Shahrokh Nikou
Åbo Akademi University

Institute for Advanced Management Systems Research (IAMSR), Turku, Finland
snikou@abo.fi

An Exploratory Smartphone Measurement: Perception vs. Actual Use

Abstract

Smartphones have become an integral part of our everyday lives. Having in-depth insights on how people use and deal with the devices, services and applications has increasingly become a necessity for many actors in mobile sector. As such, in the current study, an empirical study regarding the smartphone usage of 88 respondents has been conducted aiming to provide understandings on how smartphones are being used. To do so, a survey-based questionnaire supported by a diary study has been used to collect the log data. The results show there is hardly a correlation between what people use and what they perceive they do. The findings show that the respondents were accurate in assessing only few services, whereas for the majority of services, their assessments were not accurate.

Keywords: Smartphone, Direct Measurement, Mobile Services, Actual Use, Diary Study.

1. Introduction

Smartphones are becoming an integral part of our daily lives. There are currently over six billion mobile phone users, of which over one billion are smartphone users [1]. It is quite possible that in the near future smartphones and tablet devices become the primary personal devices for various activities including work, entertainment and pleasure. The radical improvement in smartphones' computing capabilities has made it a lot more convenient to browse the mobile internet, use email, perform payment transactions, use entertainment and context-aware applications just to name a few. Consequently, many activities which were used to be performed through desktop PCs, are now taking place via smartphone devices. For instance, the telecom operators' voice and SMS services have been replaced by mobile VoIP services like Viber, Skype and WhatsApp. Smartphones equipped with Near

Field Communication (NFC) chip can establish radio communication to perform contactless transactions. The smartphone has also become a tool to control home appliances remotely [2]. In this regard, designing and providing mobile services that has the potential to become mobile value services in this dynamically changing market is challenging. Walden et al. [23] argued that "a mobile service becomes a mobile value service when it offers the possibility to expand the limits of the possible in the structure of everyday routines". From mobile services provider perspectives, and more specifically telecom operators, device manufacturers, application developers, it is of utmost importance to have an in-depth understanding on how people use their smartphones and mobile applications. Until recently, most of, if not all, researchers have used survey methods to study how mobile phone devices and services are accepted, adopted and used among end-users. For instance, in an empirical study using survey method in Finland, [3] argue that performance and effort expectancy are the factors which influence end-users behavioral intention toward the acceptance and adoption of mobile devices/services. Concerning the adoption of mobile banking service, by making use of survey among 600 current users of mobile banking services, the authors [4] found that usefulness, social norm and the social risk are the factors that play a role in end-users' behavioral intention to adopt mobile banking services [4]. Nevertheless, the relevance of the findings via survey as the dominating method has been acknowledged through various studies on mobile device/service adoption such as in the evaluation of mobile services and substantial adoption factors [5], the impact of use context on mobile services acceptance with regard to mobile ticketing [6], mobile banking service adoption in China [7], with regard to the role of perceived fee and prior experience [8] media usage and mobile news adoption [9], adoption and acceptance of mobile health services [10], adoption of mobile information services [11], barriers and drivers in the

adoption of mobile services among Finnish mobile users [12]. However, the use of survey methods and self-reporting approach in research has led to various methodological pitfalls like, question order, recall bias, external validity, representativeness of the sample, underreporting [13]. Questionnaires are typical way of conducting empirical research on end-user, but there are problems concerning the reliability, accuracy of data and internal validity [22], and common method bias [14]. By installing a background application on the smartphone it is now possible to perform a direct measurement on how users deal with their devices, mobile services and applications. Verkasalo [15, 22] argues that by installing a background application on the users' smartphone that unobtrusively logs and record users' activities, it is possible to gain in-depth insights on user behavior [15]. Direct smartphone measurement or handset-based data collection have increasingly become popular research approaches among scholars to gain accurate understanding of user behavior. This paper aims to provide insights into the reliability of survey-based results on the use of mobile services and applications among 88 university students by contrasting the survey findings with the diary log data obtained from the usage of the smartphone. People might have privacy concern on allowing a background application to be installed on the smartphones devices; this study seeks to advocate using diaries for collecting the log data of the users' smartphone activities as a new innovative approach. Furthermore, the aim is to confront the diary results with questionnaire data collected at the same time in this study and see whether the results of the survey are different from diary results. The objective is to provide an understanding whether the perceived use of mobile services and applications can explain the actual (observed) use of mobile services. Moreover, the findings of this study are highly relevant to most of the acceptance and adoption studies where survey metrics are used.

Section 2 briefly discusses the related work and section 3 provides detailed discussion on the method of the study. Section 4 provides descriptive analysis and the results of the survey and diary study and the comparison between the survey and the dairy results. Section 5 provides extensive discussion on the finding, limitation and the future work.

