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AN APPRAISAL MECHANISM FOR SOCIAL MARKETPLACE

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Abstract

Social network platforms have been so popularized that they are to be indispensable to daily life. In recent years, the electronic commerce marketplace faces the problems: like searching for product providers and trust issues of product providers. People are used to deal with the guy they are familiar with and more believe their friends' words than unknown comments. In this paper, we develop an appraisal mechanism for social marketplace to search the product requests from buyer's social network and verify product providers based on the experience of friends within a buyer's social network. The proposed framework provides a social search mechanism to explore the product providers and estimates trustworthiness values of product providers from the view of social network for helping buyers solve the inaccuracy and inconvenience issues in social marketplace.

Keywords: Social network, Social search, Trust fraud, Social commerce.

1. INTRODUCTION

Social commerce (s-commerce) is a creating place where people can collaborate online, get advice from trusted individuals, find products and services and then purchase them. From the perspective of product providers, Nielsen's (2012) revealed that 83% of marketers viewed the social media as an important tool to promote their business strategies, and 93% of companies use social media in marketing purposes. From the views of customer, a business report by Steegenga and Forge (2012) pointed out that over 50% of customers would use the Internet and their own social network for online shopping decision support. It illustrates that s-commerce really prospers on the internet no matter from the perspectives of providers or customers. Social networks generally are concerned as the way improving the satisfactory of s-commerce. Techopediac.om (Techopediac, 2015) defines the social platform as: "A social platform is a Web-based technology that enables the development, deployment and management of social media solutions and services. It provides the ability to create social media websites and services with complete social media network functionality."

As the customers visit the e-commerce platforms, the platforms would provide the search engine to assist them searching for products. It really did a good way searching the information. However, there still have some problems. From the product providers' perspective, some providers who provide more instant products or customized products are not inclined to register and transact through online market because of additional subscription/advertising cost incurred and competition from product providers selling similar products. From the customer's perspective, although the coverage of products in e-marketplace is very high, some products (i.e. perfume or lipstick) customers want to hold, smell, and taste before they buy, so customers would also not incline to transact in that case, if they couldn't experience themselves. Through social search, the buyers could obtain the more appropriate product providers through world-of-mouth from buyer's social network, this kind of product providers, who circulate from buyer's social network, we call them "social providers". During the stage of product provider evaluation, the traditional online searching mechanisms have the manipulated problems in link calculation, as Brin and Page (2012) revealed that the spam links would impact the calculation of websites' importance and correlation. Besides, these kinds of reputation calculation mechanisms have ballot stuffing problems (Wasserman and Faust, 1994) - a product provider may colludes with a lot of buyers in order to be given unfairly high ratings by them. The appearance of social search can fix these problems because of its relying less on link structure of web pages. Through social search, it could leverage a network of trusted individuals by providing an indication of whether they thought a particular result was good or bad and it provides more current results, because a social search engine is constantly getting feedback, and it is potentially able to show results that are more current or in context with persistent changing information. As previous research (House, 1981) has noted, social appraisal is one of the important functional contents of social networks, it is worthwhile investigating and designing a mechanism for supporting buyer as they transact in a social marketplace. In this paper, we propose an appraisal mechanism for social marketplace to provide the customers transact in social marketplace. The proposed mechanism can create a whole new way to help buyers transact in social network, increasing the value of both buyer side and provider side. Eventually, the ecosystem between buyers, providers and social platforms will be much more flourishing.

The remaining sections are organized as follows. Section 2 discusses the related literature. In Section 3, the research model will be demonstrated, and the experiments will be presented in Section 4. The experiment results and evaluation are discussed in Section 5. Finally, Section 6 concludes this study and presents the directions of future research.

2 RELATED WORK

2.1 Social Commerce

The concept of social commerce was developed by Rubel (2006) which includes collaborative e-commerce tools that enable buyers to query advice from trusted individuals, finds products and services and then purchase them. The social networks that spread this advice have been found (Stephen, Wang and Leskove, 2011) to increase the customer's trust in one retailer over another. Nowadays, because fraudulent sellers in e-commerce manipulate fraud in careful and secret ways (Zhang, Bian and Zhu, 2012), the fraud strategies are very hard to investigate. In this paper, the aim is to use the power of social network of buyers for helping them to prevent trust fraud issue in social marketplace.

