

## USE OF SOCIAL NETWORK ANALYSIS AS A STRATEGY FOR E-COMMERCE RECOMMENDATIONS

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### ABSTRAK

Agen Recommender sedang banyak digunakan oleh bisnis E-commerce untuk membantu pelanggan mengambil keputusan dari sejumlah besar pilihan. Untuk meningkatkan kinerja agen rekomendasi, tiga pendekatan utama (pendekatan berbasis konten, pendekatan kolaboratif dan pendekatan hibrida) telah diusulkan untuk mengatasi masalah rekomendasi yang ide dasarnya adalah untuk menemukan kesamaan item dan pengguna dan predikat preferensi pengguna terhadap sekumpulan item. Ini memberikan potensi untuk menggunakan analisis jejaring sosial untuk membuat rekomendasi karena analisis jaringan sosial dapat digunakan untuk menyelidiki hubungan pelanggan. Dalam penelitian ini, kami mengilustrasikan konsep analisis jaringan sosial dan bagaimana konsep ini dapat digunakan untuk membuat rekomendasi yang lebih baik dalam konteks E-commerce. Peluang aplikasi dan penelitian disajikan.

**Kata kunci:** agen merekomendasikan; analisis jaringan sosial; rekomendasi *e-commerce*.

### ABSTRACT

*Recommender agents are being widely used by E-commerce business to help customers make decisions from a large amount of choices. To improve the performance of recommendation agents, three main approaches (content-based approaches, collaborative approaches and hybrid approaches) have been proposed to address recommendation problem whose basic idea is to discover similarity of items and users and predicate users' preference toward a set of items. This provides potential for using social network analysis to make recommendations since social network analysis can be used to investigate the relationships of customers. In this research, we illustrate the concepts of social network analysis and how it can be employed to make better recommendations in E-commerce context. Application and research opportunities are presented.*

**Keywords:** *recommender agents; social network analysis; e-commerce recommendation.*

## 1. INTRODUCTION

E-commerce technology can influence basic market demand and supply. On the demand side, e-commerce prevents prospective customers from checking goods before buying. Furthermore, online sellers tend to be newer companies and may have less brand capital or reputation to provide signals or quality ties. These factors can create information asymmetry between buyers and sellers, which do not appear for offline purchases. Online sales also often involve delays between buying and consuming, because of the time interval between placing orders and sending products physically. However, at the same time, e-commerce technology reduces consumer search costs, making it easier to (virtually) compare products and different producer prices. On the supply side, e-commerce enables new distribution technologies that can reduce supply chain costs and improve services.

Promising are growth for business e-commerce. In US online sales will continue grow to Jupiter Research a few years<sup>2</sup>. Jupiter predicted analyst for online retail are \$166 at 2009 and in 2012 are \$215, their growth 11% of the year.

According to the China Online Shopping Market Development Report conducted by Iresearch and China's largest auction website Taobao.com, the annual turnover in China's online shopping market reached RMB 120 billion Yuan in 2008, with a growth rate of 120% compared to the previous year.

With the rapid development of E-commerce businesses, a large amount of information available on the Web presents a major challenge for customers to find what they are interested in [1]. For example, there are millions of books available on Amazon, and millions of items for sale on eBay. Looking for many choices and making final decisions is a difficult task. Recommendation agents help customers

reduce excessive information and provide them with customized information in the target domain. In addition, providing value-added services such as recommending personalized products can build good customer relationships to retain customers. Agent Recommender is being used by a large number of E-commerce sites as a business tool to help consumers easily find the products they are interested in and make customized recommendations [2]. Companies like Amazon [13].

Netflix and eBay have implemented technology recommendations to increase customer loyalty [4]. To provide more effective and accurate recommendations, various recommended methods are proposed in the literature [5], [6]. Most of these methods take customer attributes, item attributes and interactions between customers and items as inputs and predict future interactions between customers and goods as output [4]. Most recommendations are made based on item-to-item similarities (in terms of characteristics) and user-to-user similarity (in terms of interests or preferences)

Social Network Analysis (SNA) has attracted a lot of attention in recent years [7], [8]. Different from variable analysis and topology analysis, which focuses on the concepts and attributes of objects, the SNA discusses the structure and relationship of objects. The SNA highlights finding fundamental relationships from people. Take two unknown people and two friends for example. There may not be a significant difference in their attributes. However, the relationship between two unknown people and a pair of friends is very different. In the context of recommendations, the interests of two friends tend to be related to a certain extent. This kind of information can be used to improve recommendations.

