

APPLICABILITY OF AN EFFICIENT INFORMATION SYSTEM IN AN INDUSTRIAL ORGANIZATION IN THE FIELD OF NONCONVENTIONAL TECHNOLOGIES

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ABSTRACT: The paper deals with the presentation of the role of the information system in the process of dimensional processing by electrical erosion. The main issues addressed are the analysis of the conditions that must be met by the electrical erosion processing system in order for the impulse discharges to achieve the removal of material at the surface of the object. Aspects regarding the perspectives of electrical erosion processing from a managerial point of view, the factors that influence these processes as well as methods for perfecting and improving these systems are presented.
KEYWORDS: information system, electrical erosion, processing technology.

1. INTRODUCTION

Concentrated energy processing technology that removes excess material from the surface of the object is also referred to in the specific literature as "Dimensional processing by electrical erosion". This technology is based on electric impulse discharges that have as effects the phenomena of complex, localized, discontinuous erosion, primed repeatedly between the surface of the processed object and an electrode. This energy transfer between the two components is performed in the situations of observing the physical conditions regarding the accomplishment of the discharges as well as of the locations of their effects corroborated with the assurance of the continuity of the erosive process. Among the technological advantages of this method of dimensional processing by electrical erosion we mention mainly the fact that the restrictions imposed by the processing by cutting are eliminated. The cutting method generally has a low economic efficiency in the scenario where there is a high hardness of the object to be processed, thus allowing the appearance of difficulties in generating the surface and the probability of having a low rigidity of one of the elements of the technological system. In this context, the overall realization of the processing is completed by the pulse generation of the power supply simultaneously with the repetition of the processing with concentrated energies to remove the surplus material at the surface of the processed object. The main stages of impulse electric discharge are non-stationary electric arc discharge and spark discharge. These stages are carried out temporarily at the end of the unloading period and have an estimated own duration of 0.1ms. In this way, this technology of processing by electrical erosion becomes an alternative - complementary technology, the erosive effect of electrical discharges in the impulse and the location of these effects being achieved by the existence of the two electrically conductive bodies: very small thickness, also called erosive gap. This space serves to separate the two bodies and is filled with dielectric - electrical insulation. The electric discharge occurs between the two bodies when they are subjected to a potential deference large enough to be able to penetrate through the interstitial space between the two bodies. By means of this phenomenon, a small amount of material is removed from the surface of the two interacting bodies. [1]

The conditions that must be met by the electrical erosion processing system in order for the impulse discharges to be able to remove the material from the surface of the object are:

A. the injection of electricity into the erosive interstice must be carried out directly,

B. temporary dosing of impulse electricity,

C. the impulse electric discharges must have a permanent polarized character,

D. the initial state in the erosive interstice must be restored continuously.

A. The process of injecting electricity into the erosive gap must be carried out directly, in order to meet these conditions, the electrode and the object to be processed must have electro conductive properties or these characteristics must be imprinted on these objects during processing.

B. The temporary dosing of the electrical energy in impulse, is conditioned by the location of the action of the effect energy in the area of interaction of the object to be processed with that of the electrode and the erosive agent. The realization of this process produces the effect two objects. During this process, following the continuous dosing of electricity occurs the thermal effect that propagates throughout the volume of the object to be processed. In order to limit the thermal effect the duration of the electric discharges in the pulse will have values below 0.1 seconds. This limitation of the duration of the electrical discharges in the pulse is implemented by the pulse generator or by the breaking with relative movements between the two objects in interaction of the electrical microcontacts. In this context, the duration of the break between pulses must be longer than the time required for deionization of the discharge bridge and then the duration of the transient electrical processes should be determined by the inductive or capacitive nature of the supply circuit.

