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Abstract: Loyal users are vital to the future of B2B platform with rapid development and intensive competitions. This study examines how network externality, in terms of direct network externality and indirect network externality, enhances B2B platform users' perceived value, and how such perception of value, in turn, influences their satisfaction and loyalty. First, we develop a conceptual model to describe the formation mechanism of user (seller) loyalty on B2B platform. Second, based on literature home and abroad, we develop a questionnaire. With a well-known B2B platform, we get 1,348 valid samples. At last, using structural equation modeling approach, we get the conceptual model fitted. The empirical results show that: network externality can be used as pre-drivers of perceived value thereby affecting user loyalty, but it has no direct influence on user satisfaction.

Keywords: network externality, user satisfaction, user loyalty, sellers, b2b platform, e-commerce

1.   INTRODUCTION

E-commerce develops at an unprecedented rapid pace, and gradually becomes an important part of strategic emerging industries. However, since information on e-commerce websites is fully transparent and technology is standardized, the gap between competitors is getting smaller, and thus users can switch between similar sites at any time. Then, a unique phenomenon differing from traditional economy but wide spreads in e-commerce appeared: the user satisfaction is high; also, the turnover rate is high. However, for a B2B platform, loyal users are a source of profit and foundation of market competitiveness. Therefore, fully understanding of formation mechanism and influencing factors of user loyalty, and effectively developing loyal users are critical issues in practice of managements and operations.

User loyalty served as a core of marketing has been of widespread concern to academics and enterprises in e-commerce. A lot of research has been made so far. Limited to the availability of samples, most of the research studies are on B2C or C2C platform. Yang(2004) [1] and Balabanis(2006) [2] separately took B2C and C2C platform as study object and investigated the role of switching cost impacting on user loyalty, Casaló(2008) [3] and Kim (2009) [4] made studies on B2C platform and noted that user satisfaction and quality of service were important factors affecting user loyalty. In addition, some empirical studies on B2C platform suggested that perceived value was directly affected by brand image and would affect user loyalty (Caruana, 2010 [5]; Hansen, 2008 [6]; Li ,2009 [7]).However, research on B2B platform is rare. Hansen (2008) [6] and Xie (2011) [8] suggested that brand image, perceived value, and user satisfaction were important factors affecting user loyalty for B2B platform.

The role of B2B platform is to match trading needs of buyers and sellers. This style of service has the typical characteristics of network externality. When the buyers and sellers accept B2B platform trading services, they join the network made up by the users who consume the same service, and the utility each user obtains

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depends on the number of users using the same platform [9].Since the existence of network externality, B2B platform often has aggregation effect caused by scale of users. More sellers will attract more buyers; and at the same time, more buyers will attract more sellers. However, there are only a few studies on network externality in e-commerce. Deng(2007) [10] did a research on effects of network externality on user behavior in B2B platform , and Yu (2008) [11] did the same research on mobile messaging business , both of their studies showed that network externality had a significant impact on perceived ease of use , perceived usefulness and practical behavioral. However, for B2B platform, which has typical characteristic of network externality, there is a lack of empirical analysis on how network externality effects on user loyalty. So, how dose network externality effect user loyalty on B2B platform, what impacts does it has? Taking network externality into account, this paper makes an empirical study on B2B platform user loyalty, to further describe the formation mechanism of user loyalty on B2B platform, and enrich the theoretical research in B2B e-commerce environment. We hope that this paper can propose suggestion for domestic B2B enterprise to develop and maintain loyal users.

Samples in this paper are taken from a well known domestic B2B platform that introduces Chinese products to the world, so, the sellers mainly refer to domestic sellers (suppliers). Because of some differences between domestic and foreign users (such as design of questionnaire, expression), in this study, we only focus on domestic sellers.

2.   USER LOYALTY

Definition of e-commerce user loyalty often comes from traditional marketing, it refers to that a user has preference and favorite for a particular e-commerce platform, frequently uses the platform, concerns information on the platform, and repeatedly purchases products or services on the platform. What's more, he may even unconsciously do positive "word of mouth" on the internet forums in his life [12].