2. Related work

There are a handful of studies that utilize the direct measurement of smartphone usage by installing a background application. For example, an application provided by Arbitron Mobile was installed on the smartphones of 129 iPhone, BlackBerry and Android users in the Netherlands. The author concluded that users were moderately accurate in assessing the use of SMS, email and browsing services, whereas their assessment of other services like navigation and weather information services were not accurate [2]. In a LiveLab project in the US, the authors strived to measure real-world smartphone usage and found that logging detailed smartphone usage and measuring networks from smartphones is feasible and it can provide unique information toward users' behavior [17].

In another study including 253 respondents a direct measurement has been deployed to investigate the smartphone usage and home environment has been found to be the most important place for mobile service usage [18]. Regarding the power and network consumption, software was used to measure the power and the network consumption [19]. In the OtaSizzle project in the Aalto University, Finland, a background application has been installed on the smartphones of volunteer respondents for collecting handset-based data. Although the study provided important and useful insights on how users deal with the mobile services and applications as well as the relevance of the use of direct smartphone measurement method, the authors argue that it is a complex task to set up such a study, for example participant privacy and anonymity, power consumption and to find a suitable software to collect the data as there is not any standard tool for the measurement [16]. However, using a background application running on the smartphone for direct measurement has number of benefits and drawbacks. The benefits such as external and internal validity and reliability of data and drawbacks such as battery depletion, lack of standard software and users' privacy concerns are just a few examples to name [2, 16, 22]. In order to provide an understanding on how users manage to perform various tasks on mobile devices and to identify the barriers users often face when performing a task, Karlson et al. have used a survey-based (self-report) and screenshot-based diary [20]. Diary has also been used to investigate how task switching and interruption affect information workers [24]. The diary method is used across various studies in the discipline of information systems and within studies in the context of mobile phones. For instance, Nylander et al. have conducted a diary and interview study to investigate where and why people use cell phones to access the Internet and have found that the majority of the respondents although have an access to a computer, they rather use their cell phones to access the Internet [29]. Sohn et al. conducted a two-

week diary study to investigate the mobile information needs and how they are addressed. The authors argued that depending on the time and resources available and the situational context, people use often diverse and, at times, ingenious ways to obtain needed information [30]. Diary studies are becoming increasingly important method to collect data as this method plays an important role as a mean for ecologically valid participant data capture [31]. To the best of our knowledge, there is hardly any previous study that uses diary as an instrument for collecting data and measuring the smartphone usage regarding the mobile services and the applications.

3. Methodology

This section presents the research method used in this study. Having explained the drawbacks of direct measurement, this study aims to undertake an innovative approach to collect the log data of the users' activities toward the usage of mobile services and applications by making use of a diary. Diary study increases the ecological validity as there is no observer present to affect the participants' behavior as well as reduces the per-participant burden on the researcher because the presence of the researcher is not necessary during the data collection [31]. Diary studies have been used by [25] to investigate information needs in a television viewing context and argued that the diary studies offer the ability to capture factual data. In a dairy study, unlike survey-based questionnaire study, data can be collected in a natural setting without influence and disturbance of the researcher or observer.

3.1. Diary instrument design

To carry out the smartphone measurement, a Microsoft Excel spreadsheet in the form of a diary was specifically designed for the purpose of the current study. In this way, the respondents are more willing and open to report their smartphone activities, as they have been informed the data is going to be used only for the statistical analysis. Moreover, the authors manage to control the respondents' privacy concern which has been mentioned to hinder the data collection in previous studies [22]. The respondents were asked to fill the diary for the period of seven days and indicate their mobile services and application use on a daily basis. In the Excel sheet, the first column represents a number of predefined mainstream mobile services and applications, which are expected to be more frequently used. The participants were given a possibility to add extra

services that they use and are not listed in the diary. Participants were instructed to fill their daily usage of the mobile services and the applications in cells from 00:00 to 23:59 with interval of three hours. If a respondent has used Facebook between 6am to 9am, s/he should indicate the usage in the corresponding column and specify how many minutes have spent on using that service or application. To make the diary task and recording the usage easier for the respondents, several predefined usage (e.g., between 10-20 minutes or 30-60 minutes) options were given in the dairy. As such, a respondent needed only to choose an appropriate option and fill the corresponding cell. The actual diary study took place from May 6th to May 12th, 2013. It is important to mention that the data collection was performed during a regular week in Finland (i.e., no sport events or holidays).

