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The Influence of Motivation upon Performance: A Quantitative Research Conducted Among Software Developers

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Abstract

In a complex and unpredictable business environment that is constantly changing, often the individual performance of software developers directly influences the performance of the entire organization. Thus, the more motivated employees (respectively software developers) are, the results obtained by them are higher, because the achievement of the individual objectives is closely related to the achievement of the organization's objectives.

Therefore, this paper aims to study the link between motivating software developers and organizational performance for a multinational company in Romania using Charles Handy's theory of motivation. Starting from the 4 "E" factors (energy, excitement, effort and expenditure), a quantitative research was carried out by applying a questionnaire among 32 software developers. The questionnaire was made up of Likert-scale questions, so that each software developer could choose the option that seemed most appropriate. The results revealed that there is a strong link between the four motivational factors (e factors) and organizational performance within software developers. Also, for the study of the concepts most often encountered together with motivation, software developers and performance, bibliometric research was carried out.

Keywords: organizational performance, motivation process, software developers

1. Introduction

The process of motivating software developers plays a special role in the development of the organization in which they work. The more employees are attached to the job, creating the feeling of belonging, the more they will want to complete the projects in which they are involved with maximum efficiency, achieving all the previously expected results.

Moreover, Wong's (2011) study revealed that one of the most important factors influencing the review of the whole system along with teamwork, characteristics and implications of assigned tasks, methods and software techniques used, is the motivation of software developers.

Motivation is often described by the involvement and concentration of employees in achieving assigned tasks. The elements that differentiate a motivated employee from an unmotivated one are represented by: the concern about the partial results achieved, in order to achieve the final results, the degree of involvement in work, the effort, the proactivity of the work environment (Kakar, 2017; France, da Silva, & Sharp, 2018; Oliveira & Franca, 2019).

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In essence, motivation is represented by all the efforts made by software developers for a certain period of time by developing a specific behavior to achieve one or more goals.

Today's business environment is uncertain, full of challenges, often the information held being insufficient to solve the problems that arose. Thus, in terms of the feeling of accomplishment after fulfilling their tasks, software developers will commit to a sustained effort during the work carried out to obtain superior results.

The link between software developers' motivation and organizational performance was studied during extensive research based on Charles Handy's motivational theory developed in 1976.

2. Literature review

The software development process is directly influenced by the organization's employees, respectively by software developers, the literature revealing the fact that often the motivational factors contribute positively to the development of activities with maximum efficiency. Successful implementation of organizational projects can only be achieved by a team of qualified and motivated software developers (Verner, Babar, Cerpa, Hall, & Beecham, 2014; Kachorowski et al., 2018).

The main characteristics of software developers include both their personal experience and knowledge and behavioral issues such as: norms, beliefs, values (Crutcher &Ericssion, 2000; Carver, 2004; Wong, 2011).

The study of Verner, Babar, Cerpa, Hall, & Beecham (2014) reveals that the main factors influencing the motivation process of software developers are: the good and efficient communication process maintained by the project manager with project team members, control and reassessment of risks during the implementation of the component activities, the trust that the final clients have in the project team and in the organization itself, the interim reports made during the partial implementation of the project, the collaboration between team members, the pleasant experience of a software developer in implementing a similar project. Also, the motivation process is influenced by three main factors, which were studied in detail in this paper: needs, factors, and results (Handy, 1999), figure 1.

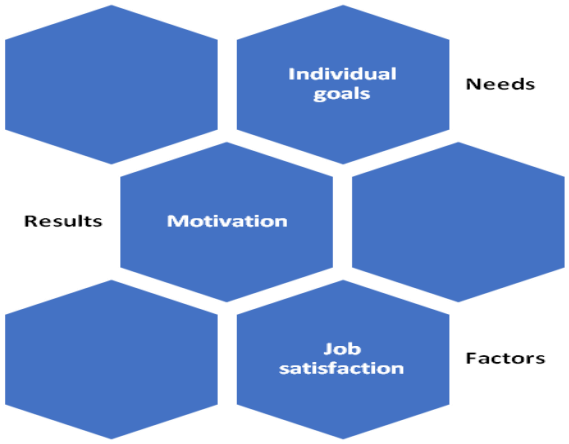

Figure 1. Motivational factors - Charles Handy's Theory
Source: adapted from Handy (1999)

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Regarding the process of motivating software developers, an essential role is played by project managers, which can lead to motivating or demotivating his team (Beecham, Baddoo, Hall, Robinson, & Sharp, 2008; Storey et al., 2019). Thus, the motivational factors used by project managers can take different forms, divided into two categories: positive and negative. The positive factors consist in amplifying the rewards offered to software developers depending on the efforts made by them, while the negative ones refer to the threat of penalties and sanctions for not properly performing individual tasks.

