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# Managing Personal Information across Multiple Devices: Challenges and Opportunities

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**Abstract.** Due to the constantly increasing volume of personal information (PI) and the current trend towards mobile devices, there is a growing need to provide access to PI across multiple devices. It has become difficult for a user to manage his/her PI across these devices. The current hierarchical systems used to organize PI do not support accessing PI across multiple devices. The aim of this paper is to discuss the outcomes of an interview study that was conducted to determine how users currently manage PI across multiple devices and to identify what problems are experienced using these devices. Results showed that participants found it difficult to access PI across their devices and do not know beforehand what information they need to access. These problems could be solved by providing an information visualization tool installed on their devices which provides a single user interface to facilitate an overall view of their PI.

**Keywords:** Personal Information Management, Multiple Devices, Interview Study

## 1. Introduction

Personal information management (PIM) involves the daily activities or tasks that users need to perform using a set of information items, such as documents, media and calendar events [1]. A user's personal information (PI) increases constantly as information is currently being stored on a number of different devices, platforms and applications [2]. This has led to a high level of dispersion of PI, referred to as the information fragmentation problem, and an increased difficulty in managing, accessing and using this information. It has become difficult for a user to access to his/her PI at any time regardless on which device the information is stored. The goal of this research is to provide support for accessing PI across multiple personal devices.

The current method used to organize PI is in hierarchies of files and/or folders [3]. Although the hierarchy is a familiar organization method, it suffers from several limitations due to its restrictive nature [3]. Current PIM solutions mainly focus on enhancing PIM on a single device or on a subset of PI [4]. Alternative applications, such as Dropbox ([www.dropbox.com](http://www.dropbox.com)) and TeamViewer ([www.teamviewer.com](http://www.teamviewer.com)), provide support for accessing PI, but also have several shortcomings.

The aim of this paper is to describe the results of an interview study that was conducted to determine how participants currently manage PI across different devices and identify the problems that participants experience in managing PI across these devices. The results of this study will inform the design of a tool to support accessing PI across multiple devices using information visualization (IV) techniques.

Section 2 discusses related work regarding PIM. Section 3 introduces the interview study and describes the themes identified from the interview data. Design implications are identified in Section 4 based on the results of the interview study. The paper concludes by discussing the main contribution of this research and future work to be completed.

## **2. Related Work**

PIM is a large, active area of research [1], [5]. The goal of PIM is to enable a user to access his/her PI relevant to his/her location, in the most appropriate form, while supporting the tasks of PIM [1]. PIM tasks were originally identified in [6] to include acquiring, organizing, storing, maintaining, retrieving and producing PI. PIM tasks were then simplified to include keeping (storing), managing (organizing and maintaining) and finding (searching and browsing for retrieval) [1]. Lower-level PI tasks include creating, sorting, moving, naming, assigning properties, copying, distributing, deleting and transforming PI [1]. The keeping (storing), organizing and finding (viewing and retrieving) PIM tasks across multiple devices form the focus of this paper.

The type of PI organization has a large impact on how the PI is viewed [3]. Jetter *et al.* [7] suggested that a user interface (UI) needs to be designed to support accessing PI to assist a user to develop his/her own processes, structures and views. Gomes *et al.* [8] stated that a meaningful IV technique may be the solution for the difficulty in finding relevant PI.

## **3. Interview Study**

### **3.1. Interview Method**

Face-to-face, one-on-one, in-person, informal, semi-structured interviews were conducted with selected participants [9]. Thematic analysis, in combination with coding techniques, was used to analyze the interview data. The interview study was used to establish how PI is currently being managed across multiple devices. PI types considered in this study included email, calendar events, document files and media, such as images and video.

The interviews were conducted with ten academic staff and postgraduate students from the Department of Computing Sciences at the Nelson Mandela Metropolitan University (NMMU), using purposive sampling based on the participants' computing knowledge and experience, and their use of multiple devices for PIM. The participants ranged between 21 and 50+ years of age. All participants had at least six years

of computer experience and all but one participant managed their PI daily using a digital device.

Four main questions were asked in the interview regarding PIM across multiple devices, which included the following:

**1. How many digital devices do you currently use to store PI?**

*Sub-questions:* What type of device is each of these? What platform(s) does each device use? Which is the main device for managing PI? If you travel, which device do you take with you? Are your devices used for personal or work information or for a combination?

**2. How do you currently manage your PI across these devices?**

*Sub-questions:* If you need information on one device that is stored on another device, how would you go about this process? Do you make use of a file manager or email to manage PI?

**3. What problems have you experienced with managing your PI across these different devices?**

*Sub-questions:* Do you have any difficulty in managing information on different devices? Do you have any problems with the file manager you use (if any)? Do you have any problems with other methods you use to manage your PI?

