



The effects of online social networks on tacit knowledge transmission

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HIGHLIGHTS

- We propose a tacit knowledge transmission model on networks with even mixing.
- Two routes of tacit knowledge transmission are considered.
- We derive the threshold that governs whether or not a kind of tacit knowledge can be shared.
- The degree distribution of the users' contact network has an important impact.

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ABSTRACT

Due to the popular use of online social networks in today's world, how to propagate employees' tacit knowledge via online social networks has attracted managers' attention, which is critical to enhance the competitiveness of firms. In this paper, we propose a tacit knowledge transmission model on networks with even mixing based on the propagation property of tacit knowledge and the application of online social networks. We consider two routes of transmission, which are contact through online social networks and face-to-face physical contact, and derive the threshold that governs whether or not a kind of tacit knowledge can be shared in an organization with few initial employees who have acquired it. The impact of the degree distribution of the users' contact network on the transmission is investigated analytically. Some numerical simulations are presented to support the theoretical results. We perform the sensitivity analysis of the threshold in terms of the propagation parameters and confirm that online social networks contribute significantly to enhancing the transmission of tacit knowledge among employees.

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1. Introduction

Knowledge transmission is critical to firms' success in today's highly competitive environment [1]. Based on Polanyi's conceptualization, Nonaka suggested that knowledge can be classified as explicit and tacit [2,3]. Tacit knowledge, as opposed to formal or explicit knowledge, refers to a category of knowledge that is difficult to transfer to another person by means of writing it down or verbalizing it, however, it is significant in humans' knowledge system and the core resource in humans' brains that dominates the behavior [4]. A new transmission route of tacit knowledge applying online social networks (OSNs) to communicate with one another emerged and has gradually become dominant in these decades, different from the traditional one, through face-to-face physical contact and communication. Online Social Networks have incrementally

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become the most popular applications such as Facebook, Twitter, Google+ and MySpace, which enable employees to share information, opinions, and knowledge simultaneously with a large number of peers. It allows rapid communication and interaction among employees as the distance barriers have been minimized [5]. The development of online social networks plays an essential role in the emergence of knowledge transmission activities in today's Internet world, and the knowledge is comprised of explicit and some tacit knowledge, as it provides a platform for people to do activities such as posting questions and answers, discussions, messaging, story-telling as well as sharing experiences [6].

Complex networks are widely applied to describe the features of complex systems in the real world, including social, biological, and communication systems [7,8]. And numerous studies focused on social network and its application have been published over the last years, due to the increasing development of human society. This interdisciplinary research field has attracted much attention of scientific communities from diverse disciplines, such as statistical physics, information science, sociology, and complexity science [9]. The new insights are contributed to the understanding the dynamics of information propagation such as knowledge transmission, which provides valuable support for leaders' management. Accordingly, this paper intends to study the effects of online social networks on employees' tacit knowledge transmission. The previous studies aimed at the propagation of tacit knowledge seem to be limited in analytic and empirical research, which analyzes and summarizes the existing phenomena, and predicts the future one [10,11]. Some researchers discuss this matter from the perspective of theoretical research, while this study is done mainly under the guidance of reductionism [12,13]. As a matter of fact, the spread of tacit knowledge between employees in an organization is a typical and complicated system. Therefore, this study does some analysis applying the method of transmission dynamics from the perspective of theoretical and quantitative research.

2. Model

Numerous studies on knowledge management (KM) have proven that the transmission of useful knowledge between employees enhances the performance of firms such as their absorptive capacity and innovation capability. Tacit knowledge carries a higher value since it is concerned with direct contact and the observation of employees' behaviors and related to more complex ways of acquiring knowledge from others. Thus, tacit knowledge is more difficult than explicit knowledge to spread among employees [14]. In recent years, studying the propagation of tacit knowledge has become much more feasible due to the wider availability of a variety of databases, fast and cheap computing power and efficient search and model-fitting algorithms. There are a number of ways in which the spread of tacit knowledge can be tracked. In terms of transmission dynamics, the similarities between the transmission of tacit knowledge and that of infectious diseases cannot be ignored. In the study of the characteristics of tacit knowledge and its propagation, we find that the spread of tacit knowledge has something in common with that of infectious diseases because of their similar transmission property, which is achieved through the direct contact between individuals. In the spread of a disease through a population, contact between an infectious and a susceptible individual can lead to the transmission of infection. Similarly, individuals or groups who have acquired a kind of tacit knowledge can motivate other individuals or groups to learn it through contact and communication.

Nowadays, the employees using online social networks to communicate share tacit knowledge with other users via online social networks and through face-to-face physical contact, and they also share tacit knowledge with the ones who do not use online social networks to communicate through face-to-face physical contact. While the employees who do not use online social networks to communicate share tacit knowledge with others only through face-to-face physical contact. We consider the employees of an organization using online social networks to communicate with one another and their contacts as an undirected network, each user in the organization can be regarded as a node in the network, and each contact through online social networks between two users is represented as an edge connecting their nodes. The number of edges emanating from a node, that is, the number of contacts a user has, is called the degree of the node. With the further integration of the global economy, enterprises have changed so fundamentally that managers pay more attention to the sharing of some key knowledge and its maximized use [15]. Therefore, we consider that the tacit knowledge being discussed requires to be mastered by all the employees in the organization. We classify the employees of an organization as the employees without a kind of tacit knowledge (S) and the ones who have acquired it (T). We all know that the employees who have acquired a kind of tacit knowledge may forget it after a period of time and become the ones without it. Furthermore, the employees who have forgotten it may acquire it once again through communication with others. Similarly, the employees without it can acquire it through communication with others and become the ones with it. It is approximately the same with the interconversion between the infectious and susceptible individuals in the spread of most infectious diseases. The classic SIS models described by dynamical systems have been extensively studied to understand the mechanisms of the transmission of these infectious diseases. Kiss et al. presented an SIR model of some infectious diseases transmission on networks with even mixing and considered multiple routes of transmission. They analytically found that these combined transmission mechanisms have a major impact on the final epidemic size [16]. Enlightened by his work, we propose an STS model of tacit knowledge propagation on networks with even mixing and consider two routes of transmission, which are through online social networks and face-to-face physical contact. Suppose $S_0(t)$ and $T_0(t)$ are the numbers of the employees who do not use online social networks to communicate without this tacit knowledge and with it at time t . Suppose $S_k(t)$ and $T_k(t)$ ($k = 1, 2, \dots, n$) are the number of the nodes of degree k without this tacit knowledge and with it at time t . Let N be the total number of employees in the organization and $N = \sum_{k=0}^n N_k(t)$, where $N_k(t) = S_k(t) + T_k(t)$. Nowadays, most

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