C. The impulse electric discharges must have a permanent polarized character, and the elementary mechanisms lead actions through which material removal processes are implemented from the electrode surface (electrode volume wear) as well as to the surface of the processing object (process productivity). For the process control measures can be mentioned those of connecting the object of processing and the electrode to appropriate polarities, the material of which the electrode is made must have high erosive resistance and it is necessary to form on these surfaces protective films of high resistance. In this sense, an important role is played by the pulse generator through which the optimal electrical connection will be made, also ensuring the regulation of an energy regime that would favor the formation of protective films. [6]

D. The initial state in the erosive interstice must be continuously restored, having met the necessary conditions for all discharges that are active in the erosive interstice. The main actions necessary to be carried out to restore the general condition of the erosive intestine are the best possible evacuation of the erosion products formed and accumulated in the interstice from the previous electric discharges. In order to restore the erosive interstice from a dimensional point of view, it is necessary to implement a process of removal in successive layers on the surface of the two interaction objects. In order to maintain the gap, it is necessary to develop an automatic control system that acts as a sub-system in the technological system of electrical erosion processing. [2]

2. PERSPECTIVES OF THE ELECTRICAL EROSION TECHNOLOGIES FROM THE MANAGEMENT POINT OF VIEW

Social practical needs have determined the emergence in our century of a new science that specialists call management. In this context, the French publication La Rousse defined management as "The science of business management techniques", and the Russian scientists Popova and Krasnopoiasa defined this science as the one that deals with the laws of general management. Management processes and relationships are the defining elements of the science of economic management and should not be confused with economic processes and relationships, which have a completely different content. A major role in the science of management has the design of new methods, technical management procedures in organizations, while having a major application. The methodological elements of this science represent the tools made available to relations and management processes in order to streamline the activities of the organization. In this sense, a defining feature of this science of organization management is the position in a central position of man as a subject and as an object of management through close interdependence with the means and objectives of the systems in which it is integrated.

In this context, the design of new management methods, technologies, systems and procedures plays an important role in this science whose applicative role is decisive. Thus, from the analysis of processes and management relationships, we can conclude that increasing the efficiency of organizations is a result of the existence of a multidisciplinary character of applied managerial knowledge. Within organizations where technologies for processing metal materials by electrical erosion are applied, management processes have the main components that represent the attributes or functions of management - organization, forecasting, coordination, evaluation and control. These attributions are in fact the typical content of the management processes that we find in all socio-economic systems, including organizations, independent of their characteristics.

The functions or attributes of management are its essence and their knowledge and understanding is an important premise for the acquisition and efficient use of technologies, methods and systems that are its own. In this context, the management process can be divided into five functions: forecasting, organization, coordination, training and evaluation - control. [3]

Forecasting is the process of establishing the main objectives of the organization, the means and resources needed to achieve them.

The organization represents the cumulation of processes necessary to be carried out in order to achieve the assumed objectives. Coordination is characterized by a cumulation of work processes through which the decisions and actions of the organization's staff are synchronized in order to make predictions within the organizational system described above. The training is characterized by the totality of the work processes through which the previously established objectives are achieved, based on the motivational factors presented in fig 1.

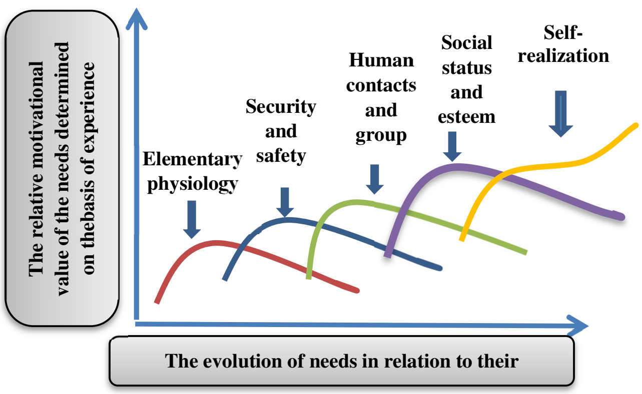

Figure 1. Maslow's motivational scale

Monitoring and evaluation is the totality of the processes regarding the performance of the organization that are analyzed and compared in relation to the previously established objectives. At the same time, the elimination of the deficiencies appeared and the integration of the positive deviations are highlighted.

The clear vision and a solid management policy of an organization with activity in the field of metal materials processing by electrical erosion are the foundation of a strong quality culture. At the same time, the implementation of clear processes, responsibilities and monitoring to ensure both quality and efficiency are the main objectives in terms of ensuring a quality management system in these organizations.

