ORIGINAL RESEARCH

Empirical analysis of the intelligent influence factors of social network services effectiveness in e-commerce based on human learning behaviors

Kerong Zhang[1]
Yasong Xu[1]
Wuyi Liu[2,3]

[1]Department of Business and Management, Fuyang Normal University, Fuyang, Anhui Province, People's Republic of China; [2]Department of Science and Technology, Fuyang Normal University, Fuyang, Anhui Province, People's Republic of China; [3]School of Biological Science and Food Engineering, Fuyang Normal University, Fuyang, Anhui Province, People's Republic of China

Background: It is crucial for companies to understanding users' choices and learning behaviors, and the corresponding influencing factors and cognitive patterns regarding social network services to communicate with potential customers.

Methods: In this study, a casual structural model was constructed and developed to model and characterize the relationships between problems to be resolved as antecedent variables and success factors as consequent variables with the intermediary variables based on human learning behaviors, whereas the concept of social network service was introduced to summarize the current issues of social network services and empirically factors affecting effectiveness of social network services.

Discussion: This study highlighted the corporate need to examine the intelligent role and learning effectiveness of social network services when studying social creativity and intelligence in a social networking environment. Firstly, the framework and hypotheses of social network services were introduced to summarize the current issues of social network services and the main influencing factors affecting the working patterns of social network services. Subsequently, the empirically established model was further tested to explore the possible meaningful relationships among those variables used.

Results: The study revealed that the social network services provider and the customer should improve their social creativity and community collaboration; these could be expanded and enhanced by increasing the social intelligence to raise the social network services' effect and the customer's externalization. Furthermore, social intelligence, community collaboration, and customer externalization were factors significantly influencing customers' social creativity, while the customer externalization and community collaboration were the two important factors affecting social intelligence.

Conclusion: The study implied that social network services providers should provide more and more intelligent and inspiring services for their customers.

Keywords: empirical analysis, computational modeling, intelligent influence factor, social network services, human learning behavior

Introduction

The network pattern of peer to peer (P2P) is a wide distribution type of computational application architecture, partitioning workloads between peers, where peers can access and acquire a portion of their network resources without the need for central coordination by servers or stable hosts.[1,2] The most exciting application of P2P is social network services, which have thrived in recent years.[1-4] The concept of social network services emerged as a website-based e-commerce and commercial IT (Information Technology)

Correspondence: Wuyi Liu
School of Biological Science and Food Engineering, Fuyang Normal University, Qing He West Road No. 100, Fuyang, Anhui Province 236037, People's Republic of China
Tel +86 182 9819 9628
Email lwui@163.com

business, and some of their online services are already provided worldwide, such as Twitter, Facebook, QQ, Cyworld, and Renren.[2–6] Learning and understanding customers' choices, influencing factors, and the working patterns of social network services are crucial for companies to communicate with their potential customers. However, it is not fully clear how their influencing factors affect the workflow of social network services and their participants.[2–7] The number of customers of social network services was estimated at around 1.2 billion and forecasted to increase to more than 2 billion.[7–11] Active customers on some main social networks sites have been increasing until now, and most articles are merely concerned with the developing network and software of usage and privacy.[2–30] From a technical point of view, social network services are a type of network software based on P2P. The applications include instant messaging, P2P VoIP, P2P net games, P2P search engine, and P2P e-commerce. Furthermore, there are many software companies supplying similar open-source social network services software, such as OpenPNE2.8, Mynets, Openkaku, Iweb, and Uchome. In order to survive in the competition, the social network services providers have to possess lasting viability. However, social network services have three major defects. Human needs and hobbies are diverse, leading to a large variety of information which is hard to classify. Without recommendations from friends, people can find it hard to access interesting information, due to information silos.[4–6,16–31] In fact, search engines in social network services can easily find pages on local websites, but the search engine cannot determine how to evaluate the topic and pages. Menasce first coined the words "Web 2.0" to describe a changed way people that interact with information and evaluate the effect of commercial websites in the commercial industry.[27–36] Ferrari and Viviani introduced business intelligence to measure websites and information and communication technologies (ICT), especially the business intelligence system (BIS), which is intended as a coordination technology able to support the communication of knowledge and decisions among individuals who perform interdependent tasks.[27] Bolton et al reviewed the knowledge of Generation Y's use of social media and evaluated the implications for individuals, firms, and society.[28] Amouzegar et al suggested that intelligence was an effective tool for new commercial website applications in social network services.[29] Nelson inferred that websites will continue to evolve with products and commercial services, and presented flat models for monetizing the advances.[30] Ma argued that computer-supporting collaborative learning and social creativity were key terms for designing work with critical reflection in examining

