

Abstract

There are two main research dimension (technological and economic dimensions) results in this project. First, the recommendation issues are the main considered in technological dimension. Among these research domains, the social network, trust mechanism, personality trait and support vector machine (SVM) were utilized for recommend Weblog/blog and employee for online users and enterprises. In the study of blog recommendation, we found some implications and empirically prove some theories in domain of social networking, and the example reveals that the proposed recommendation mechanism is quite feasible and promising. In the personnel recommendation, we found that the personality deeply affects the accomplishment of the job assessment and that is predictable. According to this founding that could recommend personnel to the most suitable position. Second, we analysis the competition and integration strategy for advertisement-supporting online social network related services and an agent-based social decision mechanism for electronic commerce (EC) service quality evaluation was proposed in the economic dimension. The users will always gain from the quality competition, however, brand competition may hurt the customers as more disturbing ads will be exerted. We also propose a system architecture which utilizes game theory and social network analysis to improve the traditional statistical evaluation process.

Keywords: Recommendation, Trust mechanism, Social networking, Support Vector Machine, Game theory, Social Decision

摘要

在這份報告裡有兩個主要面向(科技與經濟)的研究成果。首先，在科技層面中，推薦議題為此面向的主要研究重點。在這研究領域中，主要著眼於利用社群網路、信任機制、人格特質和支援向量機來推薦網路日誌給線上用戶，和推薦雇員給企業。在網路日誌推薦研究中，我們在社群網路領域中證明了相關理論的可行性，並以例子揭示所提出的推薦機制的可行與前瞻性。在雇員推薦中，我們發現人格特質深深影響著雇員的工作評價和其可預測性。以此為依據可以推薦最適員工至最適工作崗位上任職。其次，在經濟層面中我們分析線上社群網路相關服務的競爭與合作策略，並且提出了一種建基於代理人的社群決策機制來衡量電子商務的服務品質。使用戶永遠可從服務質量競爭中得利，不過服務提供者之間的品牌競爭可能因為擾人的廣告而傷害了服務使用者。最後，我們所提出社群決策機制利用賽局理論和社會網路分析，改進了傳統的統計評估過程。

關鍵字：推薦，信任機制，社群網路，支援向量機，賽局理論，社群決策

1. Introduction

As Internet technologies, such as Peer-to-Peer, Semantic Web, and intelligent agent technologies are advancing, social network computing (SNC) services are promisingly emerging. Recently, SNC service and corresponding business model become one of essential components of Web 2.0 paradigm. In this research, we study the infrastructure, applications, and economics of SNC services. Specifically, we will develop SNC recommendation systems to support the demand-side participants and propose market mechanism to support the supply-side participants.

In this project, both technological and economic dimensions of SNC will be studied. In technological dimension, exploiting P2P and ontology technologies, we first establish SNC infrastructure which supports the social interactions. Utilizing artificial intelligence technology, we further develop trust inference mechanisms to compute trust from the feedback repository of independent participants. Recommendation systems are built to evaluate service fitness to a request participant, according to trust rating and other information from data mining techniques. In economic dimension, a key performance metrics will be developed to evaluate quality of different SNC serviced. Game theoretic models are applied to investigate the interactions (competition and cooperation) among the participants (customers and business units) of self-organizing social networks in various domains. Prescriptively, we will propose incentive mechanism for enforcing an efficient SNC configuration, and develop pricing schemes and business contracts for improving profitability of the SNC providers, with respect different market structures.

By the blooming of Internet and information technology, people are connected through Internet connection and the number of Internet users of the world have already exceeds 1 billion today [16]. This situation forms a virtual relationship or social networks gradually among people or communities within the Internet environment. Online social networking systems and peer-produced services have gained much attention as a social medium of viral marketing, which exploits existing social networks by inspiring bloggers to share their own posts or personal information with the other bloggers. The weblogs indeed offers a more open channel of communication, people in the blogosphere read, commentate, cite, socialize and even reach out beyond their social networks, make new connections, and form communities [17].

In 2005, over forty percent of CEOs stated that the most important operational challenge was to find, hire, and retain the qualified employee [10]. Sixty six percent of CEOs listed high-quality employees as the most important factor to contribute to the growth of their company [10]. Ultimately, increasing the quality of hire not only can reduce the cost spending on the staff training but also enable staff to bring talent

into full play faster on their position. It is considerably the key competitive advantage in today's dynamic global economy.

