

# 14

## MOTIVATION AND CONTROL IN TECHNICAL SYSTEMS

### 14.1 INTRODUCTION

In the control theory, motivations of human actions, has big meaning. Even in ancient times, it was noted that as a result of an appropriate incentives provided to the public, increases its control ability. These developments are particularly evident in states of increased social activity which is most often the result of threats. How to explain differently a situation where better armed and more numerous forces defeated by less large opponent. The impact on society through of one form of media may enhance his activity, on another hand, with help of the second – can act destructively on society. In psyche of human the driving force of actions are motivations. Psychology, probably, as the first area of science, examined the motoric factors that determine the human activity. Understanding the phenomena that affect the psyche and next on the mental and physical condition was necessary to bring aid to people in a state of depression, or for which the requirements were placed far above average. The study of psychology certainly were used and developed in sociology dealing with the processes and rules of social coexistence. It is well known term “psychology of the crowd”, which means a human collective reactions when exposed to external stimuli. Encouraging social or professional activity has always played a big role in the organization of social life, in the functioning of technical systems. Mechanisms affecting the human psyche and thus causing a change in his activity are still the subject of much research in the science of organization and management. It is not just about influencing the growth of labor productivity. It is important to ensure the safety, healthy living and human development. Control issues in technical systems are dealing by cybernetics. It explores the parallels between the principles of operation of living organisms, social layouts (systems) and engineering (machines). The key to effective control is to know the motivation of human action and skillful managing them.

### 14.2 MOTIVATION IN CLASSICAL TERMS

By a classic statement on meaning of motivation, will be understood definitions made on the basis of the wording of psychology, sociology and management science.

All what a man makes has a reason, a reason that is not always fully realized. Then, reasons of proceeding are motives. Below is listed breakdown of motives in psychology:

- biological (e.g. hunger),
- social (e.g. altruism – behavior involving action for the benefit of others),

– intermediate between biological and social (e.g., operating under the influence of anger, jealousy, for ideological reasons).

To understand the behavior of people it has to be understood rules of their motivations. Motivation can be defined as a goal, intent, intention, goal oriented, need, lack, urge (inclination, impulse), and desire.

Psychologists use the term urge, when the source of motivation has biological nature. Terms: motive, need they use when it comes to social or psychological motivation [1].

By Reykowski [2] motivation is the process of psychological adjustment, thanks to it, aspirations are formulated, by which should \*be understood, the tendencies to takes action, oriented on a specific purpose. The task of aspirations is to steer efforts of human activities that have led them to a specific, consistent with the intention, effect.

Next, Reykowski argued that the change of motivation pursuing the same activity can alter efficiency.

In general, the motivation should be understood here, as a process that produces, directs and sustains certain behaviors of people, from other alternative forms of behavior, in order to achieve certain goals. This process occurs when two conditions are met:

- 1) the goal achievement must be seen by the man as useful.
- 2) Probability of achieving the goal by the man must be greater than zero.

In order to establish motive, the process control of activities, must be produce the belief that a certain action will lead to a result which is useful for the man (individual) [2]. Such a conviction may be based on experience or the intellectual analysis of the situation.

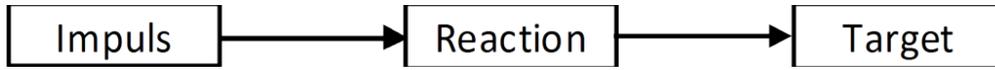
In order to launch the motivation, an entity must assume that even has a chance to achieve a result. When in his opinion, the chances are zero, the motive is not actuated. A state which at that time appears can be described as a request of unsatisfied desire, etc. Also, opportunities equal one does not inspire motivation, because they correspond to the situation where the result has been achieved. So that the motivation could rise, the probability of the outcome must be greater than zero and less than one. Increase of the probability may increase motivation, but with a very high degree of certainty the motivation can be reduced. With the increase in the probability of success, decreases the probability of failure. If the probability of failure increases, it may increase the level of motivation. Since the each components of the emotional process is under-go changes both under the influence of what is going on in the man (e.g. fluctuations associated with the activities of the internal organs, mental activity) and as well as under the influence of what is happening in the external environment (the inflow of new information), it changes adequately strength of motivational processes, and by this their mutual relationship. As a result, in human behavior are manifested a various motives, but the resulting behavior is determined by the strongest motives that often achieve control over the operation of the man. The motive, which took control over the behavior, affects both the direction of the taking actions as well as their course [2].

The goals pursued by people can be of two types:

- 1) material (e.g. salary),
- 2) assets (e.g., satisfaction).

The purpose of the employee can be getting a reward or pay increase. Goals and expectations of employees are a function of their personal characteristics, their skills and

value systems. Age, sex, level and type of education, experience, professional staff position occupied in the workplace, in force the cultural patterns, define their aspirations. The basic model of the motivation can be represented by the diagram in fig. 14. 1.



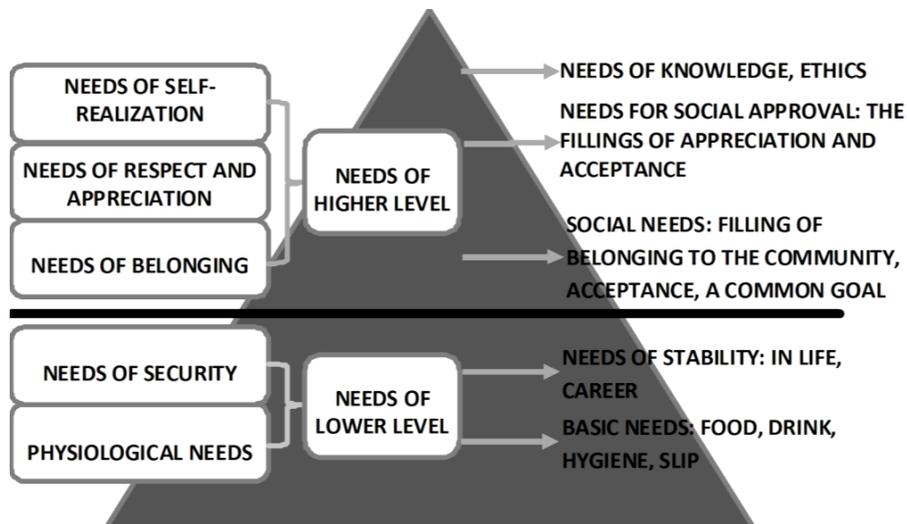
**Fig. 14. 1 Model of motivation [2]**

The essence of motivation is in the human response to sustained stimulus (mean of motivation). If the stimulus will have sufficient ability to influence, then the reaction will be action to achieve a particular goal. Otherwise, the stimulus will be ignored.

The concept of motivation can be also seen at a different angle. According to Maslow [3, 4], motivation of people action depends on the needs which govern them. We can distinguish five groups of basic needs:

- 1) Physiological needs (thirst, hunger, meal).
- 2) The needs of security.
- 3) Social needs (belonging and love).
- 4) The needs of respect and appreciation.
- 5) Self-actualization needs.

