Impact of Social Influence in E-Commerce Decision Making

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ABSTRACT
Purchasing decisions are often strongly influenced by people who the consumer knows and trusts. Moreover, many online shoppers tend to wait for the opinions of early adopters before making a purchase decision to reduce the risk of buying a new product. Web-based social communities, actively fostered by E-commerce companies, allow consumers to share their personal experiences by writing reviews, rating others' reviews, and chatting among trusting members. They drive the volume of traffic to retail sites and become a starting point for Web shoppers. E-commerce companies have recently started to capture data on the social interaction between consumers in their websites, with the potential objective of understanding and leveraging social influence in customers' purchase decision making to improve customer relationship management and increase sales. In this paper, we present an overview of the impact of social influence in E-commerce decision making to provide guidance to researchers and companies who have an interest in related issues. We identify how data about social influence can be captured from online customer behaviors and how social influence can be used by E-commerce websites to aid the user decision making process. We also provide a summary of technology for social network analysis and identify the research challenges of measuring and leveraging the impact of social influence on E-commerce decision making.

Categories and Subject Descriptors
H.1.2 [User/Machine Systems]:Human Factors, Human Information Processing; J.1 [Administrative Data Processing]:: Marketing.

General Terms
Management; Human Factors; Theory.

Keywords
Social Network; E-Commerce.

1. INTRODUCTION
Browsing, searching, and buying a product on E-commerce websites is often a time consuming and frustrating task for consumers. Over 80% of Web shoppers have at some point left E-commerce websites without finding what they want [27]. Richer E-commerce systems that connect companies to their customers could enhance customers' decision making and their bottom line [25]. E-commerce companies are attempting to support part of their potential customers' decision making process by introducing personalized Web-based decision support systems such as recommender systems. These recommender systems provide consumers with personalized recommendations based on their purchase history, past ratings' profile, or interests. These collaborative filtering based recommender systems have been applied to many E-commerce websites (e.g., movie, music, and restaurant recommendation) and shown good performance in predicting a list of products which a consumer prefers. A typical collaborative filtering algorithm builds a customer's neighborhood based on his or her preferences of shared products and weighs the interest of neighbors with similar taste to generate new recommendations [5].

Sinha and Swearingen [28], however, found that consumers are far more likely to believe recommendations from people they know and trust, i.e., friends and family-members, rather than from automated recommender systems in E-commerce websites. In reality, a person's decision to buy a product is often strongly influenced by his or her friends, acquaintances and business partners, rather than strangers. Nevertheless, online communities on the Web allow users to express their personal preferences and to share their recommendations by rating others' reviews and identifying trusting members. According to new research by Hitwise [31], social network sites including MySpace and Facebook are driving an increasing volume of traffic to retail sites (i.e., 6% of retail traffic in 2006), and are thus becoming a starting point for Web users who are interested in E-commerce. This increase in traffic from social network sites to online retailers shows that highly influential customers directly affect other consumers' decision making. Therefore, E-commerce companies can take advantage of this social influence between consumers to support customer relationship management and increase sales.

Approaches incorporating social influence into recommender systems or online marketing in E-commerce have started gaining momentum. Some researchers have suggested social recommender systems that take into account social interaction in combination with purchase preferences and profiles when generating recommendations. Lam [18] proposed a collaborative recommender system incorporating social network information, called Social Network in Automated Collaborative-filtering of Knowledge (SNACK). The similarity weight for users' ratings was modified according to the network distance (i.e., the length of the shortest path) between two users, and the preference of closed

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network neighbors was emphasized. Massa et al. [21, 22] built a trust model using trust data from Epinions.com to predict the trust value that is propagated within a network and used to make recommendations. These social recommender systems have been observed to achieve better prediction rates, and have also solved the cold-start problem in which a new user does not have enough product preferences for the system to make good predictions. The measure of social influence and trust value in a Web-based social network increasingly appears to be an important key to enhancing the accuracy of recommender systems.

Some researchers have focused on the consumer networks that are formed through the direct and indirect interactions (e.g., to read and rate reviews) between consumers to maximize the impact of direct marketing through social influence. Models have been proposed to identify a set of highly influential customers to maximize word-of-mouth effects or to find target customers based on the preferences and influencial impact from previous customers,. Domingos et al. [8] proposed a model to mine a customer's network value and optimize the choice of which customers to market to. Kempe et al. [26] solved the optimization problem of selecting highly influential customers to maximize the spread of influence through a social network. In these efforts, a measure of social influence such as cascading effects and network value is one of the key issues. Hill et al. [14] suggest network-based marketing using existing customers to identify potential customers who are likely to buy, based upon being influenced by previous customers who have bought a service. This was done in the domain of telecommunication services.