3.   RESEARCH MODEL AND HYPOTHESES

3.1   Network externality

Network externality was first proposed by Katz& Shapiro(1985) to describe the phenomenon that a good's value was closely related to the number of users using it, and they defined network externality as "the utility that a user derived from consumption of a good increases with the number of other agents consuming the good"[13].From the perspective of consumers, network externality means that the value a user gets consists of two parts:(1) autarky value, the value a user get form a good itself, which independents of the size of the network;(2) synchronization value, the extra value a user get when a new user consumes the same good, which is determined by the size of the network[14].According to Katz& Shapiro (1985), there were two kinds of network externality: direct network externality and indirect network externality. The former refers to the direct impact the increasing consumers bring on good value; The latter means that as the number of users increases, the number of complementary products increases, and its price gets lower, this bring an impact to the value of the good[13].

Many research considered network externality an important factor affecting customer's loyalty or continuance intention(Lin (2011)[15];Lin (2011)[16];Zhou (2011)[17];Zhao (2012)[18];Chiu (2013)[19]). Most of them thought that network externality had direct effect on perceived usefulness. However, network externality would increase an individual's perceived value of a product/service [13], which referred not only to the economic value [20], but also to his/her positive cognitive and affective beliefs toward the product/service [21, 22]. Thus, we propose the following:

H1a: Direct network externality positively affects users' perceived value

H2a: Indirect network externality positively affects users' perceived value

Also, network externality will affect users' emotions or attitudes of a product/service. In an empirical study on user's acceptance of the mobile instant messaging, Yang [23] (2009) found that network externality had direct positive influence on the user's attitudes. In an empirical study of microblog, Zhao[18] (2012) found that network externality produced positive effects on user satisfaction by perceived complementarity; In an empirical study of instant communication(IM),Zhou[17] (2011) found that network externality produced positive effects on user satisfaction by perceived compatibility. In addition, Molina-Castillo [24] (2011) thought that the two types of network externality were so closely that if indirect network externality existed in a market, the number of users might increase and customers would experience more value when interacting with each other. Thus, we propose the following:

H1b: Direct network externality positively affects user satisfaction

H2b: Indirect network externality positively affects users' satisfaction

H3: Indirect network externality positively affects direct network externality

3.2　Perceived value

Woodruff [25] (1997) pointed out that the perceived value was the trade-off between perceived benefits(such as quality, benefit, utility) and perceived loss(such as total costs, monetary and non - monetary) the user made in a specific usage scenarios, in respect of the product/service itself. From the above definition, we know that perceived value is essentially the overall assessment about the utility of the product/service, a user makes based on the trade-off between perceived benefits and perceived loss after consuming it. In this paper, perceived value refers to the value evaluation a user makes based on trade-off between perceived benefits and perceived loss in the use of e-commerce websites.

Woodruff [26] (1983) proposed that satisfaction was derived from overall experience of perceived value, and value created satisfied users, while continued to create a loyal customer. For a B2B platform, when users visit its site, at some standard, they will compare their experiences to expectations. If the quality of the platform they perceived met these standards, they would fill contented, and the contented state would affect the users whether to continue to use the e-commerce site. Thus we propose the following:

H4: Perceived value positively affects user satisfaction

H5: Perceived value positively affects user loyalty

3.3　User satisfaction

Woodside [27] (1989) believed that customer satisfaction was an overall post-purchase evaluation a user made, reflecting the degree of like or dislike after consuming a product/service. According to Fornell[28](1996), customer satisfaction was the overall experience a user might get consuming a products/service. User satisfaction was considered to be a kind of experience-based holistic attitude. User satisfaction in this paper refers to a holistic emotional response, performed as the feelings or attitudes of the sum related to information products or services on e-commerce websites.

A large number of scholars indicate that the user satisfaction had a positive influence on customer loyalty so far. Fornell [29] (1992) thought that high levels of satisfaction led to high levels of loyalty. Kotler [30] (1997) thought that after consuming a product/service, users would produce psychological attitude of that product/service. If they were satisfied, they would consume the product/service again; otherwise, they would choose other companies for alternatives. Zhang [31] (2007) pointed out that whether the users were willing to maintain the cooperative relations between enterprises was not decided by their satisfaction with the relationship. While other companies could provide them with value-added products/services, they might turn other company's products/services. For a B2B platform, in process of visiting the website, some degree of satisfaction or dissatisfaction would appear. If the user was satisfied, loyalty would generate, including the continued use of the website, word of mouth and so on. Thus we propose the following:

H6: User satisfaction positively affects user loyalty

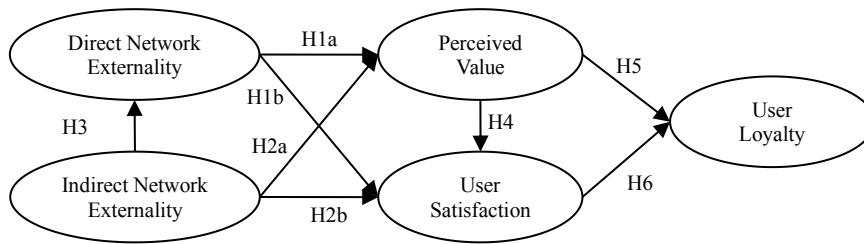Based on these assumptions, we constructed a conceptual model shown in Figure 1

Figure 1.   Conceptual model

4.   DATA COLLECTION

4.1   Measurement development

In order to ensure validity and reliability of this study, all items were adapted from literature and measured using seven-point Likert scales ranging from strongly disagree to strongly agree. Also, in order to make the scales more appropriate to the study object, we did our best to try to take practice of Chinese e-commerce enterprises into account.

Table 1.   Measurement model

Conceptions	Observed variables		Sources
Perceived Value	Perceived Value for Fair		Ma [32](2006)
	Perceived Value of Similar		
User Satisfaction	Content Satisfied		Yoon et at[33](2013)
	Process Satisfaction		Yoon et at [33](2013); Shin et at [34](2013)
	Overall Satisfaction		Yuksel et at [35](2010); Jaiswal et at [36](2010); Casaló et at [37] (2010); Forgas et at [38](2010)
User Loyalty	Behavioral Loyalty		Jaiswal et at [36](2010); Casalóet at [37](2010)
	Attitudinal Loyalty		Jaiswal et at [36](2010); Čater et at [39](2010); Karjaluoto [40] (2012); Bodet [41](2008)
Network Externality	Direct network externality	Perceived Network Size	Zhao et at [18](2012);Chiu et at [19](2013)
		Perceived External Prestige	Chiu et at [19](2013)
	Indirect Network Externality	Perceived Complementarity	Zhao et at [18](2012);Chiu et at [19](2013);Lin et at [15](2011);Lin et at(2011)[16]

4.2   Procedures and participants

First of all, we made an interview to managers and experts of a well-known B2B platform. According to feedbacks, we made some appropriate changes and additions for the scale items. On this basis, we did a large-scale survey in help of the B2B platform. Questionnaires were primarily posted by mail nationwide via the platform, and every registered enterprise was sent only once. Since the total amount of the samples cannot be known and taking convenience of the investigation into account, we used random sampling methods. To ensure data quality, we prepared 10 $ in lieu of coins for each participant.

The survey lasted 9 days (2013.5.8-2013.5.16), and a total of 1,947 questionnaires were collected (1616 questionnaires were complete).Finally, we obtained 1348 valid samples. Of the 1348 samples, there were 1207 participants completed their areas. They came from eight regions of 28 provinces and regions, mainly from the East China (44%) and South China (36%). Just from the provinces of view, most of the sellers came from Guangdong, followed by Zhejiang. There were 1,208 participants completed the types of goods they sold. The

mostly types of goods was industrial and the total proportion was 59.6%, followed by commodities (19.12%), services was the least (4.88%). Enterprise samples are shown in Table 2.

Table 2. Enterprise sample

No.	Province	Sample	No.	Province	Sample	No.	Province	Sample
				Area Distribution				
1	Zhejiang	176	11	Hebei	63		Northeast China	25
2	Shandong	107	12	Beijing	30	21	Sichuan	9
3	Jiangsu	97	13	Tianjing	9	22	Chongqing	7
4	Shanghai	62	14	Shanxi	4	23	Yunnan	1
5	Fujian	57		NorthChina	106	24	Guizhou	1
6	Jiangxi	17	15	Henan	38		Southeast China	18
7	Anhui	16	16	Hubei	20	25	Shanxi	13
	East China	515	17	Hunan	17	26	Gansu	1
8	Guangdong	424		Central	75		Northwest China	14
9	Guangxi	8	18	Liaoning	18	27	Taiwan	2
10	Hainan	1	19	Heilongjiang	6	28	Hong Kong	1
	South China	433	20	Jilin	1		HK etc.	3

Table 3. Distribution of total merchandise category

Category of goods	Sample	Proportion
Industrial Goods	720	59.60
Raw Materials	149	12.33
Home Store	201	16.63
Commodity	231	19.12
Services	59	4.88

5. DATA ANALYSIS

Using structural equation modeling (SEM), we examined our measurement model and tested the structural model. The software we used includes SPSS 17.0 and AMOS17.0.