**4. Do you have any ideas on how better to manage your PI across these different devices?**

*Sub-questions:* Have you heard of Team Viewer or Dropbox? Do you have any ideas on managing your PI other than using removable drives for file transfer? Would you like a tool that would provide an overview of your PI across your different devices allowing access to this PI? If you would prefer such a tool, would you prefer it to be an application installed on your device or a web-based application that you would use in a browser?

### 3.2. Results

The transcripts of each interview were analyzed with NVivo 10 software (www.qsrinternational.com), using coding techniques to identify themes within the data. The results of the data analysis are described in this section.

**Keeping (Storing): The number and combination of devices and platforms exacerbate the current PIM situation.** The participants of the interview study made use of various devices to manage their PI. Most participants of the interview study used at least three devices for PIM, with a few participants using five devices for PIM.

All participants of the interview study used a desktop computer provided by the university for PIM or work-related activities. Additionally, all participants commented on using their devices for a combination of personal- and work-related activities. Nine participants made use of their mobile phone for PIM and eight participants had a desktop computer at home that they used for PIM. Six participants made use of a laptop for PIM.

Nine participants had a combination of devices which made use of different platforms. Five participants considered their desktop computer at the university as their

main device used for PIM and work-related tasks. Four participants considered a combination of devices as their main devices for different purposes. Four participants mainly used a laptop when travelling and accessing their PI. Four participants travelled with their mobile phones or netbook computers.

**Management: Participants make use of email for access, removable drives for additional storage and transfer, and file managers for organization.** Participants mainly used different combinations of methods to manage their PI across their different devices. Participants still currently make use of email to access information on one device from another. Participants also mentioned using removable drives either continuously or at some stage for managing PI across different devices.

All participants made use of the Windows Explorer folder structure provided on their desktop computers and laptop devices to organize their PI. Six participants made use of Dropbox, either as their primary mechanism for accessing information across different devices or as a back-up tool. One participant mentioned that he used the same folder structure on each device to “not get lost”:

*“I have the same folder structure; it's more or less the same. So when I take something in my ‘paper folder’, I just put it on my ‘paper folder’ at home. I have that in order not to get lost, because if you have a general folder structure, you will be confused at a certain point of time.”*

**Retrieving: Participants currently find it difficult to access PI across their devices and do not know what they will need to access in future.** Participants noted various problems in managing their PI across different devices. Participants identified that the hierarchical folder structure is restrictive mainly due to being limited to categorizing a file in a single folder:

*“Finding stuff can sometimes be a problem, or, ‘I know I took a photo of this, but now where did I put it?’ I actually had that problem the other day, because when I take the stuff off my phone, I don't always put it into the correct place.”*

Participants experienced problems with naming folders appropriately, especially when backing up information and organizing different versions of PI items. Other issues identified involve versioning issues, having to remember to update folders with the latest files and problems with inconsistent structures between different devices. One participant also mentioned not being able to view information in different ways:

*“I organize my photos by dates, events and places, but that gets mixed up sometimes. If I want to have it by date and by location it's difficult. If, for example, for our holiday trips to Knysna, I can't remember what year it was, then it's a pain to go and search each year and check the photo. And then if you do it by location, if you want to find everything that happened last year then you have the other problem, or with people, ‘view all the photos that have my little girl in it, that's my bulldog.’ Then you have to go and search all the folders...”*

Eight participants identified that Dropbox mainly suffers from the same limitations as the Windows Explorer folder structure. Participants identified that a problem with using various methods for organizing files across different devices is that one is re-

quired to know beforehand what information is needed to be accessed. A participant noted that he would like all his information to be available:

*“...I will most certainly not know beforehand, and I would prefer everything to be available.”*

Participants identified that it is difficult to keep record of different versions of the same PI item. Participants found problems with the email structure and other file structures not being able to communicate, and that email items and other items cannot be linked or associated, as one participant explained:

*“It would be quite a cool thing if you had this integrated view of all your information, because here you've got the email system, which is one system, and then you've got your file structure on a particular device, which is another system, and yet there could be connections between individual emails and a topic.”*

One participant described a problem he had recently experienced involving accessing information:

*“The other day I needed a file. I was at home and my Internet was giving me hassles. I can VPN from home into this PC fairly easily, if I have the Internet connection. And there I'm sitting; I can't get hold of that file. So, I had to drive in to come and fetch a file here, to go back and work on it. So, that's the kind of problem: having no real time, online access to certain information.”*

Four participants mentioned the information fragmentation problem, some in terms of examples, including the following scenario:

*“Here is where things get tricky, because I've got photos on my phone, I've got photos which are on the office PC, and I've got photos on my laptop. In addition, my wife's netbook has got photos on as well, and one can't easily aggregate them together. You can try and bundle them together but they are so massive, you can't really forward them easily by emailing, so you've got to use a memory stick. Even working across my WiFi network at home would be a bit slow.”*

**Viewing: Participants need an IV tool installed on their devices which provides a single UI to facilitate an overall view of their cross-device PI.** This requirement is also supported by literature [7], [8]. Four participants noted that if there was such a tool, they would like it to provide some sort of automation in organizing their PI. Participants preferred the tool to be a native application installed on each device, as a browser may provide limitations for such a tool.

