Who Tweets about Technology? Investigating the Role of Twitter in the Diffusion of Technological Information

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Abstract: This paper investigates the diffusion of technological information on Twitter. It identifies the most important actors of communication, categorises them and investigates the structure of the networks in the case of two novel operation systems. We found disparate properties from other topics, interestingly behaving networks and very important structural roles of users.

Keywords: Diffusion study, Network study, Social knowledge management

INTRODUCTION

Since its foundation Twitter has become one of the most commonly used forum of electronic communication. Its uniqueness lies not only in tweet messages limited to 140 characters and being open to everyone, but also in its asymmetric network structure. Previous studies have already examined the communication patterns of trending topics, political protests, revolutions or emergency situations. This paper aims to investigate the characteristics of Twitter communication in connection with technologies. As we will see the topology of the communication channels of the technological information on Twitter have very unique structure, which differs from the already investigated communication networks.

The main questions of the present study are the following: how does information in connection with new technologies spread on Twitter? How does information flow in time? Who and with what frequency tweets about a given innovation? Along what variables can tweeters be categorized into different groups and what are the dividing features between the groups? Finally, what kind of communication channel and with what topology exists between the users?

RELATED WORKS AND THEORETICAL BACKGROUND

Many studies have already investigated the role of Twitter in many situations. To begin with, Kwak et al measured the main properties of the whole Twitter communication finding short effective diameter, low follower-following reciprocity and very popular users mostly celebrities and news media (Kwak et al, 2010). Chang and Evans showed that a very little proportion of the users leads the communication on Twitter by tweeting enormously huge amount of messages (Cheng and Evans, 2009). Saifudin et al investigated the protest against the Delhi gang rape and found that online protest leaders on Twitter were the offline protest leaders as well, and these users were far the most central and most active figures of the communication network (Saifudin et al, 2013). Furthermore, Morales et al. investigated a Venezuelan political protest where the follower distribution of the users presented power law behaviour and the users with the highest amount of connection were celebrities, politicians or bloggers accordingly the other studies. They also reported that while most of the users behave passively, there were a few but very active information provider hubs (Morales et al, 2012; Morales et al, 2014). Trending topics were also investigated by Cha et al. They revealed that the size of the audience (i.e. the number of followers) represents popularity of the users, whereas the number of retweets depends on the content value of the tweet and the mentions on the name value of the users (Cha et al, 2010). In summary, the previous studies showed that Twitter communication is very unbalanced in the sense of tweeting activity and user connections as well. The mentioned studies investigated trending topics and protests where the relevant time horizon was typically a few months or weeks long. The most important users were very often offline opinion leaders, celebrities and news channels. What we are curious about is whether Twitter works similarly in the case of information dissemination about technologies or shows unique features.

In social sciences the innovation diffusion theory has already highlighted the most important determinants of the communication process about a given technology. Rogers defines diffusion as "the process by which an innovation is communicated through certain channels over time among the members of a social system" (Rogers, 1983). Innovations and new technologies necessarily create uncertainty, but with the help of information this uncertainty can be reduced to a tolerable level where it is possible to make decision about whether the adaption of innovation or its rejection is the better option. As Rogers points out the diffusion process is embedded in social structure. The social structure establishes the framework of diffusion by setting the rules and relation systems among its elements (individuals, groups, institutions, etc.). The social structure forms the pattern of network structure which determines who communicates with whom and under what circumstances. In Rogers' theory opinion leaders have great importance in the diffusion process by capturing the important positions in the network. As soon as opinion leaders adopt an innovation in the society, due to their position they can communicate their subjective evaluation to a wide range of population and encourage their adoption of the innovation. The other important role in communication network is of the change agents. They are individuals who influence others' decisions about the adoption of an innovation to a favourable result. They also play a significant part in connecting the world of society to the world of innovation creating and disseminating institutions (Rogers, 1983).

In Rogers's theory opinion leaders have an essential role in the successful diffusion of a technology or innovation. However, later Watts and Dodds showed that under certain circumstances "ordinary" individuals have the greatest influence on diffusion cascades, but they also emphasised the importance of the network structure which has strong effect on the role of the most important unit of the diffusion. (Watts and Dodds, 2007)

Based on the previous theories the question we put in the focus of this study is how Twitter as a communication channel functions regarding technological information, and we draw up the network structure to find out who is involved in the communication, and who fulfils what roles in the network and why.