3.2. Sample

The respondents were selected from the students who were taking a relevant course regarding mobile services and applications. Students have been used in empirical research as subjects in many previous studies [27]. The benefit that scholars can gain from empirical research with students is for example, having preliminary evidence to confirm or reject hypotheses [25]. Moreover, it is argued that using students as subjects in empirical studies in a particular context is appropriate [28]. We also used a snowball technique to recruit more respondents. In order to control the external validity of the results, students were free to choose to join the research project. The respondents who possess a smartphone were only allowed to participate in the research project. The intention to use this target group was the fact that the students are assumed to be aware of the latest mobile technology, services, and applications and often they are labeled as the early adopters. The diary was distributed among 165 potential participants, out of which 143 responded, 22 non-responses were excluded from the sample. Of those 143 collected responses, 18 diaries were not completed and therefore discarded from the data set as well. To measure the perceived use of mobile services and applications a questionnaire was sent out to the respondents who filled the diary (N=125). The participants were asked to respond to the survey within two weeks. Out of 125 survey invitations, 124 questionnaires were received. After careful cross-checking and screening on the collected data (dairy and questionnaire), 88 complete responses were eligible and selected for the further analysis. 29% (N=36) of the questionnaires or the diaries were not

eligible to perform further analysis on them as they were either not completed, or respondents had difficulties to fill the diary, or there were some technical problems. 62% of the respondents were male and the rest were females. Table 1 shows the respondents' willingness to pay for applications and how much they have invested on their devices. The entire sample possesses smartphones and the most popular device brand was iPhone. Whereas the dominating operating systems was Android, as this OS brand is to a large extent being used by various mobile handheld manufacturers such as, Samsung, LG, HTC among others. The average age of the respondents was 28.2 years old. Table 1 shows how much the respondents have spent on their smartphones and their willingness to pay for the mobile services/applications. Over 50% of the respondents have spent at least 300€ for purchasing their devices, whereas their willingness to pay for purchasing applications is rather low, 36% have mentioned that they are not willing to pay any money for purchasing the applications.

Table 1. Money Spent on Devices and Willingness to Pay for Applications

Money spent on the device	
Less than 100€	N=3
101-200€	N=12
201-300€	N=24
301-400€	N=13
401-500	N=16
More than 500€	N=20
Willingness to pay for applications	
1-5€	N=37
6-10€	N=8
11-15€	N=9
More than 15€	N=2
None	N=32

4. Descriptive analysis

This section provides the survey results followed by discussing the results of the smartphone log data collected via diary instrument. Comparison between the survey and diary results will be provided later.

4.1. Survey measure

The respondents were asked to state to which extent they were currently using 23 different mobile services/applications that have been found to be the most used or innovative [21]. Table 2 shows the mean and the standard deviation values of the perceived use of mobile services within a week. As it can be seen from the Figure (see appendix A) the most used services are: mobile browsing the web,

Facebook, regular voice calls, checking the news and weather forecast, SMS, email, YouTube and instant messaging. Whereas the least used mobile services are mobile TV, banking transactions, Twitter and mobile navigation services. In order to manage the complexity of the results, we opted to categorize the services into different categories. According to the findings, the majority of the most used services and applications belong to communications and social networking applications and to a lesser degree to information services. Mobile social networking services/applications have increasingly become important for many people and firms in order to establish mutual relationships, stay connected with friends or to perform businesses. However, the outcome of the questionnaire data reveals that although Facebook is very popular among the respondents, the other social networking application i.e., Twitter is less used. The plausible explanation may be that the participants in this research are entirely students and using a more professional social networking application such as Twitter is less relevant for them currently. Regarding the SMS usage, almost 50% of the respondents indicated that they have sent 10 or more SMSs per week. Only a few respondents (N=3) have indicated that they do not use SMS anymore. It can be concluded that SMS still is one of the most used communication services among the users, although there are free text messaging services such as WhatsApp and Viber available in the market (see Figure 1). It should be noted that the scales for measuring the SMS and WhatsApp are slightly different.
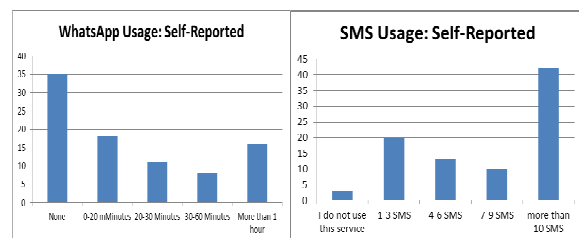

Figure 1. SMS vs. WhatsApp Usage (Self-Reported)

4.2. Smartphone measurement (diary)

The dairy data for the same respondents who participated and completed the survey questionnaire was selected to perform further analysis. We have received a massive amount of log data. The 88 participants have filled in the diary and indicated their activities and the usage of various mobile services and applications within a week. The same mobile services/applications that were included in the

questionnaire were also in the diary. The intention to use the same services/applications was to perform the comparison between the findings of the survey questionnaire and the log data from the dairy. Moreover, it is also important to see if the perceived use from the survey measures can predict the actual (observed) use for the diary log data. Table 2 shows the mean values and standard deviations for the same participants who were included in the questionnaire survey. Moreover, heavily used applications such as browsing the web, Facebook and checking the news, weather forecast reported in the questionnaire have also been reported in the dairy as the most used application.

