Motivational Factors for Distributed Software Development Teams

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Abstract— Over the last decades it has been observed that many companies around the world have started to adopt Distributed Software Development (DSD) to create competitive advantages. Aiming to increase such advantages, many of these companies add some team motivation techniques to DSD. However, the motivation of DSD teams reveals some peculiarities that should be taken into account. This paper presents a literature review on motivational factors in distributed software development. More specifically, the goal was to identify and categorize key success factors in the motivation of distributed teams. We have identified eleven success factors. We categorized each factor according to a proposal integrating Maslow's and Herzberg's motivational theories. The findings show that the factors that motivate distributed software teams are related to different levels of motivation. Despite the distinct levels each factor is associated, we concluded that even the factors related to higher motivational levels are dependent on the most elementary ones. These findings suggest that motivational factors have to be carefully considered when working with distributed teams.

Keywords – motivational factors, distributed software development, literature review.

I. INTRODUCTION

Nowadays, the arduous search that software companies are doing to improve quality and reduce costs is highly noticeable. Several strategies have been adopted by these companies seeking advantages to remain on the market. According to Liviero [1], Distributed Software Development (DSD) is one example of strategy that has acquired many supporters and stimulates several researches.

The adoption of DSD ceased to be a trend of major companies and became a reality for companies overall, regardless of their size. This new way of making software or managing projects is bringing several advantages, including the reduction of costs and productivity enhancement. However, DSD also presents a set of challenges as a side effect. In a distributed project, communication among the team members (developers, managers, etc) is hindered and the physical distance increases the complexity involved in leading and coordinating activities in the project. Another strategy that has been widely used by a considerable number of companies in search of advantages is Team Motivation. Since its first studies after the Industrial Revolution, motivational practices have been impacted by a gradual process of change and

development, and nowadays, this subject brings together several concepts from areas such as Business Administration and Psychology [2].

In this context, the fact that motivational strategies were also adopted by the software market came as no surprise. Soon, motivation of software development teams proved to have a positive impact on the productivity and software developers' quality of work [3].

Despite the fact that team motivation is a powerful tool for software development, the competition in this market requires, in some companies, more than just advantages resulting from the use of such tools. This scenario encouraged many software companies to opt for the combination of the two mentioned strategies. However, some characteristics of DSD prevent motivational practices from being used in this type of team in the same way they are used in co-located teams.

Based on this scenario, we conducted a literature review to identify key success factors that influence motivation in the context of DSD. This paper presents the findings from our review in addition to the analysis we have performed to categorize each factor identified according to the Maslow's and Herzberg's theories on motivation. We believe that our categorization helps further knowledge in the area.

The remainder of this paper is organized as follows: Section 2 presents the background including DSD definitions, motivation and motivation in DSD. Section 3 presents related work. Section 4 discusses the methodology adopted in our study. Section 5 describes our findings as well as the categorization proposed. Section 6 concludes the paper with a brief discussion and introduction of future work.

II. BACKGROUND

A. Distributed Software Development

Distributed Software Development can be defined as the activity of software development performed by a team that is geographically distributed [4]. This distribution of teams can be established at different levels of distance, such as national, continental and global

For the team to be efficient, it is extremely important that a comfortable environment be created in order to permit the

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sense of team to be easily perceived. Features such as effective participation of members, open communication, controlled differences, well-defined individual roles, frequent analysis of good and bad practices, among others, must be guaranteed, otherwise the teams that are geographically dispersed will feel unmotivated [6],[7],[8],[9],[10],[11],[12],[14].

B. *Motivation*

Nowadays, business leaders seek new ways to get people to produce more and better, even when they are constantly subjected to a discouraging context [15].

It was during the Industrial Revolution that the first practices of motivation were applied to a group of workers. At that time the stimuli basically consisted of punishments and threats. However, in the post-revolution period, it was shown that the use of punishments to increase workers' performance could present adverse effects [16]. Subsequently, as observed by Moraes [17], in some cases, the concern to keep the job was more important than the wage itself. Finally, some studies showed that human aspects were important and could increase the performance of employees in the workplace.

França and Silva [18] characterize motivation as internal to an individual, varying according to the objective, having intensity and duration, and being decisive for human behavior. Some motivational theories were formalized. Among them, two deserve to be highlighted: Maslow's theory known as the hierarchy of needs, and Herzberg's theory called the motivator and hygiene factors [15].

Maslow [19] described human needs as being organized in a hierarchic form, in which the need of a level can only be supplied if the necessities of antecedent levels have already been supplied. Maslow also associated each level of need to a motivation one. These levels are detailed below (see Figure 1):

- Physiological needs: the most basic level (the first to be met) and includes the needs associated to human survival. For example: hunger, thirst, sleep, sex, excretion, and others related to general physical comfort.

