STOCHASTIC MODELING OF TEAM COHESIVENESS AND ITS RISK MANAGEMENT

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Rezumat. *Managementul resurselor umane și coeziunea echipei sunt elemente importante ale organizațiilor de lucru de succes. Predicția și evaluarea coeziunii echipei joacă un rol-cheie în eficiența echipei și a mediului wok și, prin urmare, instrumentele predictive ale coeziunii și eficienței echipei ar spori eficiența echipei și a organizării forței de muncă, precum și ar atenua orice întrerupere în cadrul organizației. Este bine recunoscut faptul că există diverse incertitudini care pot contribui și afecta dinamica și coeziunea echipei, cum ar fi diferite obiective de carieră, aspecte culturale, integrarea și păstrarea membrilor echipei, numărul de membri ai echipei etc. Prin urmare, o modalitate de a cuantifica aceste incertitudini este abordări de modelare stocastică a resurselor umane. Modelarea stocastică este un instrument puternic care poate prezice cu o anumită probabilitate evenimentele care pot avea loc în cadrul resurselor umane. În cercetarea de față este dezvoltat și propus un model stocastic, bazat pe teoria probabilității, pentru analiza dinamicii, coeziunii și eficienței echipei. Studiul arată că coeziunea echipei și astfel, eficiența acesteia scade odată cu creșterea numărului de membri ai echipei. Acest lucru poate fi rezultatul diferențelor culturale, al obiectivelor de carieră și al integrării în echipă. Cercetarea arată că abordarea modelării stocastice este o abordare promițătoare în predicția dinamicii, coeziunii și eficienței echipei.*

Abstract. *Human resources management and team cohesiveness are important elements of successful working organizations. The prediction and assessment of team cohesiveness play a key role in the team and wok environment efficiency and thus, predictive tools of team cohesiveness and efficiency would enhance the efficiency of the team and workforce organization as well it would mitigate any interruptions within the organization. It is well recognized that there various uncertainties that can contribute and affect the team dynamics and cohesiveness such as different career goals, cultural aspects, team member integration and retention, number of team members, etc. Therefore, one way to quantify these uncertainties are the stochastic modeling approaches of human resources. The stochastic modeling is a powerful tool that can predict with certain probability the events that may occur within the human resources. In the present research a stochastic model, based on probability theory, is developed and proposed for the analysis of team dynamics, cohesiveness and efficiency. The study shows that the team cohesiveness and thus, its efficiency decreases with the increase of the team members. This may a result of cultural differences, career goals and team integration. The research shows that the stochastic modeling approach is a promising approach in the prediction of the dynamics, cohesiveness and efficiency of the team.*

Keywords: team cohesiveness, risk management, stochastic modeling, numerical modeling, dynamical systems

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1. Introduction

Human resources management plays a critical role in any organization and thus, predictive tools of workforce availability would enhance the efficiency of the organization as well it would mitigate any interruptions within the organization.

However, the human resources are often prone to the impact of various uncertainties associated with the need of skilled workforce caused by migrations, recession, pandemics, resources shortage, etc. Therefore, one way to quantify these uncertainties are the stochastic modeling approaches of human resources.

The stochastic modeling is a powerful tool that can predict with certain probability the events that may occur within the human resources.

An important environment where the theory of the dynamical system can be used is the simulation and prediction of correlation between jobs and work force availability. In this sense, the European Union (EU) represents an interesting case due the more or less control migration of the work force cause by the expansion of the EU including East-European countries such as Bulgaria and Romania.

Moreover, the uncontrolled migration of populations from the conflict zones also brought numerous uncertainties in the job-workforce correlation over the past decades. Moreover, the impact of the 2008 economic crisis also brought uncertainties to the job-workforce correlation. The hypothesis of this research is that the correlation of the job-workforce availability can be modeled using the theory of the dynamical systems, including uncertainty modeling.

The present research concerns the development of computational models that can predict the correlation of job-workforce availability. We will employ the developed computational model for the analysis of jobs-workforce correlation within EU, for different periods of time between 2006 and 2013.