Table 2. The Mean and Standard Deviation Values of the Services Used in the Questionnaire and Diary

| Scales for SMS: None, 1-3 SMS, 4-6 SMS, 7-9 SMS, more than 10 SMS Scale for Email: None; 1-10; 11-20; 21-30; 31-40; more than 40 Emails Scales for other service: None; 1-10 min; 11-20 min; 21-30 min; 31-60 min; more than one hour					Questionnaire vs. Diary	
	Questionnaire		Diary		Correlation	Significance
	Mean	Std.	Mean	Std.		
Browsing the Web	4,65	1,52	3.65	1.52	-0.012	0.915
Facebook	4,35	1,69	4.23	1.96	-0.104	0.334
Regular Voice Call	4,33	1,40	4.99	1.53	-0.187	0.081
Checking News, Sports and Weather	3.91	1.66	3.89	1.93	0.007	0.945
SMS	3.77	1.35	4.05	1.41	-0.031	0.776
Email	3.58	1.57	4.33	1.91	0.008	0.938
YouTube	3.34	1.75	2.02	1.91	-0.185	0.085
Instant Massaging	3.28	1.90	2.22	1.74	-0.019	0.862
Mobile Music	3.28	2.16	2.85	2.1	0.088	0.416
Calendar	3.23	1.36	2.67	1.88	-0.150	0.163
Taking Photo	3.16	1.24	3.1	2.08	-0.180	0.093
Mobile Games	3.15	1.90	2.52	1.75	-0.041	0.707
Skype	3.13	2.02	2.93	2.23	-0.054	0.615
Facebook Messenger	3.00	1.96	1.74	1.46	-0.097	0.371
WhatsApp	2.91	1.97	2.82	2.23	0.054	0.620
Making Note	2.83	1.43	1.57	1.16	-0.010	0.925
Visiting Application Store	2.67	1.20	2.19	2.09	-0.139	0.197
Viber	2.56	1.95	2.56	2.15	0.172	0.108
Mobile Map	2.56	1.35	1.7	1.46	-0.091	0.399
Mobile Navigation (GPS)	2.41	1.53	1.7	1.57	-0.093	0.390
Twitter	1.93	1.62	3.3	2.29	-0.156	0.146
Mobile Banking	1.92	1.39	2.3	2.02	-0.012	0.912
Mobile TV	1.86	1.46	1.65	1.46	0.074	0.493
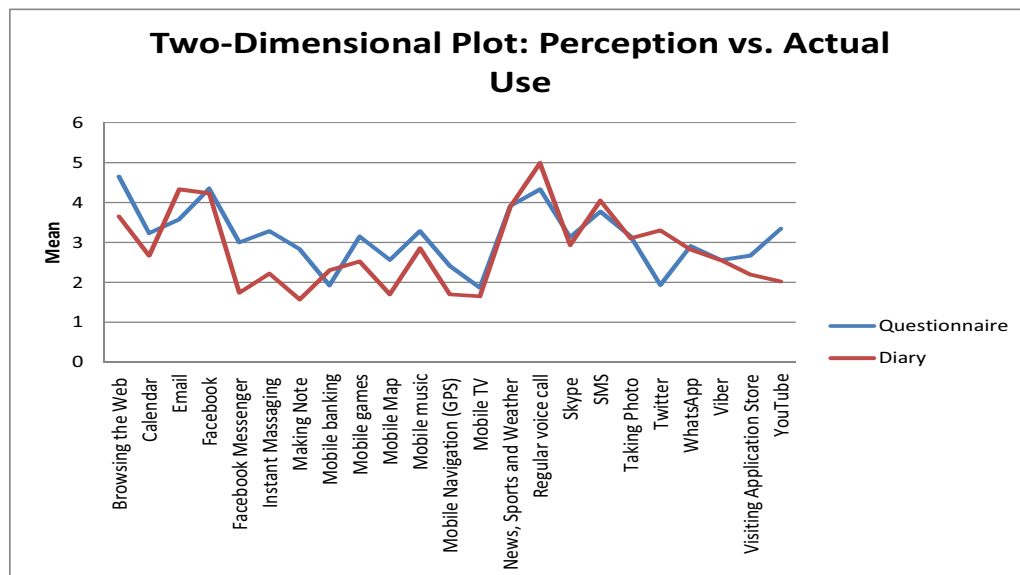
Figure 2. Two Dimensional Plot: Perception vs. Actual Use

Figure 2 shows the two dimensional plot, where the usage of 23 different services and applications in the survey (perception) is compared with the usage of the same services and applications reported in the diary (actual usage). Except for the few services (e.g., Facebook, regular voice call, Viber and email) no correlation can be found between what respondents say they use and the actual use of the services or the application. There is however noticeable differences in the usage of Twitter, Facebook messenger, instant messaging, browsing the web and YouTube reported in the questionnaire and the diary. With regard to the comparison of the data usage in the diary and the questionnaire, paired t-test was also performed to increase the accuracy of the statistical analysis. The data from self-reporting (questionnaire) and the diary (actual use) regarding to each mobile services and applications were analysed. The intention was to investigate whether the questionnaire data can predict the observed used from the diary data. As it can be seen from Table 3, the respondents were moderately accurate in assessing the usage of the some services (e.g., Browsing the Web, regular voice call, email, YouTube, Instant messaging, Viber) and for other services (e.g., Facebook, checking the news, sport, weather forecast, taking photo, WhatsApp) their assessments were not accurate.