- Safety needs: related with the need to escape from general dangers. For example: financial stability, health and well-being, health insurance and safety concerning accidents/illness and their adverse impacts.

- Social interaction and relationships: the individual needs to build healthy relationships with close people. For example: coworkers and family.

- Self-esteem: includes the conquest of pride, recognition and status.

- Self-actualization: the last level. It includes the personal fulfillment. It reflects the desire to become everything that one is capable of becoming.
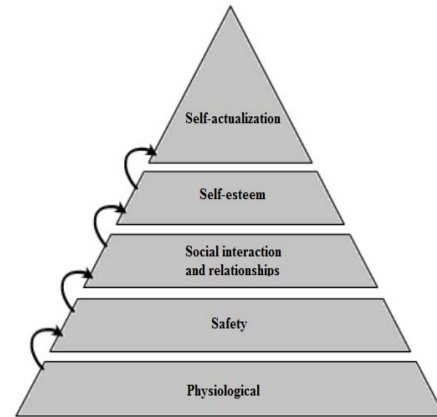

Figura 1.Maslow's hierarchy of needs

On the other hand, Herzberg [20] categorized motivational stimulus as intrinsic and extrinsic (hygienic) as defined below.

- Intrinsic factors: they are internal to the individual. They are a reflection of how the employees face their work and how they feel about it. By achieving each objective, a feeling of individual growth and self-actualization is generated and it encourages the pursuit of new goals.

- Extrinsic factors: they are originated at the environment where the individual is inserted, represented by wages, bonus, awards, prizes, rules, demands, fines, punishments, workplace, benefits, among others. Herzberg also highlights that these factors do not have motivational characteristics. Therefore, they are not enough to influence the team's performance positively and can only provide a transient effect. However, hygienic factors are considered essential, because even without motivational characteristics, the absence of some extrinsic stimuli cause demotivation.

Other motivational theories are:

- Logotherapy: developed by neurologist and psychiastrist Viktor Frankl. In order to create this theory, Frankl [21] based it on the premise that the primary motivational force of an individual is to find the meaning of life.

- Empowerment: developed by William Byham. This theory prioritizes the valorizing of the interaction among people achieved through the use of management techniques[22].

C. *Motivation in DSD teams*

Motivational practices, when well employed, increase team work performance. This trend is maintained with software development teams. Beeckam et al. [3] explain that motivation is the practice that has the biggest individual impact on productivity and software developers' quality of work.

Beecham et al. [3] conducted a research based on the literature in which 90 studies were investigated. They characterized software developers as a special group when it comes to motivation. In general, software developers present

some special characteristics, such as enjoying working with mental challenges, intensive use of communication, being used to performing self-management, among other distinguished characteristics. With the purpose of raising which factors motivate and discourage software development teams, Beecham et al. [3] performed a literature review about motivation applied to software engineering. Some of the motivational factors found were: i) affinity with the task (personal interest, clear goals etc.), ii) good management (good communication, team building etc.), iii) involvement/team work, iv) opportunities for professional development, v) appreciation for being part of the team/relationships based on cooperation, vi) rewards and incentives, vii) acknowledgement for a well-done job, and viii) technically challenging work.

In order to minimize the negative impacts that a team distribution can cause on motivational aspects, some actions should be performed in order to value motivational factors which can be fostered or even created from a DSD context. The intense contact with other members of the team and the participation in decision-making are some examples. Schweiger et al. [11] state that a team can be composed of a set of sub-teams and each of these should have a key member, also known as the focal point, who should act as a leader and integrator of the sub-team to the main team.

III. RELATED WORK

This section examines three related studies identified in our study. A comparison is presented highlighting their strengths and weaknesses.

A. Šteinberga (2011)

This work aimed to identify practices in agile development projects that help increase productivity and measures of success. They intended to understand such practices in DSD context by answering the following questions: "how motivating and demotivating factors present themselves for software engineers in DSD projects and what can be learned from agile projects for eliminating demotivating factors and enable the drivers in DSD?".

The development of this work was based on the motivating and demotivating factors of Beecham et al. [3] which was used in a research related to DSD without an extensive literature review. The research explains the factors related to motivation that are enabled by features inherent in agile approaches. It approaches and results from the relation of the characteristics of DSD and agile approaches with a focus on solving the problems created by the distribution of the project and describe how each problem can have its effects minimized by the use of certain practices of agile projects.

The research presented as key point for the development of guidelines that can be used by DSD projects in order to eliminate problems of motivation of the teams due to scattering. The authors expose how to manifest the characteristics of DSD that hinder the motivation of the team and how certain characteristics of agile projects can be combined to DSD projects to minimize the effects of these problems. The research limited itself to agile approaches, ignoring potentially favorable factors. In addition, the study does not address the cultural and individual differences and peculiarities related to motivation.

