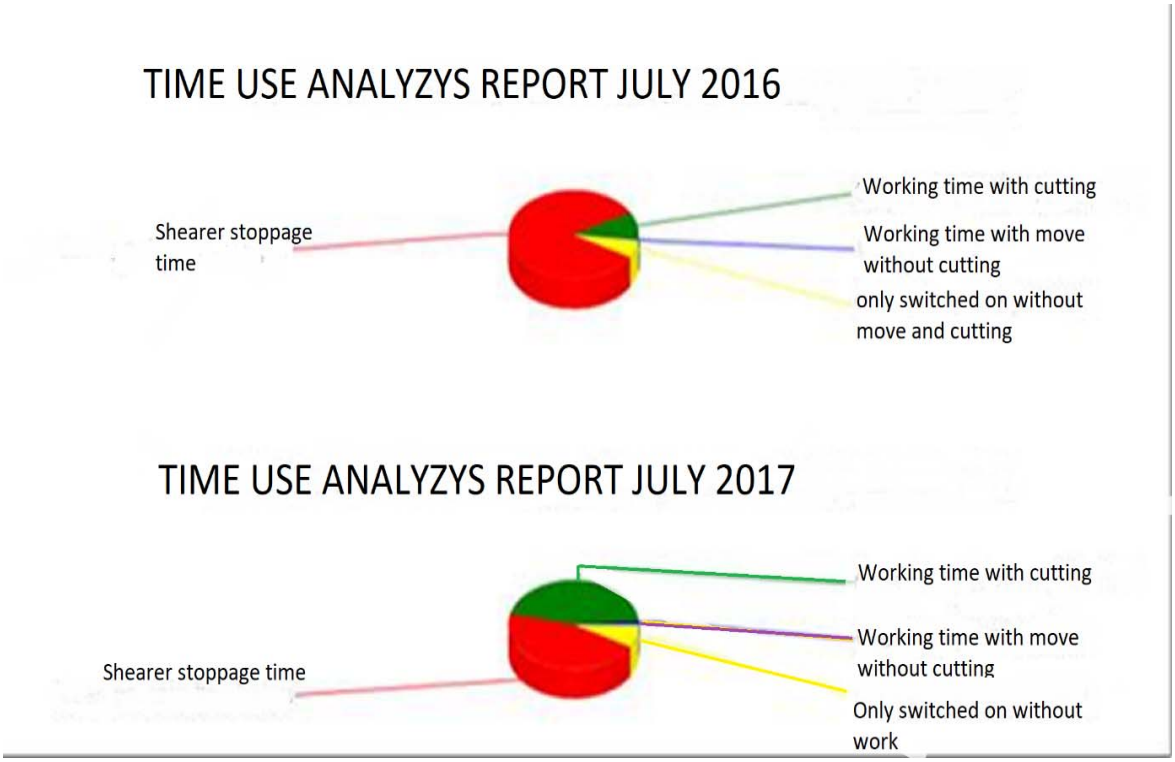

Figure 5. Change in the share of effective working time (working time in recessing) of the same longwall shearer at the available time (month) in one of the hard coal mines analyzed [Individual study basic on data FAMUR S.A.]

In the example discussed in figure 5, conclusions were drawn from the exploitation of the wall in 2016 and owing to the low use of the same key machine - the longwall shearer. The reasons eliminated included the low quality of the previous internal processes such as planning, the preparatory works process and the processes of powering and maintaining the longwall system. At the same time, it should be emphasized that the reports shown in figure 5 refer to the same shearer used in the same mining and geological conditions.

5. Conclusions

Recognizing the role of the internal supplier of material goods or services in meeting the needs and creating conditions for the implementation of other further recipients or internal clients – producers of subsequent activities (processes, operations, activities) in the mega-process implemented of each mine may be a way to improve the efficiency of this process. In summary, the following conclusions can be made:

1) there are potential reserves leading towards an improvement in efficiency, including cost efficiency by implementing a process approach,

2) recognizing the importance and responsibility of internal suppliers and customers in a mine should be a source leading to the improvement in the efficiency of the mineral extraction process,
3) the process approach should contribute to the improvement of the efficiency of the mine processes system,
4) a necessary condition is the identification of the system of mine processes as well as internal suppliers and customers,
5) the benefits of the implementation of a process approach is the elimination of contradictions, conflicts and lost profits caused by the improper organization of the process system and the implementation of processes without taking into account the fundamental purpose.

Adopting an ability to perceive an organization through its process forces its members to look at their own activities from a different perspective - they begin to understand that they are part of one large process, at the beginning of which are the client's expectations, and concluding with the fulfilment of this process. People are beginning to notice and pay attention to the fact that they are part of this process – this is also a potential source of intangible motivation for employees, which can translate into greater work efficiency.

By employing a process approach and owing to the adoption of the concept of the internal client, the perception of the processes involved, changes - from the perspective of a single workstation, to one in which all the processes preceding it in a given stage of an operation become suppliers for whom clear expectations need to be formulated and for whom feedback needs to be provided with regard to the level of services provided. Stages following a particular process should, therefore, be treated as customers or recipients, whose needs also need to be fulfilled and satisfied. Employing such an approach in hard coal mines should contribute to a significant improvement of efficiency without excessive expenditure, including investment, in a similar way as is implemented with regards to other human resource management tools which are often overlooked and underestimated. A reliable analysis of a mine's system of processes and full identification of contradictions, conflicts and lost benefits and their elimination or reduction represents an enormous potential for improving the efficiency of hard coal mines. Objective factors, e.g. in the form of mining and geological conditions do not exclude the possibility of improving efficiency without compromising safety.

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