In a five hierarchy of needs, a man meets them in a certain order – starting with the core and ends on the needs of higher order [5]. Maslow's model diagram is shown in fig. 14.2.

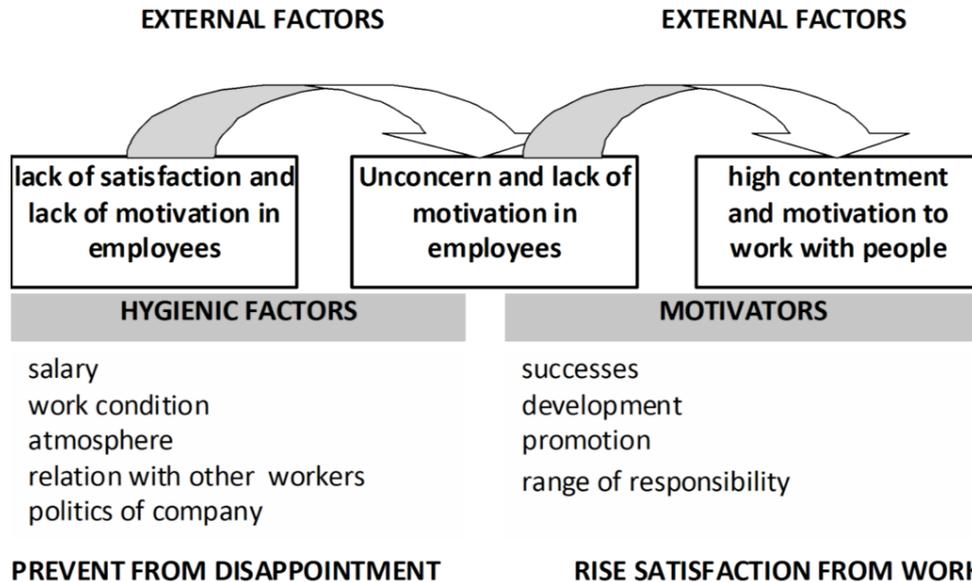


**Fig. 14.2 Pyramid of needs by Maslow [5]**

In order to be able to meet the needs of a higher order, first of all must be satisfied needs of lower level. In the case when the need of lower level has been met, than automatically it stops be a source of motivation.

In addition to these five needs mention above, Maslow distinguished also co-called additional needs that may manifest it only in some people. These include the needs of knowledge and aesthetics needs. [6] In addition, Maslow says that motivation is constant, never disappearing, subject to volatile and complex, and it is almost a universal feature, practically for every state of the organism [7].

In Herzberg's two-factor theory of motivation factors motivating people to act are divided into two groups: external (so-called hygiene factors or dissatisfaction) and internal (co-called motivators or factors of satisfaction). Interpretation of Herzberg model is shown in fig. 14.3.



**Fig. 14.3 Diagram of the two-factor theory of motivation according to Herzberg [5]**

Motivators relate to the content of performed work. They refer, among others, to: recognition, promotion, interest in work, responsibility, achievement, growth opportunities. These factors contribute in increasing satisfaction of performing work, which in turn leads to higher employee productivity. Hygiene factors do not lead directly to job satisfaction, however, they affect the level of dissatisfaction with it. Hygiene factors include: company policy, supervision, interpersonal relations, salary, working conditions, health and safety conditions, etc.

Herzberg concluded [5] that for the proper functioning of the motivators, it is necessary first of all, to secure health factors for workers. However, focusing solely on health factors not guarantee to reach the desired level of motivation by employees, these factors are perceived by subordinates as natural conditions of work.

Therefore, the provision of health factors at the appropriate level leads only to reduce employee dissatisfaction and is a kind of starting point for the use of motivators that are authoritative source of job satisfaction.

Herzberg's opponents acknowledged that his approach to the issue of motivation somewhat simplifies reality. Some of the factors – such as wage, many people include it into the motivators, especially when it is high [6].

It seems that thanks to Herzberg, was to highlight the often reproduced stereotypes, according to which, factors as for e.g.; company policy and working conditions, had effectively motivate people to work.

This brief sketch of the concept of motivation, of course, does not exhaust the discussed topics. Characteristically is, that in the sciences associated to psychology and sociology, particularly important issues is raised, related to the internal nature of a human, with its

sensitivity to: stimuli, the method of experiences and even brain functioning and decision-making systems.

Mainly the research is focused on the mechanisms of human reaction (and even generalizing – alive organisms) as a result of the impact of the environment on him. Not at the same time are creating ways of impact, but only are examined correlations between phenomena or events specific for the given environment to the examined subject.

In the sociological sciences, especially in the management sciences, motivation issue is of particular importance, because it determines the social and professional activities in the workplace. The studies are based mainly on trial and error method. This method involves methodical repetition of different treatments unless they prove to be effective until the expected result. Often are used scientific surveys.

In the management sciences, there are a very large number of different types of studies and the results of examinations. In general, they refer to a narrow field of business (economical sector) or social or even raise issues unique to a particular company. This multitude various of results imply discussions, which will lead surely to some generalizations. A broader research study related to the essence of motivation and the mechanisms of its creation can be found in work [6, 8].

### 14.3 MOTIVATION IN TERMS OF CYBERNETICS

Cybernetics is the science of control. It began to deal with the problems of decision-making, resulting in increased demand for professional advisors, the committee of experts, and even for the institutions involved in the improvement of organization and management. Therefore, cybernetics is the science of control, and thus of any intentional act inclusive deciding. One of the basic concepts of cybernetics is a system; it is defined as a set of elements and relations existing between them. Because of the large role it plays in the concept of cybernetics, cybernetics could be defined as the study of the behavior of the systems [9].

Mazur [9, 10] treats man as an autonomous system. On the basis of analysis of the autonomous control system can be inferred about the properties of human control, or the reasons (motives) of human behavior.

An autonomous system is a system capable of long duration as possible in an environment, which means that it must have:

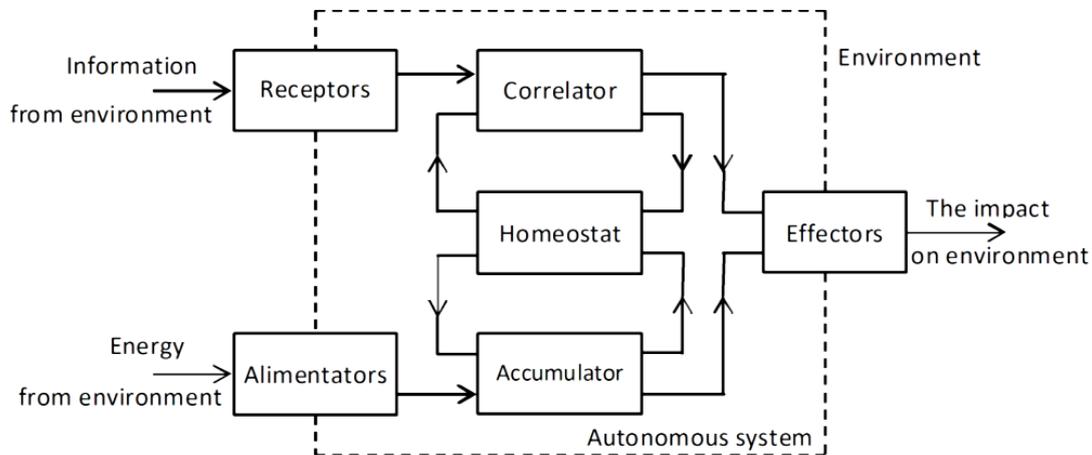
- 1) the ability to control,
- 2) the ability to prevent the loss of capacity control.

