Technical University of Varna Annual Journal
DOI: 10.29114/ajtuv.vol2.iss1.70
Vol 2 Issue 1 (2018)
Published: 2018-06-30
ISSN 2603-316X (Online)

Analysis of the possibilities and limitations of the system man-machine in the manufacturing

Kiril Yankov Kirov[1]

[1] – Technical University of Varna, Department of Mechanical Engineering and Machine Tools, 9010, 1 Studentska Street, Varna, Bulgaria

Corresponding author contact: kirov@tu-varna.bg

Abstract. *Presented in this article are the author's research on opportunities and restrictions arising from the current level of production equipment and the possibilities of the human operator. The studies are realized on the basis of consultation experience in respect the problems of achieving quality in manufacturing. The classification is proposed on the base of system "man-machine". Restraint factors are reviewed. Relational to the modern concepts of sustainable development, recommendations are presented to achieve quality in the production process and the preservation of knowledge in the organization.*

Keywords: Sustainable development, "Man-Machine" Systems, Quality, Organizational Knowledge

1 Introduction

Today's economy requires extreme fast readjustment of industrial structures to a new production. The needs and the criteria determining the adequacy of personnel and used technologies are also changing dynamically in time. Meeting the needs requires knowledge of the current production and educational technologies, as well as readiness for their implementation in the actual training of specialists. If we add the effects of globalization and the need arises to possess modern communication skills necessary for their quick integration and prosperity in terms of international teams and modern manufacturing environment. All of these requirements, it is desirable to implement in relatively limited resources. Therefore, a fundamental for the success of any organization is its ability to manage the effectiveness and efficiency of the production process, as well as its ability to quickly adapt to the needs of the modern economy.

Any organization is possible to achieve efficiency and effectiveness only when an adequate management of the status of each one of the processes are forming, managing and supporting the creation of its products. The processes must possess the ability to change, in concert with one another in a dynamic environment of constant change. Everything mentioned above, plus the risk to achieve the planned results, require very careful management of the processes and their ability to produce the required product.

The desired competitiveness in contemporary level of automation of production facilities requires extremely high competence of the professionals involved. Competence, determining the ability of professionals to communicate with production equipment for the purpose of designing, programming, management, monitoring and analysis of the results achieved. Man and machine's ability to "understand" and carry out the necessary activities in the planned way, largely become critical for competitive ability of production structures. Analysis and identification of opportunities, as well as the restrictions on the system "man-machine" are important for future research to improve the quality and performance achieved by the production structures.

2 Process. Types of systems "man-machine"

If we compare the modern theory and practice of the management of the manufacturing establishments, will mention substantial discrepancy between the approaches used in classification and management. In the theoretical approach has seen deepening concerns over separation and specificity in

Technical University of Varna
Annual Journal
DOI: 10.29114/ajtuv.vol2.iss1.70
Vol 2 Issue 1 (2018)
Published: 2018-06-30
ISSN 2603-316X (Online)

the models and approaches of management depending on the branch of industry, while modern standard models is achieved appropriate unification on management in various industries, including on the various aspects of management (e.g.: quality and environment). Modern standards of management, define the mutual approach for building control systems (ISO/IEC Directives, 2016), defined as HLS (High Level Structure). For seemingly unrelated areas, regardless of the standard and its aspect of quality management, environment (ISO 9001, 2015; ISO 9000,2015; ISO 9004, 2009; ISO14001, 2015); health and safety (ISO 45001,2015), efficient use of energy management (ISO 50001, 2015), corruption (ISO 37001), etc., have the same structure and comparable requirements. Basis element to achieve a unified approach is the notion of "process". Management systems are built of interacting processes, subject to analysis, management and improvement. Under the concept of the process means „set of interrelated activities that use inputs to deliver an intended result" (ISO 9000,2015).

The concept of system "man- machine" has been introduced relatively long time ago. The introduction of automation in the XX century played a significant role in the development of research in this direction. The initial direction of the study of the phenomenon of "man-machine" is oriented to the analysis of various aspects of the interaction of man and machine in various technical systems. The actuality of the problem is determined by its applied importance. Research is oriented towards the role of the person (man), as an operator of technical systems on achieving their purpose. The efforts are primarily focused on theoretical modeling of information processing and its modeling; study of the behavior of the human operator; theoretical study of the decision-making process, through modeling and analysis for utility (Розенталь, 1964; Шеридан, 1980; Groover, 2007; Гараедаги, 2010).

