



## Recommended Biometric Stress Management System

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### ABSTRACT

The experiences of undergoing economic crises attest that the loss of employment prompts an outbreak of mental illnesses and suicides, increases the numbers of heart attacks and strokes and negatively affects other illnesses suffered by individuals under stress. Negative stress can devastate a person, cause depression, lower productivity on the job and the competitiveness of businesses and damage the quality of life. The Recommended Biometric Stress Management System, which the aforementioned authors of this article have developed, can assist in determining the level of negative stress and resolve the problem for lessening it. The system can help to manage current stressful situation and to minimise future stress by making the level of future need satisfaction more rational. In the first case, the system facilitates individuals to make a real-time assessment of their stress level and, after they fill in a stress management questionnaire, to get rational tips for the reduction of current stress based on the best global practice accumulated in the system. The multi-variant design and multiple criteria analysis methods are used for that purpose. The generation of recommendations and the selection of the most rational are based on criteria systems and on Maslow's Hierarchy of Needs. Since this is an interdisciplinary area of research, psychologists, philosophers and experts in information management and decision-making theories and intelligent and biometric technologies participated in the development of this system. Over the course of this system's development, the biometric technologies of information, intelligence and voice were integrated. The case study submitted in this article demonstrates this developed system.

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### 1. Introduction

As the tempo of contemporary life quickens along with the increasing rates of competition on the job market, uncertainty about the future and continual demands for greater competency, the risk of experiencing stress unavoidably rises. Stress is the physiological and psychological state of tension in a person caused by external and internal irritants called stressors. Stress is a natural reaction of an organism to internal as well as external, positive as well as negative stimuli. Stress frequently manifests in our lives and it stimulates action, inventiveness and creativity. However, long-lasting, uncontrolled stress exhausts the psyche and the immune system of an organism and it can cause various illnesses.

Obviously stress not only hampers interactions but it also causes serious problems, particularly when common goals are being pursued. Research studies have shown that, at work, if the intensity of stressors is great, the speed of processing information

decreases by as much as 30–50%. A person is unable to focus attention, makes many mistakes on the job, suffers memory lapses, frequently feels tired, speaks tersely at bubbling speed, loses satisfaction in activities and is either constantly hungry or lacks appetite. Typical illnesses caused by stress are hypertension, stomach and intestine ulcers, migraine headaches, heart (myocardial) attack and certain immuno-allergic illnesses.

Research has convincingly shown that the rates of illness and death from such causes are 1.8–2.2 times higher amongst persons who have suffered long bouts of stress.

Work-related stress is an especially relevant problem. Stress is the second leading cause after backaches of work-related health problems in the European Union (28% of employees). Stress is also a stressful collapse (World Health Organisation Learning Materials, 2009).

Stress causes over a fourth of all work-related health disorders which result in an absence from work for two or more weeks thereby causing tremendous financial losses (Eurostat, 2001).

Statistics from 1999 show that work-related stress costs the countries of the European Union 20 billion Euros annually (Third European survey on working conditions 2000, 2001). Furthermore this cost rises each year. In less than one decade (2008), the

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amount has already reached 80 billion Euros. Great Britain alone incurs costs of 18 billion Euros each year due to stress.

Numerous studies have been conducted in the world attempting to explain what causes stress at work and how it can be identified and measured. Maslow's Hierarchy of Needs theory (Maslow, 1943, 1954) is probably the most widely applied.

Research shows that various scientists have specialised in depth the different and very important areas of speech and emotion analysis (Clavel, Vasilescu, Devillers, Richard, & Ehrette, 2008), emotion detection (Altun & Polat, 2009), emotion annotation (Callejas & López-Cózar, 2008), evaluation and the estimation of emotions in speech (Grimm, Kroschel, Mower, & Narayanan, 2007), ensemble methods for spoken emotion recognition (Morrison, Wang, & De Silva, 2007), speech and emotion (Douglas-Cowie, Cowie, & Campbell, 2003), emotional states that are expressed in speech (Cowie & Cornelius, 2003), voice quality in communicating emotion, mood and attitude (Gobl & Chasaide, 2003), emotions, speech and the ASR framework (Bosch, 2003), vocal communication of emotion (Scherer, 2003), emotional speech recognition (Ververidis & Kotropoulos, 2006), speech recognition (Avci & Akpolat, 2006), speaking improvement (Hsu, 2010), voice dialogue (Tsai, 2006), recognition of musical genres (Mostafa & Billor, 2009), command recognition (Savage-Carmona, Billingham, & Holden, 1998), intelligent home appliance control (Hsu, Yang, & Wu, 2010). According to Ververidis and Kotropoulos (2006) the most frequent acoustic features used for emotional speech recognition are pitch, formants, vocal tract cross-section areas, mel-frequency cepstral coefficients, Teager energy operator-based features, the intensity of speech signals, and speech rates. Ververidis and Kotropoulos (2006) reviewed appropriate techniques in order to classify speech into emotional states. Classification techniques based on hidden Markov models, Artificial Neural Networks, linear discriminate analysis, *k*-nearest neighbours, support vector machines were reviewed by Ververidis and Kotropoulos (2006). However, the above speech and emotion analysis systems cannot generate (perform a multi-variant design, multi-criteria analysis and selection out the best tips) different recommendations. The Recommended Biometric Stress Management System developed by this paper's authors can perform the aforementioned function.