In order to meet these requirements, an autonomous system must include the relevant authorities (subsystem), namely:

- effectors (the organs for impact on the environment),
- receptors (the organs to collect information from the environment),
- a correlator (the organ to process and store information),
- alimentators (the organs to collect energy from the environment),
- a accumulator (the organ to process and store energy),
- a homeostat (the organ to prevent flows of information and energy, which reduce the possibility of system to impact on the environment).

Into the effectors, should flow information determining, which of the possible impacts

on the environment are to take place. It should also flow into them, the energy allowing performance of necessary work in the actions on the environment. The border between the autonomous system and its environment is marked by broken lines. The autonomous system diagram is shown in fig. 14.4.



**Fig. 14.4 An autonomous system [10]**

The receptors, the effectors and the alimentators are the organs providing communication of autonomous system with the environment, where the receptors and the alimentators are inputs of the system, and the effectors are the outputs of the system. The correlator, the accumulator and the homeostat are internal organs of the autonomous system. Gathering information in the correlator and gathering energy in the accumulator allow using them independently from the time of collection.

The homeostat task is to maintain an autonomous system in stage of the functional balance. A lot of emphasis on the subject-matters of functional balance is included in the work [11], where is discussed the interplay of competing technical systems.

Functional imbalances are caused by changes which happen in the environment. The greater change occurs in the environment, the greater will be the impact on the system. Through mediation of receptors and alimentators it will be provided greater impact on the input of the accumulator and the correlator and on their outputs, so also on the input of homeostat. Therefore, disturbance of functional balance is the impact of the correlator and battery on homeostat. Homeostat, the internal body system, does not have contact with the environment, that why distortion for him is, what is happening in the correlator and accumulator. That why, he can remove disturbance only by impact on the correlator and the battery. If the impact of the correlator and the accumulator on homeostat increases, then the impact of homeostat on the correlator and the accumulator will decrease (and vice versa). Consequently, the impact of the correlator and the accumulator on homeostat also decreases, and thus the functional equilibrium (balance) is restored.

Example of homeostat functioning with regard to the human body is preventing overheating of the body due to strong solar radiation. Then, there is the phenomenon, homeostasis the body's self-regulation in order to maintain the basic biological parameters. As a result of thermal changes caused by strong sunlight will occur the following phenomena: the increased activity of the sweat glands (evaporation of water helps to remove heat from the

body), the appearance of pigment in the skin (tan hinders the penetration of solar radiation), thirst (drinking habits compensates the loss of water in the body and allow to keep sweating), lack of appetite (preventing intake of high-calorie). In the information processes, it appears interaction such decisions, such as: to hide in the shadows; to be in a ventilated area or cool off with a swim.

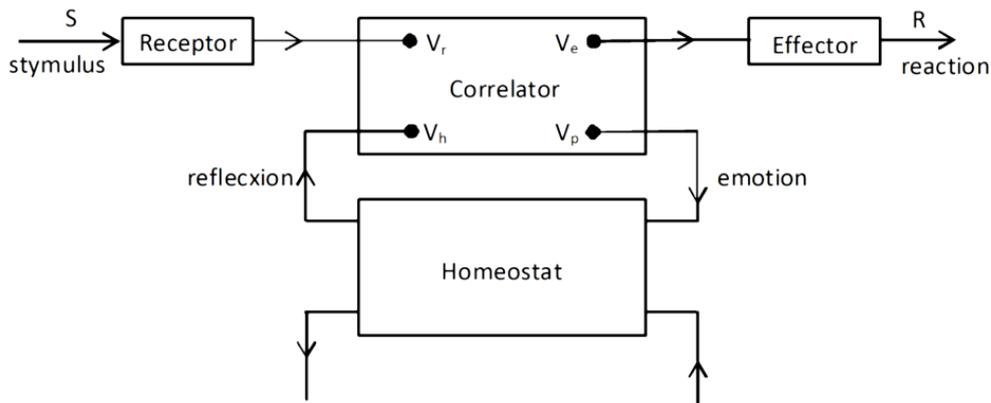
Treatment of man as an autonomous system is fully justified, because for a man, it is fulfilled every definitions of the autonomous system [10]:

- 1) the man has the ability to control itself and capacity to counter the loss of ability to control;
- 2) the man is able to maintain the functional balance despite changes in the environment;
- 3) the man is seeking to maintain its existence;
- 4) the man works in its own interest.

In the autonomous system, exist two symmetrical areas of interaction:

- 1) the area of information, including the information path: receptors – correlator – effectors and feedback from homeostat and correlator (upper part of fig. 14.4).
- 2) the area of energy, including energy path: alimentators – acumulator – effectors and feedback from acumulator and homeostat (lower part of fig. 14.4).

Information area of autonomous system is shown in fig. 14.5. Total of processes in the information is called the psyche of an autonomous system. The correlator has two inputs and two outputs (or more precisely – the two types of inputs and outputs). It functions as a transmitter of interactions (it is analogous to the human brain), which means that the processes are taking place in it.



**Fig. 14.5 Information area of autonomous system [10]**

As a result of these processes the inputs potentials causes a flow of energy, resulting in the formation of the outputs potentials. In the correlator are four potentials:

- receptor potential ( $V_r$ ), introduced by the receptor to the correlator,
- effector potential ( $V_e$ ), introduced by the correlator to the effector,
- perturbation potential ( $V_p$ ), introduced by the correlator to the homeostat,
- homeostatic potential ( $V_h$ ), introduced by the homeostat to the correlator.

Emotion is the impact on homeostat by correlator (fig. 14.5). In particular, it may be:

- aversion (aversion feeling), the emotion involving growth of the perturbation potential;
- attraction (feeling attractive), the emotion that reduces the perturbation potential.

Reflection is the impact of the homeostat on the correlator (fig. 14.5).

It can be:

- disapproval (disapproval reflection), a reflection of which is to reduce the homeostatic potential;
- approval (approval reflection), which is a reflection consists in the growth of the homeostatic potential.

Here's an example to illustrate the use of these terms in connection with the operation of homeostat. Everyone has their own sense of the normal course of social events. It can has also typical Smith, who participated in a social conversation, he treat it as a normal course. Let now the following situations to occur.

First situation.

The social conversation joys a few new people very talkative. For Smith this is a deviation from the normal state. Excess heard words make in him growth of the perturbation potential  $V_p$  (aversion), for that his homeostat reacts by reduction of homeostatic potential  $V_h$  (disapproval), power correlation decreases, reducing Smith's reaction. As a result, Smith has taken a silent position. In this way, he improved his status in the balance, but also the state of social conversation in which an excess of words fell by his silent.