"Product quality is not everything, but everything is nothing without quality." (Robert Waterman, 1982). The ISO8402: 1995 standard defines quality as "the set of characteristics of an entity, which gives it the ability to meet expressed or implied needs" (ISO, 1994).

Quality management is defined as the totality of activities necessary to achieve the proposed objectives through the optimal use of resources. [4]

In this regard, the organization requires active in the field of processing of metallic materials by electrical erosion and proposes a series of strategic objectives ": technical, social, economic and commercial, which can be achieved through" operational objectives ".

In accordance with the definitions given in the literature, we can appreciate the following characteristics of the quality management system that are presented in Figure 2.

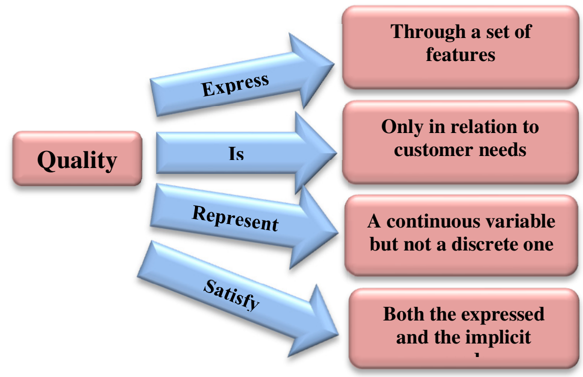

Figure 2. Quality management system

These operational objectives could be: obtaining in conditions of appropriate quality the products by the technology of processing metallic materials by electrical erosion, in the required quantity, in the agreed time interval and to be made available to the consumer at the desired time and place, however, under conditions of costs minimum production.

The implementation of a quality management system in such an organization implies the following advantages, obvious, both for customers and for the organization that provides products processed by their electrical erosion technology.

Figure 3. Quality management activities

Regarding the certification of the organization, the advantage of purchasing products and services from ISO-certified suppliers should be emphasized, customers knowing that it rigorously controls all the processes within the organization. At the same time, the existence of the certification guarantees that the operation of the organization that applies dimensional processing technologies by electrical erosion is done in a quality management system, which is also a valuable marketing tool.

3. TECHNOLOGICAL PRINCIPLES OF PROCESSING THROUGH ELECTRIC EROSION - ELECTRICAL EROSION AS A SYSTEM OF TECHNOLOGICAL ACTION

Machining by electrical erosion can be compared to a technological action system being also a method or method of dimensional processing of metallic materials.

This technological process implies the existence of three categories of factors: primary, intermediate and final factors, represented in figure 4.

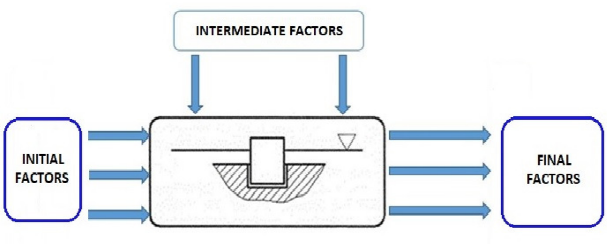

Figure 4. Electrical erosion as a system of technological action

Processing by electrical erosion technology is a dimensional processing of metallic materials that can be assimilated to a system of technological action. In this context we can define three categories of factors that influence this process:

a. the primary factors (input dimensions) that characterize the actions of the environment on the system and are represented by influencing factors or independent variables,

b. the intermediate factors (process dimensions) that characterize the transformation during the process,

c. the final factors (output dimensions) that characterize the technical and technological parameters.

The primary factors in the process of dimensional processing by electrical erosion with massive electrode can be classified as follows: (fig. 5)

The primary factors coming from the technological equipment are:

A. The parameters of the voltage and current pulses are:

- Idle voltage, that is the voltage applied by the generator to the working space,

- Discharge voltage, that is the constant value of the voltage during the application of the current pulse,

- Current pulse amplitude,

- The priming time which is the time between the moment when the voltage pulse is applied and until the moment when the current pulse occurs,

- Voltage pulse duration,

- Current pulse duration,

- Duration of the pause between voltage pulses,

- Duration of the pause between current pulses,

- Period of impulses.

B. The control parameters ordered are:

- The parameters commanded by the pulse generator,

- The parameters controlled by the automatic feed adjustment system, having the role of keeping the gap constant throughout the processing time interval.