Although some emerging research has started to incorporate social influence in E-commerce, it has been limited to data sources about social interaction captured from E-commerce interactions only, which is only a subset of the information that is becoming available. In this paper, we present an overview of the impact of social influence in E-commerce decision making to provide guidance to researchers and E-commerce companies. Specifically, we examine various ways to capture social influence using an E-commerce platform and also discuss how captured data about social influence can be used by E-commerce websites to aid users' decision making process. We also survey current technology for social network analysis which could be adopted and modified for analysis of E-commerce social interactions. We discuss research challenges of measuring and leveraging the impact of social influence. Although we do not provide a specific methodology or algorithm in this paper, our understanding of social influence in E-commerce could be a starting point to develop strategies and methodologies for a social interaction based E-commerce decision making system.

We begin by identifying the impact of social influence in various aspects of E-commerce in Section 2 and then describe how to exercise social influence on a customer's decision making process with an example in Section 3. We provide a summary of technology for social network analysis in Section 4 and discuss research challenges in Section 5. We conclude the paper in Section 6.

2. WHAT IS SOCIAL INFLUENCE?

A social network is a graph of relationships and interactions within a group of individuals, which often plays a fundamental role as a medium for the spread of information, ideas, and influence among its members [16]. A Web-based social network provides various methods such as a chat room and a discussion forum for participants who can interact, exchange opinions, and compare experiences with others. In the context of E-commerce, social networks emerge since many websites help a consumer's final purchase decision by sharing reviews written by previous customers and evaluated by potential customers[1]. Many online shoppers tend to wait for early adopters' opinions before making a purchase decision to reduce the risk of buying a new product [19]. Bearden et al. [2] observed the existence of two kinds of social influence in the adoption of a new product: normative social influence (or subjective norms) and informational social influence. Normative social influence creates social pressure for people to adopt a product or a service because people not adopting a product may be treated as "old fashioned" regardless of the individual's preference toward the product. Informational social influence is a learning process through which people observe the experience of early adopters in their social network and decide whether to buy the new product. Thus, informational social influence can have a moderating role between customers' attitudes toward a product and their intention to buy it, by enhancing consumers' confidence in their preferences and beliefs toward the product [19].

An approach to measuring the social influence between consumers of an E-commerce website provides multiple benefits. First, online shoppers are provided a number of high quality and personalized reviews of a product from trusted sources to convince them to buy. Second, a company producing a product may get customers' direct and detailed responses and be in a better position to predict market trends. Third, an E-commerce website can identify opinion leaders with high influence and maximize the effectiveness of marketing based on a social network surrounding opinion leaders. In recent work [9,14,16], network based marketing and viral marketing has proven to be more cost-effective than traditional direct marketing, which treats the customer as an independent decision maker and ignores the effect of the surrounding network. The premise of viral marketing is that targeting a few influential consumers initially can trigger a cascade of influence through a social network in which friends will voluntarily share their experiences or recommend the product to other friends [16]. Thus, a company

[1] Of course, this is not exactly a social network since the relationship between a "review writer" and "review reader" is a weak one, with no direct interaction between them. However, an influential review writer, e.g., a "Top 100 reviewer" from Amazon may exercise influence over the buying decisions of many readers, even though he or she does not know any specific person among them, and is thus not exercising 1-to-1 influence.

