A MODEL FOR EVALUATION OF THE ASYMPTOTIC STABILITY OF THE ORGANIZATION TO BEARERS OF THREATS

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SUMMARY:

A model for evaluation of the asymptotic stability of the organization in respect to the bearers of threats to it is presented in the article. It is elaborated at the basis of the chaos theory and the theory of parties concerned. The article is worked out in two sections. The concept of the model is presented in the first section. Procedure for evaluation of the asymptotic stability of the organization in respect to its bearers of threats is systematized in the second section. Possible application of the model for particular function of threat to the organization is demonstrated as well.

INTRODUCTION

The issue of evaluating of stability of the organization is still one of undeveloped problems in scientific literature on management. In this connection, *the article is* [3].

The asymptotic stability refers to the feature of a given system to strive for a certain area of possible states included in a formed attractor basin (area of belonging) of a certain attractor [7]. The model suggested is based on the idea from [7] that the system "organization" has many attractor basins, whereas in capacity of attractors are viewed its bearers of threats, called licensing institutions.

By licensing institutions[4] are meant parties concerned in the operation of the organization. They interact with the organization under given

aimed at presenting a possible model for evaluation of the asymptotic stability of the organization in respect to its bearers of threats, based on the chaos theory and the theory of parties concerned

circumstances. The conditions are associated with specific indicators of operation of the organization, called "license indicators" [7]. Changes in values of the license indicators lead to variation in the aggression of licensing institutions and as a result to change of both the values of threats to the organization and its moment states of asymptotic stability in respect to licensing institutions.

As *a starting point* of the model suggested it is assumed that current and projected threats to the organization are previously evaluated in quantitative respect.

In broad terms, the model of the article consists in: 1) examination of the asymptotic (in)stability of the parametric families of the functions of threat to the organization from its licensing institutions; 2) analysis of the asymptotic (in)stability of the analytic functions of threat as well as of its current and projected states of asymptotic (in)stability and 3) conclusions about the distance of the current and projected evaluations of asymptotic (in)stability from the transition to contrary state (i.e. to the points of bifurcation[5]).

The implementation of the model proposed

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[3] The authors are elaborating on the subject within the framework of scientific research project "Theoretical fundamentals of an internal standard of measuring and evaluating of threats to the organizations", financed by the National Science Fund to the Bulgarian Ministry of Education, Youth and Science of Republic of Bulgaria.

[4] The term "licensing institutions" was introduced by Andy Neely (see [8]). He incorporates in it the bearers of interests (in this context, bearers of threats) that could have critical attitude towards the organization.

[5] Bifurcation (forking of the paths of evolution) is a process of a qualitative transition from a state of equilibrium to chaos through very little changes, carried out successively [7].

requires definition of the bifurcation diagrams and phase portraits of the asymptotic stability in respect to bearers of threats to the organization as well as of the remoteness of the current and projected states from bifurcation points (see figure 2).

1. CONCEPT OF THE MODEL FOR EVALUATION OF THE ASYMPTOTIC (IN)STABILITY OF THE ORGANIZATION IN RESPECT TO LICENSING INSTITUTIONS

Theory of parties concerned (see [8]) is used in this context for defining relations between the organization and subjects from its environment and for quantitative description of threats from these subjects. Holders (bearers) of interests (in this context, threats) in respect to operations of the organization are defined as licensing institutions[6]. The interaction between the organization and its licensing institutions are described by so-called "license"[7]. By license is meant the formalized or non-formalized attitude of agreement to interact with the organization under certain conditions [7]. Conditions of the license are associated with specific indicators of operation of the organization, called license indicators, and are described by values of these indicators. Reaching to the critical meanings of license indicators changes the magnitude of the aggression of licensing institutions and as a result values of threats to the organization.

In the context of the theory of parties concerned, the starting point of the article that values of current and projected threats to the organizations are known requires defining in advance of: licensing institutions of the organization, license indicators of each licensing institution, functions of aggression of each licensing institution to the organization according to license indicators and functions of threat to the organization from licensing institutions according to license indicators (see figure 1). More precisely, the current evaluations of threats to the organization are generated by: 1) substitution of the values of license indicators in the corresponding functions of aggression, which results in current evaluations of the aggression of licensing institutions according to license indicators and 2) consecutive substitution of these current evaluations of aggression in the functions of threat to the organization according to licensing institutions and license indicators. The obtained evaluations of threat are aggregated by type for all licensing institutions. The projected evaluations of threat are determined by analogy with the current evaluations, but concern the package of managerial decisions on restraining threats. It is assumed that the package of managerial decisions will change values of license indicators so as to decrease the aggression of licensing institutions and consequently to decrease threats to the organization from them as well.