A virtual relationship or social network is formed and gradually evolves from interactions. These web-based and interact oriented services include Instant Messenger (IM), email, video, online album, and so on. Internet advertising is one of the most profitable revenue streams. SNS providers tend to derive the bulk of their revenues from information transmitters (advertisers) rather than information receivers (SNS users). SNS providers such as Yahoo! Messenger charges the firms who wish to conduct advertisements to promote their products/services, but permits users to access the IM services for free [3]. We assume that the revenue of the Internet advertising comes from the number of ads impressions, though several types of advertising contracts are developed. Therefore, the revenue is associated with the amount of the ads and the number of SNS users. The SNS providers can increase revenue by putting more ads on the services, however ads may be harmful. The higher level of advertising activities, the more users will switch to the opponent SNS channel. Therefore, it is very important to study the appropriate advertising strategy to pursue the objective of profit maximizing.

Web sites have been deployed in industry and business. The importance of using Web technology for electronic commerce (EC) has been discussed widely. EC can help companies cut costs and touch directly with customers. Even better, it can help an organization outperform its competition [20]. With the development of the electronic commerce, consumers are getting used to shop online. The importance placed on service quality of online retailers has already risen increasingly. Moreover, consumer evaluations of service quality are easy to get fuzzy result from human subjection. There are many criteria which can be used to evaluate the service quality of online retailers. Past researches focused on using statistics to study and evaluate the service quality. These methods work off-line and require the construction of questionnaires and many efforts have been put on data processing. After these time-consuming steps the outdated results may not be meaningful to online customers.

2. Research Goals

To resolve the above important issues, in this project, we will study both technological and economic dimensions of SNC.

In technological study, exploiting P2P, intelligent agent, and Semantic Web technologies, we will first develop SNC infrastructure for supporting the social interactions of independent SNC participants. One of the powerful approaches to resolve the uncertainty of SNC service is to adopt the trust mechanism, in which the opinion/ratings are shared in the SN. Thus, utilizing artificial intelligence technology,

we further develop trust inference mechanisms to compute trust from the feedback repository of independent participants. SN based recommendation systems are built to evaluate service fitness to a request participant, according to trust rating and other information from data mining techniques. This new type of service recommendation systems is helpful for the demand-side participants of SNC economy/marketing. Distinguishing characteristics of SN based recommendation mechanism include the adoption of social relationship and subjective rating. A mathematical computation analysis and an experimental simulation analysis will be conducted to verify its technological effectiveness and robustness.

In economic study, we will investigate economic behaviors of SNC participants, considering the effects of position and information factors in the SN, and suggest appropriate competition or integration strategies for social network providers and the benefit for self and their online users. Similarly, incentive mechanisms also be suggested to induce self-interested SNC participants to be contribute resource and feedback on others' performance with higher effort. In addition, we will develop SNC service quality evaluation mechanism based on game theory and social network analysis to improve the traditional statistical evaluation process. The purpose of this dimension is to achieve the maximum social welfare. The analytical results will be further verified and compared with the empirical evidence and analysis conducted from the existing digital content distribution industry.

3. Literature Review

There are numerous studies on technological dimension. Using trust in recommender system will improve the ability of making accurate recommendation [24], which can solve a portion of weaknesses of traditional content-based, collaborative filtering (CF)-based recommendation approaches. The work in [14], trust takes on the role of a recommender system to create predictive rating recommendations for movies. And the accuracy of the trust-based predicted ratings is significantly better than the other approaches to a movie. As to sparsity problem, [25] proposes a trust-based method that is based on trust inferences, which relaxes the sparsity and the cold-start problems.

Dunn et al. [12] has shown that managers weight individual personality characteristics as if they were nearly as important as general mental ability, during the hiring decision. Barrick and Mount [2] summarized the role of personality at work in seven divergent research streams to demonstrate that personality matter because it predicts and explains behavior at work. Beagrie [4] has estimated that two thirds of medium to large organizations use some type of psychological testing, including aptitude as well as personality, in job applicant screening. Another survey indicated that every one of the top 100 companies in Great Britain reported using personality

tests as part of their hiring procedure [10, 26]. The most prevalent reason given for using personality testing was their contribution to improve employee fit and reduce turnover rate.

In the economic dimension, Previous study about behavioral into social network services, such as Myspace, Flickr and Facebook, has been performed by survey [18] or empirical study [15]. Network externality plays an extremely role in social networking related services, which is a significant factor affects the profitability of SNS providers. [27] utilizes a example of telephone to demonstrate that the utility derive from the consumption of these goods is affected by the number of other people using similar or compatible products. Network externality indeed influence both on providers and users. Digital version of products will increase the sales in stores if the externality effect is significant [19]. Yet, the size of network externality affects consumer's demand and/or willingness to pay [28].