2.2 Social Networks and Search

An online social network is a social structure made of people who have connection with one or more designated types of interdependency. The connections among people are basically built up by information change, like daily chatting, sharing and discussing etc. The social connections and mutual interacts would increase the interpersonal tie strength, with stronger tie, a person would have more trustworthiness (Gilbert and Karahalios, 2009). As ties between two persons are stronger, they will have more willingness to share opinions with each other. Levin and Cross (2004) use the interaction effects between knowledge seekers and knowledge sources as and significant factors to prove the effectiveness of knowledge transfer.

Social search is a type of web search that takes into account the social network of the person initiating the search query. Croft, Donald and Trevor (2010) indicate that in social network, by using classification (Ex: profiles, attributes or adjectives) and the establishment of community can increase the efficiency of social search, it's easy to recognize and classify various contents and by establishing the community, the traditional problem like some complex information needs can't be answered by traditional search engines could be solved. The application of social search includes using social preferences to predict what content will be desirable to the user discovering new people and sometimes new experiences shopping (Amy, 2013) meeting friends or even traveling, or predicting the users' interests and preferences (Carmel et al., 2009). In this paper, by analyzing the buyer's social network friends, classifying which product category they denote and the fan page similarity between buyer and their social network friends, the goal is to find the social providers who have the product which the buyer seeks.

2.3 Social Support and Appraisal

Social support is a concept which involves the assistance provided by other people (Hall and Wellman, 1985). The close friendships' opinions in social networks could be seen as helpful sources of social support, for instance, providing answers to questions. Social appraisal can be regarded as one of the significant features for social support, which is the combination of psychological and behavior functions. The existing studies mainly aim to filter or provide information, for example, filtering unsuitable products and providing the products buyers may be interested. In this paper, our appraisal mechanism for social marketplace provides a social way to search providers and referrals in social network to acquire more trustworthy reviews.

3 THE SYSTEM FRAMEWORK

In this section, an appraisal mechanism for social marketplace is proposed for helping buyers to search the qualified social providers and evaluate the reputation of the qualified social providers via their social networks. The system frame is illustrated in Figure 1.

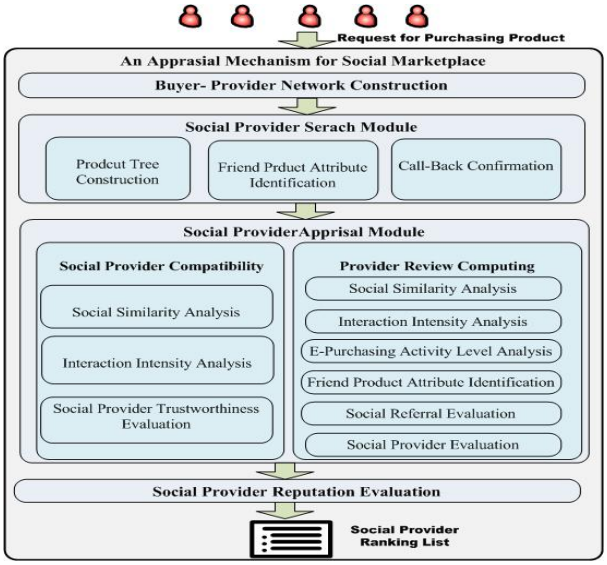

Figure 1 System Architecture of an Appraisal Mechanism for Social Marketplace

3.1 Buyer-Provider Network Construction

The objective of this module is to construct the connection between the buyer and potential product providers. On social network platforms, social interactions can be collected from their daily posts. For example, a buyer b_i has posted a message and a potential social provider ps_i replied or clicked a like to b_i . ps_i has posted a message and another potential social provider ps_j replied or clicked a like to ps_i. The example both indicate an explicit and implicit interaction connection between b_i and ps_i and between b_i and ps_j We use this concept to construct the interaction network, by collecting the "likes" and comments records from social network platform. We construct the network from buyer's interaction and expanding three layers (l=3). The network construct formula is defined as:

$$\Phi_S(l+1) = \Phi_S(l) \cup \left\{ ps_j \mid ps_j \notin \Phi_S(l), ps_i \in \Phi_S(l), Interaction(ps_i, ps_j) > \varepsilon_c \right\}.$$

Where $\Phi_S(l)$ denotes the set of participants who have ever interacted with buyers and exists in layer l, *Interaction*(ps_i ,ps_j) denotes the interaction of ps_i and ps_j within last year.

