Integrating Place and Time with Tasks: Adding Transportation to PIM

Stephen Lackey
University at Albany, SUNY
Albany, NY 12222
SL239263@albany.edu

ABSTRACT

Personal Information Management research has examined the development of applications and data structures to overcome human limitations in memory and cognition. Transportation researchers have struggled with analyzing transportation activity, an intermediate good derived from fulfillment of scheduled appointments and task completion. Recent work has explored the promise of mobile computing to improve task efficiency by bridging the gap between needed information and the physical location of the user. This paper argues that spatial-temporal extensions to personal information data document are essential to improve the efficiency of task completion and coordination.

Categories and Subject Descriptors

H.3.3 [Information Storage and Retrieval]: Information Search and Retrieval.

General Terms

Design, Human Factors, Theory

Keywords

Personal Information Management, Activity Analysis, Task management, Time, Personal Workflow management

1. INTRODUCTION

This proposal presents a framework that builds on research in Personal Information Management, Mobile Computing, and transportation Activity Analysis. Extensions of familiar PIM tools will improve management of tasks, time, and transportation resources to improve awareness of the travel and costs of commutes. Interfaces to external data sources enable opportunities for resource discovery and savings to improve the efficiency of task completion.

Computing tools have been seen as an effective way to overcome the limitations of human memory and manage the complexity of modern life [1]. The emphasis on Personal Information Management (PIM) has focused on its role as memory extension- to replace the task of remembering information with merely remembering how to find it. These tools have remained comparatively unchanged since their origin with Personal Computers in the early 1980's. PIM tools and methodologies have sought to improve the capture, organization, and retrieval of information deemed useful to further the goals of the individual.

The classic PIM applications have merely extended traditional work patterns [2,3]. Components typically include a list of addresses, a list of calendar items (appointments), a Task List, and a list of individual, free-form text notes. In electronic form, these are treated as separate applications, with separate data stores. These information sources are fragmented into "information islands", duplicated between multiple applications or devices, with minimal connections between these islands. [4,5]

This separation is further exacerbated by the differing contexts of information use; user information needs are not limited to the availability of stationary computing resources, but while mobile as well [6]. While this has advantages of simplicity, the reusability of personal information is limited at best. Data portability between PIM applications has proven limited due to a lack of open standards between applications.

PIM tools have focused storage and retrieval tasks within these "islands", where the data stored there serves as reminders of tasks and appointments. As few as 14% of needed "to-do" tasks may be organized as lists of any sort, and completed less than 80% of the time [7]. Routine, essential tasks tended to become encoded in habit, rather than recorded. The result is an excessive reliance on memory, which can quickly become overburdened. Habit can become inefficient as the user's operating environment changes. The task of traditional PIM has been to balance the task of merely extending memory without overloading it, a balance that has proven to vary by individual and work context.

2. RELATED WORK

2.1 Managing Personal Tasks and Workflows

Research has begun to focus on task management as a deficiency in traditional PIM tools. Task lists have proven to be effective reminders of critical tasks [7], with appropriate cues effectively limiting errors [8]. The occurrence of errors in task completion recognizes the divisibility of tasks into subtasks, and the need to explicitly manage the workflow of discrete tasks to reach desired objectives.

A primary shortcoming of PIM tools is their inability to accommodate the process-orientation of daily activities [9]. Though addressed in Project Management and Workflow Management processes [10], this capability remains virtually unknown in PIM tools. Though appointments, tasks, and addresses remain essential items to record and retrieve, the realization of relationships between these PIM items remain an essential yet missing component in task management [11].

Workflow management in the completion of larger tasks emerged from Computer Supported Collaborative Work (CSCW) research, but focuses on multiple actors in a workplace setting, as embedded in business functions. Personal workflow management research has emerged from directions as diverse as Grid Computing and Mobile computing. These projects share a common thread in the realization of tasks as aggregates of separate functions that require the coordination of external resources under constraints. However, work to associate tasks with locations has been limited.