SAMPLE AND METHODES

This research examined communication on Twitter about Windows 8 and OSX10.8 Mountain Lion operating systems. The sample contains tweets tagged by hashtags about the above mentioned technologies (see list of hashtags in Table 1). Our sample is based on the database collected by Eötvös Loránd University and it contains 5% of the complete Tweet flow from 1 February 2012. Table 1 shows the characteristics regarding the sample and the technologies.

The reason for choosing these operating systems is the fact that in case of both the introduction/launch of β version and their market launch happened during the data collection. Based on the sample we were able to follow communication for a favourably long time about the given technologies. In case of OSX10.8 data collection was closed sooner than in case of Windows 8, due to the fact that there was a sharp decrease in the information available in connection with it, since hashtags were taken by the next OSX generation.

TABLE 1. SAMPLE PROPERTIES

Properties	Technology	
	Windows 8	**OSX10.8**
Start of data collection	01. FEB 2012	01. FEB 2012
End of data collection	11. JUN 2013	30. APR 2013
Hashtags	#Windows8; #Win8 #W8	#OSX; #OSX8; #MacOSX; #Mountain_Lion; #Mountainlion
Tweet Frequency	19828	6504
User Frequency	12669	4663
Announcement	-	06. FEB 2012
β version	29. FEB 2012	-
Market launch	26. OCT 2012	25. JUL 2012

The first step of our analysis is the frequency distribution of the tweets in time to find out how long the communication about a technology lasts. After doing so, the tweeting activity of the users is investigated and with the help of the time of the first tweet and the tweeting activity they are divided into clusters with hierarchical and k-means cluster analysis. This helps to understand the typical behaviour of the users who communicate about technologies. Other dividing features of the users are the usernames and the descriptions. By analysing this information it is possible to reveal the identity of the communicators which is crucial to understand the work of the communication channel.

After the basic distributions in case of both technologies we analyse the topology of the existing networks among the users. The networks are defined on the base of the follower system. This network determines the spread of the information and by analysing it we can name the most influential users in the system and the topology of the network itself reveals significant information to understand the spread of the technological information on Twitter. In the network, the users who tweeted about the given technology are the nodes and the existing connections among them are the edges. The edges are directed from the followed user towards the follower.

We measured the influence of the nodes by the Retweet (how many times has the users' tweets been reposted by other users), Mention (how many times has the given user been mentioned in others tweet messages) and Replay (how many times has the user got replay for his or her tweets by others). Further on they will be referred as "influence variables". Although these are significant properties of the nodes, the network centrality is also plays a crucial part in defining the users who own central positions or make the network coherent and more connected. Two indexes are applied in order to define centrality in the networks. The first was the in-degree centrality which the number of audience of a given user, or in other words followers of the given user. The second centrality indicator was the betweenness centrality which is widely considered as a good tool for measuring central positions in communication networks (Freeman, 1979; Wasserman, 2009). We analysed the Top 100 most influential and central users of the communication; they were examined and divided into six identity groups. Centrality and influential differences between the identity groups were tested by Kruskal-Wallis test to find out which identity group plays the most important role in the communication networks. The correlation between the influence and centrality variables was tested by Spearman's rho rank correlation in order reveal what attributes are the most effective to gain central positions in these systems.

BASIC DISTRIBUTIONS

According to Kwak et al. trending topics do not live forever, nor die. In other words frequented topics have a few day long intense period with many new tweeters and long lasting periods with low amount of tweets and continuously communicating users (Kwak et al, 2010). Figure 1 shows the distribution of tweets about the two

operating systems in time. We can observe very similar behaviour as previously mentioned. In both cases the curves have two peaks which can be related to important events in connection with the technology. The first peak in case of Windows 8 is the introduction of β version on 29 February 2012, while in case of OSX10.8 16 February 2012 was the date of the announcement of the arrival of the software. The second peak in both cases is the launch of the technologies, which was 26 October 2012 regarding Windows 8 and 25 July 2012 in case of OSX10.8. Apart from the peaks communication about the operating systems was approximately steady which before their market launch was lower and higher after the launch. Tweet flow, thus is sensitive to news and important events, however there are continuous information sharing outside the intense periods as well, which lasts long, even a year. Although the two curves are similar in the dependence of important events, we can see that the peaks of Windows 8 communication are lower than the peaks of the OSX10.8 communication, but the amount of continuous communication is higher. It indicates that the arrival of the OSX10.8 was rather interesting news while in case of Windows 8 a steady communication existed independently from the news, containing more colourful information.