Table 3. Paired t-test: Questionnaire (Self-Reported) vs. Diary (Actual Use)

Paired Samples Test								
	Paired Differences							
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
				Lower	Upper			
Browsing the Web	0.76	2.57	0.27	0.22	1.31	2.78	87.00	0.01
Facebook	0.13	2.72	0.29	-0.45	0.70	0.43	87.00	0.67
Regular Voice Call	-0.66	2.25	0.24	-1.14	-0.18	-2.74	87.00	0.01
Checking News, Sports and Weather	0.02	2.54	0.27	-0.51	0.56	0.08	87.00	0.93
SMS	-0.27	1.98	0.21	-0.69	0.15	-1.29	87.00	0.20
Email	-0.75	2.46	0.26	-1.27	-0.23	-2.86	87.00	0.01
YouTube	1.32	2.82	0.30	0.72	1.92	4.39	87.00	0.00
Instant Massaging	1.07	2.60	0.28	0.52	1.62	3.86	87.00	0.00
Mobile Music	0.43	2.88	0.31	-0.18	1.04	1.41	87.00	0.16
Calendar	0.56	2.48	0.26	0.03	1.08	2.11	87.00	0.04
Taking Photo	0.06	2.61	0.28	-0.50	0.61	0.21	87.00	0.84
Mobile Games	0.63	2.64	0.28	0.07	1.18	2.22	87.00	0.03
Skype	0.19	3.08	0.33	-0.46	0.85	0.59	87.00	0.56
Facebook Messenger	1.26	2.55	0.27	0.72	1.80	4.64	87.00	0.00
WhatsApp	0.09	2.90	0.31	-0.52	0.71	0.29	87.00	0.77
Making Note	1.26	1.85	0.20	0.87	1.65	6.38	87.00	0.00
Visiting Application Store	0.48	2.59	0.28	-0.07	1.03	1.73	87.00	0.09
Viber	0.00	2.64	0.28	-0.56	0.56	0.00	87.00	1.00
Mobile Map	0.85	2.07	0.22	0.41	1.29	3.86	87.00	0.00
Mobile Navigation (GPS)	0.70	2.29	0.24	0.22	1.19	2.89	87.00	0.01
Twitter	-1.36	3.00	0.32	-2.00	-0.73	-4.27	87.00	0.00
Mobile Banking	-0.38	2.47	0.26	-0.90	0.15	-1.42	87.00	0.16
Mobile TV	0.22	1.99	0.21	-0.21	0.64	1.02	87.00	0.31

According to the results of the log data obtained from the diary, regular voice, Facebook, checking weather/news and the Twitter are the most used mobile services/application by the respondents in one week. For instance, over 50 respondents have indicated that they use the regular voice services more than one hour per week. This is followed by Facebook and checking the weather forecast and news updates. Not surprisingly, the least used services are the mobile payment, making note and the mobile TV (see Appendix B). With regard to the actual use of SMS, 63% (N=55) respondents have indicated that they have sent 10 or more SMSs during a week. Unlike the results of the questionnaires, diary log data shows that there are more people that they do not use SMS anymore (N=9). Nevertheless, it is clear that the SMS as a classical communication service is still very popular among the users, but the perception usage of this service and the actual use are to some extent different (see Figure 3). Table 2 shows the correlation and the significance values for the 23 different mobile services and applications used in this study.
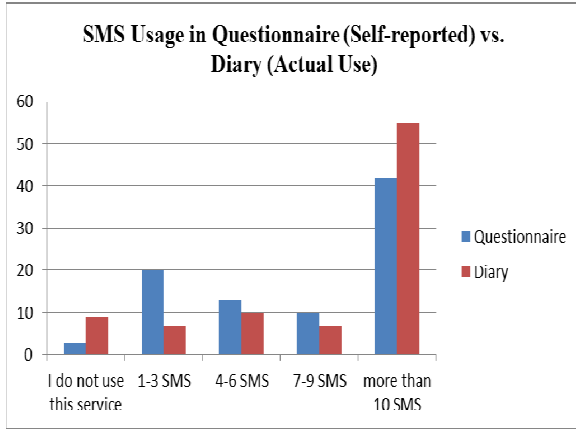
Figure 3. SMS Usage in
Questionnaire vs. Diary

