

Motivation and Its Mechanisms in Virtual Communities

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Abstract. Participation is a key aspect of success of virtual communities. Participation is dependent on the members' motivation that is driven by individual and environmental characteristics. This article investigates the individual and environmental factors that contribute to motivation and discusses mechanisms to improve motivation in virtual communities. The study is based on the Hersey and Blanchard's motivation model, the Maslow's hierarchy of needs, and the virtual community model. For the discussion of motivation mechanisms, we reviewed the literature and made qualitative interviews with members of the Wikipedia community.

Keywords: Motivation, participation, virtual community.

1 Introduction

Participation is seen as a measure of the success of virtual communities [29]. According to Wenger [34], participation refers to a process of taking part and also to the relations with others that affect this process. To be effective, participation requires both action and connection. In each virtual community there is a way to express participation, depending on the community objectives. For example, the participation in online forums, whose objective is information exchange, can be understood as posting and responding messages.

Virtual communities are a particular kind of community. Members in general communicate, collaborate, and interact using a system. They may not know personally other members. In general, their main motivation to be part of the community is aligned with the community goals. Therefore it may not be easy to obtain participation of members in virtual communities if their motivation decreases or ceases. So, it is necessary to understand motivation in the virtual community context in order to manage it properly.

Participation and motivation of members in virtual communities have attracted attention of researchers concerned with the encouragement of members in the community's activities and the development of the community itself. Distinct communities are studied, for example, e-learning communities [15,18,38], online forums [4,9], open source communities [19,33], e-government communities [1,37], online crowdsourcing [20], online game communities [14], and open content communities [17,25,39] for different reasons. Some researchers are interested to

identify the success factors for virtual communities, and analyze quantitatively or qualitatively the correlation among factors related to motivation, such as reputation, trust, and learning. In general these articles investigate distinct sets of factors. Tedjamulia et al. [31] discuss the importance of motivation mechanisms (called reinforcements) as contributors to members' motivation in virtual communities. Other articles concern about both establishing motivation mechanisms and verifying if they improve members' contributions, however they do not analyze the motivating factors as a way to improve or suggest motivation mechanisms in virtual communities.

In this article we propose an approach to reason about motivation in virtual communities, in order to achieve an adequate participation level of members in the execution of the community activities. The approach is based on the identification of factors that contribute to motivation as well as the application of mechanisms that improve motivation by handling such factors. We conjecture that after understanding the factors, it is easier to propose motivation mechanisms.

In order to understand the relationship between motivation and participation in virtual communities, we use both the Hersey and Blanchard's motivation model [12] and the virtual community model [3]. As motivation is driven by personal characteristics of an individual and can be influenced by perceptions about the community itself [12], we review the literature to identify individual and environmental factors that contribute to motivation. With respect to individual factors, we consider the human needs model proposed by Maslow [22]. For environment factors, we consider norms and system as entities as part of virtual communities. After outlining the factors, we discuss existent motivation mechanisms in virtual communities, using examples of mechanisms provided in Wikipedia [36].

The article is organized as follows. Section 2 provides a discussion about motivation in virtual communities. Section 3 concerns about the identification of individual and environmental factors that influence motivation. Section 4 describes mechanisms to address the identified factors, using examples of Wikipedia. Section 5 provides discussions about this article. Section 6 concludes and indicates future work.

2 Motivation in Virtual Communities

In this section we present our approach to reason about motivation in virtual communities. The approach is based on a motivation model proposed by Hersey and Blanchard [12], which is useful to understand the relation between motivation and participation. We investigate the relationship between the motivation model and the virtual community model in order to identify the factors that influence motivation.

2.1 Motivation and Participation

Motivation can be defined as an impulse to act according to the one's desires. If people are forced to make something, they are reacting to the pressure. If they are motivated, they choose to realize something, because it has a meaning for them [35]. Hersey and Blanchard [12] propose a model, illustrated in Fig. 1, to explain the relation between motivation and behavior of individuals in organizations. We argue that the model is also suitable to explain how the participation of members in virtual communities is related to their motivation.