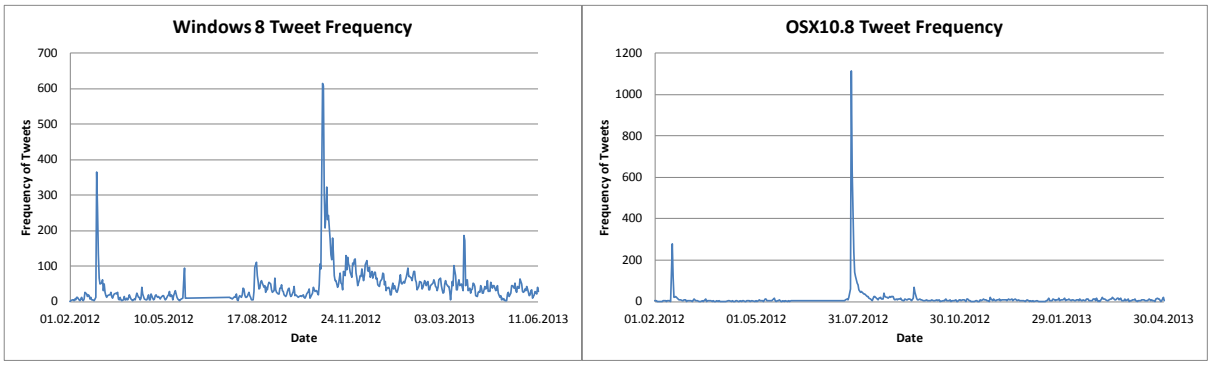

FIGURE 1. Distribution Of Tweets In Time By Technologies

As Barabási highlights in his book, Linked: The New Science of Networks many properties of different phenomena in the world from the nature to the society follows power law distribution (Barabási, 2011). In our case the distribution of tweets among the users has power law distribution. If a variable obeys the above mentioned distribution it means that many of the units have low values but quite a few unites have high or extremely high values. In case of Windows 8 10,436 users tweeted only once, while the sample consists of 12,669 individuals. On the other hand, there were users who tweeted in extreme amounts about the given operating system compared to the others. The most active user had 420 tweets about Windows 8 in the sample. In case of OSX10.8 3,844 out of 4,565 users tweeted only once. In this case the most active user had 150 tweets in the sample. The exponents of the power functions was determined with the help of the maximum likelihood method of Newman (Newman, 2005), which was 1.335 (with +/- 0.052 deviation) in case of Windows 8 and 1.416 (with +/- 0.089 deviation) in case of OSX10.8. This indicates that frequently tweeting users could not hold large proportion of the tweets. Regarding Windows 8 20% of users owning most of the tweets have only 49% share of the total tweets, while in case of OSX10.8 this proportion is even smaller, only 42%. This is not consistent with the famous 80-20 rule or with Chang and Evans results where the 75% of the tweets were related to the 5% of the users (Cheng and Evans, 2009). This clearly indicates that Twitter communication about technologies is less centralised, and the presence of “ordinary users” is higher in the communication then the previous studies showed.

CHARACTERISATION OF USERS

The users were categorised by the first date of tweeting about a given technology and by the frequency of tweeting. The results of clustering were 6 pair wise similar clusters. Figure 2 shows the clusters.