3.2 Social Provider Search Module

In this module utilizes the social network posts from friends to analyze which friends have the product that the buyer seeks. There are three steps to find the potential product providers. First, we establish a product tree that contains product category terms from Yahoo! Auctions Taiwan existing category, and mark the index of each product category, and then classify a product which buyer seeks based on its category. Second, we break down the posts in the friends' each social network into separated terms, by applying the concept of the key terms identification technique TF-IDF to identify the important terms based on term frequency and the representative of the terms across documents (i.e. the messages posted). For a term t contained in a document $d \in D$, the importance of term t can be measured by TF-IDF score. We denote $n_{t,d,i}$ as the number of times that term t appearing in the post d which belongs product category i from a social provider $SPRO_c$'s post, D_i denotes the set of posted messages in product category i, we could obtain TF and IDF score as:

$$TF_{t,d,i}(SPRO_c) = \frac{n_{t,d,i}}{\sum_k n_{k,d,i}}, \quad IDF_{t,i}(SPRO_c) = \frac{|D_i|}{|\{t : t \in d, d \in D_i\}|}.$$

Then the product theme with respect to product category i for $SPRO_c$ is defined as:

$PC_i(SPRO_c, D) = \frac{\sum_{t \in \Phi_t(D_i)} TFIDF(t, D_i)}{\sum_{i=1}^{n} \sum_{t \in \Phi_t(D_i)} TFIDF(t, D_i)}$, where $\Phi_t(D_i)$ is the set of terms included in the posts collection D_i, *TFIDF*(*t*,*i*) denotes the TF-IDF score for term *t* in product category *i*. After the above computation, we derive a product theme category vector for post collection from $SVEN_c$.

$$PC(SPRO_c, D) = [PC_1(SPRO_c, D), PC_2(SPRO_c, D).....PC_n(SPRO_c, D)]$$

Here we define $SPRO_d$ is a upper-layer social provider of $SPRO_c$. If $SPRO_c$'s category matches the category of product *a* which the buyer seeks, the provider is qualified. The set of social provider candidates is recursively generated as follows, which denotes ps_i as one of the potential social provider. Finally, the social providers would accept the confirmation request to make sure they do sell the product which the buyer seeks. And if the social provider has no product that the buyer is seeking, then the system will replace the provider with other alternative providers to give the buyer more options to select from.

3.3 Social Provider Appraisal Module

The evaluation of social provider considers the social provider's compatibility and reviews rank of social provider. These numeric outputs from these two parts would be aggregated for recommending the buyer the social providers which are the most appropriate to transact.

3.3.1 Social Provider Compatibility Analysis

The social provider with higher social interaction value or higher interest similarity to the buyer implies that he/ she denotes more credible and closer to the buyer.

***Interest Similarity Analysis*:** Using user's fan page data to calculate the similarity relationship between each buyer and social providers, and recognize which social providers are similar to the buyer. The social similarity between a buyer *i* and a social provider *c* is measured as:

$SS(i, SPRO_c) = \frac{|FP(i) \cap FP(SPRO_c)|}{|FP(i) \cup FP(SPRO_c)|}, \forall SPRO_c \in \Theta_{S\_final}$, where *FP*(*i*) and *FP*(PRO_c)is the set of fan pages that *i* and $SPRO_c$ like respectively.

Interaction intensity analysis: As comments and likes occur from both users perspectives, we consider that two users would have more attentions or more familiar with each other. It could be regarded as their helping willingness is higher than other friends. The following formulation was used to determine the interaction intensity between buyer and social provider.

$$II(i, SPRO_c) = \frac{(lkn(i, SPRO_c) + cmn(i, SPRO_c))}{sum_i(lkn, cmn)} \times \frac{(show_{SPRO_c})}{postnum_i} + \frac{(lkn(SPRO_c, i) + cmn(SPRO_c, i))}{sum_{SPRO_c}(lkn, cmn)} \times \frac{(show_i)}{postnum_{SPRO_c}},$$

where *lkn*(i,PRO_c) denotes the total number of comments that PRO_c commented at user *i* 's posts within last year. *cmn*(*i*,PRO_c) denotes the number of likes that PRO_c gave to user *i* within last year. And $sum_i(lkn,cmn)$ is the aggregation number of all the comments and likes in user *i* 's social network. And $show_{SPRO_c}$ denotes the number of posts that social provider PRO_c had commented or liked with user *i* ;$postnum_i$ represents the total number of user *i* 's posts within last year.