Motives are the origin of the behavior. They are something inside the individual that moves him/her to act. Objectives are outside the individual. Objectives can be understood as expected achievements that satisfy the motives. For example, a motive is starvation, and the associated objective is to be fed. The behavior includes activities performed by the individual in order to reach the objectives. In the previous example, the activities can be finding, preparing, and ingesting food. A person has a large number of motives, whose prioritization determines the strength of each motive. Urgent motives induce actions toward objectives to satisfy them, while less critical motives can wait to be handled. Hersey and Blanchard [12] note that the presence of objectives in the environment can also affect the motives' intensity.

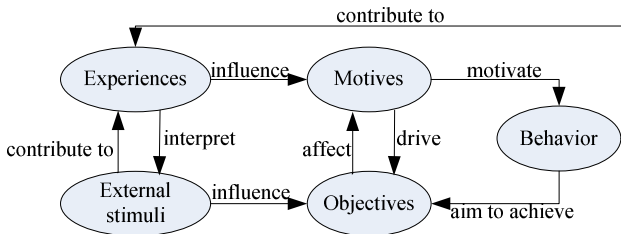


Fig. 1. Motivation model (adapted from [12])

The experiences of the individual are an internal agent responsible for the formation of expectative, which influences motives. The experiences comprise personality, intellectual education, spiritual and moral education, and values, which are acquired during life. Behavior aims to achieve objectives and can also contribute to the composition of experiences.

The external stimuli refer to facilities or limitations that the environment imposes to the objectives' achievement. For example, the objectives of a person can be influenced by the pattern of the group that he/she belongs, and also by the adjacent groups. External stimuli may be ephemeral or eventual, i.e. they can be seen as opportunities or temporal restrictions that may not persist or may occur in the future.

Experiences and external stimuli influence each other. The attention regarding the external stimuli makes the person accumulates experiences. Iteratively, experiences offer methods to help the interpretation of external stimuli and the perception of future, so experiences can influence the way the individual perceives the environment.

Behavior, or participation, dictates how the activities are performed by a person. Underperformed or badly performed activities can compromise the achievement of community's goals. To stimulate one's behavior, it is then necessary to act on his motivation. As motives are influenced by individual (the experiences) and environment (the external stimuli) factors, and we are interested on identifying these factors in virtual communities, we analyze the virtual community entities in the next section.

2.2 Virtual Community

Preece [28] defines virtual community as a group of people, who come together for a purpose online, and who are governed by norms. Considering this definition, we

consider three main entities that compose a virtual community model, proposed by Bezerra and Hirata [3], and illustrated in Fig. 2: members, norms and system.

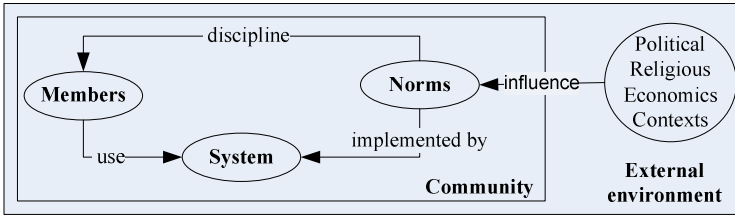


Fig. 2. Virtual community model (adapted from [3])

Members are a group of people that belong to a community. Norms are specific to a social context, and they are generally established in order to regulate the people relationships. A norm is a type of principle, precept or rule that states obligation, permission, power attribution or competence attribution. In general a norm can be imperative (that imposes duties) and/or attributive (that confers rights) [26]. A virtual community is supported by an information system based on Internet technology (web-based system). The system, also named as community system, teamware, and groupware, is used as a means for the members to achieve the community goal.

We relate the virtual community entities with the motivation model in Fig. 1 as follows. The individual factors, also called experiences, are inherent to members. The individual factors are in general associated to the human needs, considering the Maslow hierarchy [12,22] discussed later. According to Cottrell [7], performance can be enhanced or impaired in the presence of persons who can approve or disapprove our actions. Cottrell [7] argues that there are apprehensions or inhibitions related to the fact of having individuals organized in groups. So, we consider social fears as individual factors that influence motivation in virtual communities.