Second case.

Talkative people moved away, resulting decrease in a perturbation potential  $V_p$  of Smith (attraction) but for the homeostatic potential  $V_h$  (approval) increase, Correlation power will also increase adding to his reactions. As a result, he becomes chattier. In this way, he improved his status in the balance. Also was restored equilibrium in the environment, as insufficiency of words was offset by increased talkative of Kowalski.

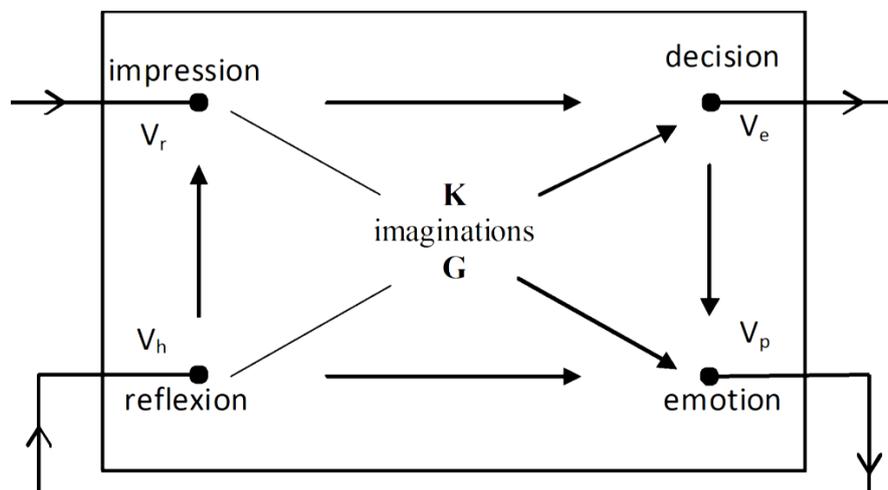


Fig. 14.6 It is a general scheme of correlation occurring in the correlator [10]

Among the four potentials occurring in the correlator, there is a number of possible associations on which will depend on the behavior of the autonomous system. A detailed analysis of all the associations presented in work [10]. Mileage correlation between these potentials is such that the inputs of the correlator ( $V_r$  and  $V_h$ ) flows the correlation power  $K$  (fig. 14.6) to the correlator outputs, in which it causes appearance of the effector potential  $V_e$  and the perturbation potential  $V_p$ . In other words, impressions and reflections produce ideas

which in turn produce decisions and emotions.

Size by correlation  $K$  depends on the conductivity correlation  $G$  and the input potential

$$K = (V_r + V_h) \cdot G \tag{14.1}$$

If we express the energy potentials as  $V_r$  and  $V_h$  in joules, and the power in watts  $K$ , then the correlation conductivity  $G$  is essentially speed of operating correlator (1/s).

According to Mazur [10], the motivation is the dependence of the effector potential from homeostat action, that is, from emotion and reflection. In other words, it is the dependence of the decision from emotion and reflection. There are two extreme types of motivation:

- offensive motivation (approval of impressions and approval of decisions);
- defensive motivation (aversion of feeling and aversion of decision).

Motivation of offensive is motivation in which, action of homeostat supports the decision. The motivation of this, even if the power correlation, flowing through the  $V_r$  to  $V_e$  due to the appearance of a stimulus  $S$ , is not sufficient to cause the reaction  $R$ , however, this reaction may be due to flow of the correlation power on the way from  $V_h$  to  $V_r$  and on the way from  $V_e$  to  $V_h$ . In other words, even a poor impression, but reinforced by perceptions caused by reflections in the form of approval of impressions and decisions, may result in the decision and reaction.

Defensive motivation is a motivation, in which the homeostat action blocks decision. Even if the correlation power which flows on the way from  $V_r$  to  $V_e$  due to the appearance of the stimulus  $S$ , was sufficient to cause the reaction of  $R$ , however, this reaction can be prevented by the correlation power drains on the way from the  $V_p$  to  $V_r$  and on the way from  $V_e$  to  $V_p$ . In other words, even a strong impression, but weakened by perceptions caused by emotion in the form of aversion (disapproval, dislike) of impressions and decisions, cannot make a decision and response of system.

Energy area (fig. 14.7) of the autonomous System includes getting power from the accumulator in cooperation of homeostat and distribution energy to the environment through effectors. With the accumulation of energy in the accumulator, input power and power spent not have to be equal. The larger the capacity of the battery is, the greater the ability of the autonomous system to control itself in the environment, the longer the system can issue energy without simultaneous downloading it from the environment.

Part of the energy drawn from the physiological environment by an autonomous system, is consumed to perform so-called idle work, while the remaining portion is utilized to operate dispositional work. Idle work is the work which has to be done so that the system could exist at all. This work can be compared to the fixed costs of the company, while the company's costs directly associated with the production is dispositional energy of the system.

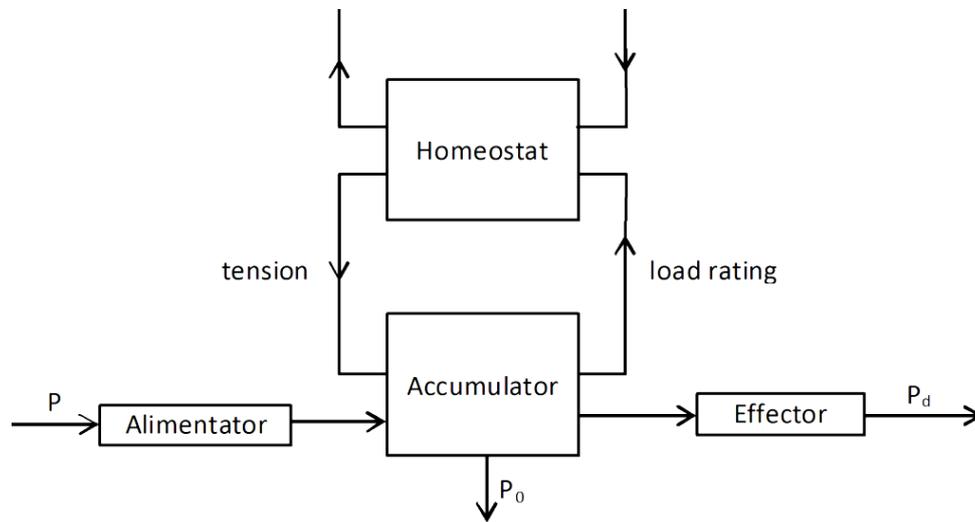
In fact, we are dealing with streams of energy flowing and flowing out of the system. That is why, we operate with the term power, so the physiological power  $P$ , the idle power  $P_0$  and the dispositional power  $P_d$  (fig. 14.7), wherein

$$P = P_0 + P_d \tag{14.2}$$

Absorbing physiological power  $P$  from the environment is related to the specifically performing work for what must be used a part of the dispositional power, defined as working (operating) power  $P_r$ . What was left of the dispositional power  $P_d$ , after covering operating

power is called the free power  $P_s$  that can be consumed freely (optionally). Thus,

$$P = P_0 + (P_r + P_s) \quad (14.3)$$



**Fig. 14.7 Energetic area of autonomous system [10]**

For example, a person living on their own work must be obtained in the diet not only energy to cover the basic metabolism (idle power), but also performed their job (working power). Similarly, the industry must have at least as large production, that given income from it could enable to cover overhead cost and the cost of the production.