The focus of social networking analysis is relationships. Much information about network relationships has been studied and many constructs have been made to capture different perspectives of relationships. Therefore, the SNA can be used to find user relationships to help make recommendations.

## **2. LITERATURE REVIEW**

### ***2.1 Review and Development Of Recommendation Agents***

The traditional approach to making recommendations is based on manually analyzing customer features, their historical transactions and the characteristics of goods, and identifying potential lists of items for each user he might be interested in. This approach has been used in many contexts of face-to-face shopping, such as shopping centers. However, it is inappropriate for an E-commerce site where there are many choices available.

The root agent recommendations can be traced back to information search and research information filtering. Information retrieval returns users of relevant information in response to their short-term questions. Information filtering works by filtering information that is not relevant to the user.

Partner agents move further to "attract consumer interest or preferences for products, both explicitly and implicitly, and make appropriate recommendations" [9]. Agent Recommender allows customized recommendations and the creation of new online stores that are designed personally for each customer [10].

### ***2.2 Application Examples***

Agent Recommender increases E-commerce sales in three ways: turning browsers into buyers, increasing cross-selling and building loyalty [10]. There is a locking effect between E-commerce and customer websites. The website uses recommendation agents to study customers, get their preferences, and give them products according to their needs. After customers receive recommendation services provided by certain websites and benefit from these services, the cost of transferring customers to other competitors' websites increases with time. This can greatly increase customer loyalty.

Many E-commerce businesses use recommender agents that are embedded on their websites to recommend customized products to customers. Amazon uses a recommendation algorithm to personalize its website to each user [3]. eBay invests in recommendation agents that offer new content to recommend items to users based on their preferences and how they value the pages they have seen through the machine.

### ***2.3 Social Network Analysis***

The SNA was originally developed and practiced by social scientists to investigate interactions between community members to understand the complex phenomena and structures of the social world. Social network theory views social relations in terms of nodes and links, where nodes represent individuals or organizations and links can be one or several types of relationships or shared characteristics among people, such as friendship, work exchanges or information exchange, etc. Interest in SNA has

grown among researchers from various fields, such as Physics, information science etc. [11]. And its application can be found in many fields, such as research on organizational knowledge sharing [12], identifying the structure of subgroups and work relations in organizations [13], investigating the structure and interaction in criminal networks [14].

Analysis of social networks can investigate the structure and properties of networks from three different levels, individual node levels (the focus is the target node), subgroup level (handles a collection of nodes with common characteristics) and all levels of the network. Thus, this can be used to investigate customer relationships from these three levels to find their preferences. Many concepts and constructs have been developed through decades of accumulated research in social network analysis research.

#### 2.4 E-commerce

E-commerce presents a number of opportunities for business organizations and individuals. Metzger argues that e-commerce companies have a broad market base. A broad market base gives companies the opportunity to grow at very low costs. Hoffman argue that there is distribution, marketing, and operational benefits that can be realized from e-commerce [15]. In other words, e-commerce can reduce distribution costs through elimination of intermediaries. Because online transactions involve very little cost, e-commerce can also reduce transaction costs [16].

Internal and external processes can also be integrated into lower transaction costs. Because companies around the world adopt more collaborative relationships with major suppliers in product development, key business processes now require cross-functional information sharing in a variety of problems. This means that companies can use e-commerce to expand distribution channels at lower costs. According to MCIvor, this low cost can be achieved through reducing paper administration and handling procedures. E-commerce can also speed up ordering, shipping and payment for goods and services while reducing operating and inventory costs. Schaeffer argues further that e-commerce dramatically reduces time for searching information and transactions for buyers and sellers [4]. The important point here is that e-commerce exceeds geographical and time limits. Because time has been saved, this has cost saving implications. However, geographical and legislative constraints continue to present significant obstacles to the distribution of goods and services in practice. Despite these obstacles, personalized product offerings combined with free market access provide customers with a wider availability of products that are hard to find. Added to this wider selection of items, customers can test products online before a decision is made to buy.

Lumpkin, Drogee and Dess argue that although the internet allows new opportunities for strategic success, ignoring business fundamentals and basic financial requirements results in business losses. According to this argument, many e-commerce companies fail to make a profit because of massive spending on mass marketing, intensive price competition, and lowering customer search costs and switching.