5.1 Reliability analysis

Reliability is used to measure the reliability and stability of the scales. 0.65 - 0.70 was the minimum acceptable ranges [42]. As can be seen from Table 4, the structure variable's Cronbach's α and C.Rs are more than 0.65, indicating that the measurement concepts have a high convergent validity and show good internal consistency.

Table 4. Reliability and validity

Concept	Item	*Cronbach α*	Composite reliability (C.R.)	AVE
Direct Network Externality	5	0.859	0.867	0.655
Indirect Network Externality	2	0.690	0.698	0.539
Perceived Value	3	0.836	0.834	0.626
User Satisfaction	3	0.855	0.858	0.668
User Loyalty	3	0.889	0.891	0.732

5.2 Validity analysis

Validity means the degree a measurement process actually achieves the purpose of measuring. In general, each AVE of concepts is greater than 0.5, indicating latent variable has a strong convergent validity; values of factor loadings coefficient range between 0.50 to 0.95, which means that the measured variables can effectively reflect the latent variable to be measured. As can be seen from Table 4 and Table 5, AVE of each conception is more than 0.5, meanwhile, factor loadings for each measurement items is more than 0.5, indicating that the survey for the B2B platform is well designed and the questions can be a good representation of the concept of measurement.

5.3 Model fitting

In this paper, we used maximum likelihood estimation to test each of the mutual influence between the main factors with AMOS17.0. Standardized path coefficients of the model and hypothesis test results are shown

in Table 6 and Table7. As can be seen from Table 6 and Table 7, value of χ^2/df can not be reached fitting standards and standardized path coefficient of "Perceived Value→User Satisfaction" is 1.019, which is more than 1, indicating that there are some problems in construction of the model, the model needs to be amended.

Table 5.   Factors loadings of observed variables

Conceptions	Observed Variables		Factor Loadings
Direct Network Externality	Perceived Network Size	Others	0.694
		Business Partners	0.669
		Expected Size	0.779
	Perceived External Prestige	Recognition	0.809
		Reputation	0.731
Indirect Network Externality	Perceived Complementarity	Supporting Tools	0.653
		Activities	0.807
Perceived Value	Perceived Value for Fair		0.784
	Perceived Value of Similar	Convenient Process	0.756
		Wise Choice	0.831
User Satisfaction	Overall Satisfaction		0.743
	Content Satisfaction		0.830
	Process Satisfaction		0.874
User Loyalty	Behavioral Loyalty	Continuous Use	0.819
	Attitudinal Loyalty	Word of Mouth	0.885
		Recommend	0.861

Table 6.   Result of model fitting

Fit Index	χ^2	df	χ^2/df	CFI	GFI	RMESA
Evaluation Criteria	The smaller the better	—	<5	>0.9	>0.9	<0.08
Estimates	690.468	96	7.192	0.959	0.938	0.068

Table 7.   Result of hypothesis testing

Hypothesis	Path	Standardized path coefficients	T	Results
H1a	Direct Network Externality → Perceived Value	.673	17.871	Y
H1b	Direct Network Externality → User Satisfaction	-.071	-.929	N
H2a	Indirect Network Externality → Perceived Value	.324	9.092	Y
H2b	Indirect Network Externality → User Satisfaction	-.048	-.987	N
H3	Indirect Network Externality→ Direct Network Externality	.639	15.903	Y
H4	Perceived Value → User Satisfaction	1.019	9.789	Y
H5	Perceived Value → User Loyalty	.441	6.052	Y
H6	User Satisfaction → User Loyalty	.490	6.593	Y

In this paper, we mainly referenced to output modification index and the test results to modify the model. Modified process is shown in Table 8.

Table 8.   Processes of modification

Processes	χ^2	df	χ^2/ df	CFI	GFI	RMESA	Amendments
M	690.468	96	7.192	0.959	0.938	0.068	Original model
M1	691.407	97	7.192	0.959	0.937	0.067	Remove the relationship between direct network externality and user satisfaction
M2	691.900	98	7.060	0.959	0.937	0.067	Remove the relationship between direct network externality and user satisfaction
M3	431.057	97	4.444	0.977	0.960	0.051	Establish correlation between the residuals of "others" and "business partners"(perceived network size)

Standardized path coefficients and hypothesis test results of the modified model are shown in Table 9. Each hypothesis is supported.