A Web site is a new type of information technology. EC customers' purchasing activities occur in the on-line sales where orders and charges are placed through Web. A successful Web site is one that attracts customers, makes them feel the site is trustworthy and generates customer satisfaction in the context of EC [20]. Past research employed various measures of IS success, including user satisfaction [1, 13] and the level of system usage [8, 9]. All of them stressed the importance of information/service quality. Service quality has frequently been evaluated in tangibility, reliability, responsiveness, assurance, and empathy using SERVQUAL [21]. In order for an agent to make statements and ask queries about a subject domain, it must use a conceptualization of that domain [6]. Ontology is a way that identifies objects, properties, and relationships of interest in specific domains that involve sharing of knowledge or resources among individuals [11].

4. Methodology

We aim to implement the SNC based information systems, propose SN based recommendation systems to support the customers for SNC or other service selection and the market mechanism for support evaluate service quality provided by EC business. Thus, in this research project, we will address and resolve important issues closely related to the areas of computer science, information economics, and social science communities. Therefore, interdisciplinary methodologies will be leveraged to develop the social network recommendation systems, observe the online social behaviors, and examine the dynamics of the service economy.

First, Internet/Web and data/knowledge engineering technologies (such as ontology and agent technologies) will be exploited to establish the SNC infrastructure and social decision process improvement. Second, we will adopt artificial intelligence related technologies (such as computation intelligence methodology set - fuzzy logic,

artificial neural network, support vector machine, and some statistics approaches) to develop intelligent social referral (trust-based) recommendation systems. Third, utilizing the reliability, stochastic process, and queuing theories, we evaluate the performance of various SNC services. We further develop a service evaluation process of the SNC service according to quality of service (QoS) and fuzzy Delphi method. Game theory and Industrial Organization will be developed investigate competition, coordination, and integration strategies of these independent agents (individual and business participants). Finally, utilizing methodology of computer simulation and econometrics, experimental simulation and empirical study will be conducted to verify the analytical results.

4.1 Technological Dimension

We are main focus on recommendation system in this aspect. There are two difference recommendation systems were completed in this project, one is blog recommendation for online users, and another one is relevant personnel selection/recommendation for enterprises.

4.1.1 Blog Recommendation

In this study, we propose an innovative recommendation mechanism on the blogosphere which employs the trust model, social relation and semantic analysis to construct a more comprehensive and more personalized framework for each bloggers on the entire blogosphere. There are various important factors and dimensions we must take into consideration under blog recommendation context. Especially we conclude three underlying critical aspects of blogosphere- Trustworthiness and Reliability, social intimacy and popularity and semantic similarity, which contribute to TR, SIP and SS scores respectively. We present a neural network-based approach to learn and predict user's preference and affinity i.e. Final Recommend Score (FRS) of each blogger and blog post, by feeding these standardized scores into neural model. Figure 1 is the architecture of the proposed NN-based recommendation mechanism.

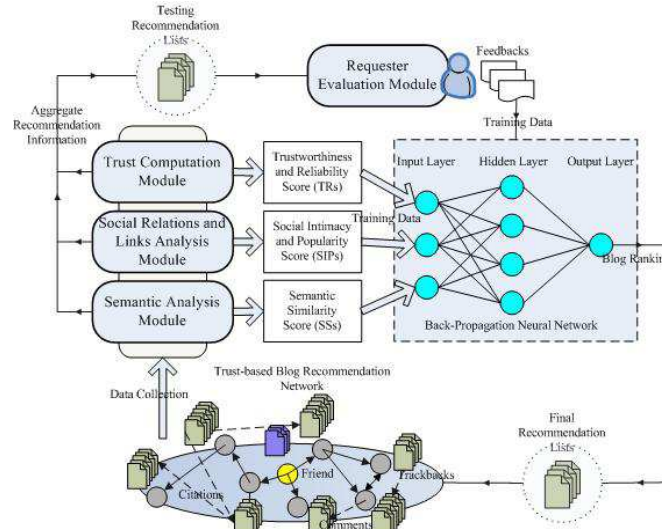


Figure 1. The architecture of the proposed NN-based recommendation mechanism.