### 3. RESEARCH METHODOLOGY

Agent-based modeling and simulation (ABMS) is a new approach to modeling systems consisting of autonomous agents who interact. Economics experiences a paradigm shift in responding to agent-based modeling. Agent-based Computational Economics (ACE) has developed around the application of ABMS to economic systems. Some classical assumptions of microeconomic theory (eg all rational economic agents, homogeneous agents with identical characteristics and rules of behavior, etc.) are relaxed in ABMS applications to the economic system. Behavioral economics is a relatively new field that combines experimental findings about psychology and cognitive aspects of agent decision-making to determine the actual economic behavior and decision-making of people. Thus, agent-modeling is a promising basis for modeling social life as an interaction between adaptive agents that influence each other = in response to the influence they receive.

### 4. RESULTS AND DISCUSSION

#### 4.1 Network Category

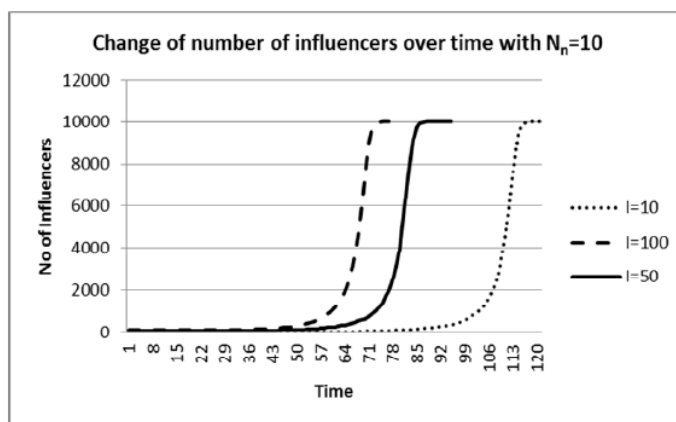
**Table 1. Network categories based on different criteria [1]**

<i>Criteria</i>	<i>Network type</i>
type of relationship	Simplex / Multiplex
direction of relationship	Directed / Not Oriented
strength of relationship	Binary / Entry / Ordinal / Value

Based on table 1 network categories based on different criteria has two categories of networks. There are multiples and simplex. Simplex network has type connection. Two types for relationship between nodes in the network.

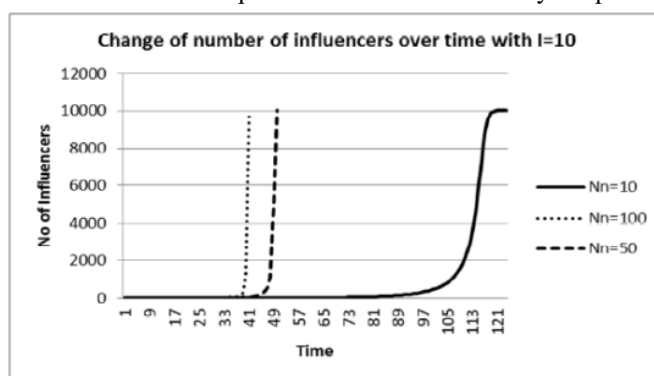
The link strength of a node can be binary (the link value is 0 and 1 where 0 means there are no links and 1 shows the link); signed (the link value can be positive, negative or zero); ordinal (representing whether the link is the strongest, the next strongest, etc.); or valued (measured at the interval or ratio level) [17]. The direction and strength of information can be represented using a neighbor matrix.

The proposed scheme is evaluated on a simulated social network environment under various conditions to estimate adoption rates (on-line shopping) against time. This has been studied using two parameters: The level of transformation of influencers into influencers and the rate of change in average transaction costs. We present simulations for networks with 10,000 artificial consumers (agents). Every consumer has an average number of friends  $F$  which is a variable simulation parameter. Also, we vary the number of Early Adopters who will act as influencers in the system. The adoption process starts when influencer agents interact with friends on the network. This process of interaction affects influential agents (provided that influential agents are friends of influencers) to reduce total transaction costs for on-line shopping, as illustrated in section II.C.



**Figure 1. Adoption Process With Varying Amounts Of Influenza [2]**

Figure 1 shows the growth of influencer numbers against time under three situations, where the initial number of influencers  $I = 10, 50$  and  $100$  respectively. The average number of friends per consumer is set at  $10$ . After the adoption process crosses a certain threshold, the adoption rate depends only on the number of friends, as can be seen from the same graph growth rate after the threshold point. However, the threshold on the time scale depends on the number of early adopters.