Thus, the existence condition of an autonomous system is that the physiological power is at least, equal to the sum of the idle and operating power.

The idle power  $P_0$  is dependent on condition of the autonomic system and operating (working) power  $P_r$  depends of the situation in the environment. The free power  $P_s$  can be used to change the situation in the environment for the better, so that to provide the same idle power  $P_0$  will suffice less operating power  $P_r$ . Then, from the dispositional power  $P_d$  will remain free power  $P_s$  and will enable further improvement of situation. Thus, the free power enables gain so-called sociological power, which used leads to a reduction of working power and, consequently, increase the free power.

The homeostat is an organ common to both areas – information and energy, it indicates that via it the information processes have an impact on energy processes, and energy processes have an impact on information processes. This means that:

- reflection is dependent not only on emotions but also on the accumulator load,
- tension (potential entered to the accumulator by homeostat – fig. 14.7) depends not only on the load of the accumulator but also on emotions (fig. 14.5),
- emotion affects not only reflection, but also tension,
- load of the accumulator affects not only the tension but also the reflection.

Since the correlation power (collerator load) depends on the information effects of environment (ambient) and of the homeostat action; and the physiological power  $P$  depends on the energetical effects of ambient and of homeostat action, wherein the homeostat action depends on both the correlation power  $K$  and of the physiological power  $P$ , so as in a result

the correlation power depends on the interaction of the information and the environment. Similarly, the physiological power depends on the information interactions and energy interactions of the environment.

The analogical situation is with the motivation of action of autonomous system – due to the information impact and energetic impact of the environment on the correlation power, the motivations of the system action have both informative and energetic character.

It follows that, for the proper functioning of the autonomic system, it should have ability of:

- 1) the collection of information,
- 2) the issue of information,
- 3) the intake of energy,
- 4) the issue of energy.

Information processes and energy processes are closely related. Any deficiencies in one or another impair a person.

According Kossecki [12] human society consists in the exchange of energy (including matter) and information. As a result of the coexistence, it takes place socialization in society, in other words they adapted to the requirements of social life. The process of adapting people to the needs of human social life is to produce the relevant rules of behavior. These rules are called social norms.

Social norms depend on the history of the system – that is, both on the personal stories of people that determines their personal experience, as well as on the history of the whole society. In terms of cybernetics social norms are considered as the relationship between stimuli acting on members of the public and relevant, caused by them behavior (reactions).

Stimuli that affecting the society become the direct cause of social activities broadly divided into:

- stimuli of informational character,
- stimuli of energetical character.

The most important stimuli types of informative character are messages which contain specific ethical commands, not backed up by any threat of reprisals or payment, ideological propaganda convincing the rightness of a given case, the messages containing information on the ambient conditions, satisfying the desire to know the reality, and the payment for which people acquire good information - for example, cultural, cognitive, etc.

The most important stimuli types of energetical character are the repression and the payment for which people acquire various goods necessary for the energetical functioning of their body – food, clothing, fuel, housing, etc.

If stimuli that cause social activities are informative, then we deal with the motivation of information. Conversely, if the social actions are caused by the stimuli with the nature of energy, then we deal with the energetical motivation.

Societies that operate under the influence of motivation of information, they are more energy efficient than the public acting under the influence of power motivation – that calling certain actions require less energy (these populations are therefore less loss of energy). This is because the people who work under the influence of ethical motives, ideological or driven by selfless desire to know the truth does not need to be coerced, controlled or highly paid as

people working under the influence of power motivation. It should be remembered that the public in order to be able to take any action must always have provided the energy necessary to perform these actions.

Cybernetics treats social norms as the relationship between the stimuli acting on members of the public and relevant, caused by them reactions (action).

Kossecki [12] defines five specific norms which affect the motivation of human action:

1) *Cognitive norms*. They define what in a given society is considered to be the truth, what are the criteria of truth, also what should be the method of reaching it. The desire to know the truth (hunger for information) becomes the motive of people action. These standards are the result of learning by man about the human surrounding world and himself. Next, these norms have the same effect on this process. There are categories of institutions that produce cognition norms. These are: scientific institutions, administrative institutions, institutions of mass media information.

2) *Constitutive norms*. Define the structure of society and its reactions to the environment. This means that they define the relationships between the various organs of the society as an organized system and the reactions of the public in relation to the external environment, from the point of view of society business as an independent system. The most important types of constitutive norms include: ideological norms, ethical norms, legal norms.

3) *Aesthetic norms*. They have a close relationship with the whole culture of the society; include arts and aesthetics generally understood. Art on the one hand reflects the mentality of the society, on the other hand is shaping it. Norms and aesthetic stimuli can negatively or positively impact on all other types of social norms, they can serve a variety of functions in the life of Individuals and society, and the therefore the related motivations with them are mixed. Aesthetic norms also always played a certain role not only in the cognitive area or in the ideologically ethical, but also in the field of biological and economic live (development) of society. Art-related Institutions can operate spontaneously, but can also exist in an organized manner, and even undergo far-reaching formalization.

4) *Economic norms*, estimate, what is beneficiary for the society, and what is not beneficiary regarding economics, also identify methods for achieving the economic benefits. These norms are developed by the aspirations of the people to ensure for themselves and other members of the society, energetical recourses of living. That is why, among the motivations related to economic norms, motivations about an energetical nature dominate.

5) *Vital norms* determine what is healthy for people and what is unhealthy for them, from the point of view of the physiological functioning of the body and determine how to maintain human health in appropriate condition. For that they are often called health norms. Specific importance here has the adequate legislation, for the public health issues, and the level of ethics, especially medical ethics. The development of vital norms has a significant impact on all areas of society and, therefore, on all kinds of social norms.

Between different groups of social norms there is a strong correlation, stimuli associated with one group of norms can result social activities within the range of another group norms. For example, under the influence of ideological precepts, people can take action of a scientific, economic, health or the arts nature.