This proposed neural network-based blog recommendation mechanism in which we apply the concepts of trust model, social relation and semantic analysis and they contain the information of the blog network about trustworthiness and reliability, Social intimacy and popularity and Semantic similarity respectively. This information is then integrated as an initial recommend score for each objects over the recommendation network, then the initial recommend list was induced for requesters. Meanwhile, a back-propagation neural network (BPNN) is proposed to forecast the FRS according to these scores. Finally, a recommend list of blog posts or bloggers is generated for the recommendation service requester. The whole process of recommendation mechanism is divided into several steps as the Figure 2 and is described as the following sub-sections.

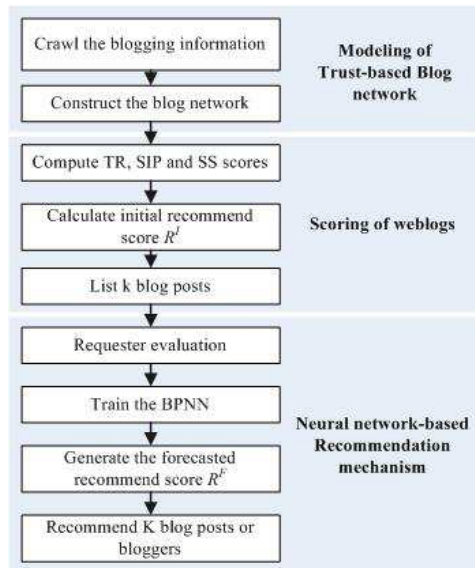


Figure 2. The whole process of recommendation mechanism and its sub-sections.

Calculate Initial Recommend Score R^I and List K Blog Posts. We compute a recommend score (either posts or bloggers) according to their scores of trustworthy, social relation and semantic similarity after a min-max standardization approach, which is applied to each scores. An initial recommend list is generated with a sequence of recommend score from high to low. Recommend scores $R(i, j)$ for each post j of blogger i for given the requester r is defined as following,

$$R^I(r, O_{ij}) = \alpha TR^s(r, i) + \beta SIP^s(r, O_{ij}) + \gamma SS^s(r, O_{ij})$$

where uppercase I of recommend score R^I stands for initial recommend score and uppercase s of TR, SIP and SS scores mean scores after the process of standardization. Parameters α , β and γ are the self-set weights of trust score, social relation score and semantic score of objects in the blog network respectively and the values are between 0 and 1.

Trust Scores (TR) computation. The computation of TR scores is divided into two steps: First, for a given requester (also blogger) r , we collect and aggregate trust information then form the trust-based blog network of him/her for further inference and filtering. Second, a search algorithm is applied to the constructed blog network in the former step, and set a maximum search layer as stopping criteria. $TR(r, s) = t_{rs}$ and

$$t_{rs} = \frac{\sum_{j \in \text{adj}(r)} t_{rj} \times t_{js}}{\sum_{j \in \text{adj}(r)} t_{rj}}$$

where r is the requester of blog recommendation, s stands for these social-reachable and available agents, and $s \in RC(r)$. t_{rs} is the value of trust degree from agent r to s , and $t_s \in [0, 1]$. means adjacent agents of agent r , i.e. friends of blogger r . $RC(r)$ means the recommender set of requester r .

Social Relation Scores (SIP) computation. To combine a complete view in recommendation process, SIP score is separated into SI and Popularity scores: SI addresses the social similarity strength or the degree of familiar on agent-agent aspect. However, Popularity emphasizes global reputation on object aspect. SIP score is introduced in the following formula,

$$SIP(r, O_{ij}) = SI(r, i) + Popularity(O_{ij})$$

$SI(r, i)$ and $Popularity(O_{ij})$ represents social intimacy relation and popularity scores respectively.

$$SI(r, i) = \text{sim}(iL(r, A), iL(i, A)) + \text{sim}(oL(r, A), oL(i, A))$$

where r, i stands for the requester of blog recommendation (source agent) and certain agent respectively, and $r, i \in A$. A denotes a set of social-reachable and available agents (or websites) which can be reached. $iL(i, A)$ is a vector which simply counts the number of social links from r to each of the agents in set A . $\text{sim}(\cdot)$ is the function to compute the similarity between two agents by inner product calculation.

$$Popularity(Q_j) = w_{co} \times \frac{Comment(Q_j)}{\max Comment(A)} + w_{ci} \times \frac{Citation(Q_j)}{\max Citation(A)}$$

where $Comment(O_{ij})$ and $Citation(O_{ij})$ counts the number of comments/citations in object j of agent i . And $\max Comment(A)$ and $\max Citation(A)$ is the maximum number of comments/citations. The parameters w_{co} and w_{ci} are the weights of in-degree links from comment and citation behaviors respectively.