The chaos theory (see [1] and [2]) is part of classical physics, using the devices of applied mathematics [3]. The application of the chaos theory in this context is for evaluation of the asymptotic in(stability) (see [2]) of the organization. The asymptotic stability is a term from the chaos theory. It is regarded as the feature of a given system to revert to state of equilibrium [2]. In other words, the asymptotic stability of a system in respect to given attractor means belonging to its attractor basin under slight variations of the manageable parameters of the system. Conversely, the asymptotic instability of the system involves leaving the respective attractor basin that does happen under critical meanings of manageable parameters. The attractor basin defines just a limited area of values of the manageable parameters of systems, which set their homeostasis [7]. The model from this article is based on the idea from [7] in capacity of attractors of the organizations to be viewed its licensing institutions and in capacity of manageable parameters – license indicators by separate licensing institutions.

The evaluation in the model boils down to definition of the current and projected states of asymptotic (in)stability of the organization in respect to its licensing institutions (attractors, see [4]) as well as to conclusions about the distance of these evaluations from the bifurcation points (points of transition to contrary state).

[6] "The term "holder of interests" is much broader than the term "shareholder" because included in the circle of holders of interests are all persons that have relationships with the organization, no matter whether they are external to it (clients and suppliers) or its members (employees and owners who often are the shareholders)" [8].

[7] "Anyone who enters into relations with the organization in fact grants his implicit license for the pursuit of its activity, and anyone who decides not to enter into relations with it in practice refuses to grant such a license. In practice this means that all organizations obtain license for pursuit of activity by several different institutions (regulatory authorities, employees, clients, suppliers) and that any of these institutions may at any time withdraw its license from the organization." [8].

The evaluation of the current asymptotic (in)stability is preceded by examination of the parametric families of the functions of threat to the organization from its licensing institutions and subsequent analysis of the homonymous analytic functions (see figure 1). Instruments, used for the purpose, are: bifurcation diagrams of the functions of threat from licensing institutions, phase portraits of the bifurcation diagrams and the first derivative of the non-linear continuous one-dimension functions of threat in respect to the aggression of licensing institutions. The projected asymptotic (in)stability is determined by analogy with the current asymptotic (in)stability, but instead of the current evaluation of aggression the projected aggression is used.

The bifurcation diagram describes the borders of the qualitative changes of the regime (from stability to instability and vice versa) when changing the parameters of the function [5] (in this context, of the function of threat). In the model the bifurcation diagram (see figure 2 (a) outlines the borders of the attractor basins of licensing institutions for the organization.

The phase portrait is a set of all phase curves in the phase space [6]. The phase space is formed from the aggregate of independent unknown variables in the function [6]. In this context the phase space is described by the axis of the unknown aggression of licensing institutions, and the phase portraits are described by the aggregate of all bifurcation points on the axis of aggression (see figure 2 (b).

The procedure for evaluation of the current/projected asymptotic (in)stability of the organization in respect to given licensing institution is accomplished in two sub-procedures: 1) examination of the parametric family of the function of threat and 2) subsequent analysis of the analytic function of threat, of the current and projected states of asymptotic (in)stability.

The examination of the parametric family of the function of threat from the first sub-procedure requires plotting of the bifurcation diagram for the parametric family of the function and its phase portrait (see figure 2). The first activity requires examination of the signs of the first derivative to the function of threat, defined for the solutions of the equalized to zero function. The phase portrait of the one-dimension function of threat is formed in the second activity by plotting the points of bifurcation on the axis of aggression.

The analysis of the specific analytical function of asymptotic (in)stability from the second sub-procedure boils down to 1) defining bifurcation points of this function (points of transition from stability to instability and vice versa – They are defined as solutions of the equation obtained from equalization of the first derivative to zero.) 2) subsequent comparing the distance of the evaluation of the current/projected (in)stability to the bifurcation points of the function (defined through the sign and the value of the result from the substitution of the current/projected evaluation of aggression in the first derivative of the function of threat) and 3) subsequent conclusions of possible states in case of change of the aggression of licensing institutions under license indicators in the interval $[0,1]$.

An example for the approbation of the model suggested for a particular analytic function of threat to the organization is shown in figure 2. The cited data are from the scientific research project “Theoretical fundamentals of an internal standard of measuring and evaluating of threats to the organizations”, financed by the National Science Fund to the Bulgarian Ministry of Education, Youth and Science of Republic of Bulgaria.

