Identifying effective influencers based on trust for electronic word-of-mouth marketing: A domain-aware approach

Shixi Liu [a,c,*], Cuiqing Jiang [a], Zhangxi Lin [b], Yong Ding [a], Rui Duan [a], Zhicai Xu [c]

[a] School of Management, Hefei University of Technology, Hefei, Anhui 230009, China
[b] Rawls College of Business Administration, Texas Tech University, Lubbock, TX 79409, USA
[c] School of Computer and Information Engineering, Chuzhou University, Chuzhou, Anhui 239000, China

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ABSTRACT

Because effective influencers in an online social network (OSN) can significantly affect consumers' purchasing decisions via trust among users in electronic word-of-mouth (eWOM) marketing, identifying these influencers with respect to user trust relationships has become increasingly important. However, many existing studies overlook the domain attribute of trust and the time-varying nature of social networks and only analyze a static snapshot of a user trust network (UTN). To address these issues and investigate this topic in the e-commerce context, this study proposes a research framework that takes into account the dimensions of trust, domain, and time. A time-varying hypergraph is developed to model the OSN using the time-varying features of multi-type relationships, and an algorithm is developed to extract a domain-aware UTN based on the time-varying hypergraph and user trust relationships. Reinforced by the dimensions of trust, domain, and time, a novel product review domain-aware (PRDA) approach is conceived that identifies effective influencers and categorizes them into three types, i.e., emerging influencers, holding influencers, and vanishing influencers, based on their popularity status across the life cycle. The experimental results from the Epinions dataset show that the PRDA approach outperforms both the social network-based influence-evaluating approach and the "popular author" approach.

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1. Introduction

In the Internet era, advanced information technologies (such as personal computers, smart phones, wearable devices, and wireless broadband communications) and Internet-based social networking applications (such as Twitter, QQ, Facebook, and Skype) have innovated and empowered online social networks (OSNs). Today, the growing popularity of OSNs has changed the way that consumers and corporations interact with others. Consumers are accustomed to seeking useful information from people with a high online status in an OSN [25]; these people are normally referred to as "big Vs", or more formally, influencers. Meanwhile, corporations are also making efforts to exploit the effects of influencers for sales and advertising [3,34]. Thus, the ability to identify influencers in OSNs has become valuable to corporations in electronic word-of-mouth (eWOM) marketing, through which marketing information can be propagated faster and promoted better via recommendations by influencers in OSNs to their followers and peers [1,12,24]. In this way, e-commerce marketing campaigns that efficiently use social network resources not only reach more customers in OSNs but also increase their response rate.

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* Corresponding author at: School of Management, Hefei University of Technology, Hefei 230009, China. Tel.: +86 18900508679.
  E-mail address: liusxchuz@163.com (S. Liu).

As an important social concept, trust plays a critical role in users' decisions, especially when the participants are anonymous and do not engage in direct face-to-face interactions [3,29]. Users in an OSN expand their trust relationships with peers who have the same interests and preferences or with whom they have good interactions, and they thereby form a user trust network (UTN) [20]. According to Nielsen's 2012 "Global Survey of Trust in Advertising", 92% of consumers worldwide said that they trusted word-of-mouth recommendations from their trusted influential peers, vastly exceeding any other form of marketing, such as advertising or branded communications [2]. In this context, trusted influencers could potentially lead consumers to accept recommendations, make purchase decisions, and select transaction partners in e-commerce [44]. Therefore, identifying trusted influencers has become a popular research topic [20,24,45].

To date, numerous approaches to identifying influencers based on a UTN have been proposed [20,24,43,45]. However, most studies have considered the effect of trust in an OSN to be universally applicable to all domains without domain-dependent specificity. Meanwhile, previous studies normally analyzed UTNs using static snapshots but neglected the nature of a UTN's dynamics [20,24]. These two issues may result in lower accuracy and efficiency for discovered influencers. For example, a comment regarding the taste of Fajita-Style Quesadillas written by an influencer who is well recognized in the Computer Hardware domain but not in the Home & Garden domain may not be convincing to his/her fans. In addition, this influencer may no longer be a highly regarded expert in the next time period in the Computer Hardware domain if he/she does not follow a new computer product, or his/her influential power may fade if rival influencers become more competent. Furthermore, corporations are not only interested in whether a user is currently an influencer but also in whether the user will maintain his/her influential power into the future. Therefore, it is important to re-address this research issue by proposing a novel approach reinforced by new dimensions.

This study focuses on identifying effective influencers by taking into account the dimensions of trust, domain, and time. In this paper, we develop a research framework based on social identity theory [30,32] to identify effective influencers by combining a topological structure of domain-aware UTNs and the review time of users. First, we extend the traditional hypergraph to a time-varying hypergraph by adding in a time dimension to model a social network with multi-type relationship features and the dynamics of evolution. Second, we propose an algorithm to build a domain-aware UTN based on the hyperedge of the time-varying hypergraph and user trust relationships. Finally, we conceive a novel product review domain-aware (PRDA) approach to identify influencers by considering domain dependency and dynamics of trust, which overcomes the limits discussed above. According to their influential power status in their life cycle, we can define influencers as emerging influencers, holding influencers, and vanishing influencers. Based on the evolution of domain-aware UTNs, the PRDA approach can identify these three categories of influencers by using the social network analysis method. The experimental results reveal that many reviewers who could be defined as influencers using traditional approaches [20,24,43] never wrote any reviews in a specific product domain and hence have little influential power in that domain. This approach could be employed to identify effective influencers in a UTN in terms of domain and time period.

The contributions of our work can be summarized as follows: (1) based on social identity theory, we develop a research framework to identify effective influencers by combining review information and the trust relationships of users in OSNs; (2) a time-varying hypergraph is proposed to model social networks with multi-type relationship features and dynamic evolution; and (3) the PRDA approach is proposed to identify effective influencers based on the evolution of domain-aware UTNs.

The remainder of this paper is organized as follows. Section 2 introduces the theoretical background and related research. Then, the methodology and problem formalization is proposed in Section 3. Section 4 presents the empirical work and reports the evaluation results. The last section concludes the paper by summarizing the most important features of the proposed approach and suggesting future research directions.

2. Theoretical background and related research

There is a rich stream of literature examining social influence based on trust within OSNs for eWOM marketing purposes, particularly in e-commerce research. The existing studies were principally conducted based on three aspects of social networks: their theories, methods, and techniques. More specifically, these studies refer to social identity theory, online social trust, social network modeling, and influencer identification.

2.1. Social identity theory

A social identity is defined as an individual's self-concept, which comes from perceived membership in a relevant social group [30,32]. Social identity theory investigates how the social context influences interpersonal and intergroup relationships and behaviors. Based on social identity theory, individuals in a social network perceptually divide their social world into ingroups and outgroups [29]. An ingroup refers to a social group that an individual regards herself/himself as a member of for a common purpose, and the individual feels a close relationship with and a significant influence toward this group's members. Thus, social identity theory predicts that people tend to identify more with ingroup members by sharing their opinions and behaving more favorably toward them compared with the members of an outgroup [29,30]. The prototype of the ingroup is an abstract cognitive representation of "us" that maximizes intergroup differences and ingroup similarities.

In OSNs, social identity occurs similarly through interactions with other users in the personal network as well as in online social groups [11], but at a much faster speed than in a traditional social network. When a member dis-identifies with an