Effects of Task Significance, Coordination and Incentive Mechanisms on Motivation of Online Teams

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Abstract: Online teams are useful due to both flexibility and facility to gather resources originally dispersed. However, its intrinsic characteristic of separation in space and time imposes challenges to participation. Belief in task significance has positive effects on moving members to participate, while incentive mechanisms can be added to foster participation. Coordination is a central to a successful collaboration, since it guides members' participation. As participation is driven by motivation, we focus on motivation. We conducted an experiment to analyze the effects on motivation of the following aspects: task significance, quality of team coordination, and usage of incentive mechanisms. We discuss the relevance of these aspects; the characteristics that make them contribute to or interfere on online motivation; as well as the interplay among the aspects that can increase or reduce the aspects' effect.

1 INTRODUCTION

The usage of information and telecommunication technology through Internet allows individuals to collaborate in online teams to accomplish tasks. Individuals, dispersed in terms of geography, organization, and/or time, are assembled together in response to specific needs for an often short period of time (Grabowski and Roberts, 1998; Powell et al., 2004).

The benefits of online teams are mainly related to the flexibility to gather valuable resources and knowledge originally dispersed among people, by reducing time and expenses for locating them (Johnston and Rosin, 2011; Karayaz, 2004). Distinct organizations may rely on online teams, for instance global companies based on research, product development, or service provision. Online teams are also useful in educational context to prepare students to online demands of global organizations (Kaiser et al., 2000), and to promote international collaborative learning (Clear and Kassabova, 2005).

Separation in space and time is an intrinsic characteristic of online teams that imposes challenges to participation. Online teams face both structural and contextual issues, including lack of social context, limitation of informal communication, and difficulty in providing shared context, visibility and knowledge transfer (Powell, et al. 2004; Casey and Richardson, 2006). Such issues can negatively affect trust, cohesion and relationship building among members (Robey et al., 2000). In this trend, research has been conducted to understand the specificities of online teams in contrast to traditional face-to-face teams.

An online task to be accomplished requires participation of members. However, it is not easy to obtain participation, since it is mainly driven by motivation (Herzberg, 1959). Our focus is then on motivation of online teams. Motivation was found to be positively affected by how members believe in the significance of the task being developed (Staples and Cameron, 2004). Coordination is seen as a serious issue that, if not well conducted, can damage team success (Casey and Richardson, 2006; Beise et al., 2010). The use of online incentive mechanisms is often advocated as a way to influence motivation aiming to improve individual behavior (Tedjamulia, 2005; Kraut and Resnick, 2008).

In this paper, we conduct an exploratory experiment to investigate effects on motivation of three aspects: task significance, coordination, and incentive mechanisms. We investigate characteristics that make the aspects contribute or not to members' motivation and in turn to team success. Team success is analyzed through the obtained participation, by assessing team effectiveness with respect to team performance and

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team satisfaction. We also reason about the interplay among the three aspects, in a way to identify possible interferences that make one aspect ineffective in the presence of another.

The paper is organized as follows. In the next section, we discuss the background of the work. Later, in Section 3, we explain how we design the experiment. In Section 4, we present the experiment results and analyze them. In Section 5, we discuss the results of the experiment. Conclusions and future work are presented in the last section.

2 BACKGROUND

Special characteristics make a task suitable to online teams. For instance, decomposability is an attribute that makes possible to structure the task into sub-tasks and engender dependences between members (Piccoli, et al., 2004). Autonomy is also important, insofar as team should be self-sufficient to solve the problem regardless of external resources. Moreover, a task should be complex enough to require interaction of members, but always considering members' skills (Staples and Cameron, 2004, Casey and Richardson, 2006). These characteristics are important when defining a task to be performed by a team. A particular characteristic, which is task significance, is critical. A task should be significant to members, in a way that they believe in its importance and purpose (Staples and Cameron, 2004).

Teamwork presupposes collaboration, which is realized through communication and coordination (Ellis et al., 1991). Communication is required to make members exchange information, negotiate and take decisions. The virtual nature of communication makes online teams prone to problems, such as false interpretation of behavior in case of non-response of messages or incorrect use of text emphasis (Crampton, 2001; Bezerra and Hirata, 2012). Although communication issues can damage team motivation, they are more limiting to larger groups or virtual communities. Coordination refers to the management of activities being carried out by members (Fuks et al., 2007). Coordination is defined by the integration and harmonious adjustment of individual work efforts towards the accomplishment of a larger goal (Ellis et al., 1991). Some studies indicate directives to enhance online coordination, for instance to specify intermediate deadlines and to promote training of members with the online environment previously (Kaiser et al., 2000). Other studies have investigated organization types used by online teams, including fixed organization (Piccoli, et al., 2004), self-organization (Bezerra, et al., 2012), and shared leadership (Robert, 2013). Coordination can be impeditive to team success, since it includes activities to organize members' actions and interactions to accommodate task execution respecting its schedule (Casey and Richardson, 2006; Beise et al., 2010).