The environmental factors, also called external stimuli, include the factors driven by the virtual community environment, which includes norms and system. The environmental factors are also influenced by the environment outside the virtual community, for example the political, religious and economics contexts, which can guide the definition of norms in virtual communities [3]. In this paper we consider the environmental factors restricted by the perspective of norms and system.

Once one identifies individual and environmental factors that contribute to motivation in virtual communities, it is possible to propose mechanisms to address the critical ones. Motivation mechanisms can be designed and implemented in virtual communities through improvements and changes in the norms and system. It is expected that they act as external stimuli of individuals in the motivation model. As external stimuli, the mechanisms can improve motivation by encouraging individuals to realize benefits of new objectives and motives, in order to stimulate participation.

One example of a motivation mechanism in an online forum is the mechanism that provides and manages a status (senior, guru, veteran, etc) to a member according to the number of questions and answers posted. The mechanism allows members to upgrade their status and induces them to establish objectives to satisfy their motive of improving reputation. So, moved by a motive, members can change their behavior

and increase their contribution to community, which characterizes an improvement of participation. It is important to note that a mechanism can affect members in different ways, because the individuals are unique due to their experiences.

3 Identification of Factors Related to Motivation

In this section we identify individual and environmental factors that can motivate members in a virtual community. We investigate the individual factors through an inquiry into the human needs and social fears. We investigate the environmental factors through the identification of services and restrictions imposed by norms and system in a virtual community.

3.1 Identification of Individual Factors

The study of human needs helps the identification of individual factors that affect motivation. Maslow [22] proposes a scheme to address human needs. It consists of a pyramid that reflects, through its levels, the intensity of each need. The pyramid, from the basis to the top, is composed by the following needs: physiological, safety, belonging, esteem, and self-actualization. Individuals behave towards the satisfaction of unsatisfied higher levels in the hierarchy. However, each individual has a personal combination of needs, which can lead to a deformation of the pyramid.

The physiological needs are related to human vital needs of subsistence, for example air, food, shelter, and clothing. Once the physiological needs are satisfied, the influence of safety needs become relevant to the individual behavior. The safety needs are those related to self-preservation, which means to be free of the physical dangers and the privation of basic needs. They are related to the guarantee of the physiological needs in a predictable future. The physiological and safety needs are mainly related to the real world, because they are essentially of physical and economics order. Regarding virtual communities, we focus on the belonging, esteem and self-actualization needs. The identified factors are provided in Table 1.

As people are social beings, they have the necessity to be part of a group and to be accepted by it, so the belonging needs constitute another level in the Maslow hierarchy of needs. The main factors associated to belonging needs are identification and socialization. Identification is the process whereby one individual want others to see oneself as unique in a group; it affects group cohesion and altruism [11]. Socialization is the process of learning the behaviors and attitudes essential to play a role in a group [5]. For virtual communities, Yamamoto et al. [37] suggest other social factors related to awareness in online public decision making, as a member usually wants that others inform their presence and opinion.

After satisfying the need to participate of a group, in general the person desires not only to be a member, but also to receive the recognition of others. The respect of others sometimes increases the respect for oneself, contributing to esteem, the next level in the Maslow hierarchy. The esteem includes two factors: prestige and power [12]. Prestige is the need of a person to have your importance recognized in the group. Prestige includes concepts as status and success [12], visibility and reputation [33], appreciation [32], self-marketing [20], and recognition [18]. Power is the ability to influence the group, and it is associated to building trust and obtaining respect from others [12].