Systems of social norms should be so shaped and so harmonize with each other to

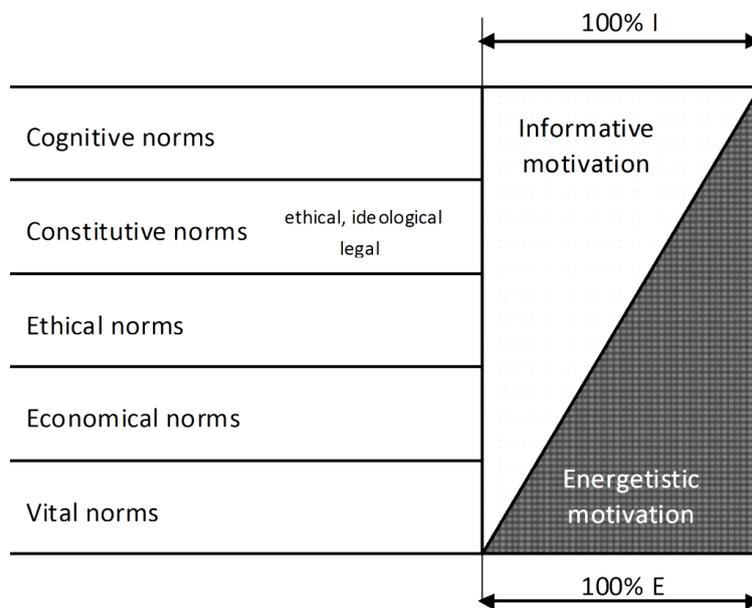
assure to provide to the society ability to keep functional balance and the development of its own structure under certain external and internal condition and the possibility of achieving the desired objectives. So, if the conditions are changing in which society operates, must also change the adequate social norms.

Change of ones social norms leads usually as a rule to the need of change also other norms. For example, changing the state of our knowledge of reality often involves not only a change of cognitive norms, but also the economic and health norms, which in turn could lead to a change of legal norms. Understanding the new laws of physics can become a basis for the invention of new tools for work, and this in turn may result in a change of economic norms, which sooner or later will also have impact on the changes other social norms, especially legal norms.

Presented above breakdown of social norms is very useful for the study of control processes in society. It turns out that in the case of social activities related to the norms cognitive and constitutive norms (ideological, ethical and legal, if they are based on the conviction of its rightness, and not just on the threat of repression) there is a predominance of informative motivation; in case of social activities related to economical and vital norms we have the advantage of an energetistic motivation (repression, payment); while the aesthetic norms occupy an intermediate position

In the cognitive norms participation of informative motivation is the biggest, while in the vital norms the biggest is participation of the energetistic motivation.

The fig. 14.8 shows the share of motivation of information I and energetical motivation E in the respective types of social norms.



**Fig. 14.8 Share of informative motivation I and energetistic motivation E in the particular types of social norms [12]**

The role of informative and energetistic motivation very clearly is seen when observing the work of people in different areas of social life. Real scientists are working on issues of interest to them regardless of the payment and whatever other personal benefits. One example

can be here Albert Einstein, who developed his theory of relativity at a time when he was not a professional researcher and could not expect any material benefits of these materials. Similarly, the idealists who worked under ideological or ethical influence, they can gain a great deal of effort and dedication, not only do not waiting for the payment, or any other material benefits, but even in spite of different energetic stimulus, by the means of which, the opponents often try to get them appropriate action to be discontinued [12].

On another hand, in the economic activities it is difficult to imagine, for example, the workers working for a long time without proper payment, or officials in the company worked with no hope of advancement and related to it material benefits. Similarly, in the case of measures aimed at improving health. It is hard to imagine, that people for a long time took up in the social scale, various activities (e.g., environmental protection) for which they do not have any grounds to expect that actually, it improves their health.

#### **14.4 MOTIVATION IN TERMS OF THE COMPARATIVE STUDY OF CIVILIZATIONS**

A single set of social norms covering the entire social life is called civilization [13, 14]. These norms govern the principles (rules) relationships that taking place between people in society. Social relations are associated with the proceedings, human action in his environment. The reasons for such actions, these are motivations. Because the rules for the organization of collective life in every civilization are diversified, so too are diversified motives of actions.

Koneczny [15] has provided tools to identify the individual civilizations with. Identification is possible by analyzing the characteristics of civilization compared to the category of social existence, they are:

- 1) Good (ethics, law and ideology guiding the social life).
- 2) True (its widely understood system of education and information).
- 3) Beauty (fine art and aesthetics).
- 4) Health (social norms laying down the rules of hygiene, medicine and therapeutics).
- 5) Welfare (economic activities, institutions, economic systems, and all the factors that ensure the material being).

A more detailed description of the categories of social existence can be found in [13, 14, 15]. In a comparative study of civilizations health and welfare are called material categories, as it is related to meeting the physical and material needs of man.

The good and the truth is called spiritual categories spiritual as it is related to the life and work of human, and meet the needs of a higher order.

Beauty occupies an intermediate position, belonging partly to the spiritual and partly to material categories.

On the basis of the category of social existence can therefore be characterized the various types of human or in other words - people with certain preferences (motives) of activities. These are people with informative and energetic motivations.

People with informational motives perceive the social existence in terms of good and truth; they are taking the cognitive actions, contributing to the increase in the progress of science, technology and art.

People on the motivation of energy, perceive social existence in terms of public health

and welfare. In the simplest terms is this consumer's type.

The present division recognizes opposite types of people to clearly show the differences in the motivation of action. Often, however, we are dealing with the intermediate's types, which in terms of motivation are very diverse.

#### 14.5 THE EFFECTIVENESS OF INFORMATION

In the control (driven) theory motivations of human actions are essential. By information's impact on society can be shaped norm-types of social behaviors and then can be effectively controlled in order to achieve the desired functional balance.

Information transmitted by the technical system to the environment, in order to achieve a favorable balance of functional, should fulfill the following functions: integrative, cognitive-methodical and selective [11, 12].

The integrative function is to develop homogeneous norms of social behavior. The methodological-cognitive function is to inform about the progress in the given field and to indicate the direction of change. The selective function is reduced to the impact of information on a particular social group.

The implementation of these functions makes it easier to obtain a part of society that will identify them-self with the system forcing changes. Implementation by the information specified functions is a necessary but not sufficient condition in order to guarantee the effectiveness of the information.

The effectiveness of the control information will depend on whether it will be done according to certain rules. Rules of transmitting information are used to provide information to the planned impact on the psyche of people with an informative stimulus to induce appropriate action or shape appropriate social norms [12].

The principles for submitting information are [11, 12]:

- 1) The principle of truth – it means harmony of the derived information derived with the information in the appropriate collection of originals, especially the experience of society.
- 2) The principle of mass and long duration of action – as true are accepted these information which come from different sources or are transmitted over a long period of time.
- 3) The principle of desired information – accepted as true are these information which correspond to the most people, and whose realization would like to see.
- 4) The principle of emotional stimulation – refers to feelings and usually has an advantage over the information only operates on a rational argument.
- 5) The principle of rationality – the informations must be understandable or raise specific associations.
- 6) The principle of specialization – adjusting information to the level and terms of different environments, on which information want to impact.
- 7) The principle of not putting dot on “i” – means that the information should not always indicate a course of action but to stimulate motivation associated with cognitive norms.
- 8) The principle of the alleged (pretended) obviousness – is proving the thesis other than the one you actually want to promote.
- 9) The principle of gradation – occurs when the changes that a technical system wants to call in the environment are so deep, that the sudden attempt to carry them out could meet with

harsh resistance from the environment.