B. Silva (2007)

This research aimed to comprehend how leadership stimulates motivation of team members. It aimed to develop a theoretical framework for guiding and better understanding the empirical study; perform the study aiming to understand the actions of the virtual team leader that stimulate the actions of subordinates; to identify through the survey theoretical and empirical elements that facilitate and hinder the motivation of virtual teams.

The author conducted a descriptive and exploratory case study of a company that operates in different states in Brazil and in one location in France. As the main findings of this research, we have: a low frequency of face-to-face interaction, which is the need felt by most members of distributed teams; the telecommunications by voice and preferably also video do not replace face-to-face contacts, but it is more efficient than interactions via text, the periodic certification that the member is part of the group; relying on materials and facilities for the development of activities is indispensable; the practice of feedback that appears as a key element for distributed teams.

This paper presents of important information to DSD team leaders as a key point for them to work more in the motivation of their teams. As limitations of this work we have an inventory of factors, which were originated only in the interviews, limiting the amount of raised factors and the research is restricted to only one company with few interviews.

C. Dwivedula (2007)

This research aimed to explore whether there is a discrepancy between "Wanting" and "Getting", and measure this discrepancy in local project and distributed teams. Also aiming to compare motivational factors ("Wanting") of the team members, to compare the ability of the team environment to support the motivational factors of its members ("Getting"); to understand the latent elements that can explain the motivational factors of the members of a team ("Wanting"), to understand the elements that team environments have the ability to provide support to the expectations of the members ("Getting"); explain the difference between the structure of the factors "Wanting" and "Getting" in terms of showing the elements that most contribute to this discrepancy. The author carried out a quantitative study based on aspects such as communication, nature of work, rewards and the differences between the configurations of local and distributed teams. The main goal of this research was to identify, based on statistical data, the area where it is possible to identify where the concentration of the biggest discrepancies between what is desired or expected by the team and what is actually proportioned to it.

These discrepancies can be understood as frustration, and this research shows that frustrating characteristics of distributed project teams focus on communication. Furthermore, the research shows the weakness of not considering the figure of the leader as a provider of motivating factors. She believes that all these elements come from the own team environment. Thus,

it is not possible to identify which practices can lead to motivational enhancement.

D. *Comparison among related works*

This section presents a brief comparison between the selected study(table 1). We analyzed each one individually and selected some motivational aspects relevant to the research. They are represented by:

- T1= Līva Šteinberga e Darja Šmite (2011)
- T2= Rovílson Dias da Silva (2007)
- T3=Venkata Sesha Ravikiran Dwivedula (2007)

Table 1 - Comparison among related work

□ = yes × = no ± = partially	T1	T2	T3
Importance of hygienic factors	×	±	□
Influence of cultural aspects	×	±	×
Influence of factors relating to the individuality of each team member	±	×	×
Importance of relationship quality existing in the team	□	□	□
Need for trained leaders (in relation to distributed projects)	±	□	×
Importance of the autonomy in distributed parties	□	□	□

In table 1 we identify some important elements, such as party autonomy distributed gaps in the studies, beyond the influence of factors relating to the individuality of the members of a team. In this comparison we can see that despite the initiatives of research in motivation and DSD, a study with the same perspective of this one has not yet been elaborated.

IV. RESEARCH METHODOLOGY

The research was conducted through a literature review. This method is adopted to help define terms and concepts on areas relevant to the research foundation, and explains theoretical problems based on secondary information, information about the current situation of the problem studied, analyzing similar and divergent opinions regarding the topic under study and find out where the gaps of knowledge that the area has [48]. In this context, this method was chosen due to the lack of formal studies on the topic of motivation specifically directed teams DDS. This research was conducted in order to answer the research question "What are the key success factors that influence motivation in the context of DSD?"

V. RESULTS

This section presents the findings of our review of. We found eleven motivational factors for DSD teams. They are referred to by the symbols F1 to F11.

A. *Motivational factors in teams DSD*

F1: Creation of appropriate infrastructure - It is essential for a project to be successful, that its employees be provided with a minimally comfortable place to work at. DSD projects still require an infrastructure that minimizes the effects of distance between parts of the team, as appropriate media, tools, distributed development, a high-speed network, among others. The lack of an adequate infrastructure will result in staff demotivation ([1],[3], [22], [23], [24], [25], [27], [28], [29], [30], [33], [35], [37], [41]).

F2: Nature of work (equal division) - Technically challenging jobs that require creativity and greatly contribute to the motivation of developers. It is important that this be taken into account in the distribution of tasks by the parties of DSD teams, for a very uneven distribution of these opportunities may lead to misunderstandings such as the idea that a part of the team is less important than the others, discouraging them ([3], [23], [24], [33], [38], [39], [42], [43]).

F3: Setting standards - Standards must be defined with the aim of improving the exchange of information. Thus allowing more agile and efficient communication, making collaborative work more profitable, which, in turn, positively stimulates the motivation of the team. Setting the default language of the company, time and frequency for synchronous communication, and implementing patterns are some examples of what can be defined ([12], [25], [35]).