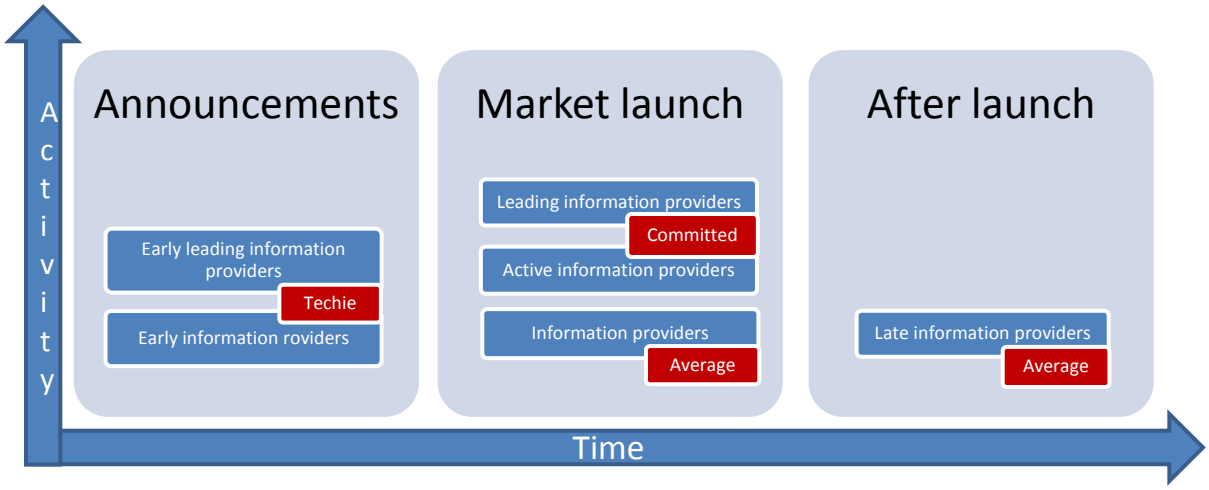

FIGURE 2. User clusters by date of first tweet and the sum of tweets

Early information providers typically communicate about the given technology only once and typically close to the date of the "big" announcement. On the other hand, next to them another group appears which persistently and frequently communicates since the appearance of the first news. They are called the *Early leading information providers*. Members of the following cluster are called *Information providers* and they are organised around the date of the most important news, the market launch. Regarding the sample size, this cluster is the biggest; however, their tweeting activity is quite low. Close to the date of the market launch two more groups appear as well with much higher activity rate. The cluster of *Active information providers* consists of strikingly fewer members than the group of Information providers nevertheless; their tweeting activity is much higher. The most active group is the *Leading information providers*. Regarding the number of their members they form a small minority, on the other hand, their cluster mean indicates the highest tweeting activity. The last cluster is the *Late information providers* who only start to communicate long after the launch and only a few times. In case of both technologies the created clusters are organised by very similar principles.
Based on the account descriptions and names users were categorised into three Identity classes. The red rectangles show the overrepresented identity classes in the user categories. In the early tweeting groups the *Techie* class is very active. These users are describes themselves as technology lovers and they are typically programmes, engineer, or as they say "geeks". *Committed* class consists of users who are so devoted to a given technology (or to the company producing it) that they indicate it in their descriptions. They tend to start the communication near to or a bit sooner than the market launch with high frequency so the proportion of them in the Elite information provider and Active information provider groups is high. Information provider and Late information provider groups have huge amount of Average users who do not have descriptions or it is irrelevant regarding technologies. Average users join the communication typically later than the other two classes, mostly near and after the market launch, and tweets with low frequency, but in summary they own the largest proportion of the messages on Twitter.

NETWORK TOPOLOGY

After the basic distribution we investigate the follower network existing among the users. 6813 users in the case of Windows 8, 1802 users in the case of OSX10.8 out of the whole samples are connected to some other user who tweeted about the same technology. In both cases there are large coherent networks which contain almost the whole set of connected nodes. These are the cores of the communication because the users in these networks have the opportunity to spread or gather information from the other users who are followers or friends and are also interested in the same technology. Others who had connections with each other but not connected to the large network were typically pairs or triads. Table 2 shows the properties of the networks.

Table 2. Properties of the technology networks

	Windows 8	OSX10.8
Network diameter	14	22
Characteristic path length	4.66	8.85
Number of nodes	6651	1456
Number of edges	49418	2965
Multi-edge node pairs	5408	638
In-degree distribution power law exponent	1.75	2.32
Out-degree distribution power law exponent	1.74	1.68

The network properties show that the two networks have major differences. The first substantial difference is that Windows 8 network is proportionally bigger than the OSX10.8 thus bigger proportion of the communicating users have the opportunity to receive from others messages about the given technology. The differences between the network diameter and the characteristic path length values indicate that Windows 8 network has many shortcuts therefore the nodes are generally closer to each other and the diffusing information has to pass through less links to reach other nodes in the system. The 4.66 characteristic path length value of Windows 8 network represents a very well linked system and this number is very close to the 4.12 average path length value of the whole Twitter network found by Kwak et al (Kwak et al, 2010) and shorter than Stanley Milgram's famous average six steps distance (Milgram, 1968) or than the average of the Messenger network path length distribution investigated by Leskovec and Horvitz (Leskovec and Horvitz, 2007). In this case Twitter seems a very effective communication platform, however, it works well in case of a connected network but outside of the network there is no capability to spread information. In contrast, with 8.85 characteristic path length the OSX10.8 network does not own the previous favourable properties and it is less capable of disseminating information effectively.

