ABSTRACT

Characterizing user behavior by social network analysis in social media has been an active research domain for a long time. However, much previous research has focused on the large-scale global social media such as Facebook, Wikipedia and Twitter. Comparatively, little research has been done for the local social media. In this paper, we study the user behavior by social network analysis in a campus-based social media platform for exchanging goods and services. We also study the correlation between social networks and users’ exchanging behaviors. Finally, we discuss the implications of our findings and future work.

Categories and Subject Descriptors
H.1.2 [User/Machine Systems]: Human factors; H.5.2 [Information Interfaces and Presentation]: User Interfaces—Theory and methods

General Terms
Human Factors

Keywords
Social media, social network analysis, social exchanging, user behavior

1. INTRODUCTION

Social media are media for social interaction through Web-based applications to share user-generated content such as information, knowledge and opinions in the forms of words, pictures, audios and videos [9]. Social Network Analysis (SNA) has been widely used in studying user behavior in social media [10]. SNA focuses on relationships such as friendships and communications among social entities and the patterns and implications of these relationships [16]. Social media such as Facebook, Youtube and Twitter have made a significant impact on today’s Internet users’ communication, entertainment and purchase behaviors.

1.1 Related research and motivation

Recently, a lot of researches use SNA to study user behavior in large-scale global online social media. For example, Singla and Richardson study the correlation between social networks and personal behavior in MSN Messenger Network [10]. Benevenuto et al. study user interaction behavior in Orkut [1]. Maia et al. study a methodology for characterizing and identifying user behaviors in online social networks and test it with YouTube [8]. While these researches do provide insights to understand user behavior in large-scale online social media, they cannot generalize to understand user behavior in small or middle-sized online social media as size of network (e.g. critical mass) has an impact on user behavior. Comparatively, there is little research on user behavior in local social media.

Regarding SNA in online marketing and exchanging platforms, Kumar and Zhang use SNA to study online customer interaction behaviors in eBay [6]. Swamynathan et al. study the correlation between social networks and user transaction satisfaction in OverStock Auction, a large-scale online auction platform [13]. Again, there seems little research on studying user behavior by SNA in local online marketing and exchanging platforms such as online exchanging platforms for local communities.

To fill the current research gap, this paper contributes by using SNA to study the user behavior in a campus-based social media for exchanging goods and services over two years. We identify how user behavior has changed over time and how friendships and groups are correlated with users’ exchanging behavior.
1.2 Research methods

The main research method is SNA. All data come from two-year (from 2008 September to 2010 September) Kassi database records. SNA data include Kassi social network relationships such as friendships, groups and conversations. The SNA tools are Condor [3] and NodeXL [11]. The reason for choosing these two SNA tools is that they have different features for different purposes. Condor is good at analyzing the dynamics of social network evolution. NodeXL is good at quickly generating a snapshot of social network visualization and offers fine-grained control of the details of visualization such as shape, color, size and label of nodes and ties. We first export the database data and transform the data formats to the formats supported by Condor and NodeXL. Then we analyze the data. We also use SAS 9 for correlation analysis between social networks and user conversation. SPSS Clementine text miner has been used for text topics categorization.

1.3 Structure of the paper

The remainder of the paper is organized as follows: Section 2 briefly introduces the studied campus-based social media; Section 3 introduces the SNA theory. Section 4 presents the SNA results; We discuss the results and our future work in Section 5; Finally, Section 6 conclude the whole paper.

2. A CAMPUS SOCIAL MEDIA

On a university campus, especially an international one, we will often witness practical needs in daily situations. New students need to know how to find a place to stay or where to buy second-hand textbooks. A student might want to find someone who can help him or her to repair a computer or share an apartment and so on. These scenarios motivated the creation of Kassi (http://aalto.kassi.eu/), a campus-based social media platform that helps students to exchange goods and services in their daily campus lives. Kassi is a product of a long-term mobile social media research project “OtaSizzle” in Aalto University of Finland (Mäntylä et al 2009). Kassi is one of the most successful OtaSizzle social media services with more than 2500 registered users. It has been developed since the summer of 2008 and was publicly released in the fall of 2009. Before its public release, the Kassi developers and the OtaSizzle project researchers tested the service. At the beginning of semesters, there are a lot of promotion activities. Kassi was introduced to Aalto students and faculties (especially the freshmen) in the seminars, lectures and orientation.

The core service of Kassi is exchanging goods and services (requesting something and offering something). There are four categories of offers and requests, namely item, favor, rideshare and housing. Users can send private messages, rate and comment publicly for an offer. Figure 1 shows the Kassi home page.