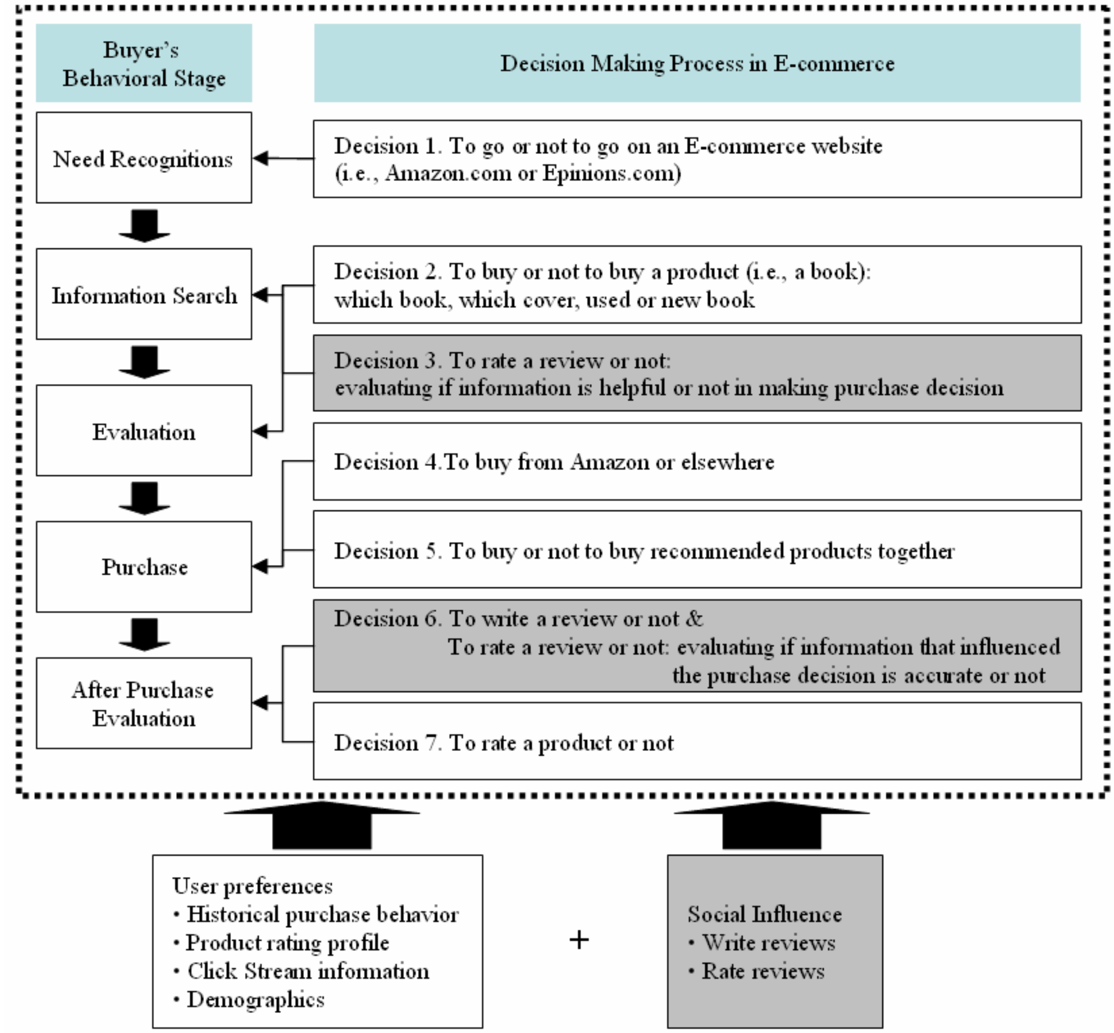

Figure. 1. A decision making process in E-commerce

can avoid marketing directly to a consumer who is largely influenced by friends, and is not very likely to buy a product unless recommended by friends.

Therefore, constructing a social network using interactions between consumers and finding the important nodes, i.e., influential customers in the constructed social network has been a key issue for marketers as well as sociologists for some time. Many kinds of centrality measures have been developed, e.g. *degree centrality,* which treats high degree nodes as important and *distance centrality,* which treats nodes with short paths to many other nodes as important [6,30]. Some online communities such as Epinions.com encourage users to provide trust data, where users explicitly express their trust of other participants, leading to the construction of personalized webs of trust. Many E-commerce websites such as Amazon.com allow a consumer to buy a product as a gift for friends and to recommend it to friends. Consumers write product reviews and also express how useful the reviews written by other consumers are. However, in general, most social networks are formed and maintained through informal, qualitative and unobserved interaction and thus it is difficult to find a social network in E-commerce websites [30]. Few researchers have studied how social influence propagates in E-commerce websites and how to use it for influencing customers' decision making in E-commerce. Most research has focused on identifying social networks in web communities and e-mail networks, which have many kinds of interactions such as reading, posting, commenting, and forwarding.

3. THE E-COMMERCE DECISION MAKING PROCESS AND SOCIAL INFLUENCE

In this section we describe a customer's decision making process in E-commerce and examine how social influence affects each decision making step. We also examine how data about the social influence can be captured by E-commerce platforms and how the data can be used to exercise influence on the customer's decision.