NETWORK ROBUSTNESS

The scale-free networks are very vulnerable to attacks (deletion of the nodes with the highest degree centrality) (Albert et al, 2000, Cohen et al, 2001). We investigate the robustness of the networks in order to find out the importance of the central users. If our Twitter networks are such vulnerable as the networks investigated by Albert et al, that means a very small number of the nodes keep the networks coherent and without them they would fall apart. We deleted the nodes with highest degree centrality from the networks percent by percent and investigated the changes in the network diameter, the characteristic path length and the proportion of the remaining largest clusters compared to the size of the originals. Figure 3 shows the results.

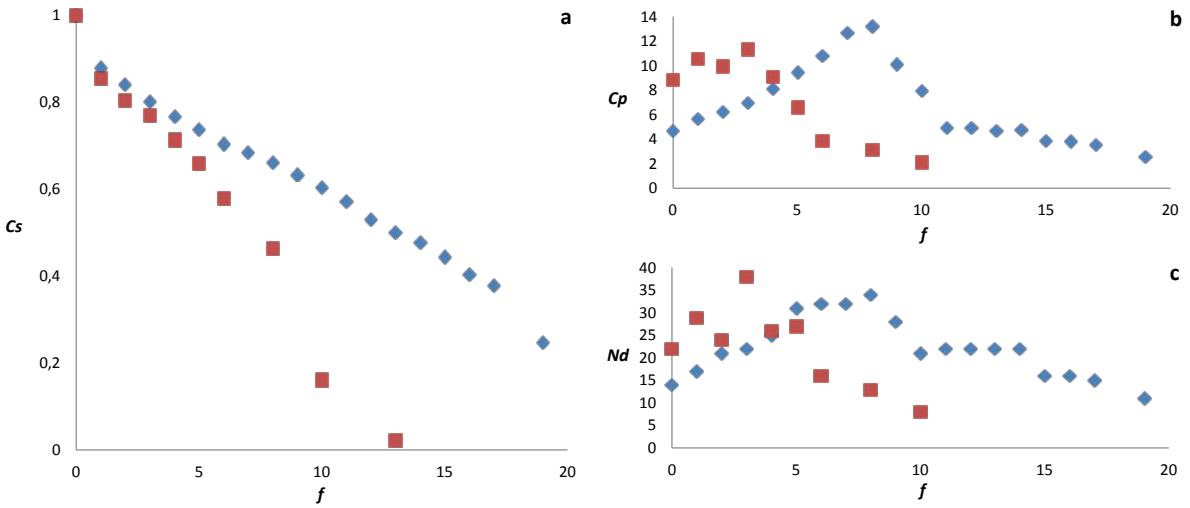

Figure 3. A, Network fragmentation under the deletion of the most influential nodes. *Cs* axis shows the rate of the remaining largest cluster, *F* axis is the deleted proportion of the nodes with the highest degree in percent, red squares symbolise the OSX10.8 network, blue squares symbolise the Windows 8 system. B, Impact of the network fragmentation on the characteristic path length, *CP* axis is the value of the characteristic path length, all other symbols are identical with Figure 3.A. C, Impact of the network fragmentation on the network diameter, *ND* axis is the network diameter, all other symbols are identical with Figure 3.A.

Albert et al found that the critical thresholds of scale-free networks for attacks are very low. In case of the Internet router system it is 3% and 6.7% in the case of the WWW system (Albert et al, 2000). Compared to them Windows 8 network has been found very robust. As we can see at Figure 2.a the size of the fragmented component decreases roughly linearly. Even the proportion of the deleted nodes reach 19% of the whole set of nodes, there is a coherent, significantly bigger network than the lagging pieces. In the same case the characteristic path length and the network diameter (Figure 2.b and c) increase linearly with the proportion of the deleted nodes, but after a certain point (8%) this process turns back and the value starts to decrease. The properties of the OSX10.8 differ from previous properties as well. The size of the fragmented cluster of the OSX10.8 network falls apart at the threshold of 13%. However, it is still more robust than the Internet or the WWW but its robustness is very far from the robustness of the Windows 8 network. Network diameter and the characteristic path length reach their maximum very soon. When the proportion of the deleted nodes grows bigger than 3%, the properties start to decrease until the network falls apart.

