

**The Influence of Socio-Technological Mechanisms on Individual Motivation towards
Knowledge Contribution in Problem- Solving Virtual Communities**

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Abstract—*Knowledge contribution in virtual communities is an important issue in the field of knowledge management. Based on Ames' theoretical framework on motivation, we propose a model for knowledge contribution in problem-solving virtual communities (PSVCs). The model includes two second-order individual motivations, with four major mechanisms in PSVCs that are associated with these motivations. Results confirm that only egoistic motive affect members' knowledge contribution in PSVCs. Further, knowledge repository and social identity are found to be important mechanisms for promoting knowledge contribution through egoistic motive. This paper concludes with theoretical and practical implications and provides insights for future research.*

Index Terms—*Problem-solving virtual community, Functional Approach, Expectancy-Value Theory, Second-Order Factor Model, mechanisms of virtual community.*

Problem-solving virtual communities (PSVCs) are virtual communities dedicated to solving problems in certain areas through collaborative networks. PSVCs have flourished and become effective and efficient tools for knowledge sharing. For example, there are communities focused on medical issues [1], programming issues [2], and pedagogical issues [3]. Typically, they are characterized as being open, large-scale, and voluntary, and often assume the form of publicly accessible discussion forums. In PSVCs, every member can be both a knowledge seeker and a knowledge contributor.

However, not every member of a PSVC likes to contribute. Despite the enormous number of participants, findings show that lurkers, i.e., virtual community members whose primary behavior is to browse for information, outnumber contributors dramatically. The proportion of lurkers can be as high as 90% of the total membership [4]. It is conceivable that members could lose their desire to remain in a PSVC when their questions are not responded to. The active participation and contribution of members is thus of vital importance to the success of a PSVC.

Hence, it is essential to understand members' motivation for active participation and contribution in PSVCs [5]. Early studies in education have proposed a theoretical framework on motivation [6]. The essence of this framework highlights two elements: 1) individuals are motivated by various goals and purposes in conducting activities, and 2) these motivations can be enhanced by individuals' perceptions on the environment, which is conceptualized as motivational climate. Ames defined motivational climate as a situationally induced psychological environment directing goals of an action [7]. Although this framework is proposed in learning and education studies, both elements are not restricted to the learning

environment. As a result, we may apply this framework as an overarching theory to investigate knowledge contribution in PSVCs. Two major research gaps are to be studied.

First, this framework has not suggested specific goals and purposes in the context of knowledge contribution. The functional approach, which is prevalent in the sociology and psychology disciplines, suggests that individuals perform the same behavior for different psychological functions or goals [8]. These goals serve as motivations towards that particular behavior. Hence, it is our objective to apply the functional approach to identify individual motivation towards knowledge contribution in PSVCs.

RQ1: What are the individual motivations based on the functional approach in the context of knowledge contribution in PSVCs?

Second, it is students' perceptions on school environment that enhance motivation in the original framework. While in the context of PSVC, it would be members' perceptions on PSVC environment. However, it is not clear what these perceptions are and how they could enhance individual motivations towards knowledge contribution. We argue that the PSVC environment is a combination of various technological and social mechanisms. The mechanisms' influences on individual motivations can be explained by Expectancy-Value Theory. It argues that human motivation towards a goal is a combination of the likelihood of achieving this goal (expectancy), and the importance of this goal (value) [9]. Perceptions of the effectiveness of PSVC mechanisms may affect the expectancy and value of individual motivations, and consequently influence the corresponding individual motivation.

RQ2: How do various PSVC mechanisms influence members' motivations towards knowledge contribution?

Our next section comprises a review of the functional approach and the Expectancy-Value Theory, as well as related literature on individual motivation and virtual community mechanisms. Then, we present our theoretical model with the corresponding hypotheses. The subsequent section is devoted to data collection and analysis. In the concluding section, we discuss the implications and limitations of this study and suggest future research avenues.

LITERATURE REVIEW

In this section, we commence with a description of the functional approach as well as the dichotomy of individual motivation. Then, we review the Expectancy-Value Theory, which provides the theoretical foundation for investigating the relationship between members' perceptions of PSVC mechanisms and their individual motivations.

The Functional Approach and Individual Motivation The functional approach has been used to explain adaptive and purposeful efforts of individuals toward personal and social goals. The central theme of the functional approach is that the same actions of individuals serve different psychological functions or goals. Consequently, in the context of PSVCs, the core contention of the functional approach to knowledge contribution is that despite the seemingly similar acts of knowledge contribution on the surface, the underlying motivational processes and the functions served by the acts can be diverse. The action in our context is knowledge contribution, and the goals that individuals try to achieve through knowledge contribution are their motivations towards knowledge contribution [8].

The functional approach has been applied to voluntary studies [10]. Voluntarism is a formalized, public, and proactive choice to freely donate one's time and effort to benefit

another person, group, or organization [11]. It is conceptually similar to knowledge contribution in PSVCs. The bipartite model of volunteering posits that people are motivated by concerns for others (altruistic motive) and self (egoistic motive) [12]. These are the two basic functions or goals that individuals pursue in voluntary behaviors.

Clary et al. observed six distinct egoistic motives for volunteering, which can be described as the value motive, social motive, understanding motive, career motive, self-enhancement motive and protective motive [13]. The value motive is adopted by individuals who believe that helping others is worthwhile. These values are perceived as essentially moral obligations for others. The social motive functions as an avenue for people to make friends through volunteering. The understanding motive enables a volunteer to learn from experience, and to improve on skills and abilities. The career motive motivates individuals who believe that volunteerism will improve career prospects. Accordingly, such individuals may perceive volunteerism as a means of preparing for future jobs. The self-enhancement motive serves to enhance a volunteer's personal sense of distinction and importance. This results in an increased sense of self-esteem, regardless of utilitarian benefits. Finally, the protective motive serves to provide an escape from personal and emotional problems and to improve one's mood.