Table 1. Individual factors related to human needs and social fears

Category	Factors		
Belonging needs	Identification	Awareness of others' presence	
	Socialization	Awareness of others' opinion	
Esteem needs	Prestige	Reputation	Trust
	Status	Appreciation	Respect
	Success	Self-marketing	Recognition
	Visibility	Power	
Self-actualization needs	Competence		Career plans
	Learning		Personal realization
	To seek new challenges		To take risks
	To evaluate the own progress		
Social fears	Fear of being identified		
	Fear of expressing opinion		
	Fear of disrupting own image		
	Fear of being criticized		
	Fear of disapproval or punishment		
	Fear of being judgment		
	Fear of misleading others		

The last level in the Maslow hierarchy is the self-actualization need, which is the necessity to maximize your own potential. The self-actualization needs are related to competence and personal realization factors. Competence refers to the desire to learn more, to seek new challenges, and to take risks [12]. Factors associated to learning include receiving answers to questions, and getting access to useful information, expertise and best practices [24]. Concerns about the career are another factor associated to self-actualization need, especially in open source communities [19]. People motivated by personal realization, are in general not interested on awards, but they are interested on receiving a feedback about your activities. For these people, it is important to evaluate the own progress and compare to the others [12].

In a virtual community, distinct needs coexist as individual factors that motivate members. For example, Ling and Mian [20] investigate the motives to use an online crowdsourcing, a platform where customers contribute to continuous innovation of products. The studied factors are learning, direct compensation, self-marketing, and social motives. Learning is the intention to expand skills, and represents the self-actualization needs. Direct compensations are related to be awarded with monetary or nonmonetary prizes, which in general are related to the esteem needs, because the prizes can indicate status and reputation. Monetary compensation can also represent the safety needs. Self-marketing is the use of your achievements to demonstrate competency, which is aligned to the esteem needs. Social motives include the expected reactions of others, which characterize the social needs.

In general members in virtual communities are volunteers. Clary et al. [6] identified six categories that influence volunteers' motivation: values (the desire to help others), social (the chance to be with others), protective (to share knowledge with

others), enhancement (to publicly exhibit knowledge), understanding (the opportunity to learn new things), and career (to develop yourself to a new or present career). These categories were used by Nov [25] to evaluate what motivates members in Wikipedia community. We argue that these categories are already addressed by the factors listed in Table 1 as follows. Values, social, and protective categories are addressed by factors about belonging needs. Enhancement category is related to factors about esteem needs. Understanding and career categories are factors about self-actualization needs.

Besides the human needs, factors that contribute to motivation can include social fears. Social fears are understood as social inhibitions that can impact negatively one's performance in a group, and that are in general related to the approval or disapproval of others [7]. The social fears, drawn from the related work, are illustrated in Table 1. Some members do not feel comfortable to show the real identity in virtual communities, in this case anonymity might be useful [16]. The fear of being identified can be related to the fear of exposing the private life, to the fear or difficulty of expressing opinions [37], and also to the fear of contributing in activities. Other barrier to motivation is the lack of confidence to contribute, because members can hesitate to share if they have fear of misleading other members with their answers [24]. Members can reduce their contributions in virtual communities due to the fear of being criticized [24]. Other problems are the apprehensions of disapproval, punishment and judgment by others [7].

3.2 Identification of Environmental Factors

To identify environmental factors that influence motivation in a virtual community, we analyze the contributions and difficulties that the community norms and the system that support the community impose to the development of members' activities. The identified factors are listed in Table 2.

Table 2. Environmental factors

Category	Factors	
Norms	Sufficiency	Adaptability
	Availability	Enforcement
	Easy to be understood	
System	Usability	Lack of contribution
	Security	Late contribution
	Awareness of opportunities	

Norms must have the sufficiency characteristic, in order to address all the relevant matters in community and consequently be able to correctly discipline members and organize their activities. Norms shall also be available for members, because the difficulty or impossibility to access them can derail the activities' execution. Yamamoto et al. [37] argue that in online public decision making, one restriction is members to understand the problem to be discussed and to express their own

opinions. Similar problem can be faced by members regarding the interpretation of norms and related procedures, so norms shall be easy to be understood.

Virtual communities are not fixed over time; they evolve due to the members' interests and demands, then the adaptability of norms in a community is other factor to be considered [3]. Airong and Xiang [1], in the e-government context, state that irrational participation, characterized by anarchy and vandalism, is a problem that does not motivate regular members. So, dealing with norm infractions is a critical factor. It can be made by using approaches of norms' enforcement, in order to both guarantee that norms are being followed, and keep the community credibility [2].