3.1 E-commerce Decision Making Process: An Example

In general, buyers' behavioral stages consist of Need recognition, Information search, Evaluation, Purchase and After purchase evaluation [9] in which a consumer has to make one or more decisions, as shown in Figure 1. For instance, consider a customer, Jane, who wants to buy a book about "social networks" in an online shopping site. Decision 1: Jane recognizes a need to buy a book about "social networks." She has to decide if she will go to Amazon.com where she shops often, or try another online store such as Barnes & Nobles. Sometimes, she also decides if it is worthwhile to visit a Web-based community site such as Epinions.com in advance to search for information about a product. Decisions 2 & 3: Upon deciding to visit Amazon.com, she searches for a book about "social networks." She reads editorial reviews, sample pages, customers' reviews about a few books and compares them based on her preference (e.g., not too thick, soft cover, and for a beginner), price, customers' reviews and reviews' ratings, as evaluated by other customers. At this point, she has to determine which book to buy and decide if she would like to rate some reviews that were helpful in making a purchase decision. Decision 4: After selecting the book to buy, she has to decide if she should buy the book at Amazon.com or some other store, which might potentially offer better shipping options or lower prices. Decision 5: When she decides to place an order at Amazon.com, she is recommended a set of books, which were frequently purchased together. She decides whether to buy the recommended books or not. Decision 6: After reading the book which she bought, the customer considers writing a review to share her opinion and to help other customers' decision making. She also decides to rate some reviews that influenced her purchase decision of the product based on the reviews' accuracy or honesty. Decision 7: She also decides whether or not she should rate the book. She knows that she can receive more personalized recommendations from Amazon.com when she rates products she has purchased most often.

At some decision steps, current Web-based decision support systems support customers' decision making based on user preference, which is calculated from historical purchase behavior, click stream information, rating of purchase products, or demographics. In addition, E-commerce companies have recently attempted to collect data about social influence by encouraging a customer to write and rate reviews (e.g., a decision step 3 and 6), because consumers are far more likely to believe information and opinions from trusted acquaintances and are convinced to buy by them.

3.2 Use of Social Influence in the E-Commerce Decision Making Process

The key to turning consumers (i.e., potential customers) to customers through social influence in E-commerce depends on capturing accurate data about social influence between customers like Web-based social communities (See Figure 2). First, E-commerce websites can ask a current customer to recommend a product to their friends who might be interested in the product (e.g., "Tell a friend" at Amazon.com), and then capture data about connections between a customer and friends. Second, E-commerce websites can offer a community where consumers discuss products that are available on their websites and share experiences. For example, Amazon.com provides consumers with their "Customer Review Discussion Board" where they post a review and comment on others' reviews and also express which reviewers they ignored (i.e., distrust) and which reviewers they have added to a friend list (i.e., trust). Amazon.com also encourages consumers to invite friends to this interesting board. Consumers who have some common interests (i.e., preferences) and trust others' opinions could have social interaction in a community which is constructed around a product even though they do not know the others personally. Therefore, E-commerce companies like Amazon.com could capture data about connections between a customer and trusted members in a product community. E-commerce companies also could achieve the data about trust from a Web-based social network like Epinions.com if users in Epinions.com allow them to use the information, because Web-based social networks have a "Web of trust" which is constructed by users' expressed trust data and is less sparse than that of E-commerce. Third, most E-commerce websites encourage customers to write reviews and to rate reviews written by other customers. The company can then gather data about the connection between a review writer and a review rater.

In order to capture these data about connections and the relationship in a community, E-commerce companies have to change their websites from a place which just sells a product to a place which offers a community as well as a product. The communities are formed by consumers who purchase the same product and share experiences or opinions around the product. E-commerce websites just offer a space for communities and functions to facilitate interactions among consumers.

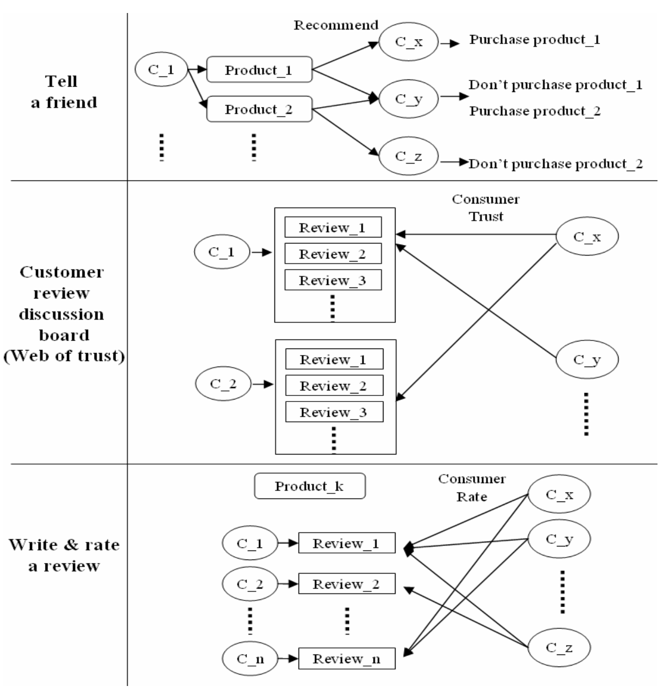

Figure 2. The data about social interaction

Based on the data about social interaction in E-commerce, we next discuss which decision steps are influenced by social network factors and how to use this information to exercise influence on the decision.

