
A Sample of Technology Substitution

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Abstract

We increasingly have access to a multitude of digital services and devices, which are used to mediate our activities. This paper provides an overview of various mediators currently being used and continuously substituted and describes the circumstances under which this happens.

Author Keywords

Ubiquitous substitution; mediators; devices; services; survey

ACM Classification Keywords

H.5.m [Information interfaces and presentation (e.g., HCI)]: Miscellaneous.

General Terms

Information Interfaces, Presentation

Introduction

Artifacts are objects designed with a particular purpose of use in mind [3]. Artifacts are there when we encounter a new activity and any action a person makes in the world is always mediated by artifacts [1]. A mediator is an artifact, which helps people act on the object of their interest in a way that would not be possible without the mediator [2].

Ubiquitous substitution focuses on continuous switching

of mediators with the purpose of enriching a user's repertoire of action possibilities. It is not about replacing one mediator with another, but instead is about providing a larger set of mediators and understanding which mediator applies better in which conditions [4].

We are increasingly placed in dynamic configurations of technology [9], where an activity is not performed by using a single computer application, but instead is supported by a wide range of devices and software with the user dynamically substituting them [5]. The goal of this research is to better understand which set of mediators are currently being used and continuously substituted and under what circumstances.

Survey

We conducted an online survey to better understand, which digital artifacts people currently use to support their activities, as well as how and where these artifacts are used. We wanted to know:

- Which types of devices people use?
- In which circumstances people use their devices?
- Which types of services people use on their devices?
- Which specific features of those services are used on which devices?

Method

A semi-structured questionnaire was chosen to provide answers to the formulated research questions. Quantitative data was collected about the activities users typically support with their devices and where they use them. Qualitative data was collected through open-ended questions.

Procedure

We conducted a pilot study using accidental sampling, which is a type of non-probability sampling that involves the sample being drawn from the part of the population being close to hand. This resulted in the sample not being representative of the population, however being sufficient for the purpose of a pilot study [8]. We chose 4 respondents for online testing and 3 for a talk-aloud testing session of the survey. The pilot study provided insights on the estimated completion time and potential areas of misunderstanding. Feedback from the pilot testers was used to improve the list of the types of services provided in the survey.

Participants

Participants were invited through Facebook and a variety of university mailing lists in Estonia and other countries.

The sampling methodology used for the survey was self-selection sampling. It is a type of non-probability sampling, which is based on the judgement of the researcher. The researcher puts a questionnaire online and invites people to respond. The advantage of this type of sampling is that the time needed to contact participants is minimized and that once selected the respondents are more likely to fill the entire questionnaire. The disadvantage is that the selection may be biased, which can lead to the sample not being representative of the population being studied or exaggerating some particular finding [6]. Therefore, generalizations are made only on the level of the sample and not on an entire population.

Apparatus

The survey consisted of three sections. Section 1, "Personal Information" included questions about the respondent; Section 2, "Services and Devices" – questions about the services the respondent uses on his/her devices;

Section 3, "Additional Questions" – questions on whether the respondent recognizes any limitations in the use of his/her devices. The questionnaire consisted of up to 33 questions depending on how many devices the respondent used. The types of services included in the survey were related to productivity and communication tools and deliberately excluded games. The collected data was intended to be used in the design of a new service, which would support activities related to work and communication.

The survey was available from the 4th of October until the 1st of November 2012. 101 full responses and 100 incomplete responses were collected. All incomplete responses were discarded, because the respondents closed the survey before meaningful data was added.

Results

Initially there were 4 age groups (under 26, 26-45, 46-65, above 65), however results were restructured as there were no respondents above 65 and only one person in the 46-65 age group. 53,5% of the respondents were under the age of 26 and 46,5% – 26 and older. 41,6% of all respondents were female and 58,4% – male.

A total of 9 countries were represented in the sample, with most respondents from Estonia, Cape Verde, and Finland.

Analysis of the results shows that laptops are the most popular devices with 90,1% of the respondents having one to use. Smartphones are used by 76,2% of the respondents. People still use desktops quite often, 53,5% of the respondents have a desktop they can use. Tablets are also quite popular among the respondents, being used by 31,7%. Smart TVs are still a very rare device to use and only 9,9% of the respondents have one. The high number of laptop, smartphone, and tablet users is greatly

exceeding the average number of users according to literature [10, 7], which can be due to the sample being young in age and more tech savvy.

Participants were asked to rank the different devices they use based on the frequency of usage and Table 1 shows the results of this ranking.