Semantic Scores (SS) computation. We apply CKIP (Chinese Knowledge and Information Processing) Chinese word segmentation system [A 11] to parse the content of blog post after the HTML tags are removed. After that, a basic cosine similarity metric of term vectors with standard TFIDF [A 12] weighting scheme is deployed to represent each index term of each blog article. Suppose there are n bloggers in the blog network, semantic score is defined as blow,

$$SS(r, O_{ij}) = sim(q, d_{ij}),$$

$$\text{where } i \in [1, n], j > 0 \text{ and } 0 \leq SS(r, O_{ij}) \leq 1$$

where q stands for index terms of blog postings which were published by requester r and we deem it as a query. Note that q could be generated by selecting any subset of objects of agent r . The variable d_{ij} is a vector of the TFIDF scores of index terms of blog post j of agent i .

4.1.2 Personnel Recommendation

The proposed personnel recommendation includes several major steps as shown in Figure 3. First, according to the different departments, respectively collect the personality trait data of exiting employees and job applicants. Second, the training datasets are use to build the personnel predict classify model by SVM of each department, respectively. Third, the testing dataset was treated as the future unknown data (representing the new job applicants) and respectively applied to estimate the performance of every personnel model of departments. Finally, the SVM prediction result assists the managers to choose which job applicant is most suitable for the job.

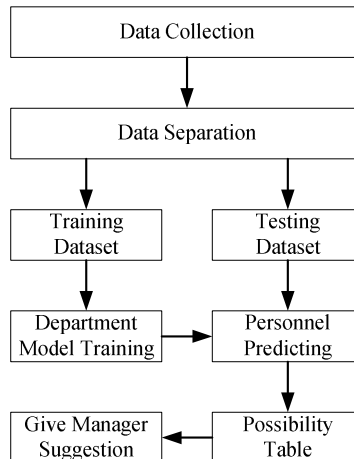


Figure 3. Major steps of model.

Data collection. In this project, we obtain the research assistance from a real company. Furthermore, we require a part of staff in the company filled out personality traits test stems from the personality questionnaire of IPIP-NEO with the 120 questions edition. Each record of personnel trait consists of 5 dimensions and 30 grades of personality factors which were identified and determined by IPIP-NEO as Table 1. This can be portrayed as the enterprise human resource structure.

Table.1 Testing scores with the classification of five factors.

Extraversion	Agreeableness	Neuroticism
Friendliness	Trust	Anxiety
Gregariousness	Morality	Anger
Assertiveness	Altruism	Depression
Activity Level	Cooperation	Self-Consciousness
Excitement-Seeking	Modesty	Immoderation
Cheerfulness	Sympathy	Vulnerability
Conscientiousness	Openness	
Self-Efficacy	Imagination	
Orderliness	Artistic Interests	
Dutifulness	Emotionality	
Achievement-Striving	Adventurousness	
Self-Discipline	Intellect	
Cautiousness	Liberalism	

Department model training. The model training procedure of each department is outlined in Figure 4. First, in the data preprocessing step, the non-numerical data must be changed to numerical data [7] before the data was fed to SVM process. Second, in order to increase the prediction accuracy rate and decrease the difference between data [5], data should need normalized before advance into next step. Third, we choose the RBF kernel function and 10-fold cross-validation method for select the best parameters in this experiment. The goal of Cross-validation method is to identify the best parameter pair (C and γ) so that the classifier can get the best predict efficiency for unknown data samples. Finally, the training dataset was fed into SVM for train each department model, respectively.

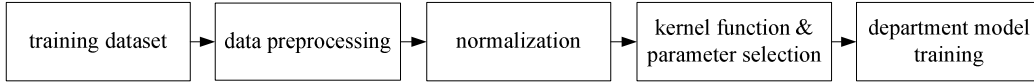


Figure 4. Procedure of model training.

Personnel predicting. The procedure of personnel predicting was illustrated as Figure 5. Within the personnel predicting process, every personnel data must not only translate the non-numerical data to numerical data, but also normalized as train procedure. Then, the dataset will individually feed into every built department human resource model. Every department personnel model will output the suitable probability of each personnel. Finally, the proposed system integrated all of the

suitable probability for managers as a basis for personnel selection decision making. This could seem as a recommendation system of recommend the right person for the right position.

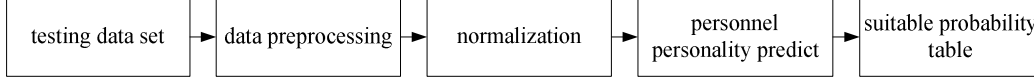


Figure 5. Procedure of model testing.