Participants provided various suggestions on how better to manage PI across different devices. Participants suggested a search tool, which is capable of searching across different devices to find information. One participant suggested a tool which would intelligently “think” for the user:

*“...Maybe also it would remember the things that I did the most, and pre-fetch stuff for me. Rather than saying, 'ok I'm going to give you all this stuff' but 'ok I'm rather going to give you pre-fetched stuff, that I'm watching you and seeing what you're doing', and that would be a cool thing. To be able to see what's there, which I can't*

*do, I can't access the stuff, and I also can't see what's there. I can't picture it. In fact...I can't visualize it."*

## **4. Design Implications**

Several design implications were identified for the IV tool suggested in Section 3.2. These design implications are categorized according to organization, visualization and interaction.

### **4.1. Organization**

1. *Provide a virtual storage solution that aggregates PI in a single location.* There is currently limited support for accessing PI across different devices. The virtual storage solution could allow the PI to reside on the original device but aggregate references to PI items, which could be accessed when the different user devices are connected, as suggested in [10]. This could address the issues identified by participants that they are unsure beforehand which PI items will be needed.
2. *Provide support for association of linked PI items.* Supporting linking of PI items could assist with version control of PI. Support for PI item association as used in Phlat [11], could also address the issue of not being able to link items of PI collections in separate applications.
3. *Provide tagging to assist with retrieval.* Tagging PI items could also assist with version control. Manually and/or automatically tagging PI items could assist with re-finding information when searching, as used in Phlat [11].
4. *Include additional facilities other than general PI types.* In addition to the common PI types, email and contacts were regularly mentioned in the interview study. Contact management is another important task of PIM which should be supported [5].

### **4.2. Visualization**

1. *Make use of a single UI to visualize PI across different devices.* All participants described scenarios where they experienced information fragmentation problems and nine welcomed the suggestion of a tool that provides a single UI to visualize PI across several devices. Systems, such as Phlat [11] and ZOIL [7], provide a single UI for different PI types, but do not fully support cross-device PIM.
2. *Visualize PI using suitable IV techniques.* It was identified that the list and indented-list may not be suitable for viewing PI. Suitable IV techniques could address the restrictive nature of the hierarchy and its ineffective use of screen space. Timelines have been used in various PIM systems, including VizMe [8].
3. *Provide different PI views.* Participants noted that only having one view of their PI is not sufficient and that the proposed tool should provide different PI views. It

was suggested that while time is useful for PIM, it should not be the only aspect considered [12].

4. *Consider each device's constraints.* Eight participants managed their PI across at least three devices. Thus, UI plasticity should be considered to ensure that the UI design will support several different devices. [13].

### 4.3. Interaction

1. *Provide intelligent searching across devices.* In addition to the IV techniques used to support browsing, intelligent searching of PI also needs to be facilitated. A combination of keyword searching, in-text searching and filters, as used in Phlat [11], could be used to allow searching PI across different devices.
2. *Provide support for file sharing and collaboration.* The current hierarchical organization method, with the exception of tools such as Dropbox, does not support file sharing or collaboration, but needs to be supported by the proposed tool [14].
3. *Provide full functionality associated with PI items.* Due to the information fragmentation problem, if an item cannot be viewed, it cannot be accessed. The full functionality of each PI item should be facilitated, as supported by ZOIL [7].
4. *Support immediate access to PI items.* The proposed tool should provide instant access to PI items if the device(s) are available, and could possibly include offline accessibility of certain PI items. Additionally, the UI delay problems experienced using Phlat should be avoided [11].

## 5. Conclusion

An interview study was conducted to determine how users currently manage PI across different devices and the problems that are experienced with PIM. A limitation of the study was a small sample size (n=10). Participants made use of various combinations of methods to manage their PI across multiple devices. The most popular methods included the use of Email, the folder structure, removable drives and Dropbox. The participants of the interview study identified a number of problems in managing PI, mainly attributed to not being able to view and access PI across different devices. The suggestion of an IV tool to support access to PI across multiple devices received a positive response. The results of the interview study were used to propose several design implications for organization, visualization and interaction. Future work will involve the design of an IV tool to visualize a user's PI across multiple devices, using suitable IV techniques.

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