2.2 Activity Analysis

Research in Personal Information Management and Task Management has focused on reminding the individual about tasks and appointments, while the transportation literature has examined the roles of personal activities in generating trips. Transportation is primarily a derived good; demand is based on its role in fulfilling external objectives. Unlike PIM efforts, activities are seen as highly location-dependent, constrained by time.

Hägerstrand [12-15] first discussed the importance of "time bundling" to find common corridors for transportation in his urban studies. He further stresses the limitations on activities based on time and location via the "time-space prism" model. Therein, location and transportation mode constrain the range of possible activities that can be completed within a fixed amount of time. The constraint of time on activity has reemerged in the 1990's within transportation research with the emergence of Information Technology tools that promised the ability to manage the complexity of coordinating and scheduling activities.

Time is a finite resource. Though it cannot be controlled, tasks and goals can be ordered to better use time and other resources towards greater efficiency. Currently, tools such as Personal Information Management programs, and appliances such as Personal Digital Assistants or Smart Phones have been created to augment human memory, to act as reminders of appointments and tasks prior to deadlines. However, these tools serve as reminders of a linear sequence of fixed events, rather than aid in the sequencing of flexible activities under constraints.

The concept of a Travel Time Budget (TTB) has emerged as a pool of time that travelers have been willing to allocate to travel in the course of making lifestyle choices in housing and work locations, though various demographic and employment factors constrain this budget. Since initial formulations in the early 1980's [16], the support for Travel Time Budgets has remained consistent. The existence of said budgets reinforces both the notion of a "time-space prism" model and the need to optimize activities within these constraints.

2.3 ATIS and Activity Management

More recent developments in Advanced Traveler Information Systems (ATIS) have sought to incorporate current developments in Information and Communication Technologies (ICT) in improving the effectiveness of trips [17]. These tools have begun to investigate opportunities to incorporate ICT to replace travel. ATIS seeks information about travel in progress to reduce the time between activities, allowing a greater number of activities within a fixed time period.

ATIS research has a limited focus of ICT to alter travel behavior [18]. Its focus on "telecommunications" may limit its understanding of the applications of ICT in not only voice and e-Commerce, but applications in coordination and collaboration which permit opportunities to gather and share information. The substitution of travel with ICT use remains unclear; though ICT use occupies a growing share of personal time, the link between activity and physical location has diminished [19], and some ICT use has no physical counterparts.

Incorporation of ICT with personal task management and external information such as ATIS or public transportation schedules hold the promise of clustering activities by location and travel corridors [17]. Clustering of activities would permit the reduction of vehicle trips and the overall efficiency of the transportation network.

2.4 Mobile Computing and Communications

Personal Digital Assistants (PDA) and Smart Phones have been widely embraced as means to help manage our daily affairs, despite their oft-cited limitations [20]. Activity and location have been found to comprise up to 70% of mobile communications, with discussions about activity twice as likely as those about location [21]. Mobile communications differ by urgency or spontaneity, and brevity [2].

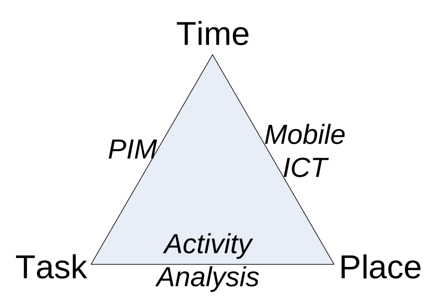
Mobile ICT research in optimizing travel effectiveness have focused on the use of task reminders. Through mechanisms such as a "Geofence", events such as approaching a location are designed to trigger reminders to perform an associated task [22,23]. Subsequent findings have held that location-based reminders were perceived as less useful than time-based reminders [24]. Time reminders remain a standard feature of PIM Calendars, where travel time may be implicit in the setting of the ubiquitous "Alarm".

These findings conflict with ATIS and Activity Management efforts in using location as a means of clustering tasks. Where ATIS and Activity Management focus on locations and the activities available, the Task or To-Do list focuses on deadlines alone. This indicates the difficulty in task decomposition, or the inability to relate place and time with tasks.