- Need Recognition

Decision 1. To go or not to go an E-commerce website: A company could anticipate a customer's latent purchase needs based on a social community or group to which a customer belongs (e.g., virtual community, companies, education) and the relationship with which a customer associates. Then, a company stimulates latent purchase needs by sending a recommendation e-mail which encourages a consumer to visit its website. For example, E-commerce websites could send Jane a direct e-mail to recommend the book, "Small World" with Kate's review, because Kate, who is trusted by Jane, bought the book, rates it highly and also wrote a good review. Jane read Kate's review about the book "Social Network" and bought it a month ago.

- Information Search & Evaluation

Decision 2. To buy or not to buy a product (which book to buy) & Decision 3. To rate a review or not: In this decision step, the consumer needs more help than at any other decision step, because the customer wants to reduce the list of products to compare. The customer also wants to reduce the risk of buying a new product and effectively make a satisfactory decision. A company could reduce the search space which has a small set of products to be compared in detail by recommending a few products based on opinion leaders' ratings in a product category (i.e., the best rated) or friends or trusted members' ratings. E-commerce websites can also assist in the consumer's final decision of selecting one product by offering previous customers' opinions (i.e., reviews) which are rated as "high quality." Most E-commerce websites encourage customers to write a review and rate reviews written by others; therefore, they can identify influential customers called opinion leaders based on how many reviews the customers wrote and how much credit the customers receive. For example, when a consumer tries to search for a book about "social network" using a keyword "social network," E-commerce websites could sort relevant books according to the average rating calculated by high quality reviews (e.g. 50% of the people found the review helpful). Among the sorted products, E-commerce could recommend opinion leaders' choices with their reviews and their ratings. If E-commerce websites could provide the ratings of reviews which are rated after customers buy the product (i.e., Decision step 6), the ratings will be more helpful in deciding to buy the product or not because they can show how accurate and honest the reviews are. Showing previous customers' ratings and comments about reviews will also motivate a customer to participate in rating reviews and writing a comment as an evaluator of reviews.

- Purchase

Decision 4. To buy at Amazon.com or elsewhere: A company has to convince a consumer to buy the selected product on its website by letting the customer know that the company offers a better price, shipping conditions or after services than other online shopping malls. In order to do this, the company allows a previous consumer to rate a product supplier such as Amazon.com or a third-party provider located in Amazon.com about price, shipping date, service quality, rewards (e.g., to get credit), recommend or not recommend, and so on. Some social network websites such as Epinions.com also allow a customer to evaluate E-commerce websites, E-commerce websites can offer a consumer the reviews of its website which previous customers wrote to build trust in the E-commerce website or the product provider. For example, E-commerce websites show how many previous customers recommend buying a selected product at Amazon.com with reasons such as free shipping.

Decision 5. To buy or not to buy recommended products together: E-commerce websites can offer additional recommendation features based on data about general customer behavior. For instance, they offer a recommendation product purchased by the customers who bought the same items or offer similar products or correlated products based on the product that was already purchased by the customer. In order to encourage social influence, E-commerce websites can make an additional recommendation based on data about a customer's social community members' behavior, instead of about general customers. E-commerce websites can also recommend products which were purchased together by a customer's trusted members with their reviews and average ratings.

- After Purchase Evaluation

Decision 6. To write a review or not & Decision 7. To rate a product or not: An E-commerce company could encourage a customer to write a review or rate a product by recommending a relevant community about the product and informing them about what has happened in the community. People tend to participate in discussions when they experience opposite opinions (even wrong or different opinions) and get feedback on their opinions from others. Thus, E-commerce websites inform a customer through e-mail about feedback on his or her review or friends' opinions.

E-commerce websites have much more potential to increase sales by supporting customers' whole decision making based on social influence data captured from E-commerce interaction as well as customers' transaction information.

4. TECHNOLOGIES NEEDED TO LEVERAGE SOCIAL INFLUENCE IN E-COMMERCE DECISION MAKING

In this section, we provide a summary of technology for social network analysis which could be used to leverage social influence in the E-commerce decision making process. Social network analysis (SNA) is a methodology for analyzing patterns of relationships and interactions between social actors in order to discover the underlying social structure [32]. The techniques for SNA have been proposed to solve problems of 1) identifying key nodes such as prominent, trusted, or expert actors in social networks, 2) extracting communities (i.e., social groups) in a large network, and 3) predicting links or trust value between social actors.