Figure 5. Regular Voice Call:
Questionnaire vs. Diary

Figure 4 shows the comparison between the questionnaire data (use perception) versus the diary data (actual use) with regard to email use among the respondents. The indicated usage values hardly provide any strong correlation between the two sets of the results. For instance, there is a huge difference between the diary and questionnaire results regarding the email usage for those who have mentioned they use this service for at least one hour per week. The diary results show that there are actually many respondents who spend more than an hour per week to check (received/sent) emails compared to the questionnaire results. The same interpretation can be done to regular voice services. The results from the diary show that there are more respondents who have actually used this service (more an hour per week), whereas the questionnaire (self-reporting) results show different values (Figure 5).
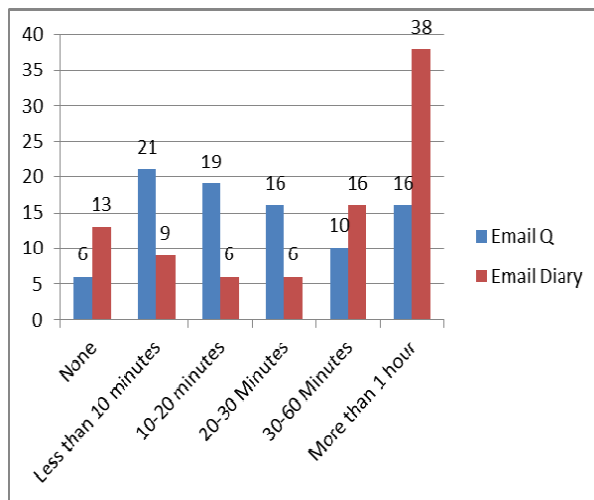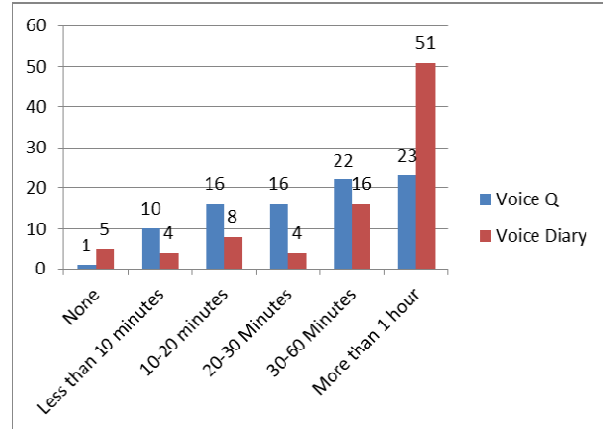

Figure 4. Email Usage:
Questionnaire vs.Diary

5. Conclusion, discussions and limitations

In this study a diary has been used as an instrument to collect the log data of the users' activities with regard to the usage of mobile services and applications. The aim is to gain insights into how users deal with the smartphones, services and the applications. A survey questionnaire has also been distributed among the respondents to investigate what are their use perceptions toward mobile services and the applications and also if the obtained results can support the dairy analysis. The findings show that the for many services and applications the questionnaire and the diary results are very far from being close to each other. In other words, it means that the analysis show the perceived use from the questionnaire measures cannot predict and support the observed use from the log data. Therefore, the findings suggest that the researchers and the scholars performing survey-based studies should pay an extra attention to interpret the research findings. However, the method used in this study for collecting data has proven to be an appropriate approach compared to questionnaire (self-reporting) approach. People often neglect to answer the questionnaire measure accurately. The use of survey methods and self-reporting approach in research have led to various methodological pitfalls like, question order, recall bias, external validity, representativeness of the sample, underreporting [13] and common method bias [14]. Using a background application installed on the smartphones to collect the log data has also been mentioned to have drawbacks, such as personal privacy issues, battery depletion and power consumption. Many smartphone users are reluctant to let a background application to be run on their devices to collect the smartphone activities. As such, collecting log data by making use of a diary can be seen as a more appropriate approach to collect

data. In this way, users do not have to worry for their privacy. The respondents who participated in this research project were completely informed about the purpose of the study. Therefore they have provided us with accurate inputs on how they deal with the devices, services and the applications.

The study results show that the usage of different services is very scattered between the perceived use and the actual use. We could not find any indications, except for few services, that show the perceived use and the actual use values correlated with each other or in other words, the perceived use of services cannot support the actual use of various mobile services and the application. The respondents who were participated in this research project were only accurate in assessing few services, whereas for the most of services they were not accurate. For instance, even with the main stream or most used services/applications such as YouTube, Twitter, and instant messaging. Most of the acceptance studies with regard to the use of mobile devices and services are based on the survey method and to a large extent the actual use of mobile services is not dealt with. Consequently the findings might have validity and reliability issues.

This study has shown that using diary to measure how people deal with the mobile devices, services and applications provides important insights into the usage pattern of various services. Service providers, device manufacturers and telecom operators can gain profound understanding from the results of this study to design and offer services and applications that match users' preferences and fit into daily routines or perform more accurate market analysis. There are some limitations regarding the diary studies as a data collection instrument or technique. For instance it is difficult to maintain participant dedication levels or convincing them that the information they are providing is useful and should be reported [26], though the problems can be eliminated if the study is carefully designed and implemented. The findings might not be applicable beyond the population used in this study.