Device	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5
Smartphone	22,8%	36,6%	21,8%	5%	4%
Tablet	3%	9,9%	21,8%	15,8%	5%
Laptop	53,5%	30,7%	12,9%	1%	0%
Desktop	20,8%	17,8%	21,8%	11,9%	3%
Smart TV	0%	3%	2%	11,9%	22,8%

Table 1: Devices ranked based on frequency of usage

A laptop is the first device to be used. In second place people are likely to use a smartphone. In third place they prefer either a desktop computer or a tablet. Respondents were least likely to choose a Smart TV.

The respondents were also asked to explain why they ranked the devices in such a way. Data shows that some people ranked the smartphone first as it was always with them, even though they did not use it all the time. Respondents also mentioned that they prefer to use a desktop or a laptop at home and at work and a smartphone or a tablet on the go.

The respondents were asked for the types of services they use regularly on their devices. This is shown in Figure 1.

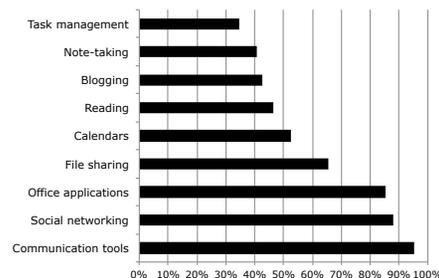


Figure 1: Regularly used services

The most common services the respondents use on their devices are communication tools, social networking, and office applications. The least common services are task management and note-taking services.

Table 2 shows that in the device specific view the order of services used and the percentage of services used is mostly the same with slight differences in desktops, where note-taking is used more than blogging, and in tablets, where task management is more commonly used than note-taking. This means that the same types of services are used across all devices almost up to an equal amount.

	Smartphone	Tablet	Laptop	Desktop
Communication tools	96,1%	96,9%	94,5%	94,4%
Social networking	90,9%	84,4%	87,9%	90,7%
Office applications	84,4%	90,6%	85,7%	85,2%
File sharing	71,4%	68,8%	65,9%	70,4%
Calendars	62,3%	68,8%	54,9%	61,1%
Reading	51,9%	62,5%	47,3%	48,1%
Blogging	48,1%	46,9%	42,9%	40,7%
Note-taking	48,1%	43,8%	42,9%	44,4%
Task management	40,3%	46,9%	37,4%	37%

Table 2: Service usage on devices

Following is a summary of specific activities the

respondents prefer to carry out on each of their devices according to the types of services presented in Figure 1.

- Communication tools – all SMS and call related activities, except for video calls, are preferred on smartphones. Reading emails and instant messaging is fairly equally divided between laptops and smartphones. Laptops are prevailing in composing emails, saving drafts, attaching files, managing and searching through emails.
- Social networking – highly dominated by laptops in monitoring, managing, and searching for friends, adding posts, commenting, and sharing. For sending direct messages laptops and smartphones are almost equally used. Smartphones prevail in check-in related services and location tagging.
- Office applications – computers have the upside here, especially laptops, which dominate over desktops in every aspect.
- File sharing – dominated by laptops across all fields.
- Calendars – smartphones are used for creating and viewing events, also for adding alerts and syncing. Laptops are better for editing events, setting recurring tasks, sharing and subscribing to calendars.
- Reading – tablets are prevalent for reading e-books and PDFs, also for highlighting text and bookmarking. Computers are more used for thorough search in text, looking up definitions, sharing, and synchronization.
- Blogging – fully dominated by laptops.
- Note-taking – laptops are considered more suitable for adding (formatted) text, images, videos, links, and tags. Smartphones are prevalent in reading tasks and notes, also in searching by location.
- Task management – smartphones and tablets are preferred for adding and reading tasks, adding dates

and notifications, synchronizing and marking tasks as completed. Laptops are preferred for creating lists and adding locations.

Based on the collected demographics we additionally compared results between men and women, Estonians and Cape Verdeans, as well as those under and above 26 years old. We merged the age groups of 26-45 and 46-65 as there was only one respondent in the latter group. The significance threshold chosen for comparing differences between segments was 10%, which was selected due to the fact that most of the results differed either by less than 10% or significantly more. Thus, only differences of at least 10% are highlighted.

While comparing men and women we saw that men use more desktops and Smart TVs, whereas in case of tablets men are twice as likely to use one when compared to women.

Comparison Estonia and Cape Verde shows that overall there are more Estonians using digital devices. The biggest difference is in the usage of smartphones and Smart TVs.