4.2 Economic Dimension

There are two main researches include in this dimension. First is the strategy analysis of competition and integration of online advertisement-supporting related services. Second one is the agent-based social decision mechanism for electronic commerce service quality evaluation.

4.2.1 Strategy Analysis

We consider a market with two social networking related services (SNS) in which users can utilize the service to communicate and share knowledge with other users. The total number of SNS users is η_0 and the total number of users of these two SNS channels are $\forall i \eta_1$ and η_2 respectively ($\eta_0 = \eta_1 + \eta_2$). For analytical convenience, in this model, we assume a user choose only a SNS channel as their major bridge to communicate with other users. Let parameter β_i stand for brand index about SNS i determined by images of SNS channels.

Variable θ_i stands for the individual type toward the brand of SNS, and is uniformly distributed with an interval $[0, 1]$. It's a relative indicator. Notable, a user with higher value of θ_i has more love tendency to use SNS channel 1, vice versa. Intuitively, $\theta_i \beta_1$ stands for brand loyalty of user i toward channel 1 and $(1 - \theta_i) \beta_2$ means brand loyalty of user i toward channel 2.

Parameter f_i means functions (or features) of SNS i determined by their own service quality level. Since the users prefer to a SNS with larger number of users because he/she can communicate with more potential users utilizing the same SNS. We describe the effect of this type of externality by parameter α . Higher α indicates stronger effect of the externality. Finally, parameters a_i is the advertising quantity conducted on SNS channel i .

Incompatible SNS Services. Considering the above factors, the utility of user i in a market with incompatible independent SNS providers can be formulated as

$$U_i^n = \begin{cases} \theta_i \beta_1 + f_1 + \alpha \eta_1 - a_1 & \text{if subscribe to SNS 1} \\ (1 - \theta_i) \beta_2 + f_2 + \alpha \eta_2 - a_2 & \text{if subscribe to SNS 2} \end{cases}$$

Let $\hat{\theta}$ denote the user type who is indifferent between using two channels. From the utility function, we can get

$$\hat{\theta}^n = \frac{\beta_2 - \Delta f - \alpha \Delta \eta + a_1 - a_2}{\beta_1 + \beta_2}$$

where $\Delta f = f_1 - f_2$ and $\Delta \eta = \eta_1 - \eta_2$. According to conditions $\eta_2 = \hat{\theta}^n \eta_0$ and $\eta_0 = \eta_1 + \eta_2$, we get the demand functions of two channels:

$$\eta_1^n = \frac{\eta_0(\beta_1 + \Delta f - a_1 + a_2 - \alpha \eta_0)}{\beta_1 + \beta_2 - 2\alpha \eta_0}, \eta_2^n = \frac{\eta_0(\beta_2 - \Delta f + a_1 - a_2 - \alpha \eta_0)}{\beta_1 + \beta_2 - 2\alpha \eta_0}$$

And the difference of demand between two SNS channels are obtained as

$$\Delta \eta^n = \eta_1^n - \eta_2^n = \frac{\eta_0(\beta_1 - \beta_2 + 2\Delta f - 2a_1 + 2a_2)}{\beta_1 + \beta_2 - 2\alpha \eta_0}$$

Compatible SNS Services. In the case, both users could benefit from the aggregate externality effect, $\alpha(\eta_1 + \eta_2)$. The utility of a typical user i is rewritten as

$$U_i^c = \begin{cases} \theta_i \beta_1 + f_1 + \alpha \eta_0 - a_1 \\ (1 - \theta_i) \beta_2 + f_2 + \alpha \eta_0 - a_2 \end{cases}$$

Similarly, we can obtain the use type who is indifference in using SNS channel 1 and SNS channel 2, under compatible situation,

$$\hat{\theta}^c = \frac{\beta_2 - \Delta f + a_1 - a_2}{\beta_1 + \beta_2}$$

, and the difference of demand between two SNS channels are obtained as

$$\Delta \eta^c = \eta_1^c - \eta_2^c = \frac{\eta_0(\beta_1 - \beta_2 + 2\Delta f - 2a_1 + 2a_2)}{\beta_1 + \beta_2}$$