Trustiness evaluation of social provider: We combine the friend product attribute identification value of social provider which derives from the social provider search module, and the interaction intensity value, social similarity value to evaluate and rank those social providers according to their tie strength and familiarity to buyers. A social provider which has high aggregated value means he/she is more reliable to a buyer. The value of social provider PRO_c is defined as: $SV(i, SPRO_c) = \frac{II(i, SPRO_c) + SS(i, SPRO_c)}{m}, \forall SPRO_c \in \Theta_{S-final}$, where *SV*(*i*,$PRO_c$) denotes the social value of PRO_c to buyer *i*, *m* denotes the number of steps that buyer *i* reaches to $SPRO_c$.

3.3.2 Provider Review Computing

To estimate the expertise degree of social network friends in social commerce domain, we quantify friend purchasing behavior through using the RFM model. And we also evaluate friend product attribute identification, interaction intensity and social similarity between a buyer and his/her friend.

A friend with higher value of these components could infer that he/ she might have more transaction experience, more similar and closer to buyer, these friends we call them "social referral" in order to provide the more reliable provider reviews to buyer.

Social Similarity Analysis: By comparing user's fan page data to calculate the similarity relationship between each buyer and social referrals, and recognize which social referrals are similar to buyer.

$SS(i, SR_c) = \frac{|FP(i) \cap FP(SR_c)|}{|FP(i) \cup FP(SR_c)|}$, where $FP(i)$ and $FP(SR_c)$ is the set of fan pages that i and SR_c like respectively.

Interaction Intensity Analysis: The interaction intensity between a buyer i and a social referral SR_c is measured as:

$$II(i, SR_c) = \frac{(lkn(i, SR_c) + cmn(i, SR_c))}{sum_i(lkn, cmn)} \times \frac{(showSR_c)}{postnum_i} + \frac{(lkn(SR_c, i) + cmn(SR_c, i))}{sum_{SR_c}(lkn, cmn)} \times \frac{(show_i)}{postnum_{SR_c}}$$

A higher value of $II(i,SR_c)$ indicates that buyer i interacts more with social referral SR_c in their daily life. The buyer would view these reviews of a highly interacted social provider more credible.

E-purchasing activity level analysis: A friend of social network with higher RFM in e-marketplace could infer that he/she has spent a lot of effort on the e-commerce domain. Also, it implies that he/she might have more transaction experiences with sellers and higher expertise. The social expert's R, F, and M variable represent the actual transactions in e-commerce. The values of R, F, and M variables are ranked in decreasing order and we rescale them with five scoring intervals from 5 to 1. The top 20% is assigned the value of 5. The value of 4 is given to the next 20% and so on.

Friend product attribute identification: The friend who often mentions some specific category in his/ her daily life is viewed as an expert or has lots of interests in this product category than other friends. Hence, we also consider this factor to identify which social referral had highly mentioned a specific product category in their posts within last year. The formula is defined as follows:

$$Con(SR_c, i) = 1, \text{for } \forall SR_c, PC(SR_c) = PC_n, PC(a) = PC_n,$$

where SR_c denotes the social referral c, if the product category of the product which buyer i seeks matches the product category which SR_c belongs, $Con(SR_c,i)$ would be marked as 1; otherwise 0.

Social referral evaluation: All components mentioned in this section, including purchasing activity level, the interaction intensity, and friend product attribute identification are using to identify whether the social referral specializes in one product category which represents buyer's seeking product or not. Hence, we aggregate these scores as the overall value of each social referral. The higher score indicates the higher expertise level we trust them more than others. The trust value of social referral is defined as follows: $ed\ (SR_c) = \frac{Score(R, F, M_{SR_c}) + SS(i, SR_c) + Con(SR_c, i) + II(i, SR_c)}{m}$, where $ed(SR_c)$ denotes the social expert degree of social referral SR_c, and m denotes the number of steps that buyer i reaches to social referral SR_c. The final set of social referral would be determined by the expertise degree of SR_c, the expertise degree should higher than threshold ε_e. Formally, $SR_{c-final} = \{SR_c \mid ed\ (SR_c) > \varepsilon_e\}$.

Provider evaluation from social referral: After evaluating social referral, we'll invite social referral to score the output of social provider. The module would not allow the friend who is social provider to score themselves. The score vector collection is defined as follows:

$$SR(SPRO) = [SR_1(SPRO_1), SR_1(SPRO_2), ..., SR_1(SPRO_{10});$$
$$SR_2(SPRO_1), SR_2(SPRO_2), ..., SR_1(SPRO_{10});$$
$$,...,$$
$$SR_n(SPRO_1), SR_n(SPRO_2), ..., SR_n(SPRO_{10})]$$

Here we use a vector with all the scores to represent $SR(SPRO)$, the social providers score for social referrals, n denotes the number of social referrals. For example, $SR_1(SPRO_1)$ denotes $SPRO_1$ score for SR_1.

