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ASPECTS OF MODELING WORK CONDITIONS INFLUENCE ON THE PERFORMANCE OF EMPLOYEES

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Abstract:*The goal of the present work is the increase of predictability for working in respect of human health and for a better performance and a longer life of the equipment. An efficiently structured system of the quality and environment management, health and security assessment, and risks estimation and combative management is intended. In the case of the studied situation - reconditioning of parts by metal spraying - we analysed by proposing and applying some models for improving a nonlinear dynamic model of the system behavior for the social responsibility, for analysing the ecologic impact of the processes. This process is computer modeled in the paper by a nonlinear formalism with Ikeda equation, for obtaining a stable output. Then, the nonlinear answer is further tested by using the TableCurve3D software.The models are in agreement with other literature works, and practical methods used abroad for assuring human staff helth and top activities.*
Keywords: *work conditions, reconditioning parts, ecology, nonlinear models, social responsibility*

1. INTRODUCTION

The analogies of type model – reality are important instruments for the study of different phenomena taking place in industry and environments. The present paper proposes the analysis and control with respect with the importance and impact of work conditions and employees' health on the results and competitiveness of an industrial unit. We have chosen the complex process of conditioning and reconditioning of parts, depending of a multitude of parameters. Any deviation of these parameters can cause the failure of the process, meaning non-conform properties. The practical researches [1] showed that metal spraying reconditionning method has a big economicity, decreasing the production costs, and being sometime the only solution for re-using some parts. Our studies taken into account the quality of the work and the impact on the environment and on the working staff, the social responsibility and the sustainable development. This is an actual abordation in context of European strategies „Europe 2020".
The increase of predictability for reconditioning of parts can be realized by a good consideration of a project of quality improving type 6Sigma DMAIC (Define – Measure – Analyze - Improve – Control) [2] for nonconformity reduction, defining the social responsibility [3], analysing the health, security and ecologic impact of the processes[4], the risks treatment with a model FMEA (Failure Mode and Effect Analysis).

2. BASIC CONSIDERATIONS

Basic assumptions of our work include studies on the social responsibility of the organization involved in reconditioning of parts by metal spraying procedees, with protection of the environment, conformed to principles of the standard ISO 14001:2005 and on some elements of guarantee of the security and health of the work - standard OHSAS 18001:2007, respectively. The responsibility of an organization for their decisions and activities on the society and environment, by an ethical and transparent behavior, which contributes to the sustainable development, takes into consideration the stakeholder expectations. This is in conformity with the international agreements and evidenced the importance of the social and environmental component. The true responsible organization is part of a system, and do not act only for obtaining a profit, without regarding on their impact on the other social partners. It evaluates correctly its place in the whole economy and applies the CSR (Corporate Social Responsibility) policies that means autoanalyzing the activity having in vue the sustainable development. The CSR principles are: responsibility, transparency, ethic, respecting the interests of the partners, respect of the laws and rules, respect of the human rights (ISO: 26000).

For the technological process studied here, there are some factors taken into account, like: noise (125dB), irritant powders in work place, radiations (UV), high temperature. For the environment, are very important: amplacement of materials, water protection, soil protection etc. Thus, the CSR policies will establish a healthy program for the staff (alimentation, periodic health control, sport, life solutions), energetic economy, reduction of consumables, water monitoring, recicling etc. Since the sustainability reffers to a whole system, a feedback loop is necessary, and this leads to a higher level activity of the considered unit. In practice, one can adopt the CSR policies step by step, with experimental character, and analyze the effects of the feedback. When positive results are obtained, a jump appears and new CSR more detailed measures can be adopted. So, a new jump on a higher level will be reached, in conformity with the nonlinear scenarios of multi-stability by repetitive feedback. This is a complex dynamics, with a general feature, which can be applied to social phenomena as well. The nonlinearity of the system is justified by the evolution of some organizations in an undesirable unsustainable form, with a nontrivial dynamics, characterized by some parameters like „gain" (g) and „losses" (α). Conforming with the nonlinear dynamics, losses of the system can be modelated by „re-injecting" some feedback signals, as previously stated. [5] Disfunctions of the system are assimilated with noise factors; by introducing a control parameter by feedback, the system can reach a higher level [6].

3. MODELING THE NONLINEAR BEHAVIOR OF THE SYSTEM

Complex equation used for describing the state of the system is:

$$E_{n+1} = A + BE_n \exp[iK/(|E_n|^2 + 1) + C] \tag{1}$$

where E_n is the output transmitted by the system (which has feedback). This form is originated from the initial one developed by Ikeda, Daido, and Akimoto:

$$z_{n+1} = A + Bz_n \exp[i|z_n|^2 + C] \tag{2}$$

where z_n has the significance of information circulating within the system with the step n and is transmitted by this one, and A is a parameter connected with the applied constant signal; C- other parameter connected with the linear dependence in time. Parameter B gives the losses in system (dissipative parameter) $B \leq 1$. If $B = 1$, then the system becomes conservative.