Profit Functions. Denote φ the fee (price) of unit advertisement charged to the sponsors by SNS providers. Notice that the benefits of operating SNS include directly benefit and indirect one. The payoff functions of the two SNS providers in the long run can be formulated as

$$\pi_1 = \eta_1 a_1 \varphi + K(\eta_1) - c(\beta_1, f_1, \eta_1),$$

$$\pi_2 = \eta_2 a_2 \varphi + K(\eta_2) - c(\beta_2, f_2, \eta_2)$$

, where $K(\eta_i)$ stands for the indirect benefit of the services which is associated with the number of the users of the SNS services. The cost function of SNS services $c(\beta_i, f_i, \eta_i)$ include the investments of brand promotion, functionality and quality development, the operational cost to accommodate and coordinate the activities of the users. In the short run, the costs of branding, product development and capacity are sunk cost and focus on the decision of appropriate advertising strategy and corresponding profit. We reduce the profit (only revenue is considered) function as

$$\pi_1 = \eta_1 a_1 \varphi, \pi_2 = \eta_2 a_2 \varphi$$

4.2.2 Social Decision Mechanism

This part research is divided into four parts: Ontology Updating and Retrieving,

Social Network Analysis, Quality of Service Evaluation Processing, Sharing Decision. In the proposed system we use agents to simulate the individuals in the real world.

Ontology Updating and Retrieving Module. This is designed for the purpose of storing the information of stores ever visited. The structure of ontology is constructed by referencing the questionnaire adopted by SERVQUAL. For the purpose of simplifying evaluation process, we divide the ontology into two parts: summary and detail. When an agent receive the service quality evaluation request, he/she first search own ontology to see if the stored was visited. If he/she did, the summarized service quality will be first sent out. However, there may be totally different evaluation results on specific on-line store, that is, agents don't agree each other on the service quality. Thus the detailed evaluation items and their rank are sent back to the service evaluation request originator.

Social Network Analysis Module. When the evaluation request originator asks for help, the request is not sent out blindly. Our design utilizes the friend of a friend (FOAF) method to expand this network, and the expanding degree is predefined to limit the depth of search. Our system will calculate the following scores to be the primary key index of evaluation:

- Degree Centrality:

Social network researchers measure network activity for a node by using the number of direct connections a node has, which is called degree.

- Betweenness Centrality:

Betweenness is a measure of how often a node is located on the shortest path between nodes. A node with high betweenness has great influence over what flows in the network.

- Closeness Centrality:

Closeness centrality is the total distance of a given node from all other nodes. They have the shortest paths to all others, that is, they are close to everyone else.

The above scores would be the base of evaluation weight of specific respondent.

Quality of Service Evaluation Processing Module. This module generates the evaluation request and calculates the results. It utilizes the Fuzzy Delphi method to make consensus if diverse service evaluation result are received.

Sharing Decision. It make the decision of responding to the evaluation request.

The system architecture is depicted in Figure 6.

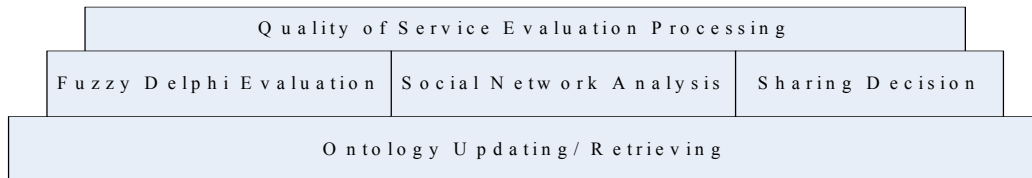


Figure 6. System Architecture.

5. Conclusion

In this project we utilized some intelligence mechanism to set up experiments to improve the efficiency of recommendation system on social network. The other side, mathematical model was built by Game theory for analysed the strategies for competition and integration within online service providers.

First, we propose an elaborate recommendation mechanism that combines trust model, social relation and semantic analysis and illustrate how it can be applied to a prestigious online blogging system – Wretch in Taiwan. For entire network, about 57.22% of objects are isolated and without any comment and citation. From statistics, we found that 99% of the objects have comments range from 0 to 15, 80% range from 0 to 2, however 57.4% of objects do not have any comments. Moreover, 99% of the objects do not have any citations. Our approach seek to increase the density of the implicit links between bloggers and between blog posts. This enhances the reliability and comprehensiveness of recommendation mechanism. By preliminary results of experimental study, we found some implications and empirically prove some theories in domain of social networking, and the example reveals that the proposed recommendation mechanism is quite feasible and promising.

Second, a useable and reliable model for predicting and discovering talent personnel was built. In this part of investigation, a model combined the SVM classifier with the credibility questionnaire, which is developed by IPIP-NEO. By means of the model, the most suitable candidate for the vacancy could be predicted. Similarly, the model could be useful in decanting the existence employee work. Based on the above facts and personnel manager's opinions, we believe that the human resource prediction framework is beneficial for business.