In the late XX and early XXI centuries, computer control of machines entered very dynamically and causes a revolution in the production environment and the role of the person in the manufacturing. Modern information technologies have created conditions for widespread and their successful penetration within the automation of production processes and management of organizations. These trends have a necessary and meaningful change within our understanding of managing of the production processes. It is obvious that in the implementation of various activities, in accordance with the level of automation, man and machine play different roles in the achievement of the objectives of the concrete processes. Taking into account the current opportunities to build production systems and the differences in the abilities of the two basic elements of the system "man" and "machine" is not appropriate to focus our attention only on the modeling of one or another of them. The changes in technological capabilities, as well as the significant differences in management of the production, depending on the role of the person in the system "man - machine", impose the introduction of classification processes, with the aim of achieve the choice of adequate approaches for achieving sustainable management and development of the organization.

In the philosophical sense of the term "machine" means a „means of production". If we try to compare the means of production and process the elements under consideration are the raw materials, the facilities, tools and machinery used in the production of goods. The concept of raw material usually is presented as an input in the process that is why it is desirable to exclude it from the classification criteria. The desire to concentrate attention on "man- machine" system determines that the active components remain tool and machine. The main difference between the concepts of tool and machine are contained, although this is not specific and uniquely possible to argue, is the term technology. Technology can be the knowledge of techniques, processes, and the like, or it can be embedded in machines to allow for operation without detailed knowledge of their workings (Kirov, 2013). If you introduce the role of man, machine and tool in an expanded system defines the ability to separate the processor of the knowledge.

On the basis of the reasoning, it is possible to propose the following classification of manufacturing processes depending on the role of the man and/or machinery for their implementation. The classification is presented in Table 1

Technical University of Varna
Annual Journal
DOI: 10.29114/ajtuv.vol2.iss1.70
Vol 2 Issue 1 (2018)
Published: 2018-06-30
ISSN 2603-316X (Online)

Table 1. Setting Word's margins.

Type System	Man	Tool	Machine
A	**Y**	**No**	**No**
B	**Y**	**Y**	**No**
C	**Y**	**Y**	**Y**
D	**Y**	**Y**	**Y**
E	**No**	**Y**	**Y**
F	**No**	**No**	**Y**

Let's mark with Y (Yes) involvement or with No - the non-participation of the item in the system "man-machine". The system has three main elements: man, machine and tool. Two of them are active: man and machine, and one is a passive - tool. The tool represents the abstraction which defines technology and through which a specific process is carried out and who has a private role in the process.

After the introduction of automation in machines it is possible to affirm that the technology or knowledge "know how" is possible to be in the two active elements of the system, i.e. the "man" and "machine". In the table, the bearer of the process technology is reflected by coloring the active item. If you sort out possible options according to the evolution of human knowledge and automation of machines will get six system types "man-machine", the description of each is as follows:

- **Type A** – a system that has only one active element, this is "the man". The man embeds the technology, and without a tool on the basis of their abilities and knowledge realizes the transformation process. In this case, the man playing also the role of the passive element "tool";
- **Type B** – a system that has an active element "man" and a passive element "tool". The man embeds the technology and he through the use of a particular instrument, on the basis of their abilities and knowledge, implements the transformation process;
- **Type C** – a system that has two active elements "man" and "machine", as well as a passive "tool". In the present case, however, the embedded element of the technology is human. He uses a specific technology for the implementation of the transformation using all three elements of the system. In this case, the machine plays an ancillary role or speed up the process;
- **Type D** – in this case we have again all active elements, similar to the type C difference appears in embedded active element of the technology. In this case, the active element is "machine". The man is not able to fulfill the process without a "machine" and he plays an ancillary or ruling role;
- **Type E** - system that has an active "machine" and a passive element "tool". In the machine is implemented the technology and it through the use of a particular instrument, on the basis of formalized knowledge of technology and sensitive capabilities, realize the transformation process. The man does not perform the role in the process, i.e. it is a passive participant. It may be an observer or initiator.
- **Type F** - system that has only one active element, this is a "machine". In the machine is implemented the technology, and without additional tool on the basis of its abilities and formalized information knowledge realizes the transformation process. In this case, the machine plays the role of the passive element "tool". The man is passive and can be only observer.