Therefore, it is crucial for an organization to have highly trained managers who are able to motivate and lead the team so that members make full use of their skills and abilities and their full potential (Kalliamvakou et al., 2017).

Developing job satisfaction and productivity among software developers is one of the main goals for software companies because employees satisfied with their work would allow companies to attract, develop and retain their talent, while more productive employees could contribute to reducing costs, increasing profit and improving the quality of products or services provided, as appropriate (Acton & Golden, 2003; Storey et al., 2019). Also, the study of Rasch and Tosi (1992) revealed that the totality of circumstances that lead to a person's motivation to make a greater effort in the work done leads to increased performance and productivity.

In the field of software development, it is much more difficult to identify an objective for measuring performance (Mockus&Herbsleb, 2002; Baltes, 2018). In addition to programming, the development of software products/programs also involves many other tasks and responsibilities such as requirements engineering, testing and troubleshooting (LaToza, Venolia, &DeLine, 2006; Sonnentag, Niessen, & Volmer, 2006). Regarding the relationship between organizational performance and information received by software developers most theories support the idea that companies can get high benefits and higher competitive advantages, increasing their performance through the ability of their employees to store, analyze and transfer information further (Alavi&Leidner, 2001; Ozer & Vogel, 2015). Therefore, organizational performance refers to the level of participation of software developers, so the more information they have and the more motivated they are to perform their assigned tasks, the higher their performance will be.

3. Method

In order to study the impact of the influence of motivation on the performance of software developers, the papers and specialized articles from different databases such as Web of Science, JSTOR, Science Direct related to software developers' motivation, as well as organizational performance were researched. Also, in order to identify the main keywords most frequently encountered, a bibliometric research was carried out on the studied topic at the level of the Web of Science database, as it contains the most representative studies and prestigious journals. The combination of keywords used was: "motivation" and "software developers" and "performance", resulting in a number of 153.

After processing the articles with the help of VOS viewer software, it can be stated that among the most common concepts along with "motivation", "performance" and "software developers" are: "satisfaction", "job-satisfaction", "participation", "intrinsic motivation", "creativity" (figure

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2). At the opposite pole, the rarest terms encountered are: “virtual environment”, “market”, “e-training” (figure 2).