Researchers have reported mean correlations among these six motives of 0.34 for adult volunteers and 0.41 for students [14]. It is argued that there might be an underlying common ground for these interrelated motives. Empirical study compared the second-order factor model with Clary's original multifactor model [15]. The result indicated that the fit of both models were highly similar (e.g. CFI: 0.89 for second-order factor model and 0.90 for multifactor model). It is suggested that egoistic motive and altruistic motive may serve as

second-order factors in individual motivation towards volunteering. Recently, Pelozo et al. implicitly treated egoistic motive and altruistic motive as second-order factors in investigating employees' participation in organizational volunteerism [16]. Although they did not explicitly claim egoistic motive and altruistic motive as second-order factors, the measurement of these two constructs included six functional motivations suggested by Clary et al. [13], which implied that each motive had several sub-dimensions and each motive accounted for the common ground of these sub-dimensions.

Studies on individual motivation to knowledge contribution in PSVCs show similar results. We summarize and re-categorize them into four major constructs based on Clary's study [13]: enjoyment of helping others, reciprocity, self-enhancement, and image. (see Table I)

Insert Table I

In addition, two major aspects of altruistic motive are identified from related literature: moral obligation and the motive to advance virtual communities [5], [17], [18]. The moral obligation motive pertains to a sense of fairness or justice resulting from concern for the welfare of others. The motive to advance virtual communities is a collectivist motive that serves to maintain communities or increase the welfare of communities as a whole [19].

The Expectancy-Value Theory and PSVC Mechanisms The Expectancy-Value Theory explains human motivation towards a goal as a combination of (a) expectancy, i.e., the degree to which people expect success towards that goal, and (b) value, i.e., the degree to which they value the goal [9]. Hence, the greater the belief that the goal would be attained and the higher the value of that goal, the greater would be the motivation to achieve that goal. In our study, the goals towards knowledge contribution have been identified in the previous section.

The Expectancy-Value Theory highlights the dependency of motivation on contextual factors. It means that a current motivation, which is goal-oriented, would be influenced by external factors associated with the expectancy and value of the goal. In PSVCs, the external factors can be various social and technological PSVC mechanisms. According to Expectancy-Value Theory, if these mechanisms are perceived to have positive effects on either the expectancy or the value of members' motivations, members' motivation to contribute knowledge would be stronger. This explains the relationships between PSVC mechanisms and individual motivations.

The definition of a virtual community reveals its dualism. On one hand, virtual communities differ from real communities in their technological advantages. On the other hand, virtual communities by inheriting the social aspects of real communities become online spaces where “enough people carry on public discussions long enough, with sufficient human feeling, to form personal relationships” [20, p. 5]. This is because the availability of electronic communication technologies on its own cannot guarantee that knowledge sharing would take place [21]. Hence, both the technological and social PSVC mechanisms play important roles in encouraging knowledge contribution. By conducting a literature review on virtual communities, we identify two types of mechanisms that are associated with members' motivations, i.e., technological and social mechanisms. More specifically, they encompass the identity mechanism, group norms, the knowledge repository, and the reputation system.

THEORETICAL MODEL AND HYPOTHESES

In this study, we investigate how self-reported perceptions on the abovementioned social-technological mechanisms of PSVC would impact individual motivation toward

knowledge contribution. Hence, we are looking at the perceived effectiveness of the knowledge repository, perceived effectiveness of the reputation system, perceived salience of social identity, and perceived pro-sharing norms. They are categorized as technological and social mechanisms. Fig. 1 depicts our theoretical model.

Insert fig. 1

Motivations *The Egoistic Motive:* In the review of individual motives to knowledge contribution, the majority of motive categories are egoistic in nature. The egoistic motive is the concern for self or self-interest. Egoistic motive towards knowledge contribution can be defined as the motive to contribute knowledge for the purpose of achieving personal benefits [22]. Egoistic motive in this study encompasses four aspects which are the self-enhancement motive, the image motive, the enjoyment motive and the reciprocity motive.

Image motive is the desire to build a positive image through knowledge contribution in PSVCs. According to the social exchange theory, status and respect are social rewards which are desired by individuals who participate in social interactions [23]. They are also recognized as social controls to encourage cooperation and helping behavior in online communities [24]. An individual's image desire is a powerful force for encouraging cooperation in public good situations [25]. Many researchers argue that members in online communities are stimulated by the image desire to participate in online activities [18], [26], [27].

The self-enhancement motive is considered as a positive effect related to ego [13]. It drives individuals by giving them a sense of self-importance from volunteering [28]. In the PSVC context, it refers to a member's belief that one's ego would grow and develop when one's

knowledge contribution enables a solution of a problem so as to make a difference. It is important to note that self-enhancement is an internal development achieved by maintaining or increasing positive feelings of oneself. It differs from image which is an external evaluation. Research shows that potential helpers are more likely to help others when they believe in themselves as being competent and confident [29].

Enjoyment is the psychic reward of helping others [30]. It helps to explain the helping behavior in single-spot interaction. That is, contributors are instantly rewarded intrinsically by the enjoyment of the interaction. Previous research shows that members in electronic communities of practice are motivated by enjoyment to make contribution. Knowledge contributors agree that they enjoy sharing their experiences and knowledge with others, and perceive contribution as an act of fun [18]. Empirical studies support the positive relationship between the enjoyment motive and knowledge contribution behavior [27], [31].

Reciprocity is an essential concept in the social exchange theory which states that individuals help others because they expect to be helped in the future [23]. Researchers have observed that participants in virtual communities might help others because they had been helped by others previously. It has been found that in open source software forums, a great number of help providers positively agree that they are motivated to respond because they had been helped previously in the same forum [18]. Prior empirical studies on virtual communities of practice have also supported that the reciprocity motivation serves as a strong predictor of knowledge contribution [27], [32].

The common ground of these specific motives is the concern for self interests, as all these four specific motives are egoistic in nature. Hence, we hypothesize that

H1: Members with stronger egoistic motivation will engage in more knowledge contribution.

The Altruistic Motive: The altruistic motive is the concern for others rather than self. Pelozo et al. find evidence of altruistic motive behind employee volunteering behavior [16]. In the research of knowledge contribution, it has been found that members are encouraged by altruistic motive to contribute knowledge to Wikipedia [33]. The moral obligation motive and the motive to advance virtual communities represent two aspects of altruistic motive in this study.