In the present research a stochastic model, based on probability theory, is developed and proposed for the analysis of human resources dynamics and risk management, for EU during the period of 2006-2013. Therefore, the studies are performed to investigate the correlation between the economic driving factor and dynamics of human resources. The research shows that the stochastic modeling approach can predict with certain probability the dynamics of the human resources correlated with the economic factors. The study also show that stochastic modeling can predict the increase of unemployment during the economic crises, which affected the EU during the period of 2008-2009.

2. Mathematical modeling and algorithms

The current research concerns the numerical modeling of the team cohesiveness and its risk management. Since there is a randomness in the human behavior, the stochastic modeling is a promising approach that can predict the human interaction and team cohesiveness. Therefore, in this research we focus on the development of a computational stochastic model, which offers the capability of predicting the team cohesiveness and its risk management. The proposed stochastic model is based on the probability of random variables. As already mentioned above there is a randomness in the human behavior which can impact the team cohesiveness and thus, it is important to employ a random variable probabilistic model.

The probabilistic model is presented in the following. First we will define the discrete and continuous random variables. Thus, a set X is called discrete if there a finite or denumerable set of distinct values,

$$\alpha_1, \alpha_2, \alpha_3 \dots\dots \tag{1}$$

such that

$$a_i \equiv \Pr\{X = \alpha_i\} > 0, i = 1,2,3, \dots, \tag{2}$$

and

$$\sum_i a_i = 1 \tag{3}$$

$$a_i \equiv \Pr\{X = \alpha_i\} > 0, i = 1,2,3, \dots, \tag{4}$$

If

$$\Pr\{X = \alpha_i\} = 0 \tag{5}$$

for every value of *a,* the random variable is called continuous. If there is a nonnegative function p(t), defined for

$$-\infty < t < \infty \tag{6}$$

Such that the distribution function F of the random variable X is given by

$$F(\alpha) = \int_{-\infty}^{\alpha} p(t)\,dt \tag{7}$$

Then p is said to be the probability density of X. if X has a probability density, then it is necessary continuous.

It is worth to mention here that in this research we focus in continuous random variables. Therefore, if X is a continuous random variable with probability density

$$p(\cdot) \tag{8}$$

its *m-th* moment is given by

$$E[X^m] = \int_{-\infty}^{\infty} x^m p(x)\, dx \tag{9}$$

provided the integral converges absolutely.
The first moment of X, comely called the mean, is denoted by

$$m_x \tag{10}$$

or

$$\mu_x \tag{11}$$

The *mth* central moment of X is defined as the *mth* moment of the random variable X-m_x if m_x exists.

If X is a random variable and g is a function, then Y=g(X) is also a random variable. If X is a discrete random variable with possible values $x_1, x_2, x_3, \dots \dots \dots$ then the expectations of g(X) is given by

$$E[X^m] = \sum_{i=1}^{\infty} g(x_i) P\{X = x_i\} \tag{12}$$

if the sum converges absolutely.

If X is a discrete random variable with possible values $x_1, x_2, x_3, \dots \dots \dots$, then the expectation of g(X) is given by

$$E[g(X)] = \int_{-\infty}^{\infty} g(x) P_x(x)\, dx \tag{13}$$

The general formula, covering both the discrete and continuous cases is

$$E[g(X)] = \int g(x)\, dF_x(x) \tag{14}$$

where F_x is the distribution function of the random variable X. It is worth mentioning here that the integral of equation 10 is the Lebesgue-Stieltjes integral.

3. Results and discussion

It is worth to mention here that defining an effective team does not ensure full efficiency of the team. Therefore, the social interaction within the team also plays a critical role. As shown in Figure 1.9, the five factors that define the dynamics of an effective team are: (i) psychological safety, (ii) dependability, (iii) structure and clarity, (iv) meaning and (v) impact. The psychological safety concerns taking the risk and being comfortable with weaknesses. It is worth to mention here that the current analysis is carried out for two-dimensional random walks. The results of the current study are presented in the Figures 1 through 10, as follows. The impact of the number of members of the team on the team cohesiveness is presented in the following. Therefore, Figure 1 presents the team cohesiveness for the case of 6 team members. The analysis shows that there is a decrease of the team cohesiveness with the increase of the number of team members. As it can be seen from the graph in Figure 1, a minimum number of 2 member is required for the analysis.