3.4 Social Provider Reputation Evaluation

Social provider reputation evaluation combines the scores of social providers in two ways. One is the score from social provider appraisal module; the other is from the scores from provider review computing module. By integrating these two scores, the buyer would not be influenced by only word of mouth of friends or social analysis anymore. The formula is shown as below:

$$REP(SPRO_c) = \alpha \times SV(i, SPRO_c) + \beta \times \frac{\sum_{n=1}^{k} SR_n(SPRO_c)}{\text{total \# of transaction times with } SSPRO_c}$$, where $REP(SPRO_c)$ denotes the reputation of social provider $SPRO_c$, k denotes number of social referral, α , β indicates the weightings.

4 Experiment Study

In this section, we describe the experimental processes designed to evaluate the proposed model. We chose one of the most popular social network platforms, Facebook as our data source. We collect the buyers' social network information through Facebook Graph API and FQL application, and in the last year records, we collected 36294 posts, 386931 like and comment records between users' and his/her friends and 469874 fan pages which is clicked by buyers' friends from 121 buyers on Facebook. Each user's data includes the number of times of their interaction with a buyer, the times he/she mentioned the product category in the post that a buyer seeks and the number of times the fan page a buyer and user both like. We refer the product category used in Yahoo! Actions Taiwan as our standard of product classification. The top 5 product category which buyers seek in this study are "Clothing& Accessories" , "Shoes, Bags & Accessories" , "Computers & Tablet" , "Appliances & Audio Visual" and "Mobile phones, accessories and Communications" and its coverage represents over 90% of products.

5. Experiment Results

In this session, we discuss the results of the experiment and insights discovered.

5.1 Social Provider Search Module Performance

For the evaluation of the effectiveness, accuracy of our recommending candidates, we examine whether the proposed candidates are actually having the product which buyer seeks. If the proposed social provider candidates have this product indeed, we believe the proposed candidates is close to buyer's need, that represents that the components we use are more efficient and close to buyers. The accuracy of the social provider search module is evaluated by the equation below, $Accuracy = \frac{|\Theta_S \cap \Theta_{S\_final}|}{|\Theta_S|}$, where $\Theta_S \cap \Theta_{S\_final}$ denotes the set of candidates who both are social provider candidates and actual selling products matching buyers requests, and Θ_S denotes the set of proposed social provider candidates. Figure 2 shows the accuracy of social provider in different product categories.

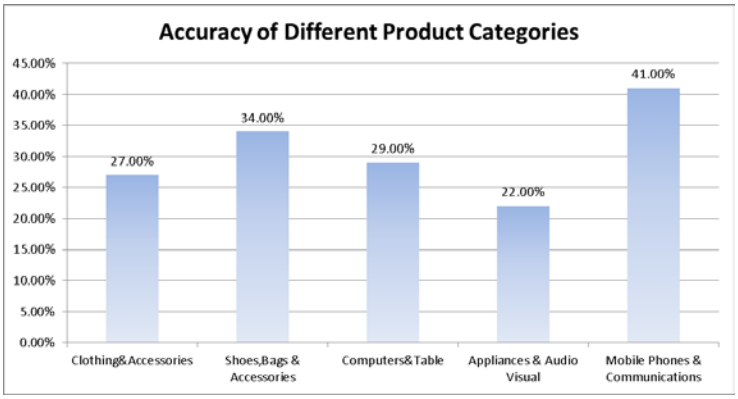

Figure 2. *Social provider accuracy of different product categories*

6 Conclusion

In this paper, we make several significant contributions described as follows. First, from the methodological aspect, we provide the social provider in social marketplace, social- providers are produced by user's three sources of social information: social similarity, friend product attribute identification and interaction intensity analysis. These three types of information can help the user find who the qualified product provider is in his / her social network with satisfaction. Secondly, from the empirical aspect, we discover that friend product attribute identification factor plays an important role in whether the friends have a product which buyer seeks or not. According to the result of the experiment, the accuracy of this factor is higher than the providers we select in random condition. Ultimately, from the practical aspect, owing to this innovative improvement of the recommendation, users on social marketplaces could have whole new trading options, because the concept of social network is also considered in our proposed system. The buyers will reduce the cost of finding appropriate providers that fit their need, avoid the opportunity to be cheated by malicious sellers or fake reviews. Our proposed system ends up increasing the business values of the whole circulation..

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