This means the central nodes take away (beside some other nodes) important edges with themselves which edges make the network more linked and bring nodes closer to each other, however after a point, the lagging nodes and network pieces start to decrease both the network diameter and the characteristic path length. Although the investigated networks have power-law degree distribution, the deletion of the nodes with the highest degree centrality does not lead to a sudden devastation of the communication networks. It seems nodes with relatively low degrees make the network connected by forming a latent lattice which can prevent the network from the breakdown.

The robustness is also measured by the deletion of the nodes with the highest betweenness centralities and found that the two networks behaved completely differently. In Windows 8 network the characteristic path length is more sensitive to the deletion of the nodes with the highest betweenness centrality values than the ones with the highest degree values. Therefore in this network the nodes with high betweenness centrality create effective pathways between the users, making short possible ways for the diffusing information. In OSX10.8 system the diameter and the characteristic path length radically decreased by the deletion. In this case the users with high betweenness attach users who have no other relation with others to the network and this function makes the diameter and the characteristic path length larger. Therefore in the OSX10.8 network these users serve as chain links whom connects otherwise unattached nodes to the system instead of making shortcuts in it.

INFLUENTAL AND CENTRAL USERS OF THE COMMUNICATION NETWORKS

The top 100 influential users

By analysing the descriptions and the screen names we categorised the top 100 most influential and central users into six groups. It is a more sophisticated version of the previous classification. The first two groups derived from the Committed class, the other groups derived from the other two classes. As we mentioned, influence variables are the Retweet, Mention and Replay.

Official accounts are related to the given technology or the firms produce them. For example the Twitter account of the @Windows, the @MacObserver, or @MSFTnews.

Enthusiasts are individuals who work for the producer company, develop or contribute the development of the given technologies or describe themselves as fun or lover of these softwares or companies.

News and blogs are very often twitter accounts of technology news sites and technology blogs or bloggers which provide information about wide range of gadgets and softwares. About the given technologies leading news portals very rarely appear in the communication. Notable exceptions are for example the @NBCNews or the @CNNEE.

Business related users are other producers in the IT sector (for example the official @intel, @HP or @Logitech accounts), enterprise CEO-s and founders (mostly SME or Start-up CEOs and founders) or marketing managers. *Techies* are technology enthusiasts who are not related to the products or the companies. They are very often software engineers, developers or IT lovers. These are only private accounts.

Average users are users with no or not relevant descriptions. Not relevant description means there is no technology, news or business related content in the description. We have already mentioned other studies which showed that celebrities or public figures often have central positions in the Twitter communication, but in these networks none of them were central or influential figures of the communication.

In the Windows 8 network Official accounts have the highest presence in all influence categories. For example 48 users out of the top 100 retweeted users are Official accounts. The second important group is the Enthusiasts. Manny of them works for the Microsoft as developer or as evangelist. The third groups in this rank are the News and Business neck and neck with each other. Then comes the Techies and last the Average users. This shows that Microsoft is running very consciously and very effectively information provider accounts which can own the most influential positions in the network. Beside it the Enthusiasts have about the quarter of the Top 100 positions strengthening the network power of the Microsoft in the Windows 8 communication.

In the case of OSX10.8 network the most influential tweeters in the Top 100 are the Enthusiasts along with the Techies. The official accounts and average users occur roughly in the same amount on the second place followed by business accounts and then the news accounts. This means that the OSX10.8 network has no leading group. It seems the Apple Inc. does not want to or cannot lead the communication by occupying important positions in the influence rankings.

Central Positions

After the influence rankings we measured the most central positions by the identity groups. Table 3 contains the distribution of the top 100 users with the highest centrality values according to Identity groups.