In future research, we aim to conduct a similar study in another context, with more participants and minimizing the technical and practical issues with regard to designing a diary that we have encountered during the data collection.

6. References

[1] West, J. and Mace, M, "Browsing as the killer app: Explaining the rapid success of Apple's iPhone", Telecommunications Policy, 34(2005), pp. 270-286.

[2] De Reuver, M., Bouwman, H., Heerschap, N. and Verkasalo, H, Smartphone Measurement: Do People Use Mobile Applications As They Say They Do? Paper presented at the International Conference on Mobile Business (2012).

[3] Carlsson, C. Carlsson, J. Hyvonen, K. Puhakainen, J. and Walden, P, Adoption of mobile devices/services—searching for answers with the UTAUT, In Proceedings of the 39th Annual Hawaii International Conference, 2006.

[4] Riquelme, H. E. and Rios, R. E, "The moderating effect of gender in the adoption of mobile banking", International Journal of Bank Marketing, 28(2010), pp.328 - 341.

[5] Nikou, S. Mezei, J, "Evaluation of mobile services and substantial adoption factors with Analytic Hierarchy Process (AHP)", Telecommunications Policy, 2012, DOI: http://dx.doi.org/10.1016/j.telpol.2012.09.007.

[6] Mallat, N. Rossi, M. Tuunainen, V. K. and Öörni, A, "The impact of use context on mobile services acceptance: The case of mobile ticketing", Information & Management, 46(2009), pp. 190-195.

[7] Deng, Z. Lu, Y. Deng, S. And Zhang, J, "Exploring user adoption of mobile banking: an empirical study in China", International Journal of Information Technology and Management, 9(2010), pp. 289-301.

[8] Kim, B. Choi, M. and Han, I, "User behaviours toward mobile data services: The role of perceived fee and prior experience", Expert Systems with Applications, 36(2009), pp. 8528-8536.

[9] Chan-Olmsted, S. Rim, H. and Zerba, A, "Mobile News Adoption among Young Adults Examining the Roles of Perceptions, News Consumption, and Media Usage", Journalism & Mass Communication Quarterly, 90(2013), pp. 126-147.

[10] Sun, Y. Wang, N. Guo, X. and Peng, Z, "Understanding the Acceptance of Mobile Health Services: A Comparison and Integration of Alternative Models" Journal of Electronic Commerce Research, 14(2013), pp. 183-200.

[11] McKenna, B. Tuunanen, T. And Gardner, L, "Consumers' Adoption of Information Services", Information & Management, 50(2013), pp. 248-257.

[12] Bouwman, H. Carlsson, C. Molina-Castillo, F.J. and Walden, P, "Barriers and drivers in the adoption of current and future mobile services in Finland", Telematics and Informatics, 24(2007), pp. 145-160.

[13] Schwartz, M. D., "Methodological issues in the use of survey data for measuring and characterizing violence against women", Violence against Women, 6(2000), pp. 815-838.

[14] Podsakoff, P. M. MacKenzie, S. B. Lee, J. Y. and Podsakoff, N. P, "Common method biases in behavioural research: A critical review of the literature and recommended remedies", Journal of applied psychology, 88(2003), 879-903.

[15] Verkasalo, H, "Handset-based measurement of mobile service demand and value", info, 10(2008), pp.51 - 69.

[16] Karikoski, J, "Handset-based data collection process and participant attitudes", International Journal of Handheld Computing Research (IJHCR), 3(2012), pp. 1-21.

[17] Shepard, C. Rahmati, A. Tossell, C., Zhong, L. and Kortum, P, "LiveLab: measuring wireless networks and smartphone users in the field", ACM SIGMETRICS Performance Evaluation Review, 38(2011), pp. 15-20.

[18] Smura, T, "*Access alternatives to mobile services and content: analysis of handset-based smartphone usage data*", ITS 17th Biennial Conference (ITS), Canada, 2008.

[19] Shye, A. Scholbrock, B. and Memik, G, "Into the wild: studying real user activity patterns to guide power optimizations for mobile architectures", In Proceedings of the 42nd Annual IEEE/ACM International Symposium on Microarchitecture, 2009, pp. 168-178.

[20] Karlson, A. K. Iqbal, S. T. Meyers, B. Ramos, G. Lee, K., and Tang, J. C, "Mobile taskflow in context: a screenshot study of smartphone usage", In Proceedings of the 28th international conference on Human factors in computing systems, 2010, pp. 2009-2018.

[21] Bouwman, H. Bejar, A. and Nikou, S, "Mobile services put in context: A Q-sort analysis", Telematics and Informatics, 29(2012), pp. 66-81.