Both E_n and A (real) are proportional to the information circulating and transmitted. We consider$B=0.5$, $C=0$ [7].

In a plan, the equation can be written under real form as:

$$x_{n+1} = 1 + u(x_n \cos t_n - y_n \sin t_n) \tag{3}$$

$$y_{n+1} = u(x_n \sin t_n + y_n \cos t_n) \tag{4}$$

u being a parameter, and t_n:

$$t_n = 0.4 - \frac{6}{1 + x_n^{\ 2} + y_n^{\ 2}} \tag{5}$$

In function of the values of u, the system can behave chaotically, then a negative feedback being necessary.

The steady state solution has the form:

$$A = |E|[1 + B^2 - 2B\cos(|E|^2 - C)]^{1/2} \tag{6}$$

and leads to a multi-states type answer of the system.

We considered *(1,1)*,*(2.5,0.25)*, *(1.9,1.9)* as initial values, and the iterative procedures evidenced in Figure 1 leaded to steady states, bifurcations to chaos [8], reverse bifurcations to stationary state etc, which means the whole complex dynamics of the system. The steady-state solution is represented by the dotted line, the stable ones by the solid line.

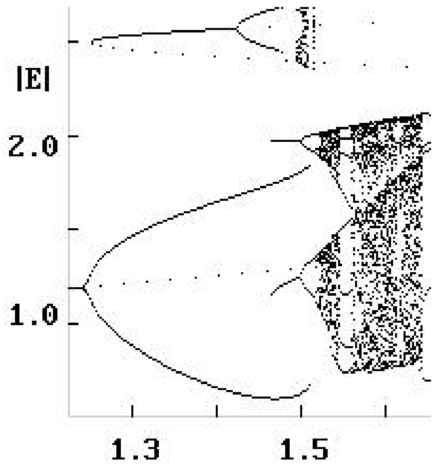

Figure 1: Ikeda Model

Where the input was implemented by us in consense with CSR policies, and the output re-enter the system by feedback loop (Figure 2), determining the jump to a higher level. By introducing the internal control parameters mechanism as smal control forces, one can manage the desired evolution of the system.

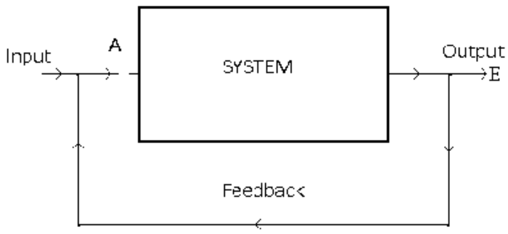

Figure 2: Schematic configuration of the system with feedback

For the graphic representation of the dynamic behavior of different kind of systems, computer tools are very useful [9]. Our system is composed by „work unity" + environment, and we used the program TableCurve3D. Figure 3 represents the steady states of our system with feedback, at a control parameter constant in time *B=0.5*, input *A*ϵ*[0,6]*, output *E* ϵ*[0.4]*, and in Figure 4, the most complete equation describing the stable system with feedback. The nonconforme practical problems are studied and selected, considering their influence as a maxim impact, with a score factor between 0 for null influence and 10 for a „catastrofal" influence.

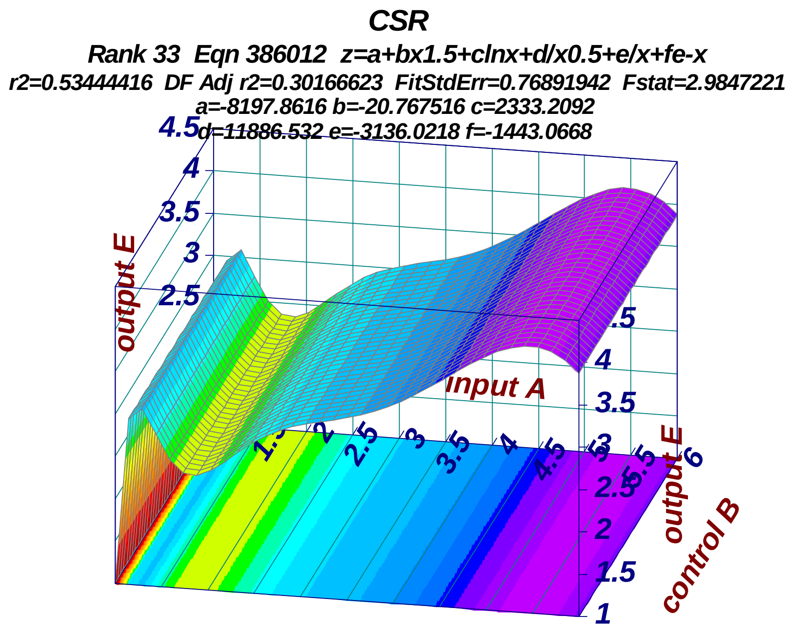

Figure 3: Steady states E in function of the input A and control parameter in time B