3. Conceptual Framework

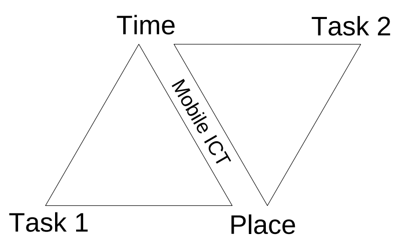
The simplified conceptual framework proposed here attempts to reconcile the contrasting goals of PIM, Activity Analysis, and Mobile ICT. Notably, the PIM focus on Time and Task overlaps the Activity Analysis focus on Task and Location. Mobile ICT in part focuses on delivering services based on time and location.

Figure 1: The Proposed Conceptual Framework



Though imperfect, these linkages between PIM, Mobile ICT, and Activity Analysis had lacked explicit treatment, despite a growing body of research which implicitly overlaps these areas. In a sample Task modeled in Figure 1, attributes of time and place are included. Tasks may have a range of locations and times where they can be performed. However, tasks as currently defined may be part of a workflow, which unifies tasks set in separate places and times. Location and time assignments to tasks would enable the realization of the goals of Activity Analysis, in merging tasks by location to minimize travels.

Figure 2: Tasks arranged by time/place overlaps



Within the framework, it is considered that Mobile ICTs that facilitate the management of tasks within times and places would be needed to further manage the workflows that intersect there. Research tools that enable "geofencing" [22,23] implicitly suggest tasks from separate workflows to combine with the one currently being followed, using opportunism to improve task efficiency rather than explicitly planning for it.

4. CONCLUSION

This work attempts to bring together divergent research in Mobile ICT, Activity Analysis, and Personal Information Management within the context of Transportation. The addition of location and time attributes with tasks has received brief reviews in the context of Mobile ICT. Standardization of these attributes may prove an essential component in Personal Information Management.

Research into Personal Workflow Management has emerged as a means of enabling workers to make sense of recorded information in Mobile ICT, owing to their greater constraints. Improving task management capabilities would offers greater responsiveness to changing circumstances during task execution. Though traditional PIM software has limited ability to manage workflows, assisted management of tasks and schedules via Mobile ICT remains a source for substantial improvement.

Transportation research has long understood that travel is based on its role in meeting external objectives. Despite a growing interest in traveler activities as a source of travel demand, users have lacked the infrastructure and ability to integrate transportation considerations into the individual decision processes. Spatially-encoded PIM data holds the promise of reducing travel demand and increasing the effectiveness of trips taken.

Personal Information Management has long been seen as burdensome and application-specific, particularly in the context of Mobile ICT. Replacing today's "information islands" with data interchange standards, or even a centrally-shared data structure, would permit greater data sharing between various PIM tools. The addition of time and location attributes would improve task and time management within PIM systems, while permitting greater responsiveness during task execution. Real time monitoring of time and location would enable the goal of access to the right information at exactly the right time and place, improving effectiveness in task completion.

5. ACKNOWLEDGMENTS

This work has emerged from a dissertation in progress, to help understand information barriers faced by travelers in utilizing mass transit despite stated preferences. I am grateful to Catherine Lawson, Eliot Rich, Sandor Schuman, and James Looby for their insights.

6. REFERENCES

[1] D.C. Engelbart, *Augmenting Human Intellect: A Conceptual Framework. Summary Report AFOSR-3223 under Contract AF 49 (638)-1024, SRI Project 3578 for Air Force Office of Scientific Research*, Stanford Research Institute., 1962.

[2] G. Schrott and J. Glückler, "What makes mobile computer supported cooperative work mobile? Towards a better understanding of cooperative mobile interactions," *International Journal of Human-Computer Studies*, vol. 60, May. 2004, pp. 737-752.

[3] J. Gwizdka and M. Chignell, "Individual Differences in Personal Information Management," *Personal Information Management*, University of Washington Press, 2007.

[4] W.P. Jones and J. Teevan, *Personal information management*, 2007.

[5] D. Elsweiler, "PhD: Thesis - "Supporting Human Memory in Personal Information Management"," University of Strathclyde, 2007.