Restrictions to the members' motivation can also be caused by the system that supports the virtual community. Researchers [10,23,14] state that the productivity of a virtual community depends heavily on the fact that its members accept the community system. The acceptance is mainly related to the satisfaction of usability requirements. Other system factor is security [24]. Security is related to the avoidance of unauthorized participation. Airong and Xiang [1] state that security is critical to the members' acceptance of e-government systems.

Other factors imposed by system are concerned to communication restrictions. For instance, in forums, sometimes there is a lack of awareness of the opportunities to participate, because members do not know that a new topic is under discussion [1,18] or that there are activities to be performed. The communication restrictions affect the elapsed time between a participation request and the participation itself. Three undesirable situations are perceived regarding this issue in online discussions. The first situation is the lack of response, when nobody responds the question of a member. The second situation is the delay of the first responses, when the first contributions take too long to occur, which in general is incompatible to the desire of the member that initiated the discussion. The third situation is when a member makes a comment about a discussion that is already finished, so the contribution is useless.

4 Motivation Mechanisms

In this section we discuss mechanisms to handle the factors, identified in the previous section, that influence motivation in virtual communities. The mechanisms were drawn from the literature and an investigation of Wikipedia motivation mechanisms.

The investigation of Wikipedia mechanisms was performed by using the information available in this community, and also by performing qualitative interviews with four Wikipedia members, identified as I1, I2, I3, and I4. The interviews were conducted via email in March, 2011. Regarding membership duration, the interviewees had respectively six months, three years, five years, and four years. Table 3 shows the mechanisms identified by analyzing the factors of Table 1 and Table 2. The next sections present discussions of these mechanisms.

Table 3. Motivation mechanisms

Category	Mechanisms
Belonging needs	Community goals, values and achievements
	Welcome message by other member
	Personalized assistance means
	User pages Discussion boards
Esteem needs	Award for the quantity of contributions
	Award for the contribution quality
	Award that includes other awards
	Recognition by the colleagues
Self-actualization needs	Creation freedom
	Activities about assets' quality
	Activities about users' management
	Activities about community promotion
	Opportunities' availability To measure and compare own progress
Social fears	Facilitation
	Request for contribution
	Possibility of anonymity
	Educative assistance
Norms	Accessible norms
	Enforcement process
	Members' participation in norms' definition
System	Users' suggestions about usability
	Security management
	Information delivery and announcement agent
	Awards considering quality and response time
	Discussion enclose

4.1 Mechanisms for Individual Factors Related to Belonging Needs

We investigated mechanisms that address the factors related to belonging. For example, the identification factor can be achieved if the member shares the same goals as the community. One mechanism to handle the identification factor is to define and promote the community goals and values, for example in Wikipedia this information is provided in pages as *Five pillars*, *What Wikipedia is not*, and *Community of Wikipedia*. The interviewee I1 stated his identification with Wikipedia goal, when he reported the pleasure of knowing that people read something he contributed. Other mechanism that can contribute to the identification factor is to inform the community history, explaining its achievements, evolution, and reliability; for example in Wikipedia some pages address these issues, such as *History of Wikipedia*, and *Reliability of Wikipedia*.

One mechanism to handle the socialization factor is to provide a welcome message when the member starts in community. The message is more effective if sent by other member and not by an automatic tool. The welcome message in Wikipedia has instructions pages to learn about article edition, such as: *How to edit a page*, *Editing tutorial*, and *Manual of Style*. The message also informs some means to get assistance, such as: *Help* page, *Village Pump* page, and to make questions directly to

the member who posted the message. According to Choi et al. [5], socialization can be improved using personalized mechanisms, for instance by reviewing newcomers' recent work and offering specific assistance to help their engagement in community.