Moral obligation is defined as an obligation arising out of contemplation over what is right and wrong. Individuals regard an act as a moral obligation based on their own expectations about this act [34]. The predictive power of moral obligation on behavior has been supported by empirical studies [35]. Prior investigations on open source software forums have found that participants are willing to help others because they feel it is their responsibility to do so [18].

The motive to advance virtual communities is a motivation by individuals who embrace a community-interest perspective on knowledge contribution in PSVCs. Community members are motivated to participate in communities based on a collectivist inclination to increase the welfare of the community as a whole [19]. PSVCs are usually dedicated to specific areas or innovations such as open source projects. Members perceive them as a good way to set standards and spread ideas throughout an entire profession. They receive benefits from maintaining such virtual communities. Employing content analysis, exploratory studies on motivations encouraging contribution to virtual communities also found that the majority of

respondents view their knowledge as a public good and desire to contribute knowledge because they want to maintain and advance a virtual community [5], [17].

The common ground of these specific motives is the concern for others, and both of the motives are altruistic in nature. Hence, we hypothesize that

H2: Members with stronger altruistic motivation will engage in more knowledge contribution.

PSVC Mechanisms Previously, we highlighted that the Expectancy-Value Theory explains how various PSVC mechanisms affect various motivations. Either egoistic motive or altruistic motive is related to a goal (gaining benefits for self or gaining benefits for others). These social and technological mechanisms influence either the likelihood of achieving corresponding goals or the value of these goals for PSVC members. As a result, they will affect corresponding motivations.

Perceived Effectiveness of Knowledge Repositories: Knowledge repositories in PSVCs are usually manifested as simple databases or FAQs. Perceived effectiveness of knowledge repositories refers to the extent to which members believe that the knowledge repository of their PSVC is well organized and provides useful past solutions.

FAQs or databases take in solutions based on certain criteria. The problems need to be representative or valuable and the corresponding solutions have to be tested and proved to be successful. Highlighting these successful solutions and their consequent positive impact on performance will provide personal benefits to knowledge contributors in terms of self-enhancement and image [31]. This is because when their knowledge repository is

perceived as effective, members know that their contribution are more likely to be used by others and hence are deemed helpful to others, and resulting in an increased expectancy of gaining self-enhancement. Meanwhile, when members believe that their knowledge repository maintains high standards in screening for useful and timely solutions, they would agree that the providers of such solutions are experts in their fields. Consequently, such impressions are likely to spread to other knowledge contributors in that knowledge repository. Hence, the expectancy of gaining image increases.

In summary, the more effective the knowledge repository is perceived to be, the more likely knowledge contributors gain benefits for themselves. Thus, according to Expectancy-Value Theory, their egoistic motive accordingly increases.

H3: The perceived effectiveness of a knowledge repository is positively related to the egoistic motivation that members have for engaging in knowledge contribution to a PSVC.

Perceived Effectiveness of the Reputation System: In the context of PSVCs, the perceived effectiveness of the reputation system is defined as the extent to which a member believes that the reputation system is capable of providing accurate and reliable information about the past behavior of all members [36].

An effective reputation system encourages members to contribute knowledge by providing them personal benefits, especially image. As in virtual communities, members are often unrelated to each other, they may have never met and have no information on each other's behavior [37]. A reputation system provides a good measure of members' past behavior within this PSVC. A reputation system is one kind of structure assurances, which are

designed to discriminate among members based on their behaviors [38]. For a PSVC, a reputation system transforms a member's past valuable contribution into a positive image [39]. Once knowledge contributors perceive the reputation system as effective, they are confident that they are more likely to gain a better image through knowledge contribution, leading to an increased expectancy of self-gain. According to Expectancy-Value Theory, their egoistic motive thus increases.

H4: The perceived effectiveness of a reputation system is positively related to the egoistic motivation that members have for engaging in knowledge contribution to a PSVC.

Perceived Pro-sharing Norms: Pro-sharing norms in PSVCs may include norms of mutual support [40], collaboration and sharing [21], willingness to value and respond to diversity, openness to conflicting views, and tolerance for failure [41]. In a situation where strong pro-sharing norms are present, i.e., where members believe that other members will also obey the rules for engaging in online social interaction, a strong sense of mutual agreement and mutual accommodation is dominant [42]. Empirical studies also have shown that with strong pro-sharing norms, members express a stronger desire to interact with others in virtual communities [43]. Hence, in the presence of strong pro-sharing norms, members believe that their contribution is more likely to be recognized and appreciated [31], and members also enjoy a higher likelihood of being helped. Thus, they are more likely to have self-interest gains. According to Expectancy-Value Theory, it leads to an increase in the egoistic motivation.

H5: Perceived pro-sharing norms are positively related to the egoistic motivation that members have for engaging in knowledge contribution to a PSVC.

Pro-sharing norms are considered as organizational support for sharing knowledge [44]. This support encourages interactions among members of the organization which in our context is a PSVC. With strong pro-sharing norms, members are more willing to interact with each other. Members' interactions with others are characterized by interdependency [23]. As the interactions among members increase, they are more likely to feel dependent on other members. Consequently, the importance or the value of the PSVC which host such interactions can be positively reinforced. Hence, members will try to maintain or advance this PSVC as the value of maintaining or advancing this PSVC increases for them. According to Expectancy-Value Theory, it leads to an increase in the altruistic motivation.

H6: Perceived pro-sharing norms are positively related to the altruistic motivation that members have for engaging in knowledge contribution to a PSVC.

Perceived Salience of Social Identity: A salient social identity increases members' sense of belonging to a PSVC, where they strongly feel that they are part of the community. The social identity theory posits that the act of individuals categorizing themselves as group members leads them to display in-group favoritism. When social identity is salient to members, maintaining a positive image within this PSVC is important to them as they feel that the bond between themselves and their PSVC is stronger. Consequently, the value of reputation within a PSVC is more important to them.

This sense of belonging also leads to emotional involvement with, or an affective commitment to, the PSVC [42]. It has been verified that committed members have a higher intrinsic motivation (such as enjoyment) towards contribution [45]. Consequently, when members perceive salient social identity within their PSVC, they are more likely to gain enjoyment when helping other members.