In order to improve members' participation in online environments, incentive mechanisms can be used as a strategy to influence individuals by addressing their motivations. Research about motivation and incentives has been conducted in distinct types of online teams and communities, for instance e-learning (Jacob and Sam, 2010; Gutierrez et al., 2011) open-source software development (Bagozzi and Dholakia, 2006; Fang and Neufeld, 2009), and knowledge sharing (Chang and Chuang, 2011; Bross, et al, 2007). Popular incentive mechanisms are those related to performance appraisal (eg. to inform the value of one's participation) and social recognition (eg. peer recognition, compliments, and praise) (Tedjamulia et al., 2005; Janzik and Herstatt, 2008). Particular settings of online teams, such as those that belong to a company, can have intrinsic compensations (as monetary compensations or careers plans) that help moving members to participate. Teams based on volunteering face augmented challenges to promote participation (Tedjamulia et al., 2005; Kuznetsov, 2006; Bezerra and Hirata, 2011).

Related work investigates in a separated way the aspects of interest, including task significance, coordination and incentive mechanisms. Our objective is both to understand the relevance of these aspects to online motivation and to reason about the possible interference among such aspects.

3 EXPERIMENT DESIGN

In this section, we explain how the experiment was conducted using a qualitative approach. We present the participants' characteristics, the type of online task to be developed as well as the provided online platform. Besides, we detail the data collection and measures, which were gathered through questionnaires.

3.1 Participants and Online Platform

We invited 32 students of an Engineering college to participate in our research. Their ages range from 18 to 25. They were divided randomly in four teams of

eight people. Here we call the teams as A, B, C and D. Each team should work online in a distinct environment keeping team independence. The online task was to specify a project to be developed by future students of the Programming course. The project should be edited collaboratively, and all discussions should be held online. Anonymity was maintained inside each team in order to eliminate possibility of offline interactions.

The online environments were designed using MediaWiki as platform. A project should then be defined as a wiki page. For discussions, members should use the respective talk page. We installed LiquidThreads extension to empower the talk page with resources commonly found in forums, such as reply button, and automatic relation between question and answers. Teams A and B used this system. Teams C and D used this system with incentive mechanisms included.

In order to select incentive mechanisms, we used the foundation about online needs proposed by Kim (2000), who brought the Maslow's hierarchy of needs to the online context and explains each need as follows. Physiological need is related to system access, and the ability to participate online. Safety need, discussed together with the concept of security, refers basically to protection from hacking. Belonging is the need to be part of a group and to be accepted by it. Esteem refers to the need to be recognized by others due to participation. Self-actualization is the need to maximize own potential, by developing skills and opening up new opportunities.

In our context, physiological and safety needs are already satisfied with the designed system. Belonging needs are addressed since groups are defined and closed. We focused on esteem and self-actualization needs. We proposed three incentive mechanisms: 'article feedback', 'contribution scores', and 'contribution appreciation'. With these mechanisms, we aim to stimulate members' participation by allowing them, respectively, to receive feedback about their proposal, to be recognized by their contributions in the article, and to have their comments appreciated in discussions. Incentive mechanisms similar to these are commonly found in successful virtual communities, such as StackOverflow and Wikipedia (Bezerra and Hirata, 2012). They act mainly with motivations as prestige, visibility, reputation, recognition, competence, challenge seeking, and progress evaluation.

The 'article feedback' is a mechanism available as a MediaWiki extension. It allows readers to evaluate wiki articles using one to five stars. We invite other 10 students, different from team members, to act as readers and provide project feedback. The 'contribution scores' mechanism is also a MediaWiki extension. It shows, at article footer, the names of members who contribute to article edition. We developed the 'contribution appreciation' mechanism. It introduces 'like' buttons in the questions and answers in a talk page with LiquidThreads extension.

3.2 Data Collection and Measures

The teams worked online during four weeks. At the end, each participant responded a questionnaire to evaluate his/her experience. Participants could also provide comments to explain their responses or to add new perspectives.

Regarding the online task, we investigated the contribution of the task significance to members' motivation, as well as what made the task attractive. The respondents should evaluate the affirmative: "Task significance contributes to my motivation". The respondents should also evaluate if the following aspects contributed to the task attractiveness: "the collaborative nature of the task", "the elaboration of a programming project", and "the possibility to use the project to future students". For the answer, we used the options: 'strongly disagree', 'disagree', 'agree', and 'strongly agree'. The neutral option was removed to force respondents to make a decision, what is called the 'forced choice' method (Allen and Seaman, 2007).