C. Programmed characteristics of the equipment are those of actuation of the tool electrode (the automatic advance movement which can be linear or circular), those of circulation of the working environment.

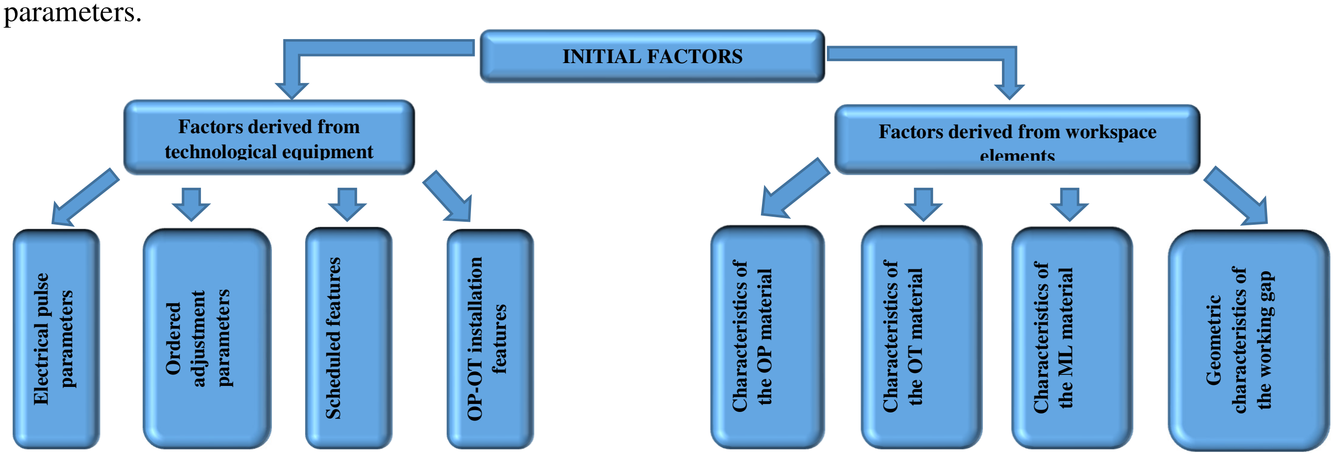

Figure 5. The primary factors of the electrical erosion processing process

D. The installation characteristics of the electrode-tool processing object - have a direct and significant contribution to the dimensional accuracy of the object to be processed.

The primary factors coming from the elements of the workspace are:

A. The characteristics of the object to be processed and those of the electrode-tool material

B. Characteristics of the working environment

C. Geometric characteristics of the working gap

The intermediate factors of the dimensional processing process by electrical erosion are:

A. The electrical energy of the current pulse:

WI = η (WiP + WiB + WiM)

where WiP, WiB, WiM represent the energies of the pulses received by the object of transfer, processing and working environment. [5]

B. The volume of material taken from the object to be processed by an impulse

C. The volume of material taken from the transfer object by an impulse.

Percentage formulas of quantities characteristic of electrical erosion

No.	NAME	MATH FORMULA	OBSERVATIONS
1.	Pulse percentage W_{iP} (%)	$W_{iM}=W_P/W_i$	Because pulses cause decomposition of some organic substances in the working environment, the volumes of solid, gaseous or liquid waste from the pyrolysis process are of particular interest, gaseous or liquid, from the pyrolysis process, are of particular interest.
2.	Percentage of impulse energy W_{iE} (%)	$W_{iB}=W_B/W_i$	
3.	Percentage of impulse energy W_{iM} (%)	$W_{iM}=W_M/W_i$	
4.	The volume of material taken from the object to be processed by an impulse v_p (mm^3)	-	
5.	The volume of material taken from the transfer object by an impulse, v_E (mm^3)	-	

Different types of downloads and their average relative percentages

No.	NAME	MATH FORMULA	OBSERVATIONS
1.	Percentage of empty discharges, P_0 (%)	$P_0=N_0/N$	The variables N0, Nf, Nk, Ng, Nm represents the number of downloads for each category, and N represents the total number of downloads.
2.	Percentage of short-circuit discharges, P_k (%)	$P_k = N_k/N$	
3.	Percentage of fictitious discharges, Pf (%)	$P_f = N_f/N$	
4.	Percentage of gas discharges, P_g (%)	$P_g = N_g/N$	
5.	Percentage of shredded discharges, P_m (%)	$P_m = N_m/N$	

The final factors of the dimensional processing process by electrical erosion are presented in figure 6:

A. Productivity characteristics: Qp = Vp / Tp where Qp represents the processing productivity, Vp the volume of material removed from the object to be processed, and Tp the processing time.