consumers' behaviors in social network services.[31,32] Marco et al identified a misalignment observed in using social network services based on a comprehensive literature review on the effect of website designed tools.[33] The IBM team suggested that it was a core competing strategy to maintain a visually impressive effective website in today's marketplaces.[34] Huang et al explored the relationship between gratifications and social network service usage, regarding the mediating role of the online experience.[35] They incorporated the dual theories from communication research (uses and gratifications) and psychology research (online flow) to examine consumer behavior in the use of social network services.[35] The study proposed that consumers' online experience of interaction and arousal served as the mediator of the relationship between social motivations and use behaviors, and their results indicated that arousal fully mediates the relationship between social gratifications and problematic social network service use.[35] Rehman assessed the social network alliances and firms' performance of Pakistani small and medium enterprises (SMEs) in a panel data analysis.[36] More recently, Zhang et al analyzed the influence of role stress on self-disclosure on social networking sites from a conservation of resources perspective.[37] Based on the conservation of resources (COR) theory, they hypothesized that the users of social networking sites responded to role stress with a subtype of positive stress, leading to investments in social resources (eg, motivation for relationship maintenance and self-presentation) and generating an increased level of self-disclosure.[37] Their results revealed the mediating effect of motivation for relationship maintenance and self-presentation on the social networking site's stress–disclosure relationship.[37] Huang et al explored the mechanism through which members with reconstructed identities become satisfied with a social network community with a new contingency model.[38] They investigated the social network members' satisfaction with interest-based social network communities from an identity-reconstruction perspective.[38] Their results supported the main effects and two moderating effects, whereas the effect of bridging social capital on satisfaction and the effect of privacy concern on satisfaction were contingent upon identity reconstruction.[38]

Social network services are online services with e-commerce platforms or websites that focus on building social networks and/or reflecting the social relations among people who share common interests or activities. A social serving network essentially consists of diverse personal data and many influencing factors, including a personal data or individual profile for each customer or user, his/her professional and social links, and a variety of

additional services. Most social network services are complex websites and provide means for users to interact over the Internet, such as email and instant messaging. In a broader sense, although online community services are sometimes considered as social network services, social network service usually means an individual-centered service whereas online community services are group-centered. Among those online community or learning groups, social networking sites allow users to share ideas, activities, events, and interests within their individual networks. However, few studies have reported on the effectiveness of social network services in online human learning so far. Meanwhile, the drawback of previous studies was that these methods cannot handle multiple dependent variables or estimate factor structures and factor relationships simultaneously for socio-psychological factors in social network services. In comparison, a structural equation model can compensate for these flaws. Therefore, the present study developed a structural equation model to explore and evaluate the intelligent influencing factors of social network service effectiveness in e-commerce circumstances or surroundings based on human learning behaviors.

Methods
The survey and data collection

The field survey questionnaires were designed with reference to the review of relevant previous studies.[9–36] These survey questionnaires were handed out and collected in streets and neighborhoods through the undergraduate social practical activities of universities and colleges in Anhui Province, China. The five hypotheses of the study were reflected in the questionnaires' survey items of five parts, ie, items of community collaboration, user externalization, social creativity, social network services intelligence, and social network services effectiveness. All the research variables and their measured items were designed to collect online learning perceptions of participants at the individual level to make each individual as an essential unit of the study. Responses of participants are scored and analyzed on a seven-point Likert-type scale ranging from 1 (strongly disagree) to 7 (strongly agree), since a previous study found that items with five or seven levels of Likert-type scale may produce slightly higher mean scores relative to the highest possible attainable score, compared to those produced from the use of 10 levels of Likert-type scale with statistically significant difference.[14] The main content of the survey questionnaires used for the subsequent analysis is provided in Supplementary material.

From June 2016 to January 2017, a total of 900 people consisting of 709 men and 191 women were surveyed in the study. The participants were mainly comprised of students (more than half of the respondents), workers (about one-fifth of the respondents), sellers and/or service workers, engineers, and self-employees. Ethical approval was approved by the Ethics Committee of Fuyang Normal University. All participants gave written informed consent for inclusion before they participated. All participants received a water cup as an appreciation of their participation in the study.