2. PROCEDURE FOR EVALUATION OF ASYMPTOTIC (IN)STABILITY OF THE ORGANIZATION TO LICENSING INSTITUTIONS.

Mathematical expression (with formulas) of the operations for study of asymptotic stability for non-linear continuous one-dimension functions in this section of the article is developed by the authors in analogy with numerical examples from [3]. The activities of the procedure are performed separately for every licensing institution by every license parameter.

I.1. Examination of the asymptotic (in)stability of the parametric families of the functions of threat to the organization.

I.1.1. Setting the parametric function of threat to zero (formula (1).

$$th_i^{f,par} = f\left(ag_i^f\right) = 0\ , \quad (1)$$

where:

$th_i^{f,par}$ is the parametric function of threat to the organization from the licensing institution f by license parameter i ;

par - the meaning for parametric presentation of function and of solution to this function;

ag_i^f - the aggression of licensing institution f to the organization by license parameter i.

I.1.2. Defining the solutions to the parametric function of threat from I.1.1.

The solutions from the activity are described by $ag_{i,1}^{f,par}, \ldots, ag_{i,dc}^{f,par}$,

where:

dc is the number of the solution to the function, $dc \in [1, pi]$.

pi - - the maximum number of solution to the function (usually it coincides with the maximum degree of the unknown aggression ag_i^f).

I.1.3. Calculation of the first derivative of the parametric function of threat from I.1.1. - $th_i^{',f,par}$ (formula (2).

$$th_i^{',f,par} = \partial th_i^{f,par} / \partial ag_i^{f,par}, \qquad (2)$$

where:

$th_i^{',f,par}$ is the first derivative of the parametric function of threat $th_i^{f,par}$.

I.1.4. Investigation of the meanings of the first derivative of the parametric function of threat from I.1.1. for every solution from I.1.2.

The activity is realized by substituting the solutions $ag_{i,dc}^{f,par}$ in the first derivative $th_i^{',f,par}$ of the parametric function of threat and subsequent algebraic examination of the derivative for the different values (positive or negative) of its parameters.

Possible results are:

- Formula (3) is fulfilled. $\Rightarrow$ *The branch of the bifurcation diagram of the function is unstable* for the respective meanings of its parameters (see figure 2).

$$th_i^{',f,par}\left(ag_{i,dc}^{f,par}\right) > 0 \qquad (3)$$

- Formula (4) is fulfilled. $\Rightarrow$ *The branch of the bifurcation diagram of the function is stable* for the respective meanings of its parameters (see figure 2).

$$th_i^{',f,par}\left(ag_{i,dc}^{f,par}\right) < 0 \qquad (4)$$

I.1.5. Plotting the bifurcation diagram and phase portrait of the parametric function of threat (see figure 2).

I.1.6. Repetition of activities from I.1. for all parametric functions of threat to the organization.

I.2. *Analysis of the asymptotic (in)stability of the analytical functions of threat and of current/projected states* of *(in)stability*.

I.2.1. Setting the first derivative of the analytical function of threat to zero (formula (5).

$$th_i^{',f} = 0 \qquad (5)$$

I.2.2. Defining the bifurcation points (of transition from asymptotic stability to instability) for the analytical function of threat (see p. B1 and p. B2 from figure 2).

The points of transition from asymptotic stability to instability ($ag_{i,dc}^{',f}$) for the specific analytical function of threat coincide with the solutions to the equation from formula (5).

I.2.3. Defining the current/projected state of asymptotic (in)stability in respect to given licensing institution by particular license parameter (see p. C and p. P from figure 2).

The activity is realized by substituting the evaluation of current/projected aggression of specific licensing institution and license parameter ($ag_{i,pre}^f / ag_{i,fu}^f$) in the first derivate of the respective analytical function of threat $th_i^{',f}$ from I.2.1. The results for the asymptotic (in)stability are analogous and are defined by formulas (3) and (4).

I.2.4. Conclusions and evaluations of the asymptotic stability of the analytical function of threat.

The conclusions and evaluations from the activity refer to the distance from the current/projected evaluation of (in)stability to the transition to the opposite state, as well as to the potential results for the given function of threat of aggression $ag_i^f \in [0,1]$ (see distances CB2 and PB2 from figure 2).

I.2.5. Repetition of the activities from I.2. for all analytical functions of threat to the organization.

CONCLUSION

The article presents a model for evaluation of the asymptotic stability of the organization in respect to the bearers of threats to it, based on the chaos theory and the theory of parties concerned. The model is explained by its concept, characterization of theories, which are at the root of the model, and of instruments used as well as by description of the procedure for evaluation of the asymptotic (in)stability to bearers of threats. The model is suitable for putting into management practice of organizations of all types.

Possible application of the model is demonstrated for a particular function of threat.