In summary, the more salient the social identity is perceived to be, the more likely knowledge contributors gain benefits for themselves, or the benefits they gain are more important to them. Thus, according to Expectancy-Value Theory, their egoistic motive accordingly increases.

H7: The perceived salience of social identity is positively related to members' egoistic motivation for engaging in knowledge contribution to a PSVC.

It has been argued that a strong sense of social identity would have a powerful impact on people's perceptions and emotions [46]. Under the influence of a strong sense of social identity, members may consider others' welfare over their personal interests. Examples are activists who may jeopardize their personal well-being for the sake of principles and ideals (e.g. environmental or human rights activists). It is reasonable to argue that a strong sense of social identity would increase members' perceptions of the value of moral obligation.

Experimental research has also demonstrated the powerful effect of group identification on participants' willingness to preserve a collective good, which could be reflected in the PSVCs in our context [47]. It has also been suggested that when a sense of belonging is present, members feel emotionally attached to a community and are willing to develop and maintain their virtual community [48]. As a result, the value of maintaining and advancing the PSVC increases.

In summary, the more salient the social identity is perceived to be, the more likely knowledge contributors gain benefits for the PSVC, or the benefits are more important to them. Thus, according to Expectancy-Value Theory, their altruistic motive accordingly increases.

H8: The perceived salience of social identity is positively related to members' altruistic motivation for engaging in knowledge contribution to a PSVC.

METHODOLOGY

Operationalization of Constructs For new constructs, such as perceived effectiveness of knowledge repositories, new items were developed based on a thorough review of relevant constructs. We followed the methods for measuring perceptions of effective online community mechanisms from a previous study [36], and developed corresponding items to measure perceptions on the effectiveness of four PSVC mechanisms. For the other constructs, we adapted extant measurement items for our PSVC context to enhance validity. All items were measured using seven-point Likert scale ranging from “strongly disagree” to “strongly agree” (see Appendix A).

Sampling and Data Collection The target virtual community, for students and alumni of a university in Asia, was founded in 1995 and has more than 60,000 registered members. It has over 100 sub-communities focusing on various topics, such as medicine, C programming language, and astrology. Since members use one account to visit all sub-communities, this virtual community maintains a central reputation system. Reputation scores, which are shown in a member's account, reflect how actively this member participates in this virtual community and how much contribution he/she has made to this virtual community. Also, since using one account can visit all sub-communities, the social identity is the membership of this virtual community instead of various sub-communities. Although each sub-community has its own knowledge repository which is maintained by sub-community administrators, the basic functions such as searching and displaying are the same for all sub-communities. The difference lies on how sub-community administrators manage it, such as the knowledge

repository structure and frequency of updates. The virtual community enacted a set of norms that have to be followed by all sub-communities. These norms include pro-sharing norms such as mutual support, openness to conflicting ideas, and tolerance for ignorance. However, the strength of these norms varies in different sub-communities, which may depend on both administrators and participants.

We selected three sub-communities based on their popularity. Their topics cover relationship issues, family issues and stock market issues. Each of them has over 100 active online users and more than 2,000 messages per day. Over 100 problems were raised within each of these sub-communities daily.

To minimize the possibility of common method bias, we followed a method suggested by previous researchers to collect data using Internet-based surveys in two stages [49], [50]. The first survey included items that measured four perceptions on mechanisms, as well as demographic variables, and control variables. Within two weeks, we received over 300 responses. After a further two weeks, we emailed the respondents and invited them to take part in the follow-up survey on measurements of individual motivation and knowledge contribution. A reminder for the follow-up survey was sent one week later. Finally we received 257 samples. All the actual postings of the subjects were also recorded during that two-week period break as an objective measurement of knowledge contribution. Through a lucky draw, 25% of respondents were given a voucher that can be used to redeem a pair of movie tickets.

Several controls were put in place to enhance the quality of our online survey data. In fact, our data collection website prompted subjects if they had missed any questions. This

prevented the likelihood of missing data. Six responses were dropped because they were from the same IP address and had been completed almost simultaneously (i.e., consecutively within 10 minutes). In the end, 251 samples were considered as valid.

DATA ANALYSIS AND RESULTS

Table II outlines the demographic profile of the respondents. The percentage of males is 61%. As a university virtual community, the majority of members are undergraduate and graduate students, comprising 97% of the sample. The average age is about 24, which is usually the graduating age for undergraduate students. They had been using the Internet for over seven years on average (7.6 years). Finally, there is a good mix of members in terms of their experience in the PSVC under study (average experience of 49 months with a standard deviation of 29 months).

Insert Table II

Reliability and validity To validate the measurement model, reliability, discriminant validity and convergent validity were assessed for all constructs. Reliability was assessed through Cronbach's alpha. Table III shows the descriptive statistics of all variables and Cronbach's Alpha. Measurement scales for all constructs showed good reliability. All alphas were found to be greater than 0.70, the recommended cutoff value [51].

Insert Table III

The confirmatory factor analysis was conducted to test the convergent validity and discriminant validity of latent variables. Convergent validity was assessed by checking loadings to assess whether there was high correlation among the items measuring the same construct. Discriminant validity was assessed by checking whether the loadings for items

were stronger on their intended construct rather than on other constructs. Results showed that our measurement demonstrated high convergent and discriminant validity (see Appendix A).

Table IV shows the correlations between constructs, composite reliability and the square root of the average variance extracted (AVE) of each construct. Since the AVE is utilized to assess discriminant validity, the square root of the AVE should be larger than the correlations between constructs [52]. All items in our results meet this requirement. Composite reliability takes into account the actual loadings used to construct factor scores and provides an alternative measurement on internal consistency in addition to Cronbach's alpha [50]. The results show that composite reliability values for all constructs are greater than 0.70, which indicate good internal consistency.

Insert table IV

We also empirically validated our conceptualization of egocentric motive and altruistic motive as second-order factors (see Appendix B).

Hypotheses Testing In this study, we used the PLS Graph Version 3.00 to test our structural model. The results, with a bootstrapping analysis are shown in Fig. 2.

Insert fig. 2

As shown in Fig 2, egoistic motive had a significant relationship with knowledge contribution while altruistic motive had no significant relationship with knowledge contribution, i.e., H1 was supported while H2 was not supported. As for the relationships between technological and social mechanisms and individual motivations, H3, H6, H7 and H8 were supported while H4 and H5 were not supported.