The empirical research framework

An integral framework or model was developed to predict the dynamic effect of social network services based on previous related studies[27–36] (Figure 1). The definitions of variables and measured items are summarized as follows: (1) community collaboration is the collaboration among communities for exceptional values and optimized applications with the measured items of information silo elimination, interdisciplinary brainstorming, and social discovery; (2) the customer externalization refers to the ability of social network services to help customers to express their ideas and interact with each other with the measured items of concretization, interpretation, and expression of the tacit knowledge in social network services; (3) social intelligence is the capability to accomplish something or obtain achievements in the online learning community successfully with easy access to actionable information through timely insights into the conditions of social network services with the measured items of predictive analytics, decision enablers, and visualization; (4) social creativity is the capability and degree of new insights, novel ideas, and fancy artifacts supported by social network services with the measured items of risk free (no risk), originality, expression, and social evaluation and social appreciation in a community; (5) the effect of social network services refers to the variables of duration, frequency, and intensity of usage with the measured items of awareness, satisfaction, and recommendation in social network services.

The hypotheses of community collaboration

Modern computing techniques can effectively allow the social community to create more virtual team communications.[1–36] Therefore, better community collaboration is better for customer externalization, social creativity and intelligence of social network services. Thus, we made hypotheses as follows.
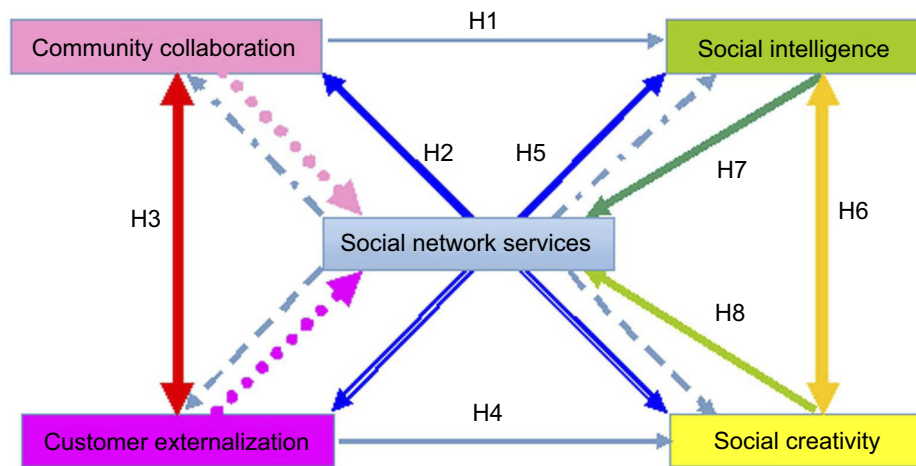
Figure 1 The empirical research model.
Notes: H1 (Hypothesis 1) means that community collaboration is positively associated with social creativity. (Hypothesis 2) shows that community collaboration is positively associated with the social intelligence. H3 (Hypothesis 3) assumes that community collaboration is positively associated with the customer's externalization. H4 (Hypothesis 4) means that customer's externalization is positively associated with the social intelligence. H5 (Hypothesis 5) assumes that customer's externalization is positively associated with social creativity. H6 (Hypothesis 6) means that the social creativity is positively related with the social intelligence. H7 (Hypothesis 7) shows that the social intelligence is positively associated with the effect of social network services. H8 (Hypothesis 8) assumes that the social creativity is positively related with the effect of social network services. These hypotheses can be group into three groups: (1) The hypotheses of community collaboration, including H1, H2, and H3; (2) The hypotheses of customer's externalization, including H4 and H5; (3) The hypotheses of social intelligence, including H6, H7, and H8. In brief, the full lines of different color and style arrows show these hypotheses of different groups and different types of monodirectional and bidirectional feedbacks, whereas the imaginary lines of different color and style arrows assumes there are possible weak feedbacks or effects.

Hypothesis 1 (H1): Community collaboration is positively associated with social creativity. Hypothesis 2 (H2): Community collaboration is positively associated with social intelligence. Hypothesis 3 (H3): Community collaboration is positively associated with customer externalization.

The hypotheses of customer externalization

Obviously, customer externalization is a significant determinant of intelligence and social creativity. Hypothesis 4 (H4): Customer externalization is positively associated with social intelligence. Hypothesis 5 (H5): Customer externalization is positively associated with social creativity.