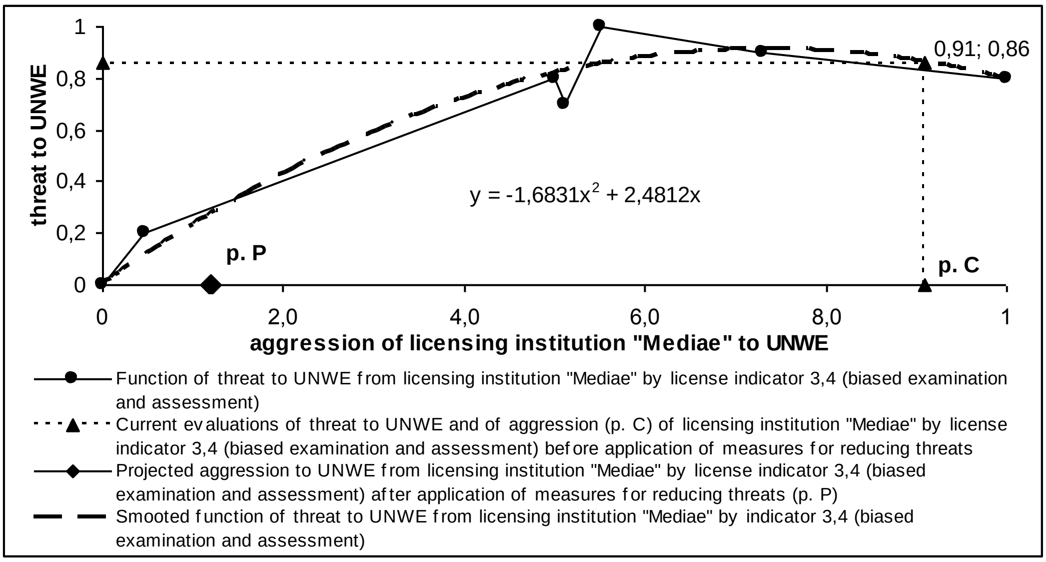
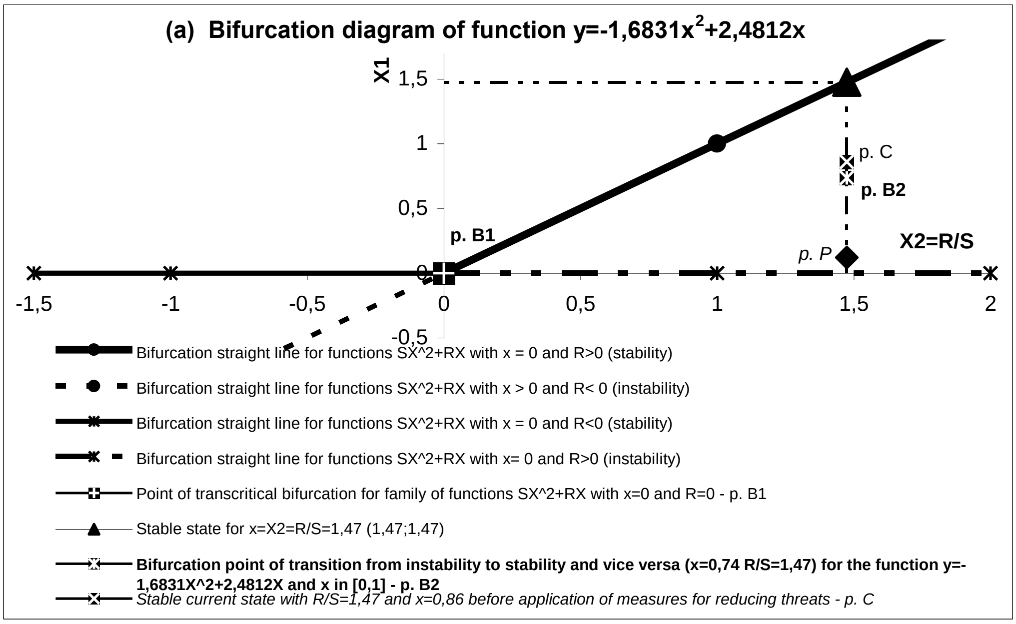


Figure 1. Function of threat of University of National and World Economy – Sofia (UNWE) from licensing institution "Mediae" by license indicator 3.4 "Biased examination and assessment"



(b) Phase portrait of function $y = -1,6831x^2 + 2,4812x$

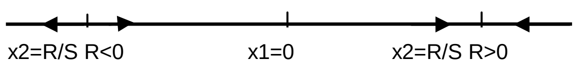


Figure 2. Bifurcation diagram (a) and phase portrait (b) of function of threat $y = -1{,}6831x^2 + 2{,}4812x$

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