# Mathematical Model of Administrative Decision in Social and Economic System on an Example of HIGH SCHOOL*

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***Abstract*— A mathematical model of the administrative decision in the social and economic system is offered on the example of a higher educational institution (HIGH SCHOOL). When referring to a complex socio-economic system, the institution should be able to fulfill the tasks that exist or are formed in the course of its activities. The synthesis of an adequate management model is considered taking into account the capabilities of Web technologies. The developed model helps to make decisions promptly and increase the speed of management of the educational organization.**

***Keywords— mathematical model; socio-economic system; Web-technologies; higher education institution; law of preservation of integrity; management decision***

## I. INTRODUCTION

Let's imagine a socio-economic system in the form of an economic system and a social system. The economic system is a whole formation consisting of mutually contributing (interrelated) constituent components (elements, managing subjects and parts) and possessing such properties that are not reducible to the properties of these components that are not derived from them and are related to the activities of economic entities, but the social the system is such an integral formation consisting of mutually contributing (interconnected) components (elements, parts and social objects) that possess their properties that are not reducible to the property am of these components is not deducible from them and intended for preservation purpose, both individuals and groups of people, ie, all of the above is the need of human resource management, which is one of the major factors in achieving the goal of guaranteed control. So management in the university with all its complex interacting system is reduced to the need for human resources management. Management is carried out by the manager, that is, the person making the decision (decision maker). LPR creates a certain model of the solution, which will be based on the qualifications of the manager (experience, moral and business qualities), as well as the technical means (Web technologies) used in the university. To ensure the adequacy of the model must take into account the basic laws of the subject area. At the heart of management is the solution. In the subject area, the basic law is the developed law of preserving the integrity of the object [1].

## II. SYNTHESIS OF THE MATHEMATICAL MODEL

As well as qualification of the manager and Web-technologies help us to analyze the available data, which speeds up the process of making the most appropriate decision. Fig. 1 shows the graph of the formation of the model of managerial decision-making by the head of the university where you can see four states under which the leader: first: recognizes the threat and neutralizes it – we will designate this state of the system as A11; when the threat is not recognized and will not be neutralized (rest state of the system) - A00; respectively, the other two states of the system are when a person in a state of uncertainty recognizes the threat, but does not neutralize it – A10 and does not recognize the threat, but thanks to the readiness of the system it neutralizes or absorbs - this is the state of A01. $\lambda$ – is the inverse of the average time of the problem; v1 is the inverse of the mean time for identifying the problem; v2 is the inverse of the average time for neutralizing the problem.

Decision-making by a person occurs on the basis of a model, by which we will understand the representation of an object or such description of the corresponding object, as well as helping to obtain characteristics about a given object [2].

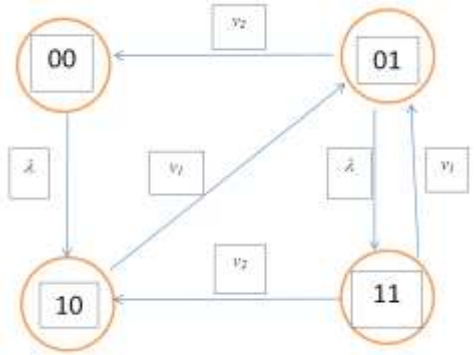


Fig. 1. Graph of the formation of managerial decision by the head of the university

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By decision we will understand such a model of the process. To synthesize our mathematical model, we will use the natural-scientific approach (EPP), based on the law of preserving the integrity of the object (WTSO), which we interpret as a persistent repetitive association of the properties of the object and the properties of the action for a fixed purpose. The law of preservation of the integrity of the object is manifested in the mutual transformation of the properties of the object and the properties of its action for a fixed purpose [3], that is, each process must be represented by three components, then we perform the synthesis of the model, which is shown in Fig. 2.


Fig. 2. Scheme of synthesis of the mathematical model of the managerial decision by the head of the university

To solve this problem, we apply the decomposition method, we dissect the solution into three elements "environment", "information-analytical work" and "solution", which correspond to the "object", "action" and "destination".

Further, applying the method of abstraction and identifying the "object" ("situation") with the periodicity of the manifestation of the problem in front of a person in conditions of uncertainty – Δtpn. "Identity" ("Decision") is identified with the periodicity of neutralization of the problem (by an average time adequate response to the problem) by a person in conditions of uncertainty - Δtnp. "Action" or "Information and analytical work" is identified with the periodicity of problem identification (average time of threat recognition) -Δtip. The characteristics of time will be justified by the fact that only time for a person is irreplaceable. Also the results of the research in the theory of functional systems of the academician of the Academy of Sciences of the USSR Anokhin P.K. showed that the person's decision is formed in the scheme "excitation", "recognition", "reaction to the situation." Therefore, in the synthesis of these three elements is formalized [4].