Common Method Bias The common method bias is a potential threat to internal validity especially concerning research using the survey method. We addressed this threat using several approaches. First, data was collected in two steps, as measuring different constructs at different times would reduce any possibility of the common method bias [49]. In our case, members' perceptions on various PSVC mechanisms were measured two weeks before their motivation were measured. Since 98% of the subjects had more than half a year experience in this PSVC, and the average experience was 49 months, we believed that the members' perceptions on various PSVC mechanisms were very likely to remain the same in these two weeks. In addition, we conducted an exploratory factor analysis according to Harman's one-factor test [49]. If a single factor accounts for a majority of the covariances in all independent and dependent variables, the risk of a common method bias is high. The results did not reveal any single factor that accounted for a majority of the variances. Hence, we posited that the common method bias might not pose a serious threat to this study.

DISCUSSION

This study seeks to address two major research questions. First, we try to apply the functional approach in the PSVC context. The results show that four first-order motivations (the self-enhancement motive, image motive, reciprocity motive and enjoyment motive) serve as indicators of the second-order factor: egoistic motive, which play an important role in knowledge contribution in PSVCs. The study continues to identify the other two first-order motivations (the moral obligation motive and the motive to advance virtual communities), which are two aspects of altruistic motive for knowledge contribution in PSVCs. Indeed, our results demonstrate that the relationship between altruistic motive and knowledge contribution is insignificant in this PSVC. This might be explained by the salience of

members' profiles in this PSVC.

Studies comparing motivations to contribute knowledge in open-source software forums and those in Wikipedia have found that egoistic motive dominates in open-source software forums while in Wikipedia, altruistic motive serves as the main motivation [33]. This is because in open-source software forums, members' profiles are salient and easily accessible. It is easy to recognize the contributor's ID as it usually appears in the heading of postings. Furthermore, members can view others' profiles by clicking on the IDs. As a result, personal identity of individuals is more salient and members are more individualistic oriented. Hence, their main concern is personal gains. However, in Wikipedia, members mainly read topics which are the result of collaboration by various contributors, and it is difficult to distinguish their contribution respectively. As a result, social identity instead of personal identity is more salient and members are more collectivistic oriented. Hence, their self interest concern is limited and their main concern is altruistic. The PSVC in this study is more similar to open-source software forums in managing members' profiles. This might be the reason that altruistic motive is insignificant in this PSVC.

Second, this study identifies perceptions on social and technological mechanisms of PSVCs that influence motivations. Our findings indicate that the effectiveness of knowledge repositories positively influences the egoistic motive, and the perceived pro-sharing norms has a positive impact on the altruistic motive while the salience of social identity is positively related to both egoistic and altruistic motives.

It is surprising to find that the egoistic motivation was not influenced by the effectiveness of the reputation system. One possible explanation for this might be that an effective reputation

system not only elevate members' image when they contribute useful knowledge, but also degrade members' image when they make useless or possibly wrong solutions. As a result, members who are not confident about their answers or solutions may think that an effective reputation system may not bring them any benefit when they contribute such knowledge. Consequently, their egoistic motivation is not enhanced.

Our findings suggest that pro-sharing norms positively influence altruistic motive. However, the relationship between pro-sharing norms and egoistic motive is not supported. Pro-sharing norms may have a dark side which is those values initially seen as a benefit may become a pathological rigidity [53]. As pro-sharing norms encourage sharing regardless of the quality, both high quality and low quality contribution would receive the same benefits in terms of other members' appreciation and reciprocity. As a result, senior members or experts who provide high quality contribution would feel such appreciation and reciprocity are devalued. According to our data analysis, the majority of our subjects are senior members. It is possible that these members believe that under the influence of strong pro-sharing norms, their high quality contribution does not receive appropriate self-interest benefits compared to those who contribute low quality contribution, and their egoistic motive will not increase accordingly.

The Expectancy-Value Theory explains that motivations are influenced by either the expectancy or value of the motive. In this study, most of the external factors are related to the expectancy of the egoistic and altruistic motives. According to the hierarchical model of functional motivation [28], functional motivations are also influenced by personal traits such as the need for activity, which account for a large variance in functional motivations. This may explain the comparatively low R-squares of the motivations in our model. However, personal traits are beyond the scope of this study.

IMPLICATIONS

Motivations are the causes of actions. This paper explores individual motivations for contribution behavior in PSVCs. More specifically, we investigated voluntary, interactive, and collaborative PSVCs, in contrast to previous studies [31], [32].

Based on the functional approach and Expectancy-Value Theory, this paper makes several contributions to extant literature on PSVCs. First, our comprehensive motivation study examines the external factors that energize, direct, and sustain behavior. This paper shows how perceptions of the mechanisms of PSVCs influence individual motivations, which in turn affect knowledge contribution behavior. Second, the application of the functional approach to the PSVC context extends prior knowledge management research on individual motivation for knowledge contribution. We use two second-order factors to capture the common ground of first-order motivations. Third, this study tested an integrated model from egoistic and altruistic perspectives, thereby providing a more comprehensive view of individual motivation for knowledge contribution.

Our study also explains the underlying mechanism of how the mechanisms of a PSVC lead to increased knowledge contribution, which empirically supports Ames' theoretical framework on motivation [6]. Our study has identified specific goals and purposes as motivation, such as self-enhancement and enjoyment. We also suggest specific psychological environments which are members' perceptions on effectiveness of both social and technological mechanisms of PSVC, and empirically supported their influence on various motivations.

Practical Implications The results of this study provide insights into how practitioners of

PSVCs can encourage knowledge contribution. An important implication of the functional approach is that matching benefits with individual motivations results in positive outcomes. Hence, in order to encourage enduring knowledge contribution, virtual community practitioners should provide mechanisms to meet the motivations of knowledge contributors. According to our research findings, knowledge repository and social identity are critical to encourage knowledge contribution in PSVCs.