As mentioned above, the transmission of information is planned impact on the psyche by a stimulus of informative character. This does not mean that by the informative impact may be treated only people with informative motivations. Model of autonomous system clearly shows that the correlation strength depends on the impact of information and energy of the environment. Similarly, it happens with the physiological strength. This means that regardless of the motives of human action (autonomous system), you can affect him by the incentives (stimulus) both information and energy.

The efficiency of information on the environment will depend on the degree of use the above principles. Remember to correct, according to the rules, the preparation and content of the communication process and about to whom the information is intended (addressed). Also remember about the recipient's motivations if they are of the type of information or energy, because on the motivation depends not only the receipt of information but also the way of respond to the information.

Table 14.1 shows the effectiveness of the various rules contained in communications of information in regard to the people with the informative and energetistic motivations. (+) Sign means the effective information interaction, and the sign (—) means no effective interaction.

**Table 14.1 The effectiveness of the procedures for submitting information in relation to people with informative and energetistic motivations, (+ - effective interaction, — - ineffective interaction)**

S.n.	Principle of submitting information	People with information motives	People with energy motives
1	The principle of truth	+	+
2	The principle of mass and long duration of action	—	+
3	The principle of desired information	—	+
4	The principle of emotional stimulation	—	+
5	The principle of understandability	+	+
6	The principle of specialization	+	+
7	The principle of not putting dots on „i”	+	+
8	The principle of alleged obviousness	—	+
9	The principle of gradation	+	+

From Table 14.1 we can see that the effectiveness of impact assessments of information is much higher for people with the energy motivations. No doubt this is due to the fact that the recipient of information motivations are able to read the actual content of the message, understand the intention of the emitter. Recipients of the motivations of power, either in the struggle for existence, or in order to achieve immediate benefits do not read the intentions of the emitter information but yielded to them frequently uncritically. If there is manifested desire to verify the information transfer, it is usually done through trial and error.

To get more familiar with the data contained in Table 14.1, we may use the following example of the information impact.

### Example

The TVP I, the morning news (February 2000), among others, issued the following statement: "In France, drivers' strike demanding higher wages for a shorter work week." This

short text on strike was accompanied by a commentary about the social burden of strikes and material losses generated by the strikes.

From the content of the strike can be concluded that French drivers not only did not want to work, but more than that they want to compel the authorities to higher salaries. In this transmission strike is unjustified and, in addition, of course, to burdensome for the public. Here are the facts of the events of that period. For the automotive's strikers, of haulage sector (France) administratively reduced the work week from six to five days. Reduction in earnings resulted from a short-time working. On the other hand, shorter working hours caused a decline in the competitiveness of the French transport companies in Europe (in the rest of the European Union the working week for track's workers was six days). The strikers have used roadblocks and have demanded the restoration of the six-week of work or compensation for losses (e.g. in the form of subsidies), as a result of the administrative decision.

The principle of the true here is fulfilled both for people with informative's motivations and energy information. People with informative's motivations will take this messages as at least incomplete, and therefore requiring review, as a result, they will know the real course of events. People with the energy motivations energy can take this information as a real one. Information about the strike in the rich Western Europe can be received by people in Central and Eastern Europe as an attempt to further improve the strikers' existence in the country already, with high standard of living.

If the information is broadcast at least for the duration of the strike, then for people with the energy motivations sustainability principle is fulfilled and the multitude of operation rule is also fulfilled. People with the information's motivation are immune to this rule, as the quality of information does not depend on its exposure to time.

The transmitted information can inspire or at least justify the claim of an energetic group of workers with the lowest standard of living. It performs the required information for people with the energy motivation. It is different for people with information's motivations for which information is desired that one which is due to their profession or interests. This does not mean that people with these motivations cannot carry out protest actions. Indeed yes, - for example, protests against the war, but the supplied information must be characterized by high integrity and complete, honest (reliability).

For people with energy motivations is met principle of emotional stimulation. This applies to those people who claim they stand out and prepare employee strikes and those who believe that because of strikes affecting them, they experience too great annoyance in everyday life – for example, because of roadblocks. For people with informative motivation principle of emotional stimulation does not apply, because their behavior is based on rational thinking. Indeed, the emotions they might take place – for example, protests against human rights, commitment to life-saving action, humanitarian actions, etc.

The principle of comprehensiveness (rationality principle) is satisfied for both the people with informative motivations and with energy motivations. People with motivations of information, based on the information given in the example, may investigate the actual intentions of the emitter. For people with energy motivations in the countries of Central and Eastern Europe, the information can be seen as the next step claims of workers' organizations in Western Europe, against employers.

Similarly as before, the specialization rule here is met. The information message is well correlated with the level of concepts from both communities with informative motivations and energy motivations. For those communities such topic as strike is well known because of the many strikes in the modern world.

The principle of not putting dots on “i” should promote the motivations associated with the cognitive norms. It refers not only to the people with informative motivations but also with energy motivations. According to this principle, the information should be presented to the recipient himself so he could draw the conclusions. Then he will identify himself with the final thesis being sure that it is the result of his independent thinking. For people with the informative motivation final conclusion can be complete knowledge and understanding of the events related to the strike of French transport workers. In the case where people are with energy motivations, may arise two communities with opposing views. One, they considered that the strikes are a source of instability and deterioration in strikers standard of living, while the second – will be seen in strikes an opportunity to improve the conditions of strikers existence.

In principle of the alleged obviousness fact, actually promoted the idea is given as a fact, but the thesis being proven are of minor importance. In the given example, the fact of certainty is the totally unfounded led strike (demand higher wages for less work), and the thesis being proven are hardship and economic losses caused by the strike.

But keep in mind that the essence of the strike is just causing a nuisance in all available forms. The strike is the energy impact of protesting people in the situation, when the information impact was not effective (for various reasons).

From these few comments is obvious that the principle of the alleged obviousness is effective only for people with energy motives.

The principle of gradation is used when the target state which is to take place in the system or the environment is far from the status quo. This principle is effective impact of information works for both for people with energy motivation and people with energy information. It is used for e.g. in science, medicine, sports and the economy. It plays an important role in the struggle between competing technical information systems [11].

It is difficult to assign the principal of gradation to the information in describe above example. It should have some information issued in a certain period of time, consider taking the correlation between them and if any occur – implicate thesis on the real purpose of the information’s influence. Despite these obvious disadvantages, taking into account the contents of this form of communication can be risk a string of probable impacts of successive information: to deter strike, ignoring the strikers, repression of strikers.

The effectiveness of information thus depends on the intentions of the emitter and the nature of the motivation of people to whom the information is addressed. The example shows that the issue of information by the technical system can cause different effects of control in an environment of informative motivation and energy motivation. Moreover, the same information can divide the environment with energy motivations into two antagonistic groups. In the shown example they are the proponents and opponents of strikes.

## DISCUSSION AND CONCLUSIONS

Motivations of activities play an important role in human life. They have influenced the course of his education, career and personal life. What's more, motivations are constantly under shaping, they are a result of psychological adjustment. This means that it can be influence on the motivations, human motivations can be controlled. Developing the motivations actually, this is control of human activities in order to achieve the desired effect.

