Psychological contract model for knowledge collaboration in virtual community of practice: An analysis based on the game theory

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ABSTRACT

In virtual communities of practice, many participants use their knowledge to achieve a common goal based on cooperation, and the key to such cooperation is knowledge collaboration. Knowledge collaboration is the primary method of increasing the virtual community of practice's knowledge ability and achieving the core competency advantage of sustainable growth. Knowledge collaboration inevitably involves the psychological elements of the collaborators. This study focuses on the elements of the psychological contract of the members of the virtual community of practice when participating in knowledge collaboration; the psychological contract summarizes the members' collaboration via seven psychological factors spread across two dimensions. Based on these factors, this study uses the game theory to create a cost game model and profit-sharing game model in the virtual community of practice knowledge collaboration. The cost game model is built upon Stackelberg equilibrium, the model is solved using backward induction, and its effectiveness is established. The profit-sharing model is based upon a modified Nash bargaining solution; the model is applied to the Python software development team in the Github community of practice and yields positive results. Finally, the research outcomes are summarized, and directions for future research are provided.

1. Introduction

With the development of network and information technology, Consistent with developments in network and communication technology, new forms of society such as virtual communities have begun to emerge in the cyberspace. People have started to communicate with each other beyond space and time constraints, establishing "societies" with frequent contact, mutual aid, and emotional and even material exchange - in other words, a "virtual reality". According to Rheingold [1], a "virtual community" is a group of people who communicate and converse through Internet, know each other to certain extent, are filled with emotions, share certain information and knowledge; it is essentially a social collective of personal relationship networks in cyberspace. More and more people are involved in knowledge collaboration in virtual communities. Community of practice was put forward by Lave and Wenger [2]. Community of practice are considered as a platform for continuous communication and sharing knowledge and an important platform of organizational learning [3,4]. Scholars

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conducted the research community of practice in face-to-face, work groups as well as email networks etc field [2,5]. At present, Virtual community of practice communities of practice have been the focus of study for researchers in the internet era [6–8]. Of these virtual communities, virtual community of practice are one of the most widely approved and used types of online community [9]. A virtual community of practice is a special virtual group with a focus on a certain topic that connects people who are interested in the topic [10]. Virtual community of practice used for knowledge sharing as well as knowledge collaboration among users to find solutions for questions, thus affecting participator decision-making behavior have been getting growing popularity [7,8,11]. The members of the virtual community of practice have a common interest in the knowledge of a specific field. A member may share a problem that he/she cannot solve alone or a valuable topic, and other members with the relevant knowledge and expertise may engage in the discussion and exploration. Topics of virtual community of practice usually include information technology, economics, management, psychology, etc. Knowledge has become the critical resource for many organizations. Knowledge collaboration is an important method for people or organization to value creation in the cooperated process of knowledge transformation, knowledge creation, and knowledge reuse etc. i.e., scientists collecting distributed knowledge resources and updating and sharing their knowledge, is an key activity in cooperation. Generally, knowledge collaboration is defined as knowledge sharing, knowledge transferring, knowledge accumulation, and knowledge transformation, which involves individual acts of offering knowledge to others as well as recombining, modifying, and integrating knowledge that others have contributed [12]. The importance of knowledge management within business communities in particular has been discussed [13]. Knowledge collaboration is an autonomous act of the participants from a virtual community of practice. Karlenzig [14] argues that knowledge collaboration is a strategic method that allows maximization of organized business performance through knowledge creation, acquisition, sharing and reuse, and he proposes online knowledge collaboration to minimize the cost of collaboration. Anklam [15] suggests that collaboration is a trend in the development of knowledge management, and he believes that knowledge management will enter a new development phase in which emphasis is placed on tacit knowledge, exchange and collaboration. Van Leijen & Baets [16] considers knowledge collaboration as a phenomenon that has emerged because the knowledge requester acknowledges his/her inability to solve certain problems, whereas the knowledge provider has the competence in the relevant area; if the parties can reach a common understanding, they can integrate their knowledge and fulfill the knowledge requirement of the knowledge requester, consequently achieving problem resolution. Gloge et al. [17] define knowledge collaboration from the perspective of information technology – the ability of a group to transfer the right information to the right person at the right time. Sharratt & Usoro [18] studied the knowledge share factors in online communities concerning about the organizational structure, technical infrastructure, trust and career advancement etc. Park et al. [19] studied the collaborative mechanism of knowledge collaboration in virtual communities. Gao et al. [20] analyzed performance evaluation of knowledge collaboration from two aspects: effectiveness of collaboration and efficiency of cooperation. Wang et al. [21] studied knowledge collaboration effects evaluation in research and development project teams. Wang et al. [22] studied Knowledge transmission with consideration of self-learning mechanism. Knowledge management requires proper knowledge collaborative working modes to come into work. To be more specific, knowledge coordination depends more on information technology. At present, many scholars have designed a wide range of knowledge collaboration models. Among these models, the existing literature of the evaluation of knowledge collaboration emphasizes the measurement of the effectiveness of collaborative approaches, however, previous studies have given less consideration on human cooperation from the perspective of psychological contract.

The psychological contract among members of a virtual community of practice participating in collaborative innovation has significant influence on the practical outcomes, and the execution of the psychological contract among all parties directly affects the outcome of the collaboration and community harmony. The earliest study regarding "psychological contracts" is the empirical research conducted by Argyis [23], Levinson et al., [24] which demonstrated the existence of a psychological contract between employer and employee. The psychological contract is an important concept for understanding the employment relationship or workplace behavior [25–28]. Many scholars designed Psychological contract framework to understand organizational citizenship behavior [29], employer and employee relationship [30], concerning career management, organizational commitment and work behavior [31], the relationships among commitment-based HR systems, psychological contracts and role behaviors [32], linkage between developmental human resource configuration and role behavior [33], talent retention [34] and multiple-foci exchange relationships [35]. Contrary to performance, psychological contract breach is possible have a negative impact on employee or employer behavior [36–38], one negative effect is the increase in employee turnover [39–41].

Game theory provides a good inspiration for the construction of a good psychological contract, and discusses how to construct a psychological contract in inter-organizational interaction through game theory. Game theory has recently expanded more broadly into human cooperation. In combination with the development of complex science and information systems, can be more effective in studying human activities [42]. Recent advances in social sciences with methods of non-equilibrium statistical physics are used to research coevolutionary mechanics of human cooperation [43]. Scholars have realized that statistical mechanics plays an important role in human cooperation [44], for example, statistical physics of crime and crime prevention strategies [45], infectious diseases and vaccination [46] etc.

At present, a majority of the existing researches focus on the knowledge sharing and exchange of virtual community of practice, and research on the psychological contract that members participate in the knowledge collaboration of virtual community of practice has been ignored. In virtual community of practice, because members themselves suffer from certain degrees of knowledge blind spots, they always encounter some problems in completing certain projects or tasks, which