The structure of this paper is as follows: Section 2, which follows this introduction, describes individual needs and negative stress in ever-changing micro- and macro-environments. Section 3 analyses the systems for the establishment, analysis and management of stress levels and Section 4—Maslow's Hierarchy of Needs and Intelligent Systems. Section 5 provides a description of the Recommended Biometric Stress Management System and Section 6—a case study. Certain concluding remarks appear in Section 7.

## 2. Individual needs and negative stress in ever-changing micro- and macro-environments

Continual changes in a micro- and macro-environment affect an individual's life, goals, needs and priorities as well as experiences of negative stress. For example, prior to the world crisis, job-seekers were more interested in the amount of wages offered than they were about guaranteed work. During the crisis, unemployment grew rapidly, and a continuing, long-term job has begun motivating employees more than a short-term, unstable job does albeit its high wages. The level of negative stress that a person experiences is proportionate to the level of needs satisfaction.

Scientists forecast that increasing unemployment will prompt an outbreak of mental illnesses and suicides. Academics at Oxford University are convinced that the economic crisis will cost thousands of lives in Europe alone. British experts attest that their

greatest fears are heart attacks and suicides—during earlier crises, these same misfortunes had been prompted due to psychological problems that residents suffered over job and income losses. To forecast how many lives the economic crisis will demand, scientists compared the most frequent causes of death and the unemployment percentages in Europe during 1970–2007. The results show that an increase of unemployment by 1% raises the risk of suicides amongst persons younger than 65 years of age by some 0.8%. Such an increase would mean up to 550 additional suicides across the European Union (Janužytė, 2009).

Existing micro- and macro-environments limit choices regarding people's lives and their activities. People's needs and possibilities depend on variable factors at the macro-level which impact people in a complex manner. Such factors include a country's natural environment, economics, politics, culture, traditions, religion, laws, tax system and so forth. The level of satisfaction of human needs depends on variable factors at the micro-level, such as choice of an area for activities, use of technology at work, managerial and motivation systems, work environment, co-workers, infrastructure of the locale and the like. These, by their own accord, depend on the impact of macro-level factors.

Wanting to assure a maximal or rational level of satisfaction of individual needs, a person's life (leisure time, work and such) must be lived within certain rational bounds which are determined by the economic, political, legal, institutional, technological, social, cultural, religious, ethical, psychological and other sorts of environments. As an environment changes, the level of individual needs satisfaction also changes (Fig. 1).

Micro- and macro-level factors, shown graphically in Fig. 1, are able to affect an integrated level of individual needs satisfaction. This means a person can only satisfy his/her needs under conditions of certain combinations of micro- and macro-factors. Such micro- and macro-factor combinations form a certain boundary. Beyond this boundary, the effectiveness of individual needs satisfaction begins to lessen. As the environment of an individual's life changes, that person's goals also change; thereby this diagram also changes accordingly. Over time this diagram will change again, because the micro- and macro-environment conditions continue to change. As the level of needs satisfaction decreases, the negative stress that a person experiences increases. Thus, when attempting to increase the integrated level of individual needs satisfaction, it is necessary to employ the knowledge and experiences accumulated around the world regarding the impact of factors at the micro- and macro-levels. This is performed by analysing the best global knowledge and experiences and then applying them in Lithuania.

By using individual work motivation in an ever-changing environment as an example, it becomes noticeable that, when the level of motivation is high, work effectiveness will also be high.

With the changing environment, the solutions of motivation problems are becoming even more complex (Himachali, 2009). This is due, in part, to the fact that what motivates employees changes constantly (Bowen & Radhakrishna, 1991). Managers need to understand what motivates employees within the context of the roles they perform and understand the process, theories and fundamental components of motivation. Options such as job enlargement, job enrichment, promotions and monetary and non-monetary compensations should be considered (Himachali, 2009). Research done by Higgins (2004) has established the ten most motivating factors: interesting work, good wages, full appreciation of work done, job security, good working conditions, promotions and growth in the organisation, feeling of being in on things, personal loyalty to employees, tactful discipline and sympathetic help with personal problems.

According to Boyett and Boyett (1999), as we enter the 21st century, we can guarantee that continual change will become the norm. Today, value lies in the knowledge and skills applied to

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