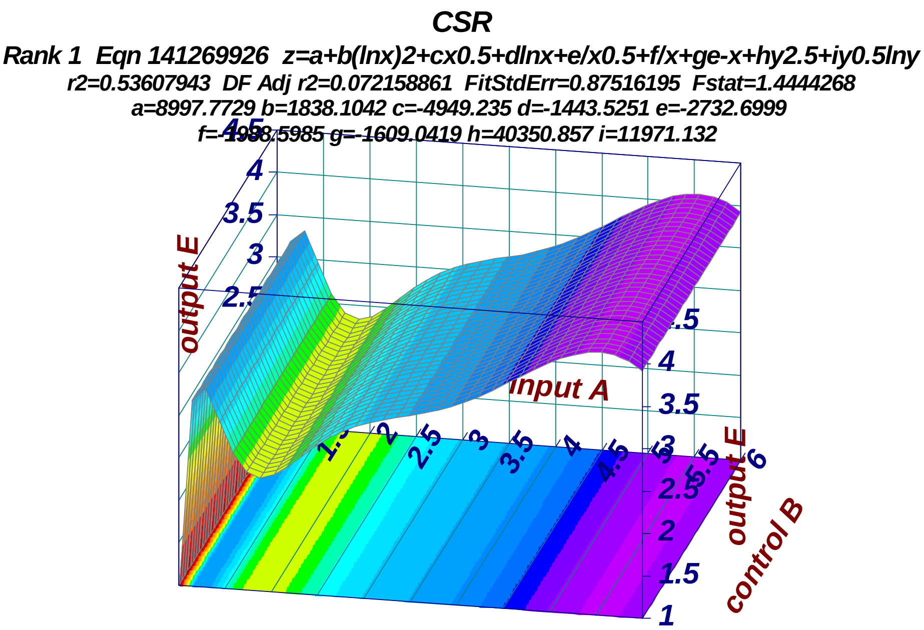

Figure 4: The most complete equation describing steady states of the system with feedback

One can see that the state of the system is modifying depending on the feedback, so giving the possibility to reach new higher stationary states, as it is evidenced in Figure 5 by Ikeda model.

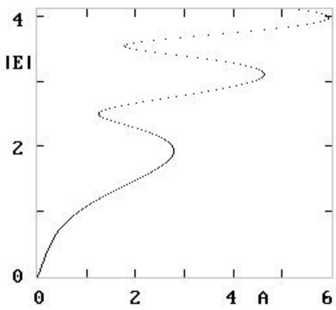

Figure 5: Stationary states curve of Ikeda model

The programme is performed in QBASIC and finally some options can be chosen, concerning the values domain, without modifying of this programme. New plots occur in terms of these new values and one can see immediately the influence on the dynamic regime of the system.

3.CONCLUSIONS

Reconditioning as a method is a very old ideea, but the specific technological flux involves many phenomena which lead to specific methods for assuring the quality, security and ecologic assumptions. Nowadays, the social responsibility of any kind of activity is determined by the elaborated standards and means a sustainable development, satisfying the needs of the present without compromising the future.
In conformity with the CE initiatives, it is fully recognized that CSR policies can play a key role in the implementation of the sustainable development, consolidating the competitiveness and the innovative character. For an industrial unit, this is the result of a triple optimization: the so-called Triple bottom line or TBL, 3BL, concept created by John Elkington [10]: ecological (environmental), social (like better work conditions, social help, non-using children for work, non-abusing them etc.), economical (long term profitabilitability). It means at the same time a base for evaluating and minimizations of the risks factors. They can help the corporatist management in understanding and remove some potential negative effects of its own activity, having as a feedback long term effect to protect the results and the reputation of the company. [11] The CSR can be applied to non-profits organizations, too.
In this context, the nonlinear dynamics methods applied showed clearly the role of the CRS methods and can lead also to the accord and synchronization of several units to implement them together.
It is obviously known that majority of neither units neither are small and medium; that it doesn't exist nor a non-responsible neither a perfect responsible organization, but they generally have different responsibility degrees, depending on the applied policies. It results, by statistical thermodynamics considerations, that an unlimited increasing of the competitiveness and profitability is impossible in a system with a big, but finite number of elementary constituents [12].

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