The hypotheses of social intelligence

Social intelligence was originally concluded from business intelligence 2.0 (BI 2.0). Social intelligence is a key point of the social network services effect, and it can be defined as the actionable capabilities to realize success with easy access to network conditions to obtain social information and services. In addition, the IBM team provided two important variables to measure the effects of professional websites: awareness and satisfaction.[34] Hypothesis 6 (H6): Social creativity is positively related to social intelligence. Hypothesis 7 (H7): Social intelligence is positively associated with

the effect of social network services. Hypothesis 8 (H8): Social creativity is positively related to the effect of social network services.

Statistical analysis

All data collected and used were entered in Excel spreadsheets (Microsoft Office, Microsoft Corporation, Redmond, WA, USA) and imported into SPSS (SPSS Inc., Chicago, IL, USA)[39] and AMOS (SPSS Inc.)[40] independently by two researchers and then double-checked and corrected by comparing the entries before performing any statistical analysis. The software package SPSS version 20[39] was used for data management, descriptive analysis, and exploratory factor analysis (EFA), whereas the software package AMOS version 20[40] was used for structural equation modeling of the field survey data analysis in the study. The structural equation modeling allowed for simultaneous testing of the relationships between latent constructs of variables (eg, the variables of social creativity and social intelligence of social network services in the study) and other measured constructs of variables (eg, the background variables of community collaboration and customer externalization). All the regression models carried out with SPSS and AMOS were adjusted for sex (or gender), age, job (or occupation), and level of education. All statistical analyses were conducted with statistically significant levels of $P<0.05$.

Results and discussion

The survey data collection and demographic characteristics of participants

The field survey questionnaires were handed out and taken back by the volunteers in the undergraduate social practical activities of universities and colleges. We surveyed 900 people, with 868 respondents returning the survey questionnaires, giving a survey rate of 96.44%. The demographics of the surveyed population are described as follows. The participants returning questionnaires were comprised of 679 (78.23%) men and 189 (21.77%) women. There were four age groups: 29 (8.64%) people younger than 19 years, 182 (68.66%) people 20–25 years old, 107 (15.67%) people 26–30 years old, and 27 (7.03%) people older than 31 years. The participant population returning questionnaires consisted of 448 (51.61%) students, 126 (14.52%) office workers, 125 (14.40%) sellers and/or service workers, 104 (11.98%) engineers, and 65 (7.49%) self-employees. The participants were invited to fill out the survey questionnaires and received an appropriate short interview with their levels of education considered.

Tables 1 and 2 summarize the main descriptive statistics and the goodness-of-fit indices of data analyses of the returned survey questionnaires in the study. The data in Table 1 show the descriptive statistics of correlations among observed variables of measured factors and the scored data of the scaled variables of measured factors of social network services. The data in Table 2 indicate the goodness-of-fit indices observed in the structural equation model of social network services in the study. In Table 1, the mean scores of surveyed respondents gave the relatively satisfaction scores (ie, the Likert-type scaled points out of 7) on the main influencing factors (ie, community collaboration, customer externalization, social creativity and social intelligence of social network services), and the effect of social network services considered in the study.

The scaled data and correlations and discriminate validity analysis among observed variables

The scaled data indicated the relatively lower satisfaction on community collaboration (4.56 out of 7) and externalization (4.58 out of 7) of customers, whereas the surveyed respondents showed a moderate satisfaction on social intelligence (4.75 out of 7) and the relatively more satisfaction on social creativity (5.12 out of 7) and effect of social network services (5.32 out of 7) (see Table 1).

In Table 1, the Pearson correlation analysis showed that the main influencing factors (ie, community collaboration, customer externalization, social creativity and social intelligence of social network services) were related to the social effect of social network services and the psychological behaviors and perceptions of participants. Among these factors, social creativity and social intelligence of social network services were closely related to the effect of social network services, with moderate correlations of 0.59 and 0.59, whereas community collaboration and customer externalization were loosely related to the effect of social network services, with moderate correlations of 0.39 and 0.33. As displayed in Table 2, all the observed values of construct reliability (Cronbach's α) of the focused variables were not less than 0.90, indicating that the covariance matrix and the null hypothesis of equal covariance were acceptable.

Model goodness-of-fit and testing of the structural equation model

Table 2 indicates the goodness-of-fit indices observed in the structural equation model, whereas Table 3 displays the hypothesis testing results of social network services in the study.