F4: Autonomy - managing the performance of the tasks themselves is a mutual-trust based activity because it involves positive incentives to motivate teams. In DSD, the actions performed by the teams must be compatible, reducing their freedom. However, the definition of standards, such as interfaces, communication protocols, etc., responsible parties also known as focal points or technical leaders gain the flexibility to manage their activities ([3], [22], [23], [24], [25], [30], [33], [38], [39]).

F5: Perception of importance - Software developers, like any human being, want to be useful and important to the society they live in. This feeling of importance is a strong motivational factor. Therefore, it is important that in DSD projects there be a concern to involve all parts of the team in important activities and to make individuals realize the importance of these parts ([3], [24], [30], [33], [38], [41], [42]).

F6: Feedbacks - Feedback about how the activities were or are being performed motivates teams of software development. It is exciting to see how your work is being seen by others and, as you can grow professionally. The frequency of feedback is also an important factor. The constant use of this practice was found to decrease the feeling of isolation between parts of a DSD group ([3], [23], [24], [25], [30], [33], [39], [43], [44]).

F7: Sharing leadership - The motivation of sharing leadership happens in two ways. The first is the fact that local leaders are more effective in managing their respective teams, and other motivational factors can be better managed by leaders who are close to the individuals. The other way is to share some functions of leadership among some members of the team, which is a practice that reinforces the perception that they are all important within it ([1], [11], [25], [30], [33]).

F8: Promoting team spirit – It is motivating to feel that one belongs to a group based on mutual support and commitment to the goals set. DSD is important in the creation of team spirit at two levels. Firstly, in the team, in which this spirit should be more intense due to the level of existing contact. The second level is related to the overall team, even with a low level of contact. It is vital that the team work together to achieve the same goal and that the project depend on the cooperation of all the parts involved in it ([3], [23], [24], [25], [30], [33], [38], [39], [41], [42], [44], [45]).

F9: Training – This is also a factor that must be observed from two points of view. The first is the sense that the team members are motivated by the acquisition of new knowledge and techniques. In other words, learning is motivating. The second comes from DSD, it is also necessary that the staff be properly trained so that they are able to deal with all the peculiarities of this new way of developing software, or this new context ([3], [12], [22], [24], [30], [33], [39], [43]).

F10: Attention to cultural differences - Culture also influences the efficiency of motivational factors. A project can contain geographically distributed DSD teams by different cultures. To extract the best from motivational factors, and also prevent problems of misunderstanding, stereotypes, among others, it is important that the cultural context of each team be institutionalized. A good practice is to use local leaders or parties. They should thoroughly understand the particularities involved in their culture, seek to help the project manager to resolve conflicts and maximize project success ([1], [29], [45], [46]).

F11: Attention to individualities - Motivational practices are usually applied to teams as a whole. However, certain situations may require individual motivation techniques to be combined with team motivation. The effectiveness of motivational factors can vary from person to person. Therefore, in the context of DSD, it is important to have leaders who work physically co-located with their subordinates. By knowing them, the leader will know the best way to motivate each individual element of his or her team ([24], [25], [39], [47]).

VI. FINAL REMARKS

Pushed by a more demanding and competitive market, companies are often forced to adopt new strategies overlooking benefits and competitive advantages. In the software market, the scenario is not very different. In this context, it is possible to identify two strategies used in order to pursuit the competitive advantages: DSD and motivation of work teams. Currently, there is no doubt that motivational factors have a great influence on team performance. However, just the use of motivational practices was not effective enough in responding to all pressures that affect the software market. Aiming other benefits that go beyond than achieving the motivation of teams, several companies adopt the use of DSD strategies. However, it is important to bear in mind that some concepts from motivational area cannot be ignored in DSD projects. Hardly demotivated teams will be able to work collaboratively with success. Therefore, the adoption of both strategies becomes a reality for several projects. Many of the motivational practices already used in traditional teams of software development can be maintained in distributed teams. Nevertheless, some characteristics of DSD require that some motivational practices be adapted for a distributed context.

This study demonstrated and summarized success factors for the motivation of DSD teams. Among them, it is important to perceive the presence of hygienic factors, besides motivational ones, as detailed by Herzberg [22] in his theory. This occurs because it is not possible to stimulate individual motivation or a team's without providing the hygienic factors, for the lack of them can cause demotivation. Once mapped motivational factors we can see the need to invest primarily in infrastructure, nature of work, setting standards, autonomy, perception of the importance of work, feedback, leadership, promotion of team spirit, training, attention to cultural differences and their individuality are the key success factors that influence motivation in the context of DSD.

As future work we aim to empirically identify additional motivational factors through the observation of industry cases of distributed teams.

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