Each page in Wikipedia has an associated talk page where discussion about the page is held. In the talk page, it is possible to be aware of others' presence and opinion, because any member can start a discuss topic or to comment an existent one. If a member desires to know more about other member, he/she can access the other user page. The talk page related to an article is a kind of discussion board, where members can debate aspects of the article and determine which content is appropriate. Other examples of discussion boards in Wikipedia are *Community Portal* and *Collaborations Page*, which encourage members to work together [17].

4.2 Mechanisms for Individual Factors Related to Esteem Needs

Mechanisms that address esteem are in general related to prizes or awards. Due to the correlation of some motivating factors, it is difficult to know exactly which ones are addressed by receiving awards. Examples of correlated factors are appreciation, recognition, status, visibility, prestige, and respect. To receive an award is a way to be appreciated and recognized, for instance, the interviewees I2, I3 and I4 reported the satisfaction of having their contribution appreciated in Wikipedia. To have awards is a means to acquire status, visibility and prestige, for instance, the interviewee I2 explained that through his awards other members are informed about his achievements. The quantity of received awards is also a way to conquer respect.

Awards are associated to the achievement of some marks, considering the number of contributions or the quality of them. In Wikipedia, the *Service Awards* take into account the number of edits during the membership period. There are twenty *service awards* in Wikipedia, for instance: *Novice Editor*, *Veteran Editor*, *Senior Editor*, and *Vanguard Editor*. In Wikipedia there is also a members' rank, called *List of Wikipedians by number of edits*, which only evaluates the number of edits.

Number-based awards can be misleading, as reported by the interviewee I1. For instance, in Wikipedia, the problem is that not all edits are representative of good contributions, for example a member working with anti-vandalism can performed many edits, but the edits are not of the same caliber as article work, so the member should not be considered to the award. One way to overcome this problem is to not count all the contributions of a member, but to allow that members evaluate the contributions of each other. This practice is being used in online forums, for instance in StackOverflow [30] there is a way to vote if questions and answers are useful. In Wikipedia, sometimes members show appreciation and respect to others by providing in their user pages a section with names of members who have collaborated with or whom received some help, as reported by the interviewees I2 and I3.

The other kind of awards is concerned to the quality of the contributions. Some examples in Wikipedia are: *Featured Article (FA)*, *Good Article (GA)*, and *Did You Know (DYK)*. *FAs* are considered to be the best articles in Wikipedia. *GAs* are considered to be of good quality articles that are not yet featured article quality. *DYK* is a section on the main page that gives publicity to newly created or expanded Wikipedia articles. If a member develops an *FA*, both he/she and the article receive the *FA* award, which is represented by a star symbol. Each award has its own symbol,

also called icon in Wikipedia. There are also awards that include a set of distinct awards, for instance in Wikipedia there is the *FOUR* award, which requires you to start an article from scratch, get it displayed on *DYK*, make it a *GA*, and then a *FA*.

The existence of such mechanisms actually improves motivation, and consequently participation. For instance, the interviewees I2 and I3 commented that, if there were no awards, they would still participate but less focused, and maybe they could have contributed less they did. The interviewee I4 complements that there have been times that he was not motivated, but the receiving of an award kept him motivated.

4.3 Mechanisms for Individual Factors Related to Self-actualization Needs

A mechanism to address self-actualization is to allow creation freedom during the execution of the community activities. In Wikipedia this freedom is perceived when a member chooses a desired article to contribute or to create. The creation freedom mechanism addresses the learning and challenge factors, for example the interviewee I1 reported that to write about a topic that you are not intimately familiar with can be a great challenge, as long as you make efforts to cover it well and in detail.

Other motivation mechanism is to provide members the possibility to participate of other initiatives in the community beyond the ordinary ones. These initiatives include strategic activities related to community organization, including the guarantee of the quality of the assets developed, and the management of users. In Wikipedia this kind of activities is performed by members who assume distinct social roles, for instance the quality of the articles is addressed by *reviewers* and *rollbackers*, and the users' management is handled by *checkusers* and *account creators*. Other initiatives comprise of helping the community promotion. In Wikipedia there are the *Wikiprojects*, which are projects to manage specific topics or family of topics within Wikipedia. There is also a special role, called *Wikipedia Ambassador*, whose objective is to both help new users and find new potential contributors, particularly teachers who want to bring Wikipedia into the classroom.