The survey data were subsequently further tested and explored with the structural equation model by the software package AMOS version 20,[40] and the testing results

Table 1 Scaled data and the diagonal matrix of correlations and discriminate validity analysis among observed variables (n=868)

Measured variable (factors)	Mean (SE)	Construct reliability (Cronbach's α)	Item1. CC	Item2. UE	Item3. SC	Item4. SI	Item5. SE
Item1. CC	4.56 (0.81)	0.90	1	0.60	0.30	0.34	0.39
Item2. UE	4.58 (0.88)	0.93		1	0.29	0.38	0.33
Item3. SC	5.12 (0.90)	0.94			1	0.54	0.59
Item4. SI	4.75 (0.82)	0.92				1	0.59
Item5. SE	5.32 (0.90)	0.90					1

Notes: Mean (SE), mean score (standard error) of the seven points Likert-type scale ranging from 1 (strongly disagree) to 7 (strongly agree). All latent correlations were significant at $p<0.01$.
Abbreviations: CC, community collaboration; UE, customer externalization; SC, social creativity; SI, SNS intelligence; SE, SNS effect; SNS, social network services.

Table 2 Goodness-of-fit indices observed in the structural equation model

Measured item	Chi-square ratio	Significant *P*-value	GFI	AGFI	RMSR	NFI	TLI	CFI
Reference threshold	<3	>0.05	>0.90	>0.90	<0.05	>0.90	>0.90	>0.90
Observed value	1.371	0.17	0.964	0.975	0.041	0.987	0.989	0.991

Abbreviations: AGFI, adjust goodness of fit index; GFI, goodness of fit index; CFI, comparative fit index; NFI, normed fit index; RMSR, root-mean-square residual; TLI, Turker–Lewis index; chi-square ratio, chi-square value/df; df, degree of freedom.

are summarized in Tables 2 and 3. The goodness-of-fit indices observed in the structural equation model of social network services are revealed in Table 2. In Table 2, the goodness-of-fit indices generally supports the established structural equation model's integrity with the field survey data when compared with the reference threshold values suggested by the previous literature. The chi-square ratio (chi-square value/df), the goodness of fit index (GFI) and adjust goodness of fit index (AGFI) are essential indices representing the capability of the built structural equation model to reproduce the actual covariance matrix. Furthermore, those statistics of comparative fit index (CFI), normed fit index (NFI), and Turker–Lewis index (TLI) were crucial fitness indices of the built structural equation model.

The present study computed a chi-square ratio (1.371) less than 3.0 (the reference threshold value of the chi-square statistic), whereas the goodness-of-fit indices (ie, GFI and AGFI, CFI, NFI, and TLI) were also found to exceed the reference threshold values or parameters, implying a good model fit in the study. In addition, the estimated statistic of root-mean-square residual (RMSR) was within a reasonable range (RMSR =0.041<0.05).

In brief, the overall fitness degree of the established structural equation model was acceptable. Therefore, based on the analyzed data shown in Table 2, it could be concluded

that the model fitness tested was satisfactory for subsequent path analyses in structural equation model (Table 3).

Based on Tables 1 and 2, and the analyzed path coefficients of the structural equation model in Table 3, the antecedent variables were compared in terms of their explanatory power in confirmatory factor analysis. All of the path coefficients of the structural equation model and the analyzed results of hypothesis testing are summarized in Table 3. From these paths and the results of hypothesis testing, social creativity was observed to have a relatively big impact on the social intelligence of social network services, with a path coefficient of 0.509, whereas community collaboration had a similar relatively large impact on customer externalization, with a path coefficient of 0.603. Both social creativity and social intelligence indicated moderate impacts on the effect of social network services with the path coefficients of 0.381 and 0.378, respectively, whereas both community collaboration and customer externalization had relatively small impacts on social creativity, with path coefficients of 0.221 and 0.235, respectively. The results observed agreed well with these hypotheses of community collaboration, holding that community collaboration is positively associated with social creativity, social intelligence, and customer externalization, and the hypotheses of customer externalization assuming that customer externalization is positively associated with social intelligence and social creativity. Obviously, better community collaboration

Table 3 Summary of the hypothesis testing results

Hypothesis	Path	Estimate	SE value	CR value	*P*-value	Decision
H1	Community collaboration →SNS intelligence	0.077	0.066	1.001	0.342	Not acceptable
H2	Community collaboration →Social creativity	0.221	0.059	3.001	0.014*	Accepted
H3	Community collaboration →Customer externalization	0.603	0.063	9.192	0.0006***	Accepted
H4	Customer externalization →SNS intelligence	0.329	0.058	2.224	0.008**	Accepted
H5	Customer externalization →Social creativity	0.235	0.062	2.236	0.013*	Accepted
H6	Social creativity →Social intelligence	0.509	0.067	8.220	0.0004***	Accepted
H7	Social intelligence →SNS effect	0.378	0.054	6.073	0.005**	Accepted
H8	Social creativity →SNS effect	0.381	0.051	6.084	0.0002***	Accepted