Table 3. Identity groups - In-degree and Betweenness centrality crosstabs of the Top 100 users

	Windows 8 network centralities		OSX10.8 network centralities	
Identity groups	In-degree	Betweenness	In-degree	Betweenness
Officials	35	21	19	1
Enthusiasts	28	35	21	21
News	9	8	7	3
Business	12	7	6	7
Techies	12	20	28	41
Averages	4	9	29	27

In Windows 8 network the Enthusiasts have similarly important positions as the Officials, and even Enthusiasts are the most represented in the case of the betweenness centrality. In contrast, Techies and the Average users are the most central users in the OSX10.8 network, and surprisingly Enthusiasts and Officials have lower presence. In the case of betweenness centrality Officials is the weakest group in the top 100 with only one user account. Generally (not only in the top 100 cases) Windows 8 Officials and Enthusiasts have significantly higher average centrality ranks than the other groups in the network, in both in-degree and betweenness cases. In the OSX10.8 system these two groups have significantly higher mean rank only in the in-degree centrality.

Correspondingly the OSX10.8 and Apple related users could not fulfil the role to being mediators in the network, therefore the network itself remains less connected with longer diameter and average path length.

Correlation between the influence and the centrality

We also investigated the connection between the centrality variables and the influence variables. Table 4 shows the results by networks.

Table 4. Correlation coefficients among the variables by networks. All correlation is significant at the 0.01 level

Centralities	Retweet	Mention	Replay	Followers
Windows 8 network correlation coefficients				
In-Degree	0,398	0,468	0,420	0,503
Betweenness	0,281	0,311	0,327	0,386
OSX10.8 network correlation coefficients				
In-Degree	0,273	0,352		0,526

In Windows network in-degree centrality has relatively strong correlation with the influence variables and the number of followers. This indicates that however influence and the centrality are closely related, there can be users who own important positions in the network without great influence on others and users can gain attention without a high number of connections or important position. Betweenness centrality has just modest correlation with the influence variables and the number of followers. Although nodes with high betweenness values are important bridges in the network with very far-reaching connections, they do not necessarily gained high attention or large follower set. This is supported by the previously mentioned finding that in the case of characteristic path length the network is more sensitive to the deletion of the nodes with the highest betweenness centrality values than the ones with the highest degree values. This means there are nodes who are not responsible for the coherency of the network or not considered as the most influencers but they have very important role in maintaining the effectiveness of the communication networks.

In OSX10.8 network betweenness centrality has no significant correlation with the influence variables just with the in-degree centrality. Reply also has no significant connection with other variables therefore these two variables are missing form relevant cells of Table 4. In-degree has weaker correlation with the influence variable in this case. These results are in accordance with the previous ones: OSX10.8 Officials and Enthusiasts do not fulfil the role of the mediator therefore the users with high betweenness centrality has no higher attention than the average. The low correlation coefficient indicates that central nods have low capability to attract other users therefore marginally users can gain attention more easily.

If we synthesize these results we can reveal the major reason of the discrepancy between the networks. Window 8 network compared to the OSX10.8 emphasises the active communication with the help of Official twitter accounts and with the help of its own Enthusiasts. Official accounts have huge audience but the "smaller units", the Enthusiasts have far reaching connections and they can make the network more effective by reducing the average distances in it. These two groups are also capable of reaching the highest attention in the groups of most influential users. The OSX10.8 network does not follow this organising principle. This network could show us how an organic communication system looks like without strong willingness of ruling the communication networks by the producer of the given technology.

CONCLUSION

In this study we highlighted the various properties of the Twitter communication about technologies. We investigated communication about two technologies which in some aspects showed similarities, but in some aspects showed major differences. In the case of both operation systems the amount of information coded into tweets highly depends on important events like announcements and market launches. In both cases we observed long lasting communication. Communication activity of the users followed power law distribution but the most active users could not own as high proportion of the whole set of tweets as other studies showed in other cases. We pointed out that users tweet in a very similar structure in both technologies. The six clusters could describe when people start to communicate and with what frequency. We found that other type of users tend to belong to other clusters. Technology lovers start the communication earlier but the most intense communication is driven by the users related to the technologies while ordinary users start tweeting later and with lower frequency. The lack of the celebrities and classical news channels in important communication positions is obvious, although these characters have otherwise important role in the so far investigated communications on Twitter. Moreover, both technologies have unique network structure, but these structures differ in many ways.