B. Dimensional accuracy characteristics, represented by deviations of different sizes.

C. The quality characteristics of the processed surface which represent its microgeometry and the properties of the surface layer. [6]

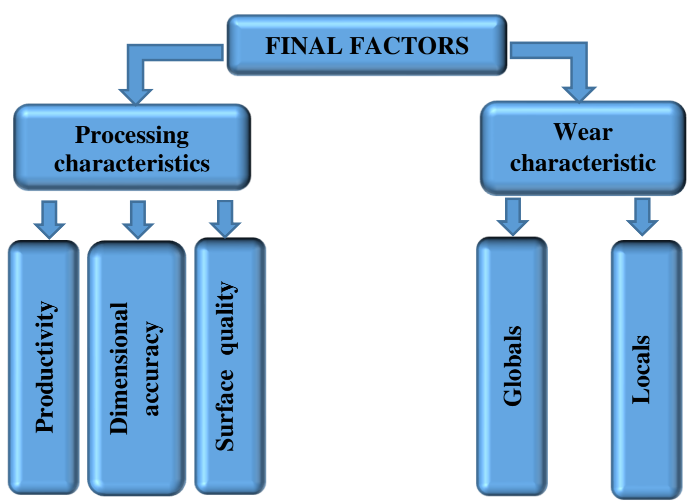

Figure 6. The final factors of the electrical erosion processing process

4. THE IMPORTANCE OF THE INFORMATION SYSTEM AND ITS ROLE IN AN ORGANIZATION IN WHICH THE DIMENSIONAL PROCESS OF ELECTRIC EROSION IS USED

An information system can be defined as the set of elements involved in the process of collecting, transmitting, processing information, the information having its central role in the system. By information system we mean the set of material and financial resources that use information technologies to collect, process, store, retrieve, transmit and view information used in processes that take place within the perimeter of an organization.

Within the information system are present: information circulated, documents carrying information, staff, means of communication, information processing systems (usually, automatic), etc. Among the possible activities carried out within this system, can be listed: the acquisition of information from the basic system, the completion of documents and their transfer between different departments, the centralization of data, etc.

In the broadest sense, an information system refers to the various interactions between people, processes, data and technologies; thus, the term does not only refer to the aspects related to ICT (Information and Communication Technology) that an organization uses, but also to the way in which people interact with technology in order to provide support for business processes. The information system represents a set of information flows and circuits organized in a unitary conception (Fig. 7).

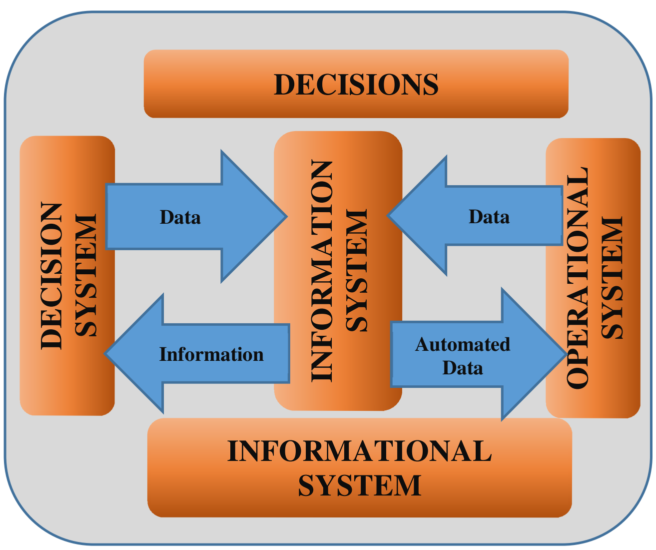

Figure 7. The position of the information system within the informational system

The decision-making system consists of all specialists who, through specific methods and techniques, forecast and plan, decide, organize, coordinate, monitor and control the operation of the operational system, in order to meet the objectives, set.