Researchers have stressed the importance of knowledge intermediaries in knowledge management systems [54]. The role of the knowledge intermediary is to codify well-grounded solutions when consensus is achieved and to store the solutions in the form of FAQs or knowledge repositories. Thus, knowledge intermediaries would reduce the work of knowledge contributors and avoid repeated and redundant discussions. As a result, administrators or moderators of PSVCs need to update their knowledge repositories to include the latest prevalent topics (frequently raised problems). Meanwhile, the knowledge repository should also be neatly designed. Problem classification should be clear and comprehensive. Various PSVCs could propose a unified classification scheme which contains a set of standard labels to classify problems. For example, a knowledge repository of web-design problems can be classified to JSP, ASP, PHP, Ajax and others. This would facilitate the searching process of members. Moreover, PSVCs can also incorporate social tagging, which is the practice and method of collaboratively creating and managing tags to annotate and categorize content, to reduce the workload of administrators. Furthermore, since the egoistic motive includes aspects of the self-enhancement motive and image motive, the authors of solutions which have been added into a knowledge repository should be informed so as to enjoy a sense of pride. Additionally, the administrators can highlight the IDs to make them salient to other members.

According to our findings, a salient social identity is very important as it affects several motives. Accordingly, it is essential for PSVC practitioners to make social identity salient among members. This can be achieved by providing email accounts for members within their PSVC or disseminating gadgets which represent their PSVC, such as T-shirts with the PSVC logo. Both online and offline events are very effective in creating a salient social identity among the members [55]. Examples of online events include online workshop and training session. Administrators can also invite experts to perform real-time consultation. Offline events can be seminars or workshops related to the PSVC topics, or gatherings just for socializing.

Professional communicators, who use strategies, theories, and technologies to more effectively communicate in the business world, could also benefit from the findings. As knowledge seekers, they could learn how to behave as a “good member” in order to encourage others to provide answers and solutions. As our findings indicate, knowledge contributors expect to gain self benefits in terms of image, enjoyment, self-enhancement and reciprocity. Professional communicators who are members of the PSVC could express their appreciation for the knowledge received [31]. Hence, knowledge contributors may gain enjoyment. Besides, members of the PSVC could also provide timely feedback on the result of the suggested solution, e.g. whether their problem has been solved, or how efficient the solution is. Hence, it may increase self-enhancement of knowledge contributors.

Effective PSVC mechanisms also need participation of members. For example, an effective reputation mechanism require members who received answers or solutions to rate them. Hence, the reputation mechanism can provide more accurate and reliable information about

knowledge contributors. Similarly, the salience of social identity is also related to members' participation. For instance, when the PSVC provides email account for members, their usages of these email accounts would increase the exposure of the PSVC and consequently make the social identity salient as others would recognize their membership of the PSVC through the email account.

Limitations Several limitations of this study deserve consideration. First, this study is based on a PSVC within a university and most members are university students. As a result, the generalizability of our findings to other settings may be a concern. For example, our findings may not be applicable to corporate PSVCs. In those PSVCs, members are mainly employees of the corporate organization who may know each other offline, and different aspects of egoistic motive may be considered (e.g. they may take their image within the PSVC more seriously). Moreover, monetary incentive may be awarded in corporate PSVCs, which might serve as an additional motivation. The choice of three sub-communities might also be a limitation of this study. Members may have different motivations while contributing knowledge to relationship issues such as love, marriage and contributing knowledge to stock market issues. Hence, our findings might be confounded by the topics of different sub-communities.

However, although the PSVC used in this study belongs to a university, it enjoys a high level of independency. This PSVC shares many characteristics of public virtual communities such as free registration, self-administration, and the lack of monetary incentive related to contribution. Hence, our findings are expected to be applicable to public virtual communities.

Second, our study does not consider the potential moderating effects of the characteristics of

problems in PSVCs. For example, studies on open-source software forums have suggested learning as an egoistic motive toward knowledge contribution [18]. Because in open-source software forums, problems (e.g. how to design a new function) might be very complex, and iterative testing and debugging are required to solve them. Members can learn from the process of solving the problem by actively engaging in the discussion. However, if the problem is not complex and the answer to the problem is straightforward, contributors may not learn from it. As a result, the complexity of problems may moderate the relationship between the egoistic motive and knowledge contribution. Moreover, other characteristics of problems such as interdependence, i.e. the degree to which the interaction and coordination of team members are required to solve problems, may moderate the relationships between motivation and knowledge contribution. A high interdependence situation requires participants to exchange materials, resources, and information to solve sub-problems, with more interaction and coordination among participants. In a low interdependence situation, participants can solve their sub-problems independently without many interactions and coordination. Consequently, the altruistic motive might be a stronger predictor of knowledge contribution in a high interdependence situation than in a low interdependence situation. Future investigation could compare various PSVCs with different problems.

Finally, this study uses self-reported measurements to gauge members' knowledge contribution. Self-reported measurements cannot accurately reflect members' actual knowledge contribution. The number of postings during the survey period by each subject is also not a perfect indicator of actual knowledge contribution, because a great portion of these postings may be social support or chit-chat. In addition, there is a potential threat of common method bias using self-reported measurements only. Future endeavors should use a variety of methodologies (e.g. interviews, content analysis) to capture actual knowledge contribution.

FUTURE RESEARCH

This research is a first step toward investigating the influence of mechanisms of PSVCs. We have found that perceptions of the effectiveness of the knowledge repository and the salience of social identity have positive influence on knowledge contribution through egoistic motivation. It is feasible for future studies to focus on specific functions and features such as search engines or ranking systems within PSVCs. Experiments can be conducted to test whether different mechanisms could have effects on knowledge contribution. Furthermore, additional mechanisms such as managerial support or incentive mechanism can be investigated on knowledge contribution in organizations.

Another area for future research is the collection of longitudinal data to investigate the feedback effect of knowledge contribution [24], [31]. Knowledge contributors' perceptions on PSVC mechanisms may be influenced by the consequences of their contribution, e.g. if members know that their reputation scores increase upon their contribution, they may be more likely to feel that the reputation system of this PSVC is effective. Studies using longitudinal data may verify such feedback effect.