Besides the core service, Kassi also provides social networking functionalities such as user profiles, friends and groups. Profile pages show users' basic information such as address, phone and bio description and friendships and groups. Users can build friendships with other users, create new groups and join existing groups.

3. SOCIAL NETWORK ANALYSIS THEORY

In order to better understand the interpretation of the SNA results in the paper, it’s helpful to brush up a little about SNA theory. SNA studies the social relationships (ties) such as friendships and communications among social actors such as individuals or organizations (nodes) and the patterns and implications of these relationships [16]. The three most popular individual or actor centralities to measure the relative importance of an actor in a network are as follows [16]:

- **Degree Centrality**: Degree centrality is the number of ties a node has. For example, in a friendship network, the friendship degree of an individual is the total number of friends he or she has. For directed networks or graphs, degree centrality divides into in-degree (the number of ties connected to a node) and out-degree (the number of ties connected from a node). For example, in a personal email communication network, the in-degree is the number of emails received and the out-degree is the number of emails sent.

- **Betweenness Centrality**: Betweenness centrality measures the importance of a node as a "bridge" or "middleman" role in a network.

- **Closeness Centrality**: Closeness centrality measures the closeness by geodesic distances of a node to other nodes in a network.

Except the aforementioned three node or actor centralities, these are also network or group degree, betweenness and closeness centralities. From Freeman’s group centrality computation formula [16], we know that the group centrality equals to 0 when all actors have exactly the same centrality index (degree, betweenness or closeness centrality), and equals to 1 if one actor, “completely dominate or overshadow” the other actors. In order words, if group centralities decrease, this means that group members' positions or behaviors become more similar or “democratic” in the network. On the contrary, if the group centralities increase, this means that group members behaviors become more differentiated or “hierarchical” as few core or leader players dominate the network.

4. RESULTS

4.1 Exchanging behavior

As we introduced in the Section 2, the core function of Kassi is to help students to exchange goods and services
Table 1: Statistics of different types of exchanging activities in Kassi

<table>
<thead>
<tr>
<th></th>
<th>Offers</th>
<th>Requests</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Items</td>
<td>848</td>
<td>270</td>
<td>1118</td>
</tr>
<tr>
<td>Favors</td>
<td>184</td>
<td>85</td>
<td>269</td>
</tr>
<tr>
<td>Rideshare</td>
<td>10</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>Housing</td>
<td>40</td>
<td>27</td>
<td>67</td>
</tr>
<tr>
<td>Total</td>
<td>1082</td>
<td>392</td>
<td>1474</td>
</tr>
</tbody>
</table>

Figure 2: Top 50 discussion terms categories

Figure 3: Conversation network

Figure 4: Betweenness, degree and density dynamics of the conversation network over two years (left) and the number of new conversations held each day (right) (x-axis: time, y-axis: betweenness (red), degree centrality (blue) and density (green) (left), number of new conversations held each day (right)).

4.2 Friending behavior

The friendship network in this paper is the whole friendship network of Kassi instead of an egocentric network. The whole network analysis focuses on the structural patterns of the whole network interactions and behaviors, while the egocentric network approach focuses on a specific person (the "ego") and his or her personal networks [2].

A friendship network is a one-mode network which means the subjects of social network analysis belong to a single set, and an undirected network which means if actor A is a friend of actor B, then actor B is also a friend of actor A [16].

Figure 5 shows the whole Kassi friendship network by NodeXL. We can see that only a few users such as user 12 and user 108 have high degree centralities. Most users have limited numbers of conversations.

Then we use Condor to analyze the dynamics of conversation over time. From the left side of Fig. 4, we can see that the the friendship network degree centrality and betweenness centrality decreased gradually after public release in September of 2009. From the SNA theory introduced in Section 3, we know that this means that at beginning of the Kassi public release, a few users act as leaders by overshadowing other users by their higher degree centrality and betweenness centrality because of the promotion activities. With the time went by, the behavior of users in Kassi network become more similar after the public release of Kassi.

From the right side of Figure 4, we can see that the new conversations per day are quite steady after the public release.

4.3 Grouping behavior

In Kassi, registered users can create their own groups or join existing groups. The group network is a two-mode network because the relationship is between two sets namely the users and the groups [16].

Figure 7 shows the whole Kassi user groups network by NodeXL. There are 59 groups, which we name G1, G2 and so on. Most users are connected with a few core groups such as G4, G24 and G14. The phenomenon of users’ co-presence
in multiple groups, which is popular in Facebook [7], is not common in Kassi.