4.1 To Identify Key Nodes

In order to identify key nodes in social networks, various centrality measures have been used: *Degree, Betweenness, Closeness, PageRank and HITS.* These measures compute rankings or scores over a subset of actors in a social network which indicate degree of importance or expertise [29]. The central nodes often play a role by issuing information, ideas and influence, or bridging different communities [6]. The removal of central nodes could disrupt a network more than peripheral nodes. In other words, the central nodes could be effectively used to maximize social influence within a social network. *Degree* [10] measures how active or popular a particular node is. It is defined as the number of direct links a node has. *Betweenness* [10] measures how many times a particular node lies in a shortest path between two nodes. Nodes with high betweenness scores often act as communication channels like brokers and gatekeepers between different communities that transmit resources [6]. *Closeness* [10] is defined as the sum of the length of the shortest path between a particular node and all other nodes in a network. The *PageRank* algorithm [4] measures the importance of web pages by analyzing the underlying hyperlink structure of web pages. The *HIT* algorithm [17] discovers authoritative information sources on a topic based on the relationship between a set of relevant authoritative pages and the set of hub pages that join them together in the link structure. Theses centrality measures can be used to rank consumers based on the amount of influence on customers' purchase decision making and identify opinion leaders who often write reviews earlier than other consumers in some categories

4.2 To Extract Communities

How to extract a community or a social group in a large network has also been an important topic in SNA. A weighted network in which each link has a weight could be separated into groups by maximizing the within-group link weights while minimizing between-group link weights. The weight of the link is often defined as the strength of the social relationship based on the co-occurrence of two nodes X and Y on the Web pages [23]. Several indices measure the co-occurrence [23,30]: matching coefficient, $n(X \cap Y)$; mutual information, $\log \frac{n(X \cap Y)}{n(X)n(Y)}$; Dice coefficient, $\frac{2n(X \cap Y)}{n(X)n(Y)}$; Jaccard coefficient, $\frac{n(X \cap Y)}{n(X \cup Y)}$; overlap coefficient, $\frac{n(X \cap Y)}{\min(n(X), n(Y))}$; and cosine, $\frac{n(X \cap Y)}{n(X)n(Y)}$, where $n(X)$ and $n(Y)$ are hit counts of X and Y, respectively, and $n(X \cap Y)$ and $n(X \cup Y)$ are the respective hit counts of "X AND Y" and "X OR Y." An unweighted network could also be separated into groups by maximizing the within-group density while minimizing the between-group link density [6]. To measure link density, centrality measures such as betweenness, degree, and closeness could be used. In an E-commerce environment, mining cohesive subgroups where consumers have relatively strong connections and similar purchase behavior or common interests is a key issue for marketers in order to maximize the word-of-mouth effect in an individual subgroup.

4.3 To Predict Links and Trust Value

Algorithms for predicting unobserved link or trust value between social actors are commonly found in SNA, because a typical social network and a web of trust are too sparse. The main research approaches are 1) to predict the social link between actors at time t+1, given a social network at time t, 2) to predict the unobserved social links, given a social network with an incomplete set of social links between a complete set of actors, and 3) to predict the social link between actors, given information about actors or to predict a trust value given a small set of expressed trust or distrust among actors [29]. They often use the Latent space model [15], Dynamic latent space model [26], Eigen value propagation [12], Probabilistic relational models (PRMs) [1,11] or various machine learning algorithms such as a decision tree, k-NN, multilayer perceptron and SVM [13]. In the context of E-commerce, a network of consumers is connected by ratings or trust values between consumers and consumers tend to express a small number of ratings and trust. Therefore, current techniques for predicting links and trust value can be used to predict links and the links' weights such as trust value between unconnected items. The trust propagation model could be also constructed using technology.

5. RESEARCH CHALLENGES

E-commerce companies have two types of relevant information for the present discussion, namely user preference information and social influence information. As shown in Figure 3, a product rating matrix is constructed with data from a purchase cycle and is used to develop a user preference similarity matrix. Current recommender systems make personalized recommendations using a product rating matrix and user preference similarity matrix. A user interaction matrix is constructed with data from a review cycle. A user trust matrix can be developed based on the user interaction matrix, using the above described SNA techniques. The trust matrix shows who an individual consumer trusts and who an individual customer is trusted by, which can be used to identify highly influential customers. At this point, an E-commerce company should consider how to combine the user preference information, contained in the product rating matrix and user preference similarity matrix, and the social influence information, contained in the user interaction matrix and user trust matrix. This would be one of the success factors of E-commerce decision support systems. Moreover, the approach of combing user preferences and social influence in E-commerce is an important future research area. In this section, we present two specific problems and the research challenges therein.