The operational system represents the set of human, material and financial resources as well as the entire organizational, technical and functional set, which ensures the effective achievement of the objectives set by the decisions transmitted by the decision-making system.

The information system comprises all the information, flows and information circuits, as well as all the means, methods and techniques, which ensure the processing of the data necessary for the decision-making system. It provides the link between the decision-making system and the operational system in two ways:

a) By processing and transmitting decisions from the decision-making system to the operational system;

b) By recording, processing and transmitting information from the operational system to the decision-making system.

In any field of economic or social activity, there is an information flow on the basis of which any activity is carried out. At the level of an economic agent, the information system ensures the connection between the decisional and the operational system (management system and execution system); thus, the functioning of the information system involves the development of the following activities:

- data entry on the operating system,
- data processing in order to ensure useful information in the decision-making process,
- obtaining the requested information, in order to then take decisions which will be transmitted to the operational system,
- carrying out the control and monitoring the observance of the decisions.

The automation of processes at organizational level focuses on five main areas: strategic alignment, value delivery, risk management, resource management and performance measurement:

a) Strategic alignment focuses on ensuring the link between economic processes and IT plans, defining, maintaining and validating the value proposed to be achieved through the use of IT;

b) The supply of value focuses on obtaining value throughout the life cycle of the information system, ensuring that it offers the promised advantages in accordance with the adopted strategy;

c) Resource management considers the optimization of investments and the proper management of critical IT resources: applications, information, infrastructure and human resources. The main aspects aim at optimizing knowledge and infrastructure; [7]

d) Risk management implies the degree of awareness of risks by management, a clear understanding of the company's appetite for risk, understanding of compliance requirements, transparency regarding risks;

e) Performance measurement tracks and monitors strategy implementation, project completion, resource use, process performance and service delivery, using, for example, aggregate indicator charts, which translate strategy into action to achieve measurable objectives beyond conventional accounting.

The improvement of the dimensional processing systems by electrical erosion is conditioned both by the appearance of new materials with special properties, and by the performances of the information systems that control the erosion processes.

In this context, one of the major advantages of these technologies is the constant reliability of EDM machines (Electrical Discharge Machining) doubled by the implementation of the information system with the role of controlling from a computer point of view all the technological parameters of the electrical erosion process.

Thus, the computer-generated programs and the fact that the electrode is constantly fed from the coil (the electrode wire is used only once) leads to a higher quality of the machined parts, the first part being identical to the last. Another advantage of implementing software in the process of electrical erosion is the elimination of tool wear from conventional machines. In addition, very low tolerances can be maintained at no additional cost. Through wire EDM technology, any material that has electrical conductivity can generally be cut. The computerized power supply system offers efficient and stable processing technology to provide excellent processing speed, a constant discharge density and a high-quality finish. Thus, the surface quality resulting from the standard wire EDM process often eliminates the need for finishing operations.

5. CONCLUSIONS

The advantages of using the electrical erosion technology to produce three-dimensional shapes that could be difficult to produce using conventional processing processes. It should be noted that one of the advantages of using this technology is that tolerances of about 0.005 can be achieved, that complex and difficult shapes can be produced that cannot be produced by conventional methods. Another advantage is that very delicate parts can be processed in this way, because, since the electrode does not come into contact with the workpiece, no cutting forces are produced that could affect the finished product.

However, an important limitation of the use the electrical erosion technology is that it can only be applied to the processing of conductive materials and, in addition, the processing costs are higher than typical conventional processes, such as milling or turning.

In this context, using the electrical erosion technologies, the highest precision requirements can be achieved and these methods can be applied to the finishing as well as to the processing necessary for superfinishing. By correlating these qualities of electrical erosion processing technologies, the parameters such as size, shape, position and precision can be achieved thus respecting the highest requirements in fields such as micro processing and nanotechnology.

It should also be noted that the future development of these technologies is directly influenced by the evolution of information systems and applications needed to control and streamline these electrical erosion processes.

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