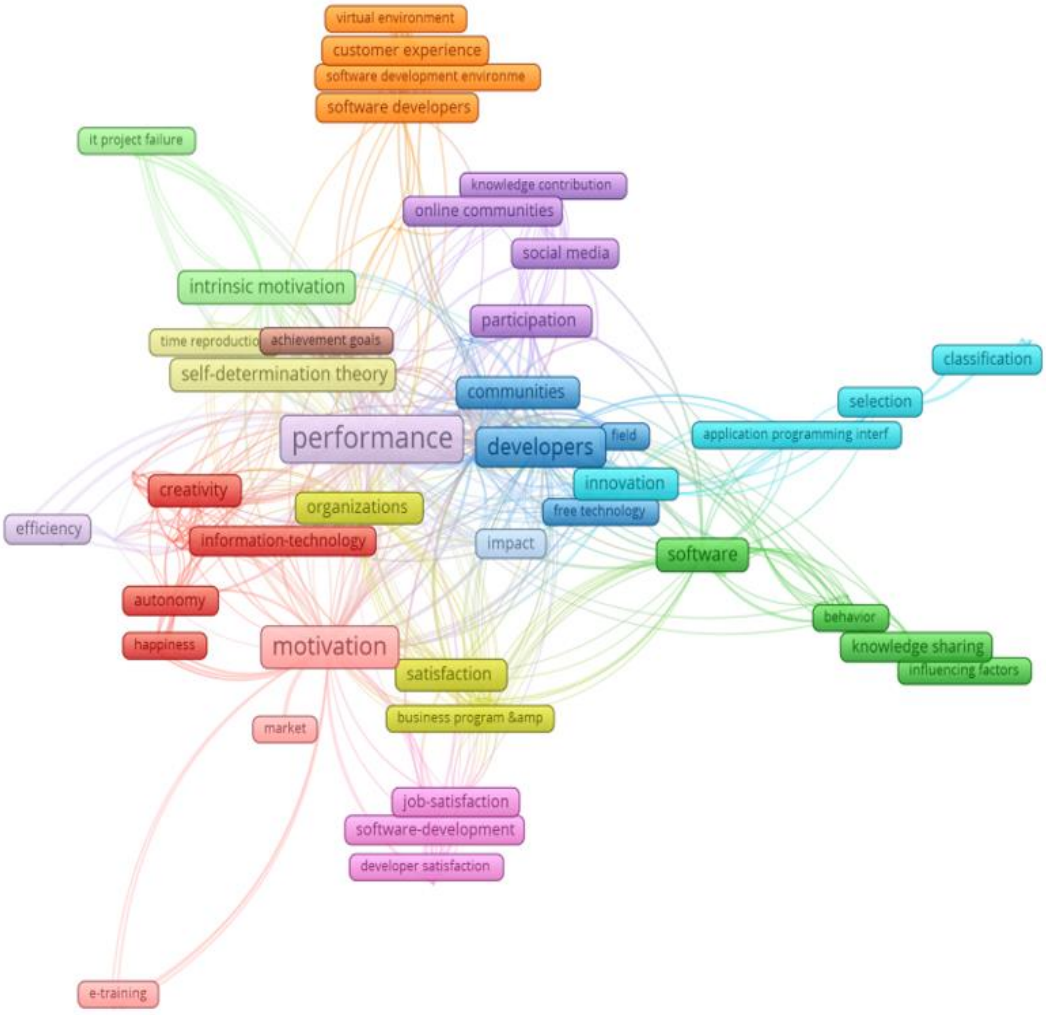

Figure 2. Frequency of keywords – motivation of software developers
Source: Authors' own contribution

As regards, the quantitative research is using as its sole tool of research a questionnaire that was addressed to the software developers working for a company. The questionnaire itself is tracking Charles Handy’s “E” factors inside the branch of a multinational software developing company based in the United Kingdom, that is a global supplier of developing and implementing enterprise software solutions and has a history of more than forty years in this market.
In Romania it has one of their largest solutions hubs from the world, in which they are employing more than 600 people that are working in different functions of the company as in Finance, Supply chain, Human Resources or Software testing and developing.

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3.1. The research instruments

The main tool of research in this study is a questionnaire developed on a Likert scale bases, that tracks the opinions of a representative sample of software developers from the company (n=54) with different positions and experience.

The questionnaire was filled in in the period of September to October 2021, using Google Forms, and the review of performance that was filled in by the managers of the respondents was done in the period of December 2021 to January 2021.

Table 1 – Respondent's management level

Level	Respondents	Cumulative %
06 Senior Manager	1	2%
07 Manager	1	2%
08 Master	1	2%
09 Expert	8	15%
10 Specialist	26	48%
11 Intermediate	13	24%
12 Entry	4	7%
Total	54	100%

Source: Authors' own contribution

In our sample, only 2 respondents (4%) are senior managers that are overseeing other manager and gives their support in handling teams or departments, 9 respondents (17%) are expert level professionals that are handling complex or difficult situations, and 43 respondents (79%) are on execution level with the gross being specialists in their field 26 respondents (48%).

The perceptions of all the respondents are analyzed by the questionnaire using Charles Handy's Motivation Calculus framework, with a focus on the four "E" factors and it is done as a way to understand the respondents own given importance to the "E" factors to fulfill the organizational goals.

For this reason, in the questionnaire we have used a simple and direct type of wording as the intent was to achieve results that can be validated and used in our study and we have used Likert scale, with a five-grade intensity scale, which is an ordinary attitude scale.

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Table 2 – The questionnaire

Question	1 - Strongly disagree	2- Disagree	3 - Neutral	4 - Agree	5- Strongly agree
1. To achieve the organizational goals more **effort** is needed from your part	0	3	12	27	12
2. To achieve the organizational goals more **energy** is needed from your part	0	0	33	19	2
3. To achieve the organizational goals more **excitement** is needed from your part	0	6	22	22	4
4. To achieve the organizational goals more **expenditure** is needed from your part	0	11	15	25	3

Source: Authors' own contribution

Calculation method for Question 1: (1*0+2*3+3*12+4*27+5*12)/54= 3.8889
Calculation method for Question 2: (1*0+2*0+3*33+4*19+5*2)/54= 3.4259
Calculation method for Question 3: (1*0+2*16+3*22+4*22+5*4)/54= 3.4444
Calculation method for Question 4: (1*0+2*11+3*15+4*25+5*3)/54= 3.3704

The company, with the closing of the Financial Year in October each year, is starting the process of performance review for all their active employees and each supervisor must analyse and mark the performance of his subordinates using the company's own performance-based matrix tool.