Table 9.   Result of hypothesis testing (after modification)

| Hypothesis	Path	Standardized path coefficients	T	Results
H1a	Direct Network Externality → Perceived Value	0.719	18.231	Y
H2a	Indirect Network Externality → Perceived Value	0.270	8.069	Y
H3	Indirect Network Externality→ Direct Network Externality	0.664	15.763	Y
H4	Perceived Value → User Satisfaction	0.913	26.330	Y
H5	Perceived Value → User Loyalty	0.423	6.510	Y
H6	User Satisfaction → User Loyalty	0.511	7.693	Y
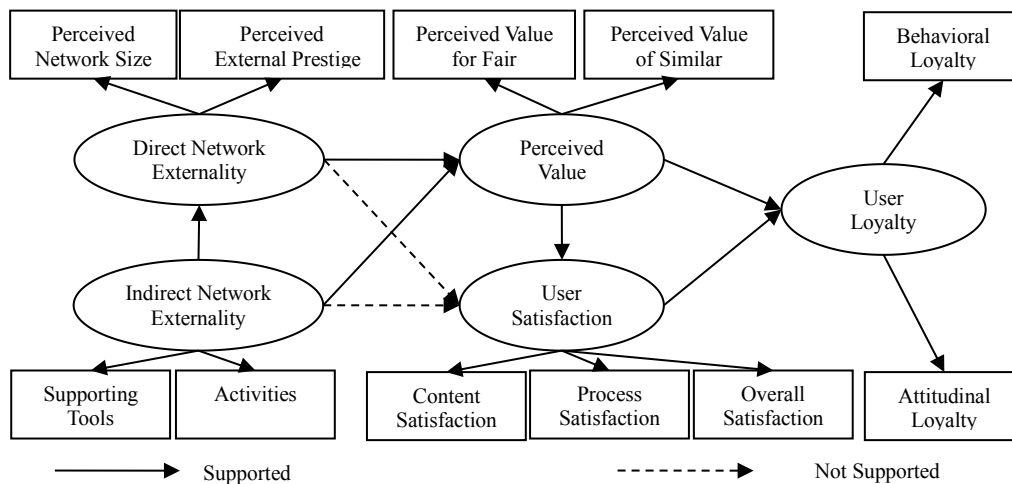
Figure 2.   Model testing results

6.   CONCLUSIONS

From above analysis, we can get that six of our eight hypotheses are supported. In this section we will discuss the surprising findings.

Network externality has no significant effect on user satisfaction. This means that users on a B2B platform will not change their attitude towards to the B2B platform because of the scale of users or level of credibility. The reason may be that users on B2B platform are rational. To a certain extent, they focus more on the utility they get, that is perceived value.

Network externality has significant effect on perceived value, and direct network externality (0.719) has more effect than indirect network externality (0.270). Simultaneously, direct network externality has indirect effect on user loyalty and the total effect is 0.640（0.719×0.423+0.719×0.913×0.511）. This means network externality can be used as intensive pre-drivers of perceived value thereby affecting user loyalty.

User satisfaction has significant direct effect on user loyalty; this demonstrates again that users on B2B platform are rational and satisfied users are expected to develop into loyal users.

Therefore, B2B platform can expand the impact of network externality, to improve perceived value and improve user's loyalty. Specific practices can be: improving the international brand, good promotion for the platform; improving compatibility and complementarity of the platform, optimizing user experience in the platform (such as APP, games, community).

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On the theoretical side, our study extends the research on the role of network externality by examining their performance in the post-adoption phase from an individual level. Thus our study adds useful knowledge to the understanding of how network externality affects post-adoption.

However, there are some limitations. To begin with, our study investigates only sellers and the formation mechanism of buyer loyalty has not been discussed in this paper. Second, our study investigates network externality on one side of the platform, however, cross- network externality also exist. Thus, future research should devote attention to the effects of cross- network externality. Third, our results might be specific to the context of China due to the source of data. Although this platform has a relatively large seller base in China, we believe that deriving more generalized results would likely require applying same model in other countries.

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