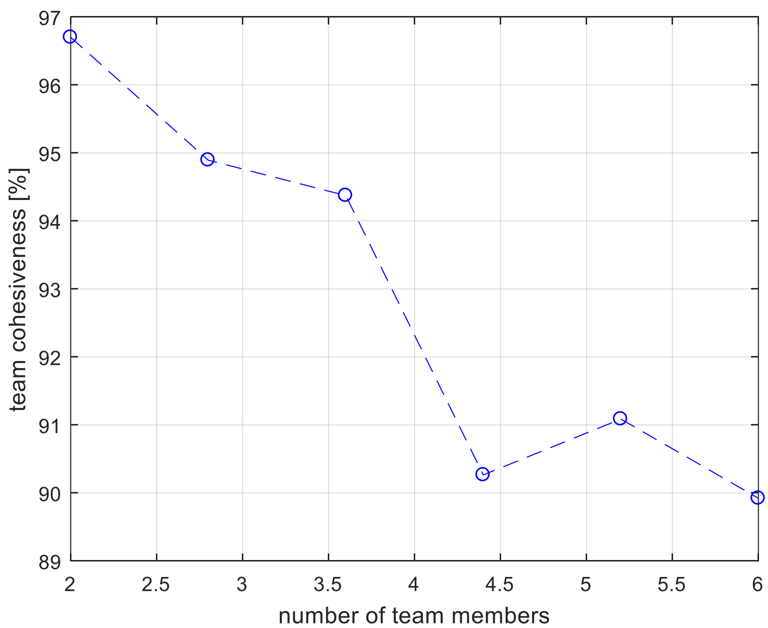

Fig. 1. Team cohesiveness for a number of team members=6

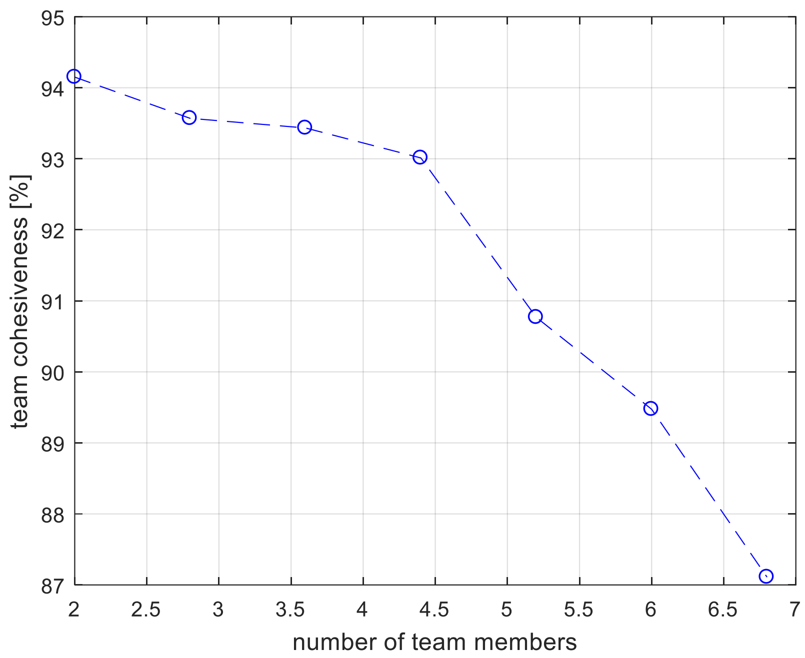

Fig. 2. Team cohesiveness for a number of team members=7

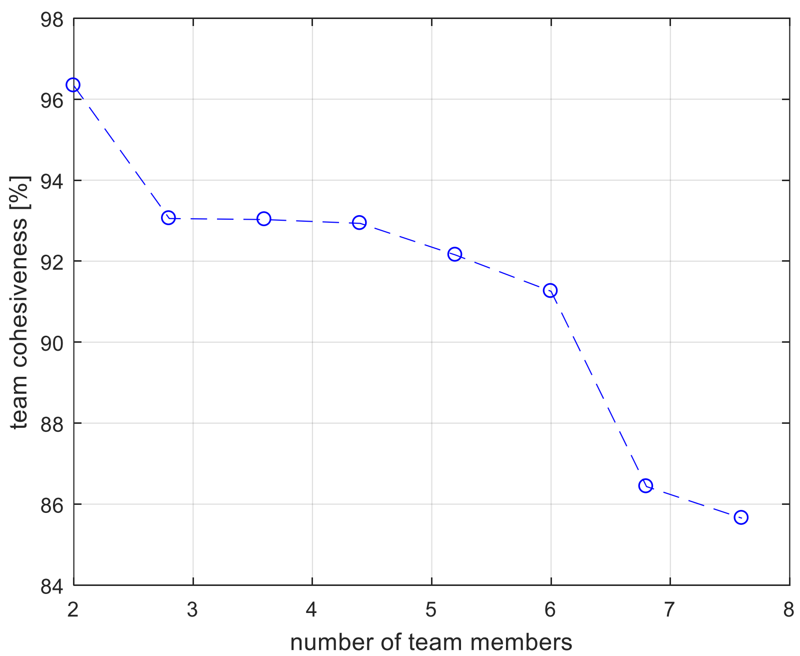

Fig. 3. Team cohesiveness for a number of team members=8

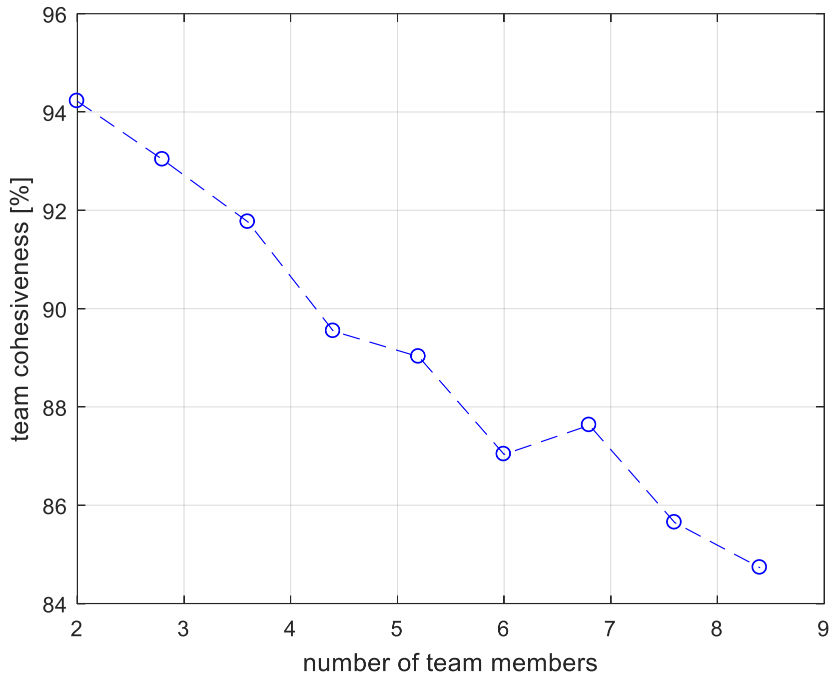

Fig. 4. Team cohesiveness for a number of team members=9

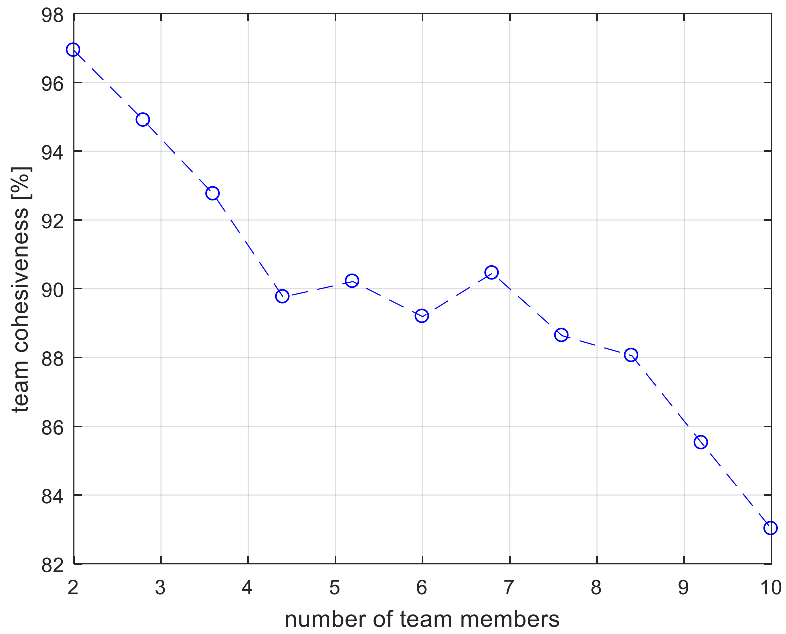

Fig. 5. Team cohesiveness for a number of team members=10

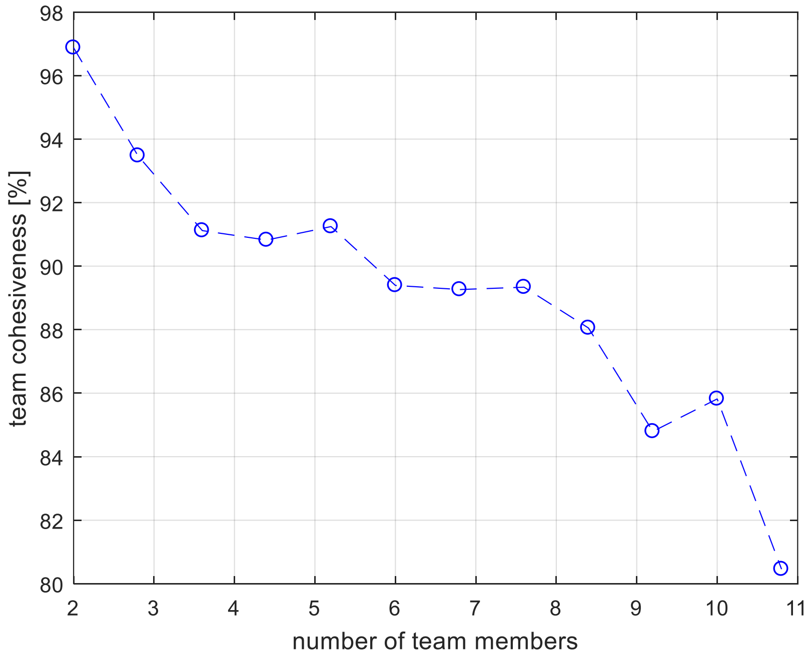

Fig. 6. Team cohesiveness for a number of team members=11

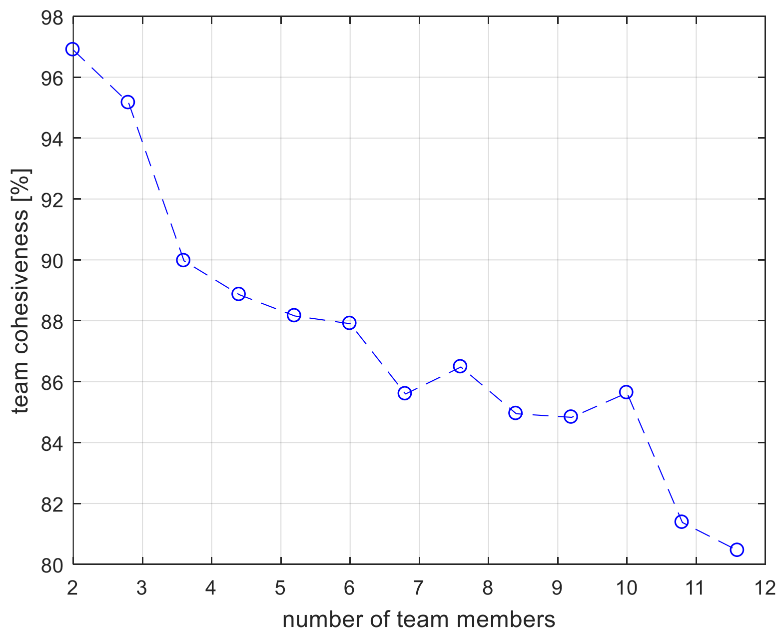