3 Restraint factors. Impact on the capacity of the system "man-machine".

The main restraint factors in the development of system "man-machine" is rooted in its non-homogeneous, it appears to be a form of union between nature living and machines. The development of modern information processing technologies giving us opportunities to create machines, with automated control, exceeding the potentiality of living organisms. If we try to compare the two active ele-

Technical University of Varna Annual Journal
DOI: 10.29114/ajtuv.vol2.iss1.70
Vol 2 Issue 1 (2018)
Published: 2018-06-30
ISSN 2603-316X (Online)

ments in the system, we find the main restraint factors of development and achieving the needed capacity (Kirov, 2013).

1. The main advantage of the element "man" is its ability to formalize the information acquired through the realization of certain processes and on the basis of her creative interpretation to build up knowledge of a higher level, allowing him to improve their knowledge about the process and its management.
2. Its main disadvantages are associated with the speed of absorption and transmission of information (training and exchange of information) and the acquisition of knowledge (experience and qualifications). Associated with these problems is and the speed of decision making in management, as well as their objectivity. A major problem in man is the slow training and loss of knowledge for the Organization when operator is going out of the process.
3. Main advantages of the "machine" are linked to the speed with which can be exchange and process information. Advantage is the ability to store, process and share enormous amounts of information, and to interpret it with high precision, of which they are not capable for human beings.
4. Despite the significant successes of artificial intellect, the contemporary "machines" are too far away from the opportunity to exchange knowledge and experience. If we have to be objective, it is more correct to be determined, as impossible at this stage of the development of modern technology.
5. An essential problem is the inability for the direct exchange of information between man and machine. At the time, the exchange of information is realized through sensory organs of man, which is a significant problem. On the modern stage of development of civilization we are too far away from being able to achieve a "symbiotic relationship" between the active elements of the system in order to improve its capacity.

Determination of active elements (type) of the „man-machine“ system identifies opportunities and approaches to be used in the management of the processes and their interaction.

4 Conclusions

1. The "man-machine" system is possible to be defined, as the basis for the classification of production processes.
2. Prosed is a system of classification of types of production processes. The classification is based on the determination of the active elements of the system and their role of the process..
3. The different types of systems should be managed through the use of different approaches and methods. The classification it is possible to contribute to the system in order to determine the applicable approaches and to improve efficiency and to archive objective management.
4. Presented are basic advantages and restraint factors in development of various types of systems, on the basis of active elements.
5. The use of the proposed qualification is logically lead to significantly improvement of the ability of industrial enterprises to improve their competitiveness and achieve sustainable development

References

ISO/IEC Directives, Part 1, (2016) *Consolidated ISO Supplement – Procedures specific to ISO,* (Seventh edition).

ISO 9001, (2015), *Quality management system. Requirements,* (Fifth edition).

ISO 9004, (2009), *Quality management system. Management for the sustained success of an organization*, (Third edition).

ISO 14001, (2015), *Environmental management system. Requirements*, (Third edition).

Technical University of Varna
Annual Journal
DOI: 10.29114/ajtuv.vol2.iss1.70
Vol 2 Issue 1 (2018)
Published: 2018-06-30
ISSN 2603-316X (Online)

ISO 45001, (2015), *Occupational health and safety management system. Requirements*, Under development.

ISO 50001, (2015), *Energy management*, (First Edition).

ISO 37001, (2015), *Anti-bribery management system. Requirements*, (First Edition).

ISO 9000, (2015), Quality management system. Fundamentals and vocabulary, (Fifth edition).

Гараедаги Д., (2010), *Системное мышление: Как управлят хаосом и сложными процесами*, Минск, „Гравцов Букс“, ISBN 978- 985-6926-03-0, (Второе издание).

Розенталь П., Макадамс Х., (1964), *Поиск новых технологических процессов*, Мир, Москва, Труды ASME, год, кн.1, стр.63-67.

Groover M. P., (2007), Fundamentals of Modern Manufacturing. Materials, Processes and Systems John Wiley & Sons Inc., USA, ISBN -13 978-0-471-74485-6

Шеридан, Т, Феррелл, У., (1980), *Системы человек-машина*, Москва, Машиностроение.

Kirov K., (2013), *Science, Research, Technology and Quality*, Second University Scientific Symposium, Dobrich, 11- 12. October, Volume 2, pp.81-87.