The possibility to participate of strategic positions stimulates members, because they can learn new activities, acquire experience and assume risks, for instance the interviewee I2 commented that he assumed other roles as *rollbacker* and *Wikipedia Ambassador* to pick up experience in many areas. The members in Wikipedia have the possibility not only to participate of distinct initiatives, but also to manage them, for example the interviewee I3 is responsible for the process to grant two awards, namely *FOUR* and *WAWARDS*.

Other motivation mechanism is to guarantee that the opportunities are available for all members, according to their experiences and competence. It is also found in Wikipedia due to the possibility of a newcomer to conquer additional roles, as occurred with the interviewee I1, a newcomer who already is *rollbacker* and *reviewer*.

The career factor can be indirectly addressed by the previous mechanisms, for example if member's job in real life has a close relation with the community goals, as commented by the interviewee I2 who is a social media consultant and occasionally write Wikipedia articles for clients.

A mechanism to address the factor about the evaluation of own progress can be implemented by the availability of information about other users, including the received awards and performed positions. In Wikipedia it can be accessed through the

user pages. The rank in *List of Wikipedians by number of edits* is another way to compare own progress with others.

4.4 Mechanisms for Individual Factors Related to Social Fears

Jacob and Sam [15] use facilitation techniques to promote student participation in online forums. The techniques include the use of Socratic questioning prompts, for example, questions about clarification, assumptions, reasons and evidences during an online problem solving session. The facilitation is a mechanism that can help to address the fear of expressing opinions and the fear of misleading others, because it helps to structure one's position. Other mechanism that can help is to request the contribution of the member, because, if the member is invited, he can feel more comfortable to participate. According to the interviewee I2, the invitation to members in Wikipedia occurs mostly for science articles due to the lack of experts to contribute.

A mechanism to handle the fear of being identified is the possibility of anonymity. For instance, the interviewee I3 commented that there is always a fear of loss of privacy online. In Wikipedia, members use usernames, so they can expose their identities or other personal information only if they desire. Unregistered members can also contribute to Wikipedia; in this case their work is logged with IP address. Usernames are common in online forums. The anonymity is used as a way to alleviate the pressure of exposing one's thoughts.

The fear of being criticized can be addressed by the establishment of norms in community to avoid this kind of offensive practice. Regarding the fear of disapproval or punishment, the interviewee I1 commented that he was worried, during the article edition, about being reamed out by users who think that every single phrase needs a citation. To address it, the community can implement educative assistance to help members unfamiliar with the community norms. For example, in Wikipedia there is an automatic tool called *Sinebot* that gives an advice when the member does not sign a post.

4.5 Mechanisms for Environmental Factors

Regarding the environmental factors driven from community norms, the availability factor can be managed by conferring access of members to all norms. In Wikipedia, norms are available as general articles. The enforcement factor can be addressed through an enforcement process that has the following activities [2]: events' monitoring, incidents' analyses, sanction application, damage recovery, and unexpected event handling. Examples of actions to enforce norms include the blockage of members for a period of time and the suspension of his/her user account.

A mechanism to deal with the adaptability of norms is to allow members to participate in the definition norms. In Wikipedia, members are responsible for promoting the evolution of norms, according to their interests and demands, characterizing Wikipedia as a self-organized community [3].

The environmental factors related to the system of a virtual community can be critical, for instance some interviewees presented concerns about the system factors suggesting that they are the main reasons that decrease members' motivation.

A mechanism to deal with the usability factor is to provide a forum to collect the suggestions of members about issues to be enhanced in the system. In order to assure the accountability of the members' activities, the security management is critical. To overcome the factor about the lack of awareness of opportunities to participate, Lan and Yan [18] propose the use of an information delivery agent and information announcement agent in an online student discussion forum. The objective is, respectively, to inform learners about new discussions in community, and to show which discussions were not already read by a specific learner. In Wikipedia there is a similar mechanism, known as *watch*, which allows registering a page to be informed when it changes.