[22] Verkasalo, H, "Handset-based measurement of smartphone service evolution in Finland", Journal of Targeting, Measurement and Analysis for Marketing, 16(2007), pp. 7–25.

[23] Walden, P, Han, S, Carlsson, C, and Majlender, P, "The sleeping giant–a longitudinal study surveying the mobile service market in Finland", In Proceedings of the 15th European Conference on Information Systems, University of St Gallen, St Gallen, Switzerland, 2007, pp. 1875-84). The Free Press.

[24] Czerwinski, M. Horvitz, E, and Wilhite, S, "A diary study of task switching and interruptions", In Proceedings of the SIGCHI conference on Human factors in computing systems, 2004, pp. 175-182.

[25] Elsweiler, D. Mandl, S, and Kirkegaard Lunn, B, "Understanding casual-leisure information needs: a diary study in the context of television viewing", in: Proceedings of the third symposium on Information interaction in context, 2010, pp. 25-34.

[26] Palen, L. and Salzman, M, "Voice-mail diary studies for naturalistic data capture under mobile conditions, In: Proceedings of the ACM conference on Computer supported cooperative work (New York, NY, USA) (E. Churchill and J. McCarthy, eds.), ACM Press, 2002, pp. 87–95.

[27] Baresi, L. Morasca, S. and Paolini. P, "An Empirical Study on the Design Effort of Web Applications", In Proceedings of the 3rd International Conference on Web Information System Engineering (WISE2002), pages 345–354. IEEE-CS Press, 2002.

[28] Compeau, D. Marcolin, B. Kelley, H. and Higgins, C, "Generalizability of Information Systems Research Using Student Subjects—A Reflection on Our Practices and Recommendations for Future Research", Information Systems Research, 23(2012), pp. 1093-1109.

[29] Nylander, S. Lundquist, T. and Brännström, A, "At Home and with Computer Access – Why and Where People Use Cell Phones to Access the Internet", In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, ACM, 2009, pp. 1639-1642.

[30] Sohn, T. Li, K.A. and Griswold, W.G, "A Diary Study of Mobile Information Needs", In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, ACM, 2008, pp. 433-442.

[31] Brandt, J. Noah, W. and Scott R. Klemmer "lowering the burden for diary studies under mobile conditions", In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, 2007, pp. 2303-2308.

Appendix A:
Perception of use of the mobile services and the application in one week

Service/Application Usage in One Week (Questionnaire)
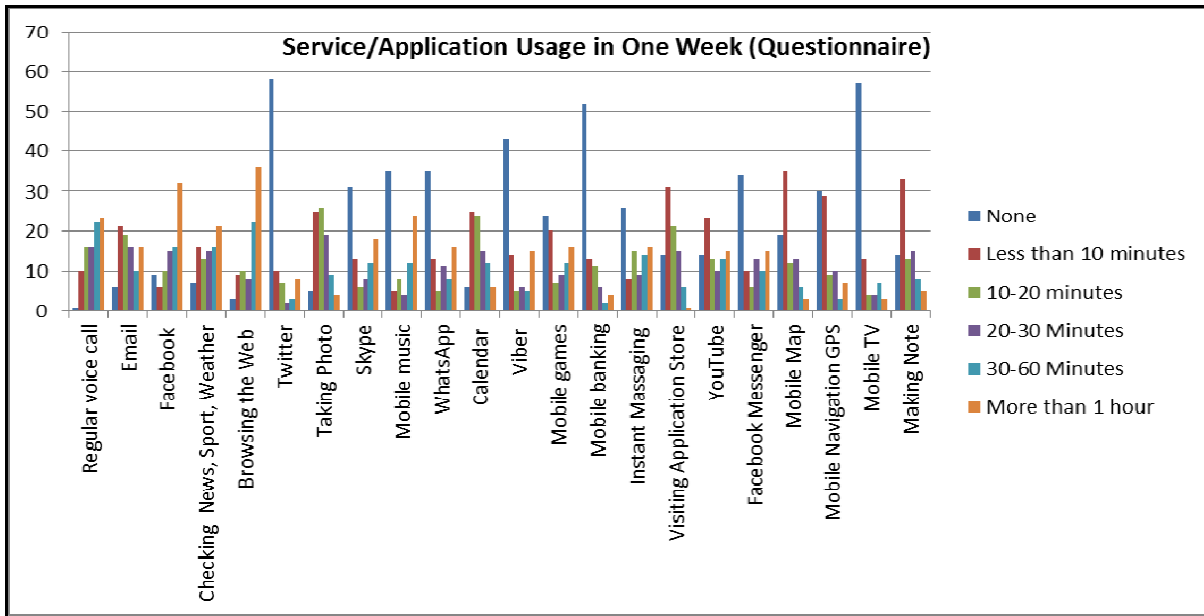
Appendix B:
Actual use of the mobile services and the application in one week

Service/Application Usage in One Week (Diary)