The main difference between the networks was the presence of the Official twitter accounts and the Enthusiast users. In case of Windows 8 they successfully expropriated central positions in the network and consisted most of the influential users. With them the Windows 8 network becomes more connected and the average distance between the nodes was remarkably low. It clearly shows that the network structure of the communication is very important and Microsoft puts emphasis on wiring the network in order to provide effective information diffusion. In contrast, OSX10.8 network missed these kinds of users and the network structure remained less favourable to the effective information diffusion. We also investigated the robustness of these networks and found them very resistant to attacks which indicates that a latent lattice keeps the network coherent consisted by users with relatively low amount of degrees.

Hence the presence of a company on Twitter is essential for a twofold reason. First, a company can influence customers not only by providing information about the given technology but also with the help of the company co-workers it can inject its messages into interpersonal communication networks. We saw the Enthusiasts have important role to dense the network. For example, a developer at Microsoft can get the role of opinion leader in case of software or gadgets in his or her personal network hence can spread messages and impressions about the technology or can help reduce the uncertainty with advice. This kind of strategy works on the micro level of the communities but the sum of the micro effects have significantly positive outcome on macro level, as we saw the differences between the networks. Microsoft uses this strategy well, and tries to reduce the social distance between the company and the consumers by widely using their co-workers as change agents, who can "speak the language of the mass", and own proper knowledge to influence attitudes of others toward a favourable way. This strategy also helps to increase the total amount of controlled tweets, thus can create counterweight against the critics. The second important reason of the intense presence on Twitter is the huge amount of information about the technology. From Twitter the company can get valuable opinions about the strengths and weaknesses of its product from the users. By following back the followers one can get access to much more user opinions and perceive concern and uncertainty about the technology. The huge amount of multi-edge node pairs indicates that this strategy is working in practice. This strongly increases the company's knowledge about the market opinions, concerns thus it can receive good ideas about the possible ways of development.

REFERENCES

Albert, R., Jeong, H., Barabási, A.L. (2000) "Error and attack tolerance of complex networks" *Nature, 406*, 378-382

Barabási, A.L. (2011). *Linked: The New Science of Networks* (4th ed.). Budapest: Helikon

Cha, M., Haddadi, H., Benevenuto, F., Gummadi, K.P. (2010). "Measuring User Influence in Twitter: The Million Follower Fallacy" *Association for the Advancement of Artificial Intelligence*

Cheng, A., Evans, M. (2009). An in-depth look inside the twitter world. http://sysomos.com/insidetwitter

Cohen, R., Erez, K., ben-Avraham, D., Havlin, S. (2001). "Breakdown of the Internet under Intentional Attack" *Physical Review Letters, 86(16)*

Freeman, L.C. (1979). "Centrality in Social Networks Conceptual Clarification" *Social Networks, 1*, 215-239

Kwak, H., Lee, C., Park H., Moon, S. (2010). "What is Twitter, a Social Media or a News Media?" *Proceedings of the 19th international conference on World wide web*, 591-600

Leskovec, J., Horvitz, E. (2007): „Worldwide Buzz: Planetary-Scale Views on an Instant-Messaging Network" *Microsoft Research Technical Report*

Milgram, S. (1967). „The Small-World Problem" *Psychology Today, 1*, 61-67

Morales, A.J., J., Losada, J.C., Benito, R.M. (2012). "User structure and behaviour on online social network during a political protest" *Physica A: Statistical Mechanics and its Applications Volume 391, 21*, 5244–5253

Morales, A.J., Borondo, J., Losada, J.C., Benito, R.M. (2014): "Efficiency of Human Activity on information spreading on Twitter" *Social Networks, 39*, 1–11

Newman, M. E. J. (2005). „Power laws, Pareto distribution and Zipf's law" *Contemporary Physics, 46(5)*, 323-351

Rogers, E.M. (1983). *Diffusion of Innovations* (3rd ed.). New York: Free Press

Saifuddin, A., Kokil, J. (2013). "Protests against #delhigangrape on Twitter: Analysing India's Arab Spring" *eJournal of eDemocracy and Open Government, 5(1)*, 28-58

Wasserman, S., Faust, K. (2009). *Social Network Analysis*. New York: Cambridge University Press

Watts, D., Dodds, P. (2007): "Influentals, Networks, and Public Opinion Formation" *Journal of Consumer Research, 34*, 441-458