Fig.7. Team cohesiveness for a number of team members=12

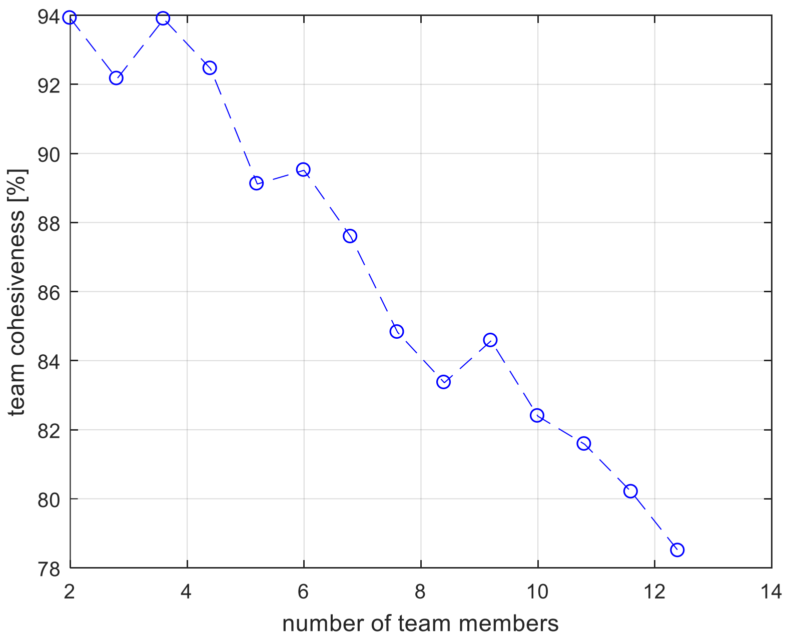

Fig. 8. Team cohesiveness for a number of team members=13

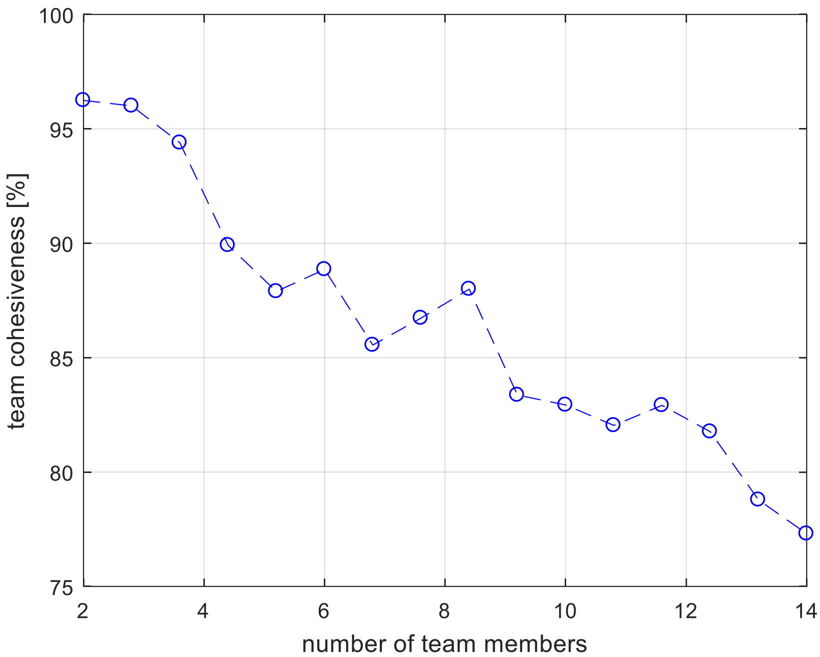

Fig. 9. Team cohesiveness for a number of team members=14

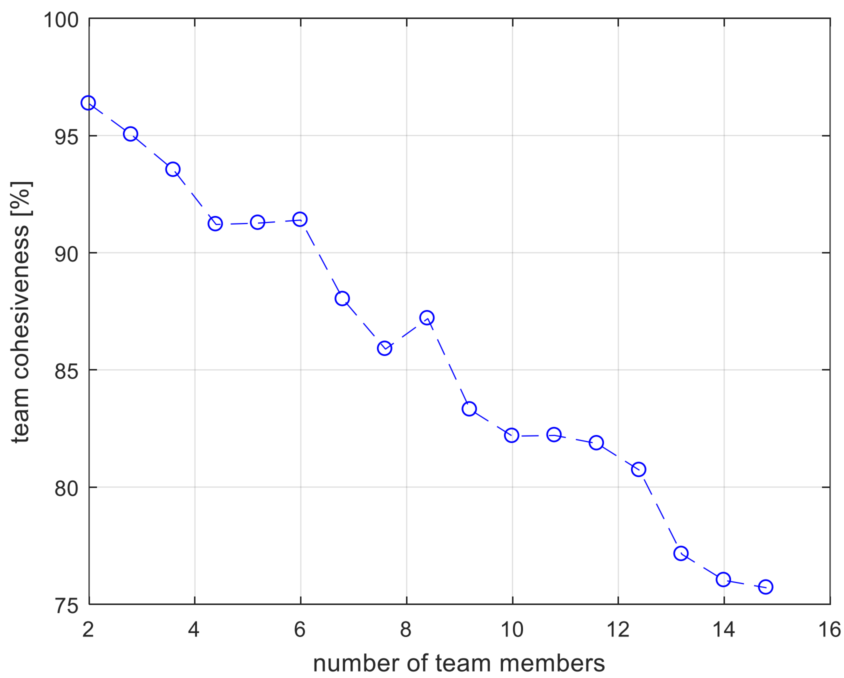

Fig. 10. Team cohesiveness for a number of team members=15

From Figure 1, it can be seen that for a team consisting of 2 members the cohesiveness is about 97% and decreases with the increase of the team members. Thus, for a team of 6 members the cohesiveness decreases to 90%.