To reason about coordination, we asked about the contribution of the coordination satisfaction to members' motivation. The respondents should evaluate the affirmative "Satisfaction with coordination contributes to my motivation", using the options: 'strongly disagree', 'disagree', 'agree', and 'strongly agree'. We also asked participants to evaluate the following aspects: team commitment, deadline meeting, and activities' division. For these questions, the options of answer were: 'very poor', 'poor', 'normal', 'good', and 'very good'. Besides, we collected the amount of comments presented in forum in order to analyze participation in the communication process as result of the coordination activities.

Regarding incentive mechanisms, we designed different questions for teams without incentives (A and B) and teams with incentives (C and D). The goal was to investigate, respectively, if the possibility of inclusion of incentives could influence motivation, and if the presence of incentives really

stimulated motivation. For teams A and B, we made the following questions about each mechanism: "Could the incentive mechanism be useful?" and "Could the incentive mechanism motivate you?". For teams C and D, we asked: "Was the incentive mechanism useful?" and "Did the incentive mechanism motivate you?". The response options were only 'yes' or 'no'. We also gathered comments about the systems that supported collaboration of the teams.

We analyzed team effectiveness according both team performance and team satisfaction. Team performance is related to the delivery of a timely and high-quality product or service as result of online task. Team satisfaction is associated to the satisfaction of members after team interaction (Johnston and Rosin, 2011; Powell, 2004). In order to evaluate team performance, we asked two volunteers to act as evaluators by giving a grade (zero to ten) to team projects. Evaluators were students in the same college, but they were more experienced than the participants that performed the online task. They analyzed projects according to a defined criteria, which include: originality (if the project is different from the common programming activities), learning potential (if the project is able to improve programming learning in future students), attractiveness (if future students could be motivated to develop the project), and text quality (if the project is well written and easy to be understood). As team satisfaction is linked to the individual satisfaction of taking part of the team, we invited each participant to evaluate others' performance in the same team. We used the following options: 1 (very poor), 2 (poor), 3 (normal), 4 (good), and 5 (very good). The mean of grades assigned to a member can then indicate the quality of participation of that member.

4 RESULTS AND ANALYSIS

We present the results separated according the studied aspects as follows: task significance, coordination, incentive mechanisms, and team effectiveness.

4.1 Task Significance

A high percentage of participants (89%) agreed or strongly agreed with the sentence "Task significance contributes to my motivation", which shows the relevance of the task definition. Among the aspects that made the task attractive, 81.5% participants agreed or strongly agreed that the collaborative nature of the task contributed. To elaborate a programming project was considered relevant to task attractiveness for 85.2% of the participants. The possible usage of the project to future students made the task attractive for 88.9% of the participants. The feedback of participants was similar in teams. We did not observed relevant differences in teams about task as a motivation factor.

We observed that participants were really motivated with the task itself and its characteristics. It is important to understand that these characteristics were relevant for those participants in that context. Participants were students in a Programming course, so their activities were in general the development of programs. To specify a project was then considered more appealing. Students of the chosen college live together in dorms, and they know each other. They found funny to design something to future colleagues to work on. It would be a mix of reception and retaliation to new students. Some participants reported that to participate in a research made them attracted to the task. Other participants commented that a positive aspect was the offline repercussion of their participation, since their roommates found the idea interesting and so they felt prestige.

4.2 Coordination

Participants, in 74% of the cases, agreed or strongly agreed with the sentence "Satisfaction with coordination contributes to my motivation". The result shows that if people are satisfied with coordination, they can be more motivated and consequently perform better. Collaboration in teams revealed coordination problems related to commitment, deadlines' meeting and activities' division. Team commitment to perform the task was considered 'very poor' by 3.7% of participants, 'poor' by 22%, 'normal' by 44%, 'good' by 22%, and 'very good' by 8.3%. Participants considered deadline meeting as 'poor' in 22.2% of the cases, 'normal' in 26%, 'good' in 26%, and 'very good' in 25.8%. The main problem was the division of activities among members. Participants considered it 'very poor' in 26% of the cases, 'poor' in 52%, 'normal' in 15%, 'good' in 3.7%, and 'very good' in 3.3%.