Using the methods of decomposition, abstraction and aggregation, we transformed the concept of "management solution" into an aggregate – the mathematical model of the administrative decision P = F (ΔtPP, ΔtIP, ΔtNP), where: Δtpp – the periodicity of the problem before the person in conditions of uncertainty; Δtip – periodicity of recognition and identification of the problem; Δtnp is the periodicity of neutralization of the problem, and P is the probability that the problem arising before the person in the conditions of uncertainty is recognized and resolved. This is the condition for the existence of a management process. Further, if we consider the average time of identification (recognition of the situation) and the neutralization of the problem, then they will depend on two factors: Δtip = ΔtipHF + ΔtipTO: the first, this is the human factor, that is the time that is necessary for a person based on his mental and physiological capabilities; and the second is the factor of technical equipment (TO) of the university, which includes Web technologies (site, information and educational resources, security and threat detection systems), which is taken into account in the solution model by the average time of using the Web technologies of the university to reduce identification time of the problem, which either shortens the time spent on identification or does not influence it in any way ΔtipTO≤0 (this characteristic is always a value not positive, since it should shorten the duration of identification (detection) problems). The average time of neutralization (elimination) of the problem Δtnp = ΔtnpHF + ΔtnpTO, will also have two components: the first ΔtnpHF, this is the qualification of the leader (human factor (BF)), which is accounted for in the decision model by the average time of neutralizing (eliminating) the problem based on personal psycho -Physical characteristics (PFD) LPR, ΔtnpTO (this characteristic is always a value not positive, as, by definition, reduces the duration of detection of threats) [5].

This interpretation of the basic components of the mathematical model of the human solution allows us to present these elements with the characteristics of information technology capabilities, through the indicator of the effectiveness of the implementation of the management decision P (the probability that each problem arising before the decision-maker is recognized by him and allowed (neutralized)), our dependence in the following form: P = F (ΔtPP, ΔtiphF + ΔtIPT, ΔtnpHF + ΔtnpTO).

LPR in the management of the university can perform in various combinations two functions: to identify (detect) the problem and to neutralize (eliminate) the problem (use available resources) [1]. In accordance with the described feature of making an administrative decision, it will be necessary to introduce the following probabilities P00, P10, P01, P11, finding the system in states A00, A10, A01, A11. The process of forming a solution can be considered as a Markov chain, for example in the work on safety research [2], but this approach does not allow to sufficiently take into account the dynamics of the process. In this connection, in this paper it will be necessary to use continuous Markov chains. For the states of our system A00, A10, A01, A11, we will use the Kolmogorov–Champion system of differential equations [4], making the assumption of stationarity of the process, transform the system of differential equations to a system of algebraic equations, and obtain the solution in the following form:

$$P_{00}= \nu_1\nu_2/\lambda(\lambda+\nu_1+\nu_2)+\nu_1\nu_2$$

$$P_{01}= \lambda\nu_1/\lambda(\lambda+\nu_1+\nu_2)+\nu_1\nu_2$$

$$P_{10}=\lambda\nu_2(\lambda+\nu_1+\nu_2)/(\nu_1+\nu_2)[\lambda(\lambda+\nu_1+\nu_2)+\nu_1\nu_2]$$

$$P_{11}=\lambda\nu_1/(\nu_1+\nu_2)[(\lambda+\nu_1+\nu_2)+\nu_1\nu_2]$$

The resulting relationships will help us to work out the requirements to the properties of the process of developing managerial decisions that take into account the capabilities of Web technologies, namely, in the ratio (1):

$$P_{00}= P\ \nu_1\nu_2/\lambda(\lambda+\nu_1+\ \nu_2)+\ \nu_1\nu_2, \quad (1)$$

where P is the probability that each problem arising before the decision maker is recognized by him and neutralized.

In this relationship, we have linked three parameters, which depend on the technical capacity of the university, which includes Web technologies [6]. Thus, we have established the dependence on data conditions in the manifestation of the problem (Δtpp) for recognizing an emerging threat activity Δtip = ΔtipChF + ΔtipTO and respectively from the data to eliminate the threat detected Δtnp = ΔtnpChF + ΔtnpTO.

## III. Conclusion

Summarizing, we can draw the following conclusion that the mathematical model of the managerial decision of the head of the university is offered to work, which allows to take into account the possibilities of the university. Synthesis of the system of differential equations allowed to implement a guaranteed approach to university management. The mathematical model of university management can be further refined with the introduction of additional parameters or other conditions. This approach, on the one hand, makes it possible to create an adequate model of university management, and on the other hand it allows us to consider the possibilities of the technical equipment of the university quite fully for practice. The introduction of the developed model into the management system of the university will allow to increase the efficiency of the management of the educational institution while meeting the requirements of the guarantee of achieving the management goal.

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