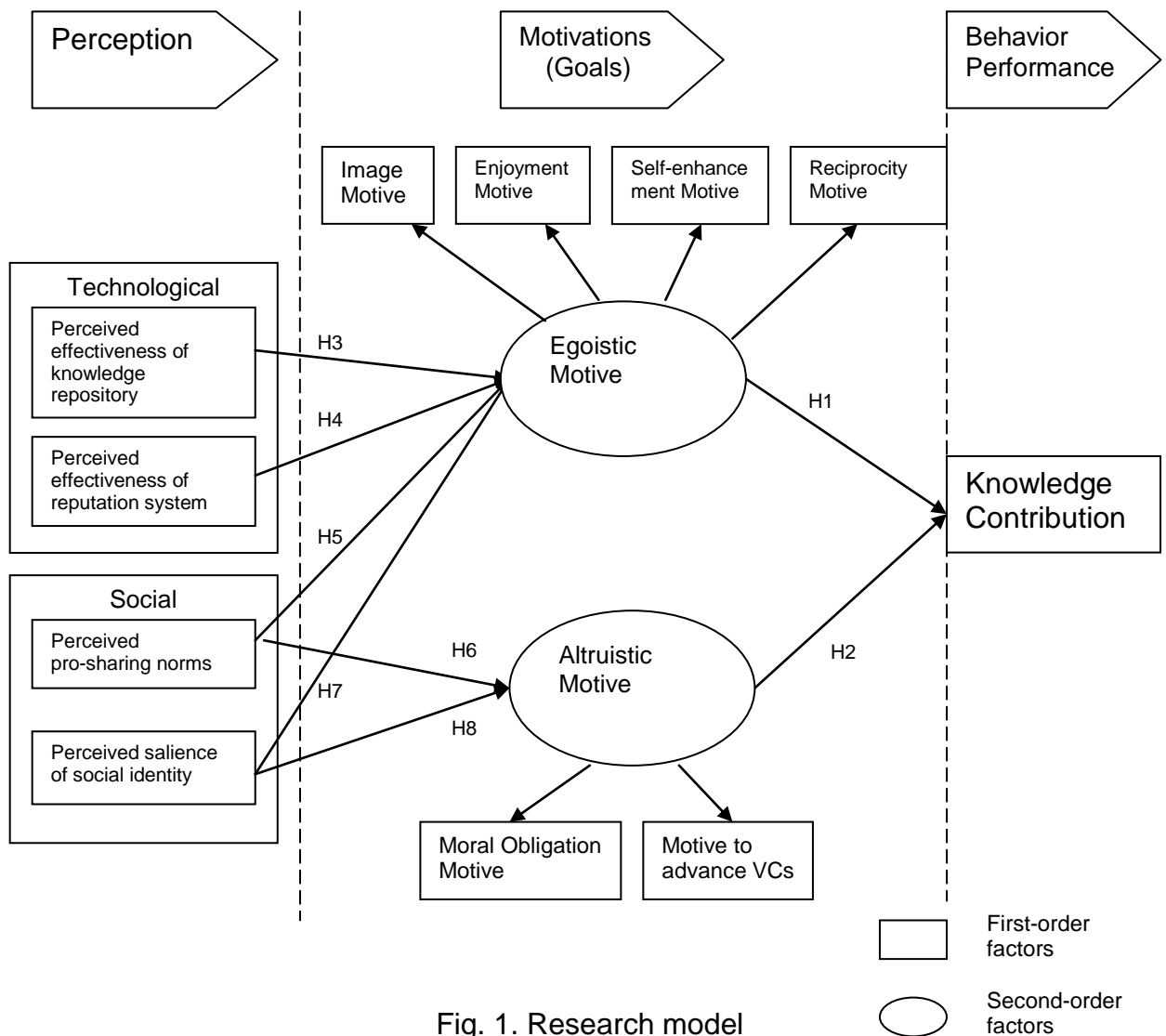


Fig. 1. Research model

TABLE I
SUMMARY OF INDIVIDUAL MOTIVATION

Second order construct	First order construct	Motivation	Definition/Explanation	Source
Egoistic	Enjoyment of helping others	Enjoyment	When people derive intrinsic enjoyment from helping others without expecting anything in return	Kankanhalli et al. [31]
		Enjoyment	Intangible return in the form of intrinsic satisfaction	Wasko and Faraj [27]
		Enjoyment	Intrinsic reward	Wasko and Faraj [27],

			Lakhani and von Hippel [18]	
Reciprocity	Reciprocity	A benefit for knowledge contributors because they expect future help from others in lieu of their contributions	Kankanhalli et al. [31]	
	Reciprocity	Favors given will be received in the future	Wasko and Faraj [17], [27]	
	Reciprocity	Generalized exchange that help given to a person is reciprocated by someone else in the group and not by the particular recipient of the original help	Lakhani and von Hippel [18]	
	Anticipated reciprocal relationships	Desire to maintain ongoing relationships with others, especially with regard to knowledge provision and reception	Bock et al. [32]	
Self-enhancement	Enhancement	Intangible return in the form of self-actualization	Wasko and Faraj [17]	
	Enhancement	Enhance one's personal sense of distinction and importance	Clary et al. [13]	
	Knowledge self-efficacy	Confident beliefs that one's knowledge can help to solve job-related problem, improve work efficiency, or make a difference to their organization	Kankanhalli et al. [31]	
	Sense of Self-Worth	Individuals' degree of liking themselves, based largely on competence, power, or efficacy regarding conduct	Bock et al. [32]	
Image	Image	Positive reputation showing to others that they possess valuable expertise	Kankanhalli et al. [31]	
	Reputation	Establish self as experts	Ardichvili et al. [5]	
	Reputation	An important asset that an individual can leverage to achieve and maintain status within a collective	Wasko and Faraj [27]	
	Reputation	Desire to gain reputation or enhance career prospects	Lakhani and von Hippel [18]	
Altruistic	Moral obligation	Moral obligation	Altruism, belief that it is part of being a member	Wasko and Faraj [17]
		Moral obligation	Obligation to contribute to the organization as a whole	Ardichvili et al. [5]
		Job obligation	Part of the job responsibilities	Lakhani and von Hippel [18]
		Commitment	An obligation to participate in the collective	Wasko and Faraj [27]
		Value	Altruistic and humanitarian concerns for others	Bock et al. [13]
	Advance virtual communities	Community interest	Maintain and advance their professional community of engineer	Ardichvili et al. [5]
		Helping the cause	Promote OSS as a whole	Lakhani and von Hippel [18]
		Advance the	Maintaining the community or	Wasko and

	community	profession as a whole	Faraj [17]
	Commitment to the network	A sense of responsibility to helping others on the basis of shared membership	Wasko and Faraj [27]