According to the interviewees I2 and I3, the inability to get help could keep people from contributing in Wikipedia. We believe that a mechanism to address the factors regarding the lack of contribution and the late contribution can be the specification of a desirable deadline for contributions. For example, a member initiates a discussion and defines the response deadline, so other member that contributes to the discussion, respecting the deadline, can be recognized. Other mechanism can be is the definition of a deadline to close the discussion, so no further comment could be provided about an issue already debated.

5 Discussion

We believe that the identification of factors is useful to design motivation mechanisms in virtual communities. It also helps to analyze the motivation mechanisms already implemented in community.

It is not our objective to provide an exhaustive list of factors and mechanisms, but to discuss some factors and existent mechanisms. The identified factors that influence motivation are quite general and can be used as suggestions for distinct virtual communities. Given a community, it may be necessary to prioritize the factors and to propose mechanisms to address the critical factors firstly. Each community has to forge its own prioritization of factors, because the factors can vary according to the community goals and maturity, as well as the members' perceptions. After defining motivation mechanisms, a coverage analysis can be made, in order to guarantee that the proposed mechanisms address all the critical factors. It is important to observe that sometimes a single mechanism can handle more than one motivating factor.

We believe that self-organizing communities have an advantage to design motivation mechanisms. The advantage is due to the possibility of members to define norms and influence the changes in the system, so members can act on the environmental factors that affect motivation. Besides, members can work together on the definition and establishment of motivation mechanisms to address individual factors. For example, in Wikipedia, the discussed mechanisms were proposed by the own members and are also managed by them.

Two suggestions about motivation mechanisms can be proposed. The first is to divulgate mechanisms in community, so that the users can consider mechanisms in their objectives. The second suggestion is to be able to evaluate their efficacy on stimulating motivation, and consequently participation. The efficacy of a motivation mechanism can be decreased during its life cycle, raising a concern about the

deactivation of the mechanism. Sometimes mechanisms lose their ability to motivate due to a variety of reasons, for instance, members' perception can change. However, the absence of them may be felt by the members. These mechanisms can be characterized as the maintenance factors, discussed by Herzberg et al. [13]. Therefore, if a mechanism cannot be provided for a long term, it is recommended both to specify a duration for the mechanism, and to inform the duration to the members. Besides, before deactivating a mechanism, it is necessary to analyze if it will not result into undesirable consequences to motivation.

Even motivated by the presence of motivation mechanisms in the virtual community, a member can face barriers to participate. Some barriers can be associated to the lack of ability to perform an activity, the personal concept of enjoyment [14, 25], and the personal preferences [4,14]. Other barriers are related to lack of specific resources, for instance, the lack of time [4]. These barriers were not specifically analyzed in this article, because we are mainly concerned with factors that can be addressed by motivation mechanisms.

6 Conclusion

The participation of members in virtual communities can be encouraged indirectly by improving members' motivation. We identified factors that improve motivation, using Hersey and Blanchard's motivation model, Maslow's hierarchy of needs, and virtual community model, and classify them into individual and environmental factors. To identify individual factors, we used the human needs and social fears. To identify environmental factors, we reasoned about norms and system in virtual communities. Afterwards, we discussed the motivation mechanisms. To help in the discussion, we used examples and a qualitative survey obtained from Wikipedia.

The research performed in this article leads to some suggestion of future work. One future work is to investigate the effectiveness of Wikipedia motivation mechanisms to determine if they actually reach their goals. An interesting work is to experiment a mechanism proposed in this article to compensate a member considering both the quality of contribution and the delay to provide it. Other work is to understand how the intensity of human needs and social fears varies for members according to their membership trajectories in a virtual community.

We consider that the interactions between members of virtual communities are mainly performed in the virtual world, however, there can be face-to-face or phone call interactions, for example, one member can comment with other about something interesting or ineffective mechanisms in a community. The research question to pursue is how the interactions outside the virtual community influence the members in the virtual community.

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