Notes: Significance levels: *$p<0.1$; **$p<0.01$; ***$p<0.001$.
Abbreviations: SNS, social network services; SE, standard error; CR, critical ratio.

will be better for customer externalization, social creativity and intelligence of social network services, whereas customer externalization is a significant determinant of intelligence and social creativity. Furthermore, conclusions can be drawn from these observed results and data that social creativity and social intelligence are positively related to social intelligence and the effect of social network services. The conclusions agreed with the hypotheses of social intelligence. Moreover, these observed results also validated that there were close interactions among the main influencing factors, such as community collaboration vs customer externalization, and social creativity vs social intelligence of social network services. However, community collaboration showed little impact on the social intelligence of social network services, with a path coefficient of 0.077.

On the other hand, both social creativity and social intelligence were critical influencing factors of the social effect of social network services, whereas both community collaboration and customer externalization were relatively important influencers on the social creativity of customers. However, community collaboration had almost no direct impact on the social intelligence of social network services observed in this study. Additionally, the effect of social network services appeared as the performer of social creativity and social intelligence, whereas social creativity was the conductor of community collaboration and the externalization of customers in online learning in social network services.

The study was designed to explore the relationship between the main intelligent influencing factors, and the effect of social network services using a structural equation model. The social serving network essentially consists of diverse personal data and many influencing factors, including a personal data or individual profile for each customer or user, his/her professional and social links, and a variety of additional services. Most social network services are complicated website-based and provide means for users to interact over the Internet, such as email and instant messaging. Our findings showed that there were two pairs of close interactions among the main influencing factors, ie, community collaboration vs customer externalization, and social creativity vs social intelligence of social network services. Both social creativity and social intelligence were critical influencing factors of the social effect of social network services, whereas both community collaboration and customer externalization were relatively important influencers on the social creativity of customers. The effect of social network services could act as the performer of social creativity and social intelligence, whereas social creativity might be the conductor of community collaboration and the externalization of customers in online learning in social network services. The

present study also revealed that the social network services provider and the customer should improve their social creativity and community collaboration that could be expanded and enhanced by increasing the social intelligence to raise their social network services' effect and customer externalization. Furthermore, social intelligence, community collaboration, and customer externalization were significant influencing factors affecting customers' social creativity, while customer externalization and community collaboration were two important factors affecting social intelligence. The present study implied that social network services providers should provide more intelligent and inspiring services for customers.

Conclusion

The present study obtained the following conclusions. First, the social network services provider and the customer should improve their social creativity and community collaboration that could be expanded and enhanced by increasing the social intelligence to raise the effect of social network services and customer externalization. Furthermore, the social intelligence, community collaboration, and customer externalization in social network services were significant influencing factors affecting customers' social creativity, whereas customer externalization and community collaboration were two important factors affecting social intelligence as well. Additionally, the study revealed that all the users' comments and communications, and other relevant psychological attachments in social networks would affect the consumers' trust and adoption as well as their community collaboration and social creativity in social network services, in which people with higher anxiety scores tend to be more susceptible to social comment information and need more social communications and community collaboration. In summary, the present study implied that social network services providers should provide more intelligent and inspiring services for the customers' social network services.

Acknowledgments

Disclosure

The authors report no conflicts of interest in this work.

References

1. Schollmeier R, Gruber I, Finkenzeller M. *Routing in mobile ad-hoc and peer-to-peer networks*. A Comparison. [Lecture Notes in Computer Science] Web Engineering and Peer-to-Peer Computing. NETWORKING 2002 Workshops. Pisa, Italy, May 19–24, 2002, pp. 172–187. London, UK: Springer -Verlag; 2002. Available from: https://link.springer.com/chapter/10.1007%2F3-540-45745-3_16. Accessed May 21, 2019.

2. Yeoh W, Koronios A. Critical success factors for business intelligence systems. *J Comput Inf Syst*. 2010;50(3):23–32.