Third, we discuss the adoption of advertising strategy on the SNS based on four types of market structures on. Utilizing game theoretic model, we analyze the impact of integration (service compatibility and business alliance) on the resulting advertising strategy and demand distribution. We have shown that the impact of service compatibility and business integration is significant. While gaining the benefit from contacting more people, the users are always worse when SNS are compatibly connected. The providers will benefit from both service and business integration. The users will always gain from the quality (features) competition, however, brand competition may hurt the customers as more disturbing ads will be exerted. In general, business integration will result in a higher diversity if ads exerted in two SNS.

For the ease of modeling, firstly we assume user's benefits are negatively associated with the number of advertisements while the service provider's profit increases with it. Although these service providers are now trying to alleviate the disturbance of advertisements by inserting ad tabs on the side or dividing a separated

ad section for users to view. This may cause the users match with the proper ads with a higher probability.

Finally, propose a system architecture which utilizes game theory and social network analysis to improve the traditional statistical evaluation process. The system successfully simulates the real world interaction and enriches the evaluation process. To prevent the result from being biased by prejudice of specific agent, we trim the extreme result. Besides, we adopt fuzzy Delphi method to make consensus once the diverse results are received. To simplify our system design, we use pre-defined questionnaire stored in ontology and ask for the agents to respond based on this. However, the result is then subject to the questionnaire and may not catch the real world case.

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計畫成果自評

本計畫工作已順利完成，其主要核心為建基於社群網路上的推薦機制，以及以賽局模型為基礎之經濟市場中的競、合策略分析。本專題計畫正式完成項目與計畫初預期項目之情形如下：

1 社群網路上的推薦機制

此次的研究專案中，於此研究領域中研究團隊已發表了兩篇國際會議論文如附錄 2, 4。其中，以網路日誌推薦為研究主題的文章更是獲得了 ICEB 國際研討會的最佳論文獎項。在廣泛的回顧相關研究文獻之後，我們以社群網路為基礎，結合信任機制、社交關係和語意分析的混合應用，提出了網路日誌推薦機制。研究中證明了理論的可行性，而研究成果也充份表明了此種推薦方式確實可對線上使用者帶來益處，為使用者省去搜尋切合自己需求之資訊的時間，而也可使日誌作者藉此提高自己在網路社群中的知名度，拓展自己交友圈。

另外，在人員挑選方面，本團隊也提出了一個近似推薦系統的人員挑選系統。以一份在網路上相當具有公信力的人格測試問卷定義出公司內各部門績效優秀員工的人格特質，進而找出整個部門、管理人員的特質。以此為基準，配合適合的監督式機器學習機制，預測、推薦最適員工至最適職務上任職。為企業達成適才適所的人力資源效益。

2 經濟市場中的競、合策略分析

附錄 1, 3 即為此領域研究已正式發表於國際論文研討會的研究成果。在此經濟分析層面中，我們賽局理論建置能符合真實情況的數學模型設定，將其推廣分析消費者對產品特性的接受度，以及廠商競爭與整合後，對社會所造成的影響。深入探討可供企業進行電子廣告行銷的媒介商（例如 MSN、Yahoo messenger 等）之間的競爭與合作策略，進而分析如何的競爭或是合作策略，能使使用者、媒介商和廣告商三方皆可獲利。更進一步地，藉由分析相關參數對廠商利潤的影響，我們提供對於社群廣告制度建立與行為規範的設定標準與依據。

在此經濟分析方面，我們的另一項研究成果為成功的建立了社群決策機制。團隊成員整合了相關的線上電子商務服務品質衡量研究文獻與相關統計學的知能後，投入研究一種建基於代理人的社群決策機制，藉此來衡量電子商務的服務品質。我們所提出一種新的社群決策機制，其中利用賽局理論和社群網路分析，改進了傳統的統計評估過程。

目前本專題研究成員正進一步著力於整理此研究專案中的研究成果，期能將最後成果投稿於國際期刊。本研究團隊在經濟分析與企業智慧應用上的傑出表現是我們認為能夠大幅超越過去資訊管理領域在網路服務品質研究上的優勢，成就資訊管理獨特的存在價值，同時這也是本研究室的核心目標，而這同時是全球資訊管理學術界頂尖學府（諸如 MIT、CMU 等）目前所專注的領域。因此，如受到獎勵資助的研究時程能得以延伸，本研究團隊有自信能夠做出更創新、突破的核心研究。

附錄

已發表會議論文

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