Similar to Fig. 6, Figure 8 also illustrates that the grouping activity was high around September of 2009 and become stagnant afterwards.

4.4 Correlation Analysis

In order to better understand the correlation between different behaviors such as conversation, friending and grouping, we use SAS for the correlation analysis.

4.4.1 Reciprocity

Reciprocity or mutualism is a phenomenon which has been observed in many online communities [4, 15]. In order to measure reciprocity, we make Pearson correlation analyses between the offers and requests and between the conversation in-degrees and out-degrees by SAS.

Table 2 shows that there are strong positive correlation between offers and requests and between conversation in-degrees and out-degrees. Earlier Kassi user researches also find out that reciprocity is a key factor for user’s participation motivations [5, 12].

4.4.2 Social networks and exchanging activities

As we introduced in the Section 2, Kassi also supports social networking functionalities except the core exchanging service. Then one interesting question is whether the so-
Table 2: Correlation analysis for reciprocity

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>offers &amp; requests</td>
<td>0.526</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>in-degrees &amp; out-degrees</td>
<td>0.566</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

Table 3: Correlation analysis for social networks and exchanging behaviors

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conversations &amp; Offers</td>
<td>0.631</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Conversations &amp; Requests</td>
<td>0.69</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Conversations &amp; Friends</td>
<td>0.235</td>
<td>0.3516</td>
</tr>
<tr>
<td>Conversations &amp; Groups</td>
<td>0.312</td>
<td>0.0795</td>
</tr>
</tbody>
</table>

From Table 3, we can see that conversations are strong positive correlated to requests and offers. This is easy to understand for the design purpose of Kassi. However, friendships and groups are not correlated with current Kassi core service usage. In fact, Figure 6 and Figure 8 also suggest this result. Figure 6 and Figure 8 show that degree and betweenness centrality lines are almost horizontal (unchanged) after the public release of Kassi.

5. DISCUSSIONS AND FUTURE WORK

5.1 Discussions

First, we discuss the our findings in Section 4 and their implications. From exchanging behavior analysis, we know that after the public release of Kassi, users exchanging behavior becomes more similar. From correlation analysis, we know that users’ conversations are strong positively correlated with users’ requests and offers and there are reciprocal relationship between requests and offers. Therefore, to improve Kassi service usage, it’s important to extract users’ requirements at the points of interest in their daily lives and further facilitate users to post their requirements and offers in Kassi.

From the friending behavior analysis and grouping behavior analysis, we know that friending and grouping behaviors become stagnant after the public release. The correlation analysis between social networks and conversations further confirm that currently there are not much correlations between social networks and users’ exchanging behavior. Possible reasons for this result are as follows: 1) Currently majority of Kassi service usages are related to physical items than intangible services, which may more related with utility than social value [12, 5]; 2) Kassi is a local (campus-based) social media. Trust is not an issue if compared with large-scale social media like Facebook; 3) because of the critical mass, social networks in small local social media may not be very attractive to users as them in large-scale social media. In fact, in the later new version of Kassi, the former built-in local social networking functionalities have been removed. However, from our observation from database statistics and Google Analytics, the Kassi usage situation has not been much affected. The daily usage is still quite steady.

Based on the research results in this paper and the earlier Kassi user research [12, 5] and our later observation, we have two preliminary suggestions for practitioners who build similar local social media platforms for exchanging goods and services:

- Pay more attention to the utility (e.g. make exchanging process easier) than the social value of the platform.
- Instead of developing another set of local social networking functionalities, taking advantage of the existing popular social networking platforms APIs such as Facebook and Twitter might be a wiser choice.

5.2 Future work

Currently SMS function for Kassi and a mobile version of Kassi is under active development to further facilitate users to post their requests and offers at the points of interest. Kassi and Facebook APIs integration is also under active development to facilitate users to take advantages of existing Facebook social networks. In future work, we will analyze whether and how Facebook social networks will contribute to Kassi service usage.

As the international collaborations of OtaSizzle project, Kassi currently has been replicated and adapted in BUPT (Beijing University of Posts and Telecommunications) University of China and is planned to be replicated in UCBerkeley University in U.S. and Nairobi University in Africa later [14]. In future work, we will also compare the user behaviors and service usage differences in these different cultural contexts.

6. CONCLUSIONS

This paper uses social network analysis to analyze different user behaviors in a campus-based local social media for exchanging goods and services over two years. We also analyze the correlations between different behaviors. Finally, we discuss the implications of our findings and future work.

7. ACKNOWLEDGMENTS

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8. REFERENCES