3. Ackland R. Social network services as data sources and platforms for e-researching social networks. *Soc Sci Comput Rev*. 2009;27(4):481–492. doi:10.1177/0894439309332291

4. Deng S, Huang L, Xu G. Social network-based service recommendation with trust enhancement. *Expert Syst Appl*. 2014;41(18):8075–8084. doi:10.1016/j.eswa.2014.07.012

5. Koo Y, Lim S, Kim K, Cho Y. Analysis of user characteristics regarding social network services in South Korea using the multivariate probit model. *Technol Forecast Soc Change*. 2014;88:232–240. doi:10.1016/j.techfore.2014.07.001

6. Sun J, Xu W, Ma J, Sun J. Leverage RAF to find domain Experts on research social network services: a big data Analytics methodology with Map Reduce framework. *Int J Prod Econ*. 2015;165:185–193. doi:10.1016/j.ijpe.2014.12.038

7. Shen GC, Chiou JS, Hsiao CH, Wang CH, Li HN. Effective marketing communication via social networking site: the moderating role of the social tie. *J Bus Res*. 2016;69(6):2265–2270. doi:10.1016/j.jbusres.2015.12.040

8. Kwon O, Wen Y. An empirical study of the factors affecting social network services use. *Comput Human Behav*. 2010;26(2):254–263. doi:10.1016/j.chb.2009.04.011

9. eMarketer. *Where in the world are the hottest social networking countries?* February 2012:29. Available from: https://www.emarketer.com/Article.aspx?R=1008870. Accessed May 28, 2019.

10. Lin KY, Lu HP. Why people use social networking sites: an empirical study integrating network externalities and motivation theory. *Comput Human Behav*. 2011;27(3):1152–1161. doi:10.1016/j.chb.2010.12.009

11. Goh KY, Heng CS, Lin Z. Social media brand community and consumer behavior: quantifying the relative impact of user- and marketer-generated content. *Inf Syst Res*. 2013;24(1):88–107. doi:10.1287/isre.1120.0469

12. Cachia R. *Social Computing: Study on the Use and Impact of Online Social Networking*. Seville: Institute for Prospective Technological Studies/JRC; 2008.

13. Rosenkrans G. The creativeness and effectiveness of online interactive rich media advertising. *J Interact Advert*. 2009;9(2):18–31. doi:10.1080/15252019.2009.10722152

14. Dawes J. Do data characteristics change according to the number of scale points used? An experiment using 5-point, 7-point and 10-point scales. *Int J Market Res*. 2008;50:61–77. doi:10.1177/147078530805000106

15. Watson HJ, Wixom BH. The current state of business intelligence. *Computer*. 2007;40(9):96–99. doi:10.1109/MC.2007.331

16. Park N, Kee KF, Valenzuela S. Being immersed in social networking environment: facebook groups, uses and gratifications, and social outcomes. *Cyber Psychol Behav*. 2009;12(6):729–733. doi:10.1089/cpb.2009.0003

17. Farh CIC, Bartol KM, Shapiro DL, Shin J. Networking abroad: a process model of how expatriates form support ties to facilitate adjustment. *Acad Manage Rev*. 2010;35(3):434–454.

18. Shirky C. Here comes everybody: the power of organizing without organizations. *Publishers Weekly*. 2007;39(5491):22.

19. Yan H, Su KK, Sun W. Research of factors affecting effectiveness of social network service. 2012 Annual IEEE Symposium on Robotics and Applications (ISRA); 2012; Kuala Lumpur:447–450.

20. Fischer G. *Social Creativity: Making All Voices Heard*. University of Colorado Center for Life Long Learning and Design Department of Computer Science; Boulder, CO: University of Colorado; 2005.

21. Kawamura T, Fukuhara T, Takeda H, Kono Y, Kidode M. Ubiquitous memories: a memory externalization system using physical objects. *Pers Ubiquitous Comput*. 2007;11(4):287–298. doi:10.1007/s00779-006-0085-4

22. Gao Q, Dai Y, Fan Z, Kang R. Understanding factors affecting perceived sociability of social software. *Comput Human Behav*. 2010;26(6):1846–1861. doi:10.1016/j.chb.2010.07.022

23. Bartling B, von Siemens FA. The intensity of incentives in firms and markets: moral hazard with envious agents. *Labour Econ*. 2010;17(3):598–607. doi:10.1016/j.labeco.2009.10.002

24. Saxena A, Khanna U. Advertising on social network sites: a structural equation modelling approach. *Vision J Bus Perspect*. 2013;17(1):17–25. doi:10.1177/0972262912469560

25. Hope S. Creativity, content, and policy. *Arts Educ Policy Rev*. 2010;111(2):39–47. doi:10.1080/10632910903455736

26. Teamcenter. *Community Collaboration–Extend Your Teamcenter Data to the Enterprise Value Chain*. Plano (TX); Team Center; 2010. Available from: URL: https://www.plm.automation.siemens.com/en_us/Images/2992_tcm1023-3192.pdf. Accessed May 28, 2019.