TABLE II
DESCRIPTIVE STATISTICS OF SUBJECTS

Gender			
Male	153(61%)	Female	98(39%)
Education:			
High school	1 (0.4%)	3 years college	7 (2.8%)
Bachelor	150 (59.8%)	Master	71 (28.3%)
PhD	22 (8.8%)		
Age	24.3 (S.D.=3.3)		
Internet Experience (Years)	7.6 (S.D.=2.2)	Virtual Community Experience (Months)	49.8 (S.D.=29)

TABLE III
DESCRIPTIVE STATISTICS AND MEASUREMENT RELIABILITY

Construct	No. of Items	Mean	S. D.	Cronbach's Alpha
Perceived Effectiveness of Knowledge Repository	3	4.85	1.18	0.833
Perceived Effectiveness of Reputation System	3	4.48	1.42	0.885
Perceived Pro-Sharing Norm	5	5.34	1.14	0.907
Perceived Salience of Social Identity	5	3.71	1.27	0.868
Enjoyment motive	4	5.16	1.13	0.905
Self-enhancement motive	4	4.50	1.16	0.896
Image motive	4	4.24	1.11	0.914
Reciprocity motive	4	4.78	1.18	0.845
Moral Obligation motive	4	4.14	1.23	0.856
Motive to Advance VCs	4	5.63	1.08	0.936
Knowledge Contribution	4	3.56	1.34	0.929

TABLE IV
CONSTRUCT CORRELATIONS, DISCRIMINANT VALIDITY, AND RELIABILITY

Constructs	Composite Reliability	EKR	ERM	PSN	SI	ENH	IMG	ENJ	REC	MO	AVC	KC
EKR	0.888	0.816										
ERM	0.734	0.238	0.705									
PSN	0.927	0.458	0.359	0.847								
SI	0.920	0.347	0.278	0.327	0.836							

ENH	0.933	0.304	0.185	0.232	0.465	0.881						
IMG	0.935	0.292	0.014	0.063	0.311	0.595	0.885					
ENJ	0.932	0.312	0.149	0.252	0.341	0.577	0.434	0.880				
REC	0.935	0.292	-0.05	0.204	0.391	0.481	0.493	0.461	0.885			
MO	0.903	0.252	0.197	0.271	0.408	0.451	0.357	0.452	0.377	0.836		
AVC	0.947	0.231	0.020	0.139	0.129	0.330	0.339	0.530	0.358	0.249	0.904	
KC	0.954	0.135	0.067	0.054	0.382	0.464	0.423	0.473	0.309	0.359	0.131	0.915

Legend:

AVC: the motive to advance virtual communities
 EKR: perceived effectiveness of knowledge repository
 ENH: self-enhancement motive
 ENJ: enjoyment motive
 ERM: perceived effectiveness of reputation system
 KC: knowledge contribution

MO: moral obligation motive
 PSN: perceived Pro-sharing norm
 REC: reciprocity motive
 IMG: image motive
 SI: perceived salience of social identity

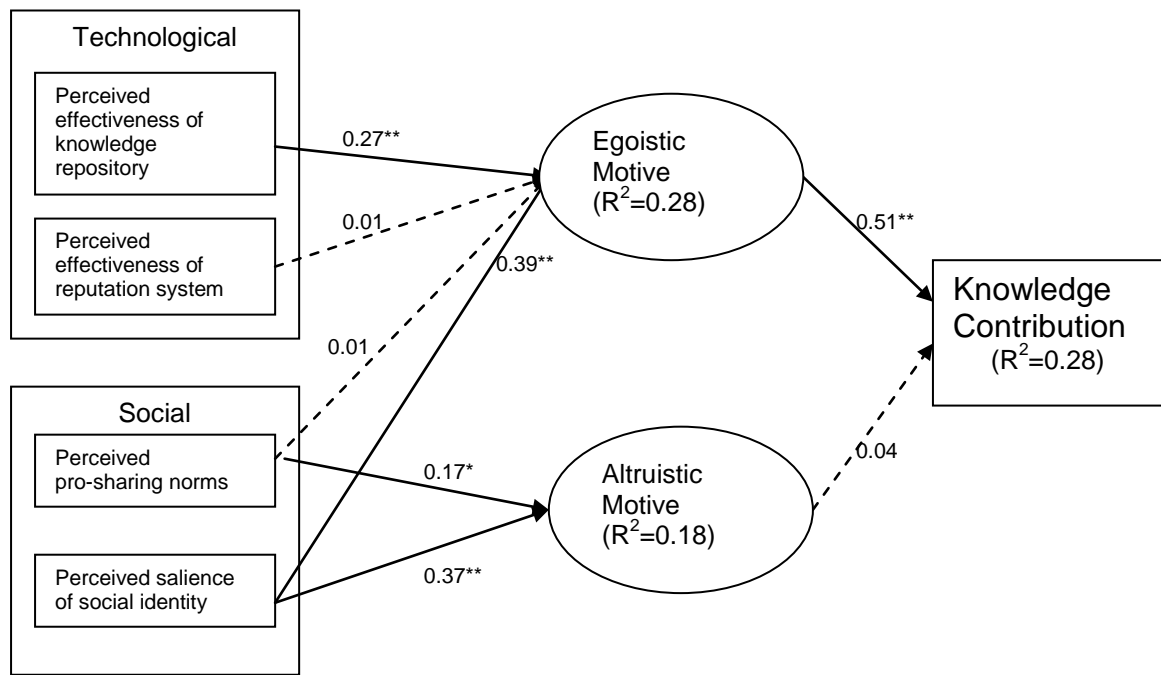


Fig. 2. PLS results

Notes: * denotes significance at the P<0.01 level
 ** denotes significance at the P<0.001 level

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