Comparing people under and over 26 we can see that older people use devices more. For example, there is almost a 2 time difference for desktops and tablets.

The results of device ranking across different segments resembled the overall results only to some extent, with the laptop being the first preference for all and the Smart TV being the least used. However, the order of smartphones, laptops, and desktops changes across different segments. In case of men, women, Estonians, and both age groups the smartphone is the second device to use. In the Cape Verde context the second device to use is the desktop and

the smartphone is in the third place. The tablet is in the third place for men, Estonians, and those over 26. Women and those under 26 prefer to use the desktop in the third place instead, whereas men, Estonians, and those over 26 ranked it in the fourth place. Finally, Cape Verdeans rank the tablet in the fourth place.

In terms of services there are differences in social network usage, which is skewed more towards women. Men tend to focus on using calendaring, reading, note-taking, and task management services. From the country perspective we see Estonians using more calendaring, file sharing, blogging, and task management. Age-wise usage of file sharing, calendaring, and blogging is skewed towards those above 26.

Analysis of service usage across devices shows that in case of blogging and task management men use tablets the most and desktops the least. Women tend to use laptops the least across all services, but in case of file sharing there is a preference towards desktop usage, whereas reading is done more on tablets, less on laptops. Estonians use laptops the least for reading and calendaring. Cape Verdeans do not use smartphones for calendaring at all and in terms of file sharing, calendaring, reading, blogging, note-taking, and task management, service usage is very unevenly distributed. For younger respondents service usage is also unevenly distributed, especially in case of file sharing, calendaring, reading, and blogging. For older users tablets are preferred for reading and blogging. Smartphones are quite commonly used as well, while laptops are used less. Task management is preferred on mobile devices instead of the desktop.

Discussion

The respondents who considered cross-device services important, explained that such services and the possibility

to synchronize data put them on top of things. People want to be up-to-date anytime, anywhere, and on any device. One does not have all devices always at hand, therefore a substitute is necessary. One respondent mentioned that it would be silly to look for another device just because the one at hand does not have the necessary service/application or cannot handle a particular task. Cross-device services appear to save time, make life more convenient, help people be on top of things, and avoid additional work (such as managing multiple calendars) or losing data (one can start an activity on one device and finish on another). There is no need to think about the differences of tools.

The results also show that there are differences in all of the analyzed segments across both device and service usage. We assume that in case of Estonia and Cape Verde this is due to economical conditions, but also because Estonians have migrated more of their daily activities to the digital realm. The same applies to those aged under and over 26, which could be due the fact that older users can afford to own or have access to more devices. In case of gender differences women are more oriented towards communication tools, whereas men are more oriented towards time management and productivity services.

Overall, the results lead us to the conclusion that when designing solutions for supporting technological substitution, it is important to take a close look at the unique preferences and behaviors of each target group.

Closing Remarks

The typical list of devices that our respondents use based on the frequency of usage is a laptop, a smartphone, a tablet, and a desktop. Smart TVs are used the least due to their limited functionality and inconvenient input mechanisms.

The most common services the respondents use on their devices are communication tools, social networking, and office applications. The least used service types are task management and note taking services. Therefore, we can assume that our respondents are quite likely to use sheets of paper for notes or a diary for calendaring as these activities have not yet digitalized that much compared to others.

The general results of the study lead to the conclusion that service usage is distributed evenly across devices, however, a closer look at the various segments shows that for certain types of services and groups of users this is not the case. It is thus important to understand whether people would prefer to have access to their services across all devices, but they are currently not able to due to various economical and other conditions, or whether users are satisfied with using specific devices only for specific activities. Answering these questions requires a closer look.

Conclusion

The new wave of human-computer interaction is characterized by people using a plethora of different artifacts to support their activities. Each of these artifacts provides its own set of affordances, which influence the way activities are carried out on them.

Our survey provided insight into how respondents were using different software and hardware mediators to support their activities, thus illustrating the concept of ubiquitous substitution. The approach was to deliberately take into account the fact that people increasingly tend to have access to multiple heterogenous devices and services and that it is necessary to take this perspective into account when designing a new generation of digital artifacts.

Future steps should address the implications of these ever-changing software and hardware mediator configurations in the design processes of the underlying services as we are no longer designing interactions for one user and one device scenarios, but rather for one or many users and many devices, yet most interaction design approaches build on the single user and single device assumption. Therefore, we need to understand what changes must be brought into the process to address the emerging challenges.

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