27. Ferrari E, Viviani M. *Privacy in Social Collaboration. Handbook of Human Computation*. Springer New York. Print ISBN 978-1-4614-8805-7; Online ISBN 978-1-4614-8806-4; 2013:857–878.

28. Bolton RN, Parasuraman A, Hoefnagels A, et al. Understanding generation Y and their use of social media: a review and research agenda. *J Serv Manage*. 2013;24(3):245–267. doi:10.1108/09564231311326987

29. Amouzegar H, Tarokh MJ, Hidaji AN. A new perception model for web competitiveness. CONFIRM (International Conference on Information Resources Management) 2008 Proceedings, 2008 (5-1-2008), paper 6. Available from: https://aisel.aisnet.org/confirm2008/6. Accessed May 21, 2019.

30. Nelson GS. Business Intelligence 2.0: are we there yet? Sas Global Forum Users Group; April 11 - 14, 2010.; Washington: SAS Global Forum 2010 Business Intelligence/Analytics Paper 040; 2010.

31. Ma AW. Computer supported collaborative learning and social creativity: a case study of fashion design. *J Inf Inf Technol Organ*. 2008;3(1):17–40. doi:10.28945/129

32. Ma AW. Computer supported collaborative learning and critical reflection: a case study of fashion consumerism. *Interdiscip J e-Skills Lifelong Learn*. 2010;6(1):87–102. doi:10.28945/1170

33. Marco MD, Rossignoli C, Ferrari A, Mola L, Zardini A, Ferrari A. BI as a service: an attempt to understand the leading adoption factors. Proceedings of the 1st International Conference on E-Business Intelligence (ICEBI2010); Gainesville, FL, 14–16 December 2010. Springer; 2010.

34. IBM Team. *Helping to Improve the Effectiveness of Your Web Site: IBM Express Web Effectiveness Assessment*. IBM (International Business Machines Corporation); 2006.

35. Huang LY, Hsieh YJ, Wu YCJ. Gratifications and social network service usage: the mediating role of online experience. *Inf Manage*. 2014;51(6):774–782. doi:10.1016/j.im.2014.05.004

36. Rehman UN. Network alliances and firms' performance: a panel data analysis of Pakistani SMEs. *Eurasian Bus Rev*. 2016;6(1):37–52. doi:10.1007/s40821-015-0033-1

37. Zhang SS, Kwok RCW, Lowry PB, Liu Z, Wu J. The influence of role stress on self-disclosure on social networking sites: A conservation of resources perspective. *Inf Manage*. 2019. doi:10.1016/j.im.2019.02.002

38. Huang J, Zhao L, Hu C. The mechanism through which members with reconstructed identities become satisfied with a social network community: a contingency model. *Inf Manage*. 2019. doi:10.1016/j.im.2019.01.006

39. Feeney BC. *A Simple Guide to IBM SPSS Statistics for Version 20.0*. Chicago, IL: SPSS Inc.; 2012.

40. Arbuckle JL. *IBM SPSS Amos 20 User's Guide, Amos Development Corporation*. Chicago (IL): SPSS Inc.; 2011.

Supplementary material
The main items of the survey questionnaires
Part 1. Community collaboration

1. I can find useful information from various channels in social network services sites.
2. I can extend my horizon by communicating with people with different backgrounds in social network services sites.
3. I can share find valuable information from friends in social network services sites.

Part 2. User externalization

1. Using social network services helps me express my vague ideas in a concrete way.
2. Using social network services helps me interpret my thoughts to others effectively.
3. Using social network services helps me express my tacit knowledge to others.

Part 3. Social creativity

1. I can analyze information and make personal plans in social network services sites.
2. I can make good decisions with the support of social network services sites.

3. The social network services sites can offer me visualized content.

Part 4. Social network services intelligence

1. I can try new things in social network services without much risk.
2. I can sometimes draw inspiration from the content of social network services sites.
3. I can express my unique perspectives in social network services sites.
4. I can receive thanks by providing effective recommendations to others in social network services sites.
5. I am motivated by others' rewards and acknowledgments in the social network services community.

Part 5. Social network services effectiveness

1. I remember some famous social network services site names.
2. I am satisfied with the services of social network services sites.
3. I will recommend my favorite social network services sites to my friends.