



The influence of network structures of Wikipedia discussion pages on the efficiency of WikiProjects



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ARTICLE INFO

Keywords:

Network social capital
Effectiveness
Wikipedia
Community governance
Longitudinal study
Leadership

ABSTRACT

As a platform for discussion and communication, talk pages play an essential role in Wikipedia to facilitate coordination, sharing of information and knowledge resources among Wikipedians. In this work we explore the influence of network structures of these pages on the efficiency of WikiProjects. Project efficiency is measured as the amount of work done by project members in a quarter. The study uses the comments on WikiProject talk pages to construct communication networks. The structural properties of these networks are studied using ideas from social network theory. We develop three hypotheses about how network structures influence project effectiveness and examine the hypotheses using a longitudinal dataset of 362 WikiProjects. The evaluation suggests that an intermediate level of cohesion with a core of influential users dominating network flow improves effectiveness for a WikiProject, and that greater average membership tenure relates to project efficiency in a positive way. We discuss the implications of this analysis for the future management of WikiProjects.

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1. Introduction

With the advent of Web 2.0, recent years have witnessed a growing popularity of a community-based peer production approach to software development and knowledge creation. Companies and non-profit organizations are increasingly relying on input from online communities to build knowledge and software artifacts. Well-known examples of peer production communities include Linux, Apache, Wikipedia, and OpenStreetMap. Different from traditional organizations which rely on markets or managerial hierarchy projects to organize production (Benkler, 2006), there exist no comparable hierarchy counterparts in online peer production systems (Ung and Dalle, 2010). In such systems, the primary purpose of project-like structure is to share resources (e.g., artifacts, wikis, mailing lists, norms) among participants. For instance, in Wikipedia, “WikiProjects” play an important role in sharing information and knowledge resources, coordinating collaborative activities for related topics. Wikipedia defines a WikiProject¹ as follows:

A WikiProject is a group of editors that collaborate on encyclopedic work at a collection of pages devoted to the management of a specific topic or family of topics within Wikipedia. A WikiProject is a group of people, not a set of pages, a subject area, or a category.

The success of online peer production systems have generated great interest among researchers to explore the mechanisms behind these systems, of which Wikipedia attracts the most attention. For instance, Adler and Alfaro (2007) proposed a trust quality metric to measure the reliability of Wikipedia content. Kittur and Kraut (2008) examined how Wikipedians improve the quality of articles through explicit and implicit coordination. Ung and Dalle (2010) explored the influence of the WikiProjects by examining project-based coordination activity, and found bursts of activity which appear to be related to individual leadership. Zhu et al. (2011) found strong evidence of shared leadership in Wikipedia, with editors in peripheral roles producing a large proportion of leadership behaviors. Nemoto et al. (2011) examined the influence of pre-existing social capital on the efficiency of collaboration among Wikipedia editors, and found that higher social capital helps improve the efficiency of editors. While these studies shed light on important aspects that affect the success of peer production systems, a major limitation of these studies is that they fail to consider the broader social environment in which project participants coordinate and collaborate.

Despite the success as a means of knowledge sharing and collaboration, little is known about the mechanism behind

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¹ <http://en.wikipedia.org/w/index.php?title=Wikipedia:WikiProject.Council/Guide&oldid=615488861>.

community-based peer production from the perspective of social network analysis. Nevertheless, investigating social structure is a useful way to understand team practices since it allows researchers to explore questions with respect to coordination, control, socialization, continuity and learning – all topics of great interest for studies of collaborative groups (Crowston and Howison, 2005). In this study, we take a social network approach to investigate the impact of network structural properties on WikiProject effectiveness. We focus the study on the WikiProject unit as its primary purpose² is to promote and facilitate coordination, collaboration, sharing of information and knowledge resources among participants interested in related topics to create and improve articles. We measure the efficiency of a WikiProject as the amount of work done by project members in a quarter. We are interested in the following questions: Does the structure of communication networks related to a WikiProject affect its efficiency? If yes, what type of network structural properties will improve project efficiency?