Teams explained how they organized themselves. The feedback was important to support the findings about problems with task coordination. Team A commented that initially they discussed ideas of projects. After choosing a topic, one

member elaborated a project and other members only complemented it. Before the end of the task, one member commented that the majority of the team stopped contributing. One member also assumed that he did not participate as desired. Similar problems were found in team B, where members discussed the initial ideas, but two members were mainly in charge of the project edition.

More aggravated problems were found in team C. In this team, one member gave the idea and practically elaborated the project alone. Other member mentioned that communication was difficult and suggested that to have few people in team could improve collaboration. One member commented that the online task demanded time to be accomplished and he was not available as expected. In team D, two members conducted the task by suggesting the theme and making the team develop the text. One member reported that he found grateful to collaborate online by exchanging experiences and observing others' algorithms. Other member commented that he contributed to the project by both elaborating and improving the text. According to one member, the team was very motivated and engaged. Other member said that the team was a little disorganized. Time and internet availability were reported as factors that limited the participation of one member.

We observed that problems related to coordination were presented in all teams but with distinct severity levels. Regarding communication, the quantity of comments in the forum was the following: 34 in team A, 42 in team B, 20 in team C, and 86 in team D. We observed that team C, which demonstrated more coordination problems, communicated less. Team D, with better task coordination, communicated more. It shows the importance of communication in the collaboration process, especially to achieve better coordination.

4.3 Incentive Mechanisms

We analyzed the feedback of participants regarding the three developed incentive mechanisms: 'article feedback', 'contribution scores', and 'contribution appreciation'. In Table 1, we present the quantity of members that agree with the utility and motivation potential of the incentive mechanisms. For instance, regarding 'contribution scores', in team D, 8 members said that it was useful and 6 members found it motivating. To better understand, we have to keep in mind that each team was composed by 8 members.

Table 1: Utility and motivation of incentive mechanisms.

Incentive Mechanism	Aspect	Quantity of members by team			
		A	B	C	D
Article feedback	Useful	6	4	3	6
	Motivating	6	4	0	3
Contribution scores	Useful	5	8	5	8
	Motivating	5	4	0	6
Contribution appreciation	Useful	5	4	3	7
	Motivating	5	4	1	5

Teams A and B evaluated, in general, the incentive mechanisms as useful and they had a tendency to believe that mechanisms would be motivating. It shows that the incentive mechanisms were adequate to that context, and they really had a potential to motivate members. Comparing teams C and D, it is interesting to observe that both used the incentive mechanisms but they had very different experiences with them. Incentive mechanisms were more valuable for team D. We believe the coordination problems found in team C impacted, since members were not involved and did not use the mechanisms in fact. For instance, 'contribution appreciation' mechanism is valuable if members contribute and they are able to evaluate others' contribution. According to the feedback of team D about the incentive mechanisms, the 'article feedback' mechanism was less motivating. We argue that there were impediments that constrained the usage of this mechanism and consequently affected its motivating potential, for instance, the reduced number of external readers and the short-time characteristic of the task.

Participants reported their experience with the systems that supported the online teams. One member in team A said that wiki features were not simple to use. Other member in team A added that wiki page is not easy to deal with. As a member in team D explained, the problem was mainly how to format text in the page that is a little complicated. We used wikis as MediaWiki platform provides. Although it seems to work well in successful communities like Wikipedia, it has limitations related to usability as reported by some participants. According to participants, a positive point of the system was the forum. In this case, the usability problem of talk pages in MediaWiki was overcome by the use of LiquidThreads extension. The extension makes transparent the need to add

formatting to keep tracking between questions and related comments.

4.4 Team Effectiveness

The evaluators assigned the following grades to projects designed by online teams: 8.5 to team A, 9.8 to team B, 9.5 to team C, and 9.5 to team D. We observed that teams reached good performance. Problems related to coordination were not perceived looking only the quality of the team outcome. For instance, team C even with challenges reached a great result. We argue that it happened because the online task had an intrinsic characteristic of creativity. Teams could overcome their internal problems and elaborate a project with quality.

Table 2: Members' assessment about satisfaction.

Member	Team A	Team B	Team C	Team D
M1	4.1	3	2.6	4.3
M2	3.7	2.3	4.8	2.8
M3	2.7	2.8	3.2	4
M4	4.3	2.4	3.4	3.6
M5	3.8	5	3.4	2.3
M6	3	2.4	3.2	3.4
M7	4.2	2.7	3	4.9
M8	2.1	4.6	3.8	2.9

To reason about team satisfaction, we compute the mean of the performance evaluations of each member. The evaluations were made by co-workers with grades from 1 (very poor) to 5 (very good). Results are shown in Table 2. The data can reveal collaboration challenges found in teams. For instance, in Section 4.2, we commented that two members were mainly in charge of the task execution in team B. We can see in Table 2 that members M5 and M8 in team B were better evaluated than others. Other interesting case occurred in team D, where collaboration was reported to be more productive. We noted that three members (M1, M3 and M7) performed better, but others (as M4 and M6) also have their importance. The data regarding team satisfaction can also be misleading in case of problems with members' engagement. For example, in team C we identified the member (M2) who participated more. The other grades are uniform and near to 3 (average performance). It may be interpreted as a uniform participation. However, in fact, it indicates that members who did not participate were not able to assess others.