[6] P.L. Mokhtarian and C. Chen, "TTB or Not TTB, that is the Question: A Review and Analysis of the Empirical Literature on Travel Time (and Money) Budgets," *Transportation Research Part A*, vol. 38, Dec. 2003, pp. 643-675.

[7] V. Bellotti, B. Dalal, N. Good, P. Flynn, D.G. Bobrow, and N. Ducheneaut, "What a to-do: studies of task management towards the design of a personal task list manager," *Proceedings of the SIGCHI conference on Human factors in computing systems*, Vienna, Austria: ACM, 2004, pp. 735-742.

[8] P.H. Chung and M.D. Byrne, "Cue effectiveness in mitigating postcompletion errors in a routine procedural task," *International Journal of Human-Computer Studies*, vol. 66, Apr. 2008, pp. 217-232.

[9] S. Hwang and Y. Chen, "Personal Workflows: Modeling and Management," *Mobile Data Management*, 2003, pp. 141-152.

[10] H. Tarumi, K. Kida, Y. Ishiguro, K. Yoshifu, and T. Asakura, "WorkWeb system--multi-workflow management with a multi-agent system," *Proceedings of the international ACM SIGGROUP conference on Supporting group work: the integration challenge*, Phoenix, Arizona, United States: ACM, 1997, pp. 299-308.

[11] E. Falke, "The associative pda 2.0," *CHI '08 extended abstracts on Human factors in computing systems*, Florence, Italy: ACM, 2008, pp. 3807-3812.

[12] T. Hägerstrand, "Reflections on "what About People in Regional Science?"," *Papers in Regional Science*, vol. 66,

1989, pp. 1-6.

[13] F. Snickars, *Dynamic Allocation of Urban Space*, Saxon House, 1975.

[14] K. Ellegård, “A time-geographical approach to the study of everyday life of individuals – a challenge of complexity,” *GeoJournal*, vol. 48, Jul. 1999, pp. 167-175.

[15] T. Hägerstrand, “Space, time and human conditions,” *Dynamic allocation of urban space*, 1975, pp. 3–12.

[16] B.P. Bailey and S.T. Iqbal, “Understanding changes in mental workload during execution of goal-directed tasks and its application for interruption management,” *ACM Trans. Comput.-Hum. Interact.*, vol. 14, 2008, pp. 1-28.

[17] K. Vaughn, M. Abdel-Aty, and R. Kitamura, “A framework for developing a daily activity and multimodal travel planner,” *International Transactions in Operational Research*, vol. 6, 1999, pp. 107-121.

[18] *Managing Demand Through Travel Information Services*, U.S. Department of Transportation Federal Highway Administration, 2004.

[19] S. Shaw and H. Yu, “A GIS-based time-geographic approach of studying individual activities and interactions in a hybrid physical–virtual space,” *Journal of Transport Geography*, vol. 17, Mar. 2009, pp. 141-149.

[20] J.A. Fails, A. Druin, and M.L. Guha, “Collocated mobile collaboration,” *Proceedings of the 27th international conference extended abstracts on Human factors in computing systems*, Boston, MA, USA: ACM, 2009, pp. 3495-3496.

[21] F.R. Bentley and C.J. Metcalf, “Location and activity sharing in everyday mobile communication,” *CHI '08 extended abstracts on Human factors in computing systems*, Florence, Italy: ACM, 2008, pp. 2453-2462.

[22] P.J. Ludford, D. Frankowski, K. Reily, K. Wilms, and L. Terveen, “Because I carry my cell phone anyway: functional location-based reminder applications,” *Proceedings of the SIGCHI conference on Human Factors in computing systems*, Montréal, Québec, Canada: ACM, 2006, pp. 889-898.

[23] N. Marmasse and C. Schmandt, “Location-Aware Information Delivery with ComMotion,” *Handheld and Ubiquitous Computing*, 2000, pp. 361-370.

[24] A. Kessell and C. Chan, “Castaway: a context-aware task management system,” *CHI '06 extended abstracts on Human factors in computing systems*, Montréal, Québec, Canada: ACM, 2006, pp. 941-946.