Figure 2 presents the analysis of the team cohesiveness for a number of team members equal to 7. The study shows that the increase of the number of team members to 7 causes a decrease of team cohesiveness to about 87%. Further increase of the team members causes a further decrease of the team cohesiveness, and thus, for a team formed of 8 members the team cohesiveness decreases below 86%. Similar trends were observed with the further increase of the team members and thus, for a team formed out of 9 members the team cohesiveness decreases to about 84%, while for a team formed of 10 members, the team cohesiveness decreases to 83%.

Further increase of the team members to 11 causes an even further decrease of the team cohesiveness to about 80%, while for team of 14 members the team cohesiveness decreased to about 77%. For a team of 15 members, the team cohesiveness decreases to about 75%.

Overall, the study shows that the increase of the team members causes a decrease of the team cohesiveness and this is due to several factors such as: (i) different work abilities of the team members, (ii) different work perspectives and culture, (iii) job motivation and (iv) career advancement.

5. Conclusions

A stochastic model using the theory of probability is developed and employed for the prediction of the relationship between the number of members of a working team and team cohesiveness. The study shows that the stochastic modeling is a powerful tool that can be used successfully in the prediction of the dynamics of human resources while establishing a correlation between the team members and team cohesiveness. The study shows that the stochastic modeling of the human resources dynamics is a promising predictive approach that can help in enhancing the management of human resources and thus, enhance the team efficiency and productivity.

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