5 DISCUSSIONS

In order to motivate members of a virtual team to perform an online task, the main directive is that the task should be attractive to them. To propose an adequate task is a challenge. We need first to understand the characteristics of the members and the context where they are settled. The analysis can include both online and offline attributes, for instance, participants in the experiment found the task interesting due to the possibility to employ the outcome to colleagues in future. Incentive mechanisms can be used to stimulate participation. To propose incentive mechanisms, it is required first the identification of motives that drive members. In the experiment, for example, we proposed incentives related to prestige, recognition, and reputation. There is no formal guidance to design incentive mechanism. In this way, one future work is to research directives to guide designers in the planning of online incentive mechanisms. Directives should include discussions about context, characteristics, and motivations of members.

As we observed in the experiment, especially in team C, the quality of coordination is extremely important to online motivation. A poor coordination can negatively impact members already motivated by the task. It can also make incentive mechanisms lose force, for example, a mechanism to appreciate others' contributions is not useful if members do not contribute. We noted that the volume of online communication can reveal collaboration issues. A relevant problem regarding coordination was the unfair division of activities in teams, mainly due to lack of engagement. A relevant issue is then to engage members in activities that they feel confident to perform, in order to gather contributions to fulfill the entire task. Further investigation is required to design an online environment where members can propose and identify activities for them or for their co-workers. In this context, incentive mechanisms can be used specifically to stimulate engagement.

In the experiment, participants reported difficulties to edit wiki pages in MediaWiki. Possible problems with the talk pages were overcome by using a MediaWiki extension that automatically formats discussions as we found in typical forums. It shows the importance of usability in online environments, since it can negatively influence members' motivation. We argue that usability is an example of hygienic factor, as defined by Herzberg et al. (1959). A hygienic factor refers to a factor whose the presence is not stimulating, but the absence can reduce motivation. Other

consideration is that, sometimes, barriers can prevail and limit members' participation, for instance one participant reported impediments due to the lack of time, and other, due to internet problems.

Regarding team effectiveness, we observed that team satisfaction is a good thermometer of online participation. Team satisfaction can reveal coordination problems related to engagement. In the experiment, we measured team performance by assessing the quality of the developed task. As this measure only analyzes the outcome, it cannot explain possible participation issues during the process. As a limitation of our research, results and discussions should not be generalized, since they were drawn for a specific experiment. More experiments should be made in order to improve confidence on our initial results.

6 CONCLUSIONS

We used an experiment to investigate three aspects that influence motivation in online teams, including task significance, coordination, and incentive mechanisms. We also analyzed the impact of participation on team effectiveness, characterized by team performance and team satisfaction.

Task significance is essential to motivate members in online teams. It is the way to guarantee the initial attractiveness of members to participate online. Characteristics as task relevance and usefulness are primordial. Offline aspects can also affect positively task significance, for example the repercussion of task results and the reputation conquered for participating in an important task.

The quality of coordination is other aspect that influences online motivation. If the activity execution is well coordinated, the number of productive interactions increases, resulting in more motivated members. Disturbances in coordination can occur due to unfair division of activities among members, which ends up overloading some members. Problems with unequal participation among members can be revealed by team satisfaction, but obfuscated by analyzing only team performance.

Incentive mechanisms can be used to act on motivation and consequently improve participation. An effective identification of adequate tasks and design of effective incentive mechanisms have to consider members, their contexts, characteristics and intrinsic motives. Esteem and self-actualization needs constitute suitable categories of motivations to be addressed by online incentive mechanisms. Incentives mechanisms stimulate collaboration, when members are initially engaged, but if in the occurrence of problems, such as lack of coordination, the mechanisms are ineffective. So, incentive mechanisms work only if coordination and communication are properly assured.

The findings are based on our experiment; therefore, we intend to expand our analysis by performing new experiments with more groups and distinct tasks. As future work, we plan to design features to promote online engagement in order to improve activities' division, by allowing members to define activities and identify responsibility. Incentive mechanisms will be used to support this new environment. Further investigations include the definition of a process with directives to help designers to propose incentive mechanisms to members in online teams and virtual communities.

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