**Figure 2. Adoption Process With A Number Of Friends That Varies Per Consumer [2]**

Figure 2 shows the growth of influencer numbers over time under three situations, where the average number of friends per consumer,  $N_n = 10, 50$  and  $100$  respectively. As shown in Figure 2, the growth rate becomes sharper with the increase in the number of friends. In addition, the starting point of the adoption process also depends on  $M_s$ , because a large number of friends increases the likelihood of faster adoption.

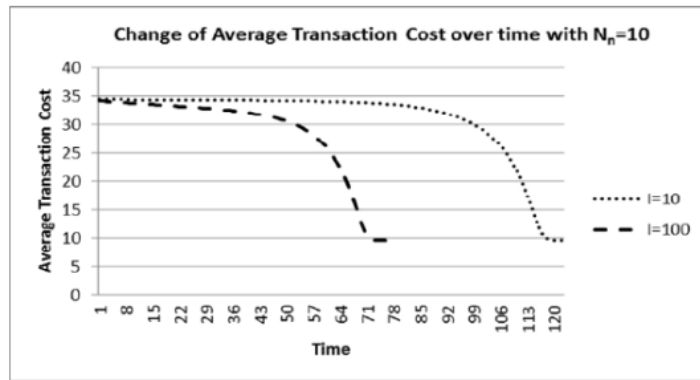


Figure 3. Average Transaction Costs With Varying Influencers [3]

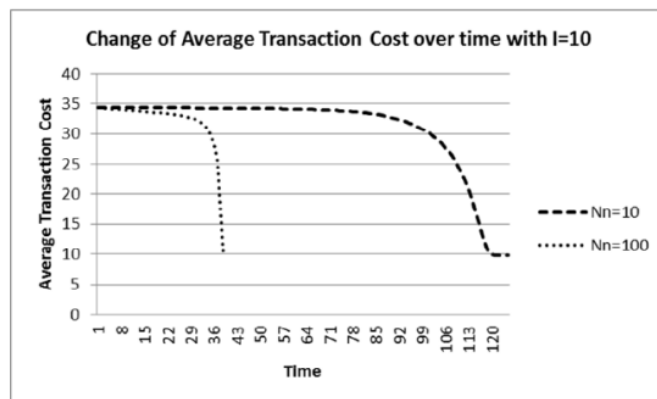


Figure 4. Average Transaction Costs With Varying Number Of Friends Per Consumer [4]

Figures 3 and 4 illustrate the adoption process by showing a decrease in transaction costs on average with time. The adoption process is complete, when the average transaction costs are below the TH threshold (= 10.0). The nature of the graph is identical to figures 1 and 2. As far as branded and non-durable items (i.e. items that don't really need a guarantee of quality assurance), electronic goods, or even the travel agent in question, online

The store offers clear benefits from lower prices, hassle-free and fast shopping, and a thorough experience of fast and effective transactions that fail to be given traditional markets in some cases. Thus, an increasing number of consumers opt out of traditional shopping methods. They are guided further by their social network connections, as shown. Brick and mortar companies that deal with the items mentioned above must have a strong online presence if they want to save their existence. Only then can they survive the paradigm changes we have shown here.

## 5. CONCLUSIONS AND SUGGESTIONS

Social network analysis provides a means to mine customer relations. Based on our previous presentation, the analysis of social networking can have important implications for making E-commerce Recommendation. Some customers have more influence on other customers, they are known as "leaders" or "pioneers". Their positive attitude can influence other customer responses. New products tend to be known by more customers through influential ones. Providing customers with what other influential customers buy can help them make a decision. Analysis of social networks can be used to mine the interests of users from two perspectives, individual customer perspectives and subgroup perspectives. Vertex similarity (from the perspective of individual customers) allows finding whose preferences are similar to targeted customers in terms of their general environment. Integrated subgroups (from a subgroup perspective) can be used to divide the entire network into subgroups and customers in the same subgroup have the same preferences. E-commerce companies can borrow these ideas directly to learn customer preferences to improve recommendations.

The recommendation approach has been widely applied in the E-commerce domain to handle information overload and to provide personalized products for customers. Usually, this approach is

divided into three categories: a content-based approach, namely an item-centric centric approach, which is a centralized user and hybrid approach. The basic idea of the recommendation approach is to find items with characteristics and customers similar to the same tastes and then predict customer preferences for goods. Analysis of social networking that focuses on individual relationships provides the potential to make recommendations in the context of E-commerce. This paper presents several examples to show how social network analysis has been used to provide personalized recommendations to customers and show opportunities for future research.

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