To answer these questions, we investigate the relationship between network social capital and project efficiency in the context of Wikipedia. There is no universal and precise definition of network social capital (e.g., network closure (Coleman, 1988) versus structural holes (Burt, 1992) as social capital). Following Portes (1998), we define network social capital as the benefits network members secure from their membership in social networks or other social structures. We develop three hypotheses with respect to the influence of network structural properties on project efficiency and examine the hypotheses on a longitudinal dataset of 362 WikiProjects. The overall results suggest that an intermediate level of small-world structure with a core of influential users dominating network flow improves effectiveness for WikiProjects, and that greater average membership tenure relates to project efficiency in a positive way. This research provides insights into understanding the influence of network social capital on WikiProject efficiency and offers several practical implications for project management in Wikipedia.

The rest of this paper is organized as follows. The next section provides a discussion about the formation of communication networks and network resources, and a review of related work to develop hypotheses. In Section 3, we explain network measures and variables about project characteristics. Next, we discuss data collection and model specification. Section 5 presents the results, followed by an exploration of leadership behavior and language coordination in project communication. The last section presents discussion and conclusion.

2. Collaboration and network resources

2.1. Communication network and network structures

The primary purpose of WikiProject is to coordinate and organize the collaborative activities among project participants, as stated in Wikipedia²:

A WikiProject's pages are not used for writing encyclopedia articles directly, but as resources to help coordinate and organize the group's efforts at creating and improving articles. The discussion pages attached to a project page are a convenient forum for those involved in that project to talk about what they are doing, to ask questions, and to receive advice from other people interested in the group's work.

When faced with difficulties or in need of help, members generally turn to discussion pages for support from the community.

² <http://en.wikipedia.org/w/index.php?title=Wikipedia:WikiProject&diff=614844785&oldid=614844781>.

New members can learn discipline, rules and regulations about Wikipedia, and how to make contributions by social learning and interaction with experienced pioneers. On many occasions, members have discussions on the discussion pages in order to reach consensus on controversial issues or make collective decisions regarding rules, regulations, and improvement of the system. The social relationships among participants facilitates coordination, the flow and sharing of information and knowledge resources across the whole community. In essence, social networking plays a foundational role in the functionality of WikiProjects in terms of facilitating information flow and the organization and coordination of the collaborative activities. The interactions among project participants in discussion pages form a communication network for the project.

Specifically, the communication networks for WikiProjects can be constructed by parsing and coding the messages left on WikiProject talk pages recorded in the data dumps. For each message written by user A as a reply to user B's message, the two users were added as nodes into the network and a corresponding edge from A to B was created, with weight of the edge representing the number of messages A replied to B. By accumulating the communication on the talk pages of a WikiProject, we obtain its complete communication network from the inception of the WikiProject to the present time. We then get the communication network for a WikiProject in a specific quarter by extracting the nodes and edges from the overall network according to the timestamp associated with each edge. Fig. 1 illustrates the strategy of how the networks are constructed using discussion topic "arsinh, etc." on the talk pages of WikiProject Mathematics.³

Fig. 2 is a snapshot of communication networks for WikiProject Mathematics and Military History in the 18th Quarter (01/10/2006–31/12/2006). All the networks reported in this work are produced using Gephi software (Bastian et al., 2009). It is obvious from Fig. 2 that a group of core members implicitly coordinate user activities and dominate network flow in both networks.

Because of their foundational role in facilitating the flow of information and knowledge resources among network members, network relationships have been described as network resources (Gulati, 1999; Ahuja, 2000). Similar to the technological and other collaboration networks, communication networks for WikiProjects are also associated with network benefits such as resource sharing and information diffusion. Resource sharing benefits enable network members to combine professional knowledge and accumulated skills, whereas information diffusion benefits can provide access to knowledge spillovers (Ahuja, 2000). Both benefits can potentially help improve members' work.

2.2. Performance and network structures

Theoretical and empirical work exploring the affects of organizational tenure on job performance has suggested that organizational tenure generally promotes performance (e.g., Reagans and Zuckerman, 2001; Ng and Feldman, 2010). Reagans and Zuckerman (2001) performed a quantitative analysis on social networks, organizational tenure, and productivity of 224 corporate R&D teams, and found that average organizational tenure, network density, and network heterogeneity help improve team productivity. Their study suggests that R&D teams with heterogeneous networks and more senior members could enrich the research process and encourage coordination, thus promote greater productivity. Ng and Feldman (2010) investigated 350 empirical studies, and found that long-tenured workers generally

³ http://en.wikipedia.org/wiki/Wikipedia_talk:WikiProject_Mathematics_Archive/2011/Sep#arsinh.2C.etc.

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