Determinants of human motivations are well recognized as a result of psychological and sociological research. It systematized them into two main groups. First one of an energy character contains factors: such as wages, the need for social and cultural life and the wider consumption, safety in terms of health and existential. Second one informative refers to the spiritual (internal) of man and contains min. factors such as the need to possess the knowledge, ethics, recognition at work and possible activities for the public (e.g. charities). Depending on which factors are preferable for the division of people's motivations respectively with energy, and the motivations for such information. The same result occurs on the basis of cybernetics, and comparative study of civilizations.

Control of human beings to change the motivation in the performance of the same action can alter the efficiency of the system. Of course, such a change may be beneficial to the system (increased productivity, better quality of production), or fatal in consequences (loss of productivity and quality, staff turnover). Confirmation of the positive impact of changes in motivation to score production will let the following example [16].

In the 70s of the last century were carried out in Poland sociological research, which aimed to study the influence of awareness on the quality of the worker's work he does. It was promoted the view that the employee does not need to know what for serves element on which he is working on. Just will be enough that he will do it according to the technical documentation. The economic stimulus will be the factor that will ensure a high quality of work, understood as minimizing the defects. It was done by letting two different factories, the departments machining, to perform the same elements. The staff of the first department did not know which these elements are used for. They should perform it according to the technical documentation and the economic pressure – the more products with defects, the lower the discretionary premium.

To the employees of the second division, was exactly explained that they produce machine parts to the modern combine with specification what kind of function these parts will perform in this machine. Of course, in the second department uses the same technical documentation and for deficiencies was applied the same economic pressures.

Evaluation of the work of each department was the amount of defects created in the production process. It turned out that more defects noted in the first department. Therefore, greater effectiveness was characterized work done by second department. This example shows that the informational motivations of workers have a very positive impact on the functioning of the technical system.

Control processes of human beings take place in the area of the system, as well as, focused on the environment, where there are also other technical systems.

As part of the given technical system, the task is to control the phenomenon of homeostasis, so that will maintain the desired internal state of functional balance, which

comes down to for e.g.: high productivity, continuous improvement of the offered products, a high level of education whether to continuously and effectively reduce the cost of living of the population. The guarantor of effective homeostasis is to prefer stimuli of informative character.

The impact of the technical system on the environment is control processes, which purpose is to produce a functional balance between the system and the environment. The interaction can take various forms depending on the purpose, which was selected by the system. Because people with the energy motivation are more susceptible to control, so purpose of the initial (pilot project) impact on the environment is to develop in it energetic motivation. This process can be lengthy and not always (for various reasons) succeeds. For striking example of actions aimed at changing people's behavior motivation are the times of occupation or annexation (conquests). Towards enslaved population informational constraints are much more severe than energy. Aboriginal population was mainly needed to perform physical labor, so it had to provide the necessary force (labor power). Delivered to them knowledge was only related to work and it ensured the maintenance of obedience.

Although such drastic methods it is difficult today to experience, it must be remembered that in a highly competitive environment need to continually reduce the cost of production. The main component of these costs is salary (wages). Therefore, efforts to acquire, so called cheaper labor force, it will focus on shaping energy motivation societies. On the other hand, the comprehensive development of society requires shaping the attitudes of an informative nature.

So it comes to a situation that seemingly has no satisfactory solution. But the experience of the societies of the past periods shows that the key to solving is to develop in them appropriate attitudes, motivating effective human action, even in very difficult socio-economic circumstances.

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## MOTYVATION AND CONTROL IN TECHNICAL SYSTEMS

**Abstract:** *The study presents issues related to the motivation of human action and its shaping. The issues are presented from the point of view of psychology, sociology, management science and cybernetics. It was found that in the application of appropriate stimuli may affect motivation to change and consequently the change in quality of performance. The common denominator of these areas of study is the conclusion that the motivation may be the result of the conditions of information or energy. Maslow, human motivations, addicted from needs. He introduced the so-called pyramid of needs, from which it follows that the greatest impact of human motivations are the needs of an energetistic nature. But the Herzberg in his two-factor theory of motivation found that motivations are the result of exposure to man, so-call motivators such as stimuli (incentives) of the informative nature. At the same time he provided the conditions which made the effectiveness of these motivators. Mazur introduced the man as an autonomous system and describe the processes that determine the motivation of action. He said that the man, as the system must be able both to retrieve from environment as well to place on in to the environment, the information and energy. This means that the motives of human actions can have only informative and energetistic character, what largely corresponds with the results of sociological research. Kossecki linked motivations of human activities with distinctive social norms and depends of the human norm type, he found that motivations can be informative, energetistic, or mixed. To similar conclusions is reaching when it is depending the type of motivation of man's relation to the basic categories of social existence, given by Koneczny. Using the principles of transmission of information it has been shown that the efficiency of the control depends on the motivation. People with the energetistic motivation are more likely susceptible to control. In the discussion are presented examples of control in technical systems, typical for the problems presented in the work.*

**Key words:** *motivation, control, technical systems, the impact of information*

## MOTYWACJE I STEROWANIE W SYSTEMACH TECHNICZNYCH

**Streszczenie:** *W pracy przedstawiono zagadnienia związane z motywacją działań człowieka i jej kształtowaniem. Problematykę przedstawiono z punktu widzenia psychologii, socjologii, nauk o zarządzaniu oraz cybernetyki. Wspólnym mianownikiem wymienionych dziedzin nauki jest wnioskowanie, że motywacja może wynikać z przesłanek informacyjnych lub energetycznych. Masłow motywacje ludzkie uzależnił od potrzeb. Przedstawił tzw. piramidę potrzeb, z której wynika, że na motywacje człowieka największy wpływ mają potrzeby o charakterze energetycznym. Z kolei Herzberg w swojej dwuczynnikowej teorii motywacji stwierdził, że motywacje są wynikiem oddziaływania na człowieka tzw. motywatorów, tj. bodźców o charakterze informacyjnym. Jednocześnie przedstawił warunki, od których uzależnił skuteczność tych motywatorów. Mazur przedstawił człowieka jako system autonomiczny oraz opisał procesy determinujące motywacje działań. Stwierdził, że człowiek jako system musi mieć możliwość zarówno pobierania z otoczenia jak i wprowadzania do niego informacji oraz energii. Oznacza to, że motywacje działań człowieka mogą mieć tylko charakter informacyjno-energetyczny, co w dużym stopniu koresponduje z wynikami badań socjologicznych. Kossecki powiązał motywacje działań człowieka z charakterystycznymi normami społecznymi i w zależności od normotypu człowieka stwierdził, że motywacje mogą mieć charakter informacyjny, energetyczny lub mieszany. Do podobnych wniosków dochodzi się uzależniając typ motywacji od stosunku człowieka do podstawowych kategorii bytu społecznego, podanych przez Konecznego. Posługując się zasadami przekazywania informacji pokazano, że skuteczność sterowania zależy od rodzaju motywacji.*

**Słowa kluczowe:** *motywacje, sterowanie, systemy techniczne, oddziaływanie informacyjne*

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