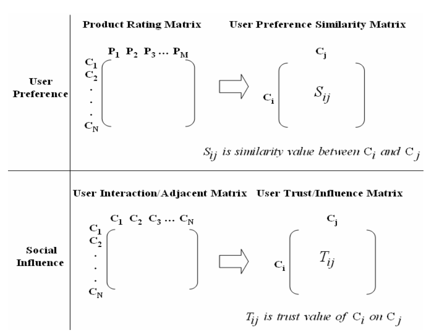

Figure 3. E-commerce information source

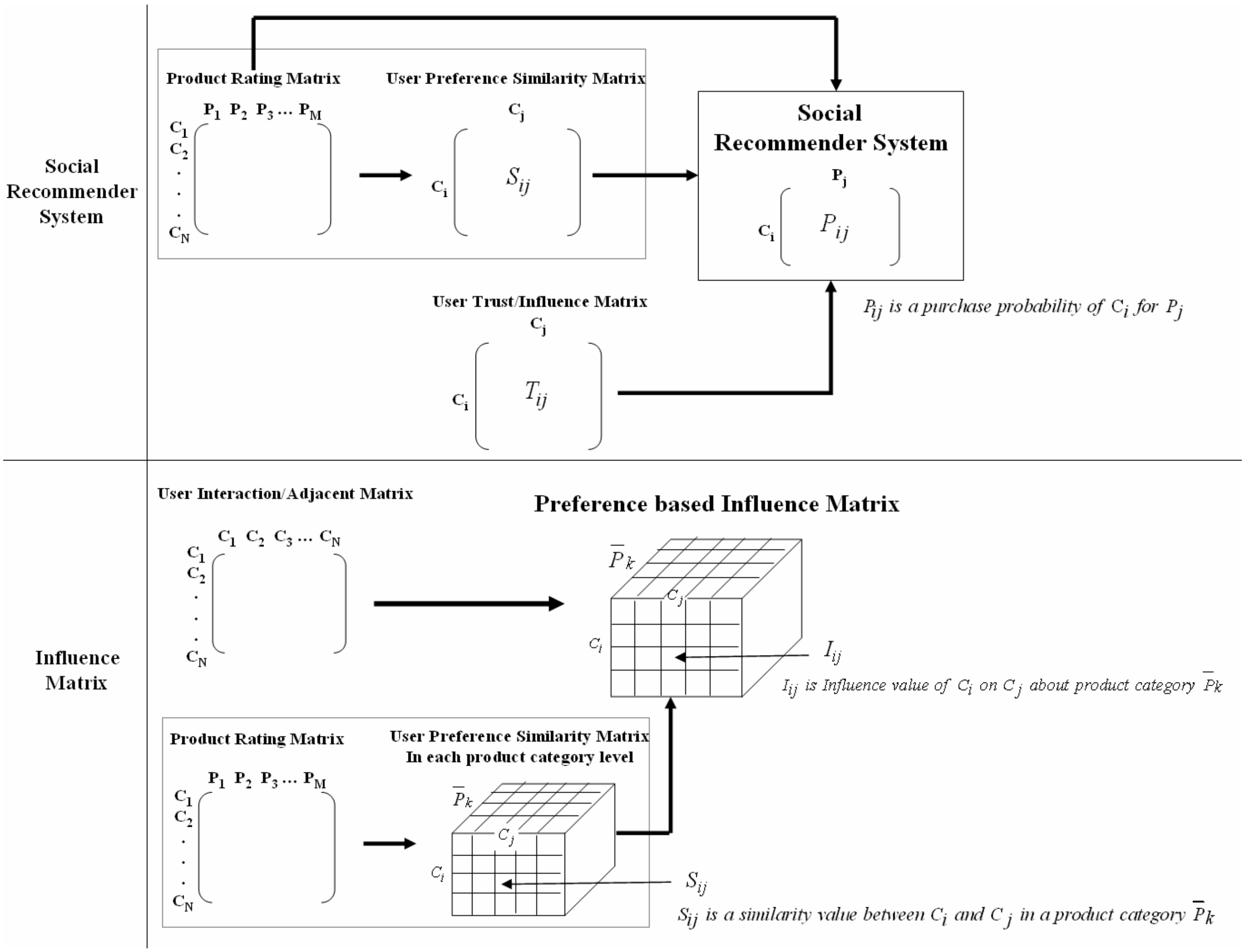

Figure 4. The approaches of combining a user preference and social influence

5.1 Social Recommender Systems

Recently, social recommender systems, which integrate information from product rating matrix, user preference similarity matrix and user trust matrix to generate a recommendation, have received more attention (See Figure 4). The systems can make a personalized recommendation to a target customer's trusted social circle by understanding the influence the target customer has over his or her social circle. However, a number of issues need to be addressed before such recommendation can become a reality. Specifically, to improve the quality of a social recommender system and to leverage social influence with the system, the following questions must be answered:

- What is the relationship between user preference similarity and trust value?
- A consumer is not interested in a product according to her consumer preference information. However, others in her social circle rate the product highly. Should a recommender system recommend the product to the consumer? To what degree is this a function of the personality of the target customer, and how can this be factored in?
- How much impact does social influence from trusted people have on changing a consumer's inherent preference?

If there is a strong relationship between the user preference similarity and trust value among users and if the strength of the relationship can be measured exactly, then a social recommender system can increase the accuracy of a recommendation and mitigate the weaknesses of a traditional recommender system such as a cold-start problem and a sparse problem by combining the trust matrix. Therefore, the preciseness of the trust matrix significantly affects the performance of the social recommender system. Therefore, different propagation mechanisms should be examined to construct an accurate trust matrix in a particular application. The trust value can be used as an alternative value of a preference similarity or complementary weight when calculating a recommendation prediction.

5.2 Integrated Influence Matrix

A key challenge is how to combine the user preference and social influence to develop a more sophisticated influence matrix, i.e., trust matrix, (see Figure 4). Figure 3 shows a trust matrix constructed from only user interaction data such as writing and rating reviews or expressing trust or distrust. However, both the properties of relationships between social actors (e.g., intensity and frequency of relationships) and the attribute of social actors (e.g., their age, gender, preference and interests) are believed to influence the social network structure [6]. The influence matrix shows how much one consumer influences other consumers' purchase decisions of each product or product category. In order to leverage the social influence based on the influence matrix, the following questions must be answered:

- If a company markets a new product in a product category $\overline{P}_k$, who are the initial target customers?
- In order to maximize the marketing effectiveness or word-of-mouth effect, how many customers must a company market to for the first time?
- In order to maximize the word-of-mouth effect, how is a highly connected subgroup constructed based on the speed of propagation of social influence within a subgroup?
- Who are the next target customers considering customers' preference and social influence achieved by trusted people?
- A customer influences a small number of people in a product category $\overline{P}_k$. However, is the impact of influence strong enough to convince them to buy a product? Is the consumer worth being targeted?
- What is the optimal marketing cost for an individual customer considering the customer's social influence such as how many consumers a customer influences and how much they are influenced to purchase products?

The answers to the above questions start from the principle of direct marketing: market to the most valuable customers whose expected profit is greater than the cost of a marketing action. While a traditional direct marketing method has intrinsic value for gaining customers (i.e., the expected long-term or short-term profit from sales to the customer), network-based marketing (i.e., viral marketing, word-of-mouth marketing) emphasizes network value that is derived from a customer's influence on other customers as much as intrinsic value [8]. Therefore, the ability to quantify network value or network effect is a key step to determine the initial target customers, the number of target customers, the optimal marketing cost, the optimization of subgroup for marketing and so on. The network value of a customer could be measured based on a customer's network neighbor size, the purchase probability of network neighbors and the influence of other members affected by the strength of connectivity and preference similarity among network neighbors.

6. CONCLUSION

Although social influence has impact on E-commerce decision making, few studies have considered social influence in an E-commerce decision support system, because until recently data about social interaction has not been adequately captured in E-commerce. Currently, however, the E-commerce customer base is at a turning point from a transaction-based society to a relationship-based society. As Web-based social networks have become more popular, consumers who may not have complete information about a product or service often make use of previous customers' opinions. It has become apparent that the customer decision process is influenced by information from trusted people, not from product manufacturers or recommendation systems. The social influence from high quality reviews written by previous consumers can have a direct, positive effect on potential consumers' decision making, and this effect can propagate through a social network. E-commerce companies are well positioned to take advantage of the social influence between consumers as a decision support tool by allowing a consumer to evaluate the appropriateness of recommendations and reviews. E-commerce companies can ultimately increase sales with less marketing cost. Thus, we believe that social influence becomes a natural supplement that can be advantageously used by corporations in the E-commerce decision making process.

In this paper, we present an overview of the impact of social influence in E-commerce to point researchers and E-commerce companies in the right direction. The main issues we should focus on are how to capture social interactions in E-commerce websites, how to combine social influence data into user preferences, and how to exercise social influence on customers' purchase decision making, in order to expect the greatest impact of social influence in E-commerce

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