Table 3 – The Performance Score

Level	Score	Cumulative %
5 – Outstanding	3	6%
4 – Exceeds expectations	21	39%
3 – Meets expectations	30	56%
2 – Needs improvement	0	0%
1 – Unacceptable	0	0%
TOTAL	54	100%

Source: Authors' own contribution

As we can see from table 3, each employee can receive a score from 1 (Unacceptable) to 5 (Outstanding). Scores of 1 to 2, implies that the employee in question needs additional development or support and a development plan has to be done for him.
In our sample, most of the respondents are having scores of 3 (Meets expectations) – 56%, and 21 respondents (39%) are exceeding expectations, while only 3 respondents (6%) are outstanding.

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3.2. Research analysis

We have statistically analyzed the valid data by calculating the correlation between the "E" factors and the performance results the respondents obtained at the end of the analyzed period, by using the Pearson coefficient (r) to measure the intensity and meaning of the connection of the two variable – "E" factors score and the Performance score.

In our study, we have used it to show and prove the dependence of the Performance scores obtained by the respondents on the "E" factors intensity that they have given to the four factors.

The Pearson coefficient is one of the most used statistics tests in the socio-economic sciences and has been validated in practice over the years by many specialists around the world.

$$r = \frac{\sum (x - m_x)(y - m_y)}{\sqrt{\sum (x - mx)^2 \sum (y - my)^2}}$$

As we can see above, Pearson's coefficient formula, in which mx and my are the averages, and x and y the variables.

For this reason, the coefficient can take value of (-1, +1), which represents values between -1 (negative, inverse, perfect correlation) and +1 (positive, direct, perfect correlation). A total absence of correlation/total independence between the two variables is a coefficient of 0.

In practice, the Pearson's coefficient correlation is interpreted as:

- |rxy| = (0;0.1) – a connection that is either non-existent or very weak;
- |rxy| = (0.1;0.3) – a weak connection that requires the application of the Student test to verify the statistical significance;
- |rxy| = (0.3;0.5) – a medium intensity connection;
- |rxy| = (0.5;0.7) – a strong connection;
- |rxy| = (0.7;0.9) – a very strong connection;
- |rxy| = (0.9;0.1) – an almost perfect connection.

Using the Pearson coefficient means that we must consider that both variables are influencing themselves and there is dependency involved as well, because we cannot determine their causality, and we only know that they can vary and see the direction in which they do, without knowing which variable is influencing the other.

For this reason, we need to calculate and interpret the determination coefficient, because we will be able to see and of course interpret if the covariance is higher than in reality, and a higher value of the coefficient will lead to a higher value of the determination coefficient as well.

Table 4 – Correlation of "E" Factors and Performance Score

	"E" Factors	*Performance*
"E" Factors	1	
Performance	0.5851	1

Source: Authors' own contribution

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In our study, the Pearson correlation coefficient shows a strong connection between the "E" Factors and the Performance scores of 0.5851 – 58.51%

Table 5– Determination coefficient

	E" Factors	*Performance*
E" Factors	1	
Performance	0.3424	1

Source: Authors' own contribution

The determination coefficient is 0.3424 – 34.24%

4. Conclusions

We can see that without a doubt there is a valid connection between the way each respondent is perceiving and giving importance to the four "E" factors: effort, energy, excitement, and expenditure in order to fulfill the goals they have inside the company, and the performance score they have obtained.

The above statement can be confirmed by the Pearson's correlation results of r=0.5851, that states without a doubt that there is a strong connection between the two variables we have analyzed, and the determination coefficient r2 =0.3424 that is tracking the statistical significance, and shows the practical relevance of the two variables, or plainly put, shows the 34.24% of the variance is common.

The above statements and statistical data allow us to say, that without any doubt whatsoever, there is a strong connection between how a person is self-perceiving and intrinsic motivates himself in using effort, energy, excitement and expenditure towards achieving the organizational goals as part of his own motivation calculus.

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