On the adoption of groupware for large displays: Factors for design and deployment

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ABSTRACT
Groupware systems on large displays are becoming increasingly ubiquitous in the workplace. While these applications face many of the same challenges to adoption as conventional desktop-based groupware, the public and shared nature of these systems heighten these challenges as well as present additional difficulties that can affect adoption and success. Our field study of seven large display groupware applications (LDGAs) uncovered several factors of their design and deployment that influenced their adoption and usage within the workplace.

Keywords
Large displays, groupware, collaboration, adoption patterns

INTRODUCTION
In his seminal CSCW article, Grudin outlined a number of challenges for the successful creation of groupware applications [1]. In the realm of LDGAs, we have found that common characteristics of these systems that distinguish them from desktop applications heighten the existing challenges and present new ones. Four of these characteristics are:

- *Form factor* – The size and visual impact of large displays cause users to perceive and interact differently.
- *Public audience and location* – The location in shared space affects the amount of attention users direct at LDGAs as well as the visibility and privacy of interactions.
- *Not in personal workspace* – The location outside of users' personal workspaces affects the amount and type of interaction and exploration in which users engage.
- *Not individually owned*—The lack of personal ownership of LDGAs affects the extent to which people use them or interact with the content.

We conducted a study involving three different groups: a) researchers working on LDGAs b) members of workgroups in which LDGAs were deployed, and c) salespeople for a corporation that produces large displays and LDGAs. Our goal was to identify common factors affecting the success of adoption of these applications. Our study entailed face-to-face interviews, telephone interviews, and observations of seven systems that had had varying success in being adopted into normal workgroup tasks.

FACTORS AFFECTING THE ADOPTION OF LDGAs
Our research uncovered five important factors that were common across many of the systems we studied. Each stemmed from the four common characteristics of LDGAs that we identified. The factors are a combination of technical and social issues that influence system design as well as techniques for deployment that affect adoption and usage.

1. Task specificity and integration
The value and usefulness must be more evident than for conventional groupware because users may spend less time exploring and experimenting with LDGAs.

In many LDGAs, the specificity of the tasks involved was crucial to the adoption of a tool that seemingly supported general collaboration practices. Systems introduced for the sake of promoting specific collaboration or information sharing tasks generally were more successfully adopted than those introduced for general collaboration purposes. Tools designed or deployed to support specific tasks were more likely to be successful if they either deployed for a task for which their use was critical or a task whose content itself was critical to the user. In one example, professors teaching certain classes chose to make use of a collaborative display for teaching and class discussions. The use and interaction with the technology was critical for the tasks of taking or teaching the class; students taking the class used the display not because they were required or told to do so, but because it was deeply integrated into critical tasks involved with being a part of the class. In another case, an LDGA was introduced and adopted for space exploration planning, a critical task whose inherently collaborative nature increased scientists' ability to carry out the task efficiently.

2. Tool flexibility and generality
LDGAs that support general collaborative practices may be adopted by new user groups or for novel tasks because of their high exposure and public and shared nature.

Although LDGAs introduced for specific tasks or tightly integrated with important tasks have had good success in being adopted, we have also observed the value of broad and

flexible collaboration support in their design. Most successful systems we observed provided support for a breadth of different practices that people employ to collaborate, even though the systems were deployed to support specific tasks. In short, tools that offer a variety of interaction methods that users can select as needed have been more widely adopted than those that lock users into very specific interactions.

A flexible tool that is deployed to support a specific task may be also appropriated for other tasks as people realize the tool's potential. A system that supports a broad set of collaborative practices may be used beyond its intended purpose. In one case, a tool designed to help visiting scientists collaborate was appropriated by teams of resident engineers because it provided them with general tools for creating shared digital artifacts as well as an easy method of distributing documents among users.

3. Visibility and exposure to others' interactions

The interactions of others demonstrate usage and value because the form factor and public nature of these applications can make user behaviors highly visible.

Although certain features existed of which users were aware, they were exposed to the potential value of the features after observing others making use of them. In one particular instance, the item forwarding feature of an information sharing application in an LDGA existed in the interface for approximately three months before it received use. Though the feature was highly visible and people were aware of it, users did not perceive it as useful until they saw others using it. Through seeing people forwarding items and possibly from receiving forwarded items, users began to use that feature and it became widely adopted. Because large displays are perceived as more public than desktop systems [2], the value of exposure to others' interactions on LDGAs can influence usage and the perception of value.

4. Low barriers to use

Barriers must be low so users can quickly discover value because LDGAs may be less amenable to exploration and have a lower frequency of use than desktop groupware.

It is important that users be able to interact successfully and easily with the system early in their usage in order for the system to be adopted into normal tasks. Systems that require significant time to install or configure, have time-consuming steps to initiate use, or have functionality that is not visible tend to find small audiences or a drop in usage after the initial deployment. In one application that requires user-submitted content, users have the option of posting information via a web form or an email address. Because email is perceived as quicker and easier than going to a form and filling it out, it is often used to post, while the web form is not. Another system that requires users to install and configure an application on their desktop machines in order to use the LDGA is used by only a small portion of its workgroup, despite a steady, long-term deployment. The researchers attributed this to the lack of an easy installation process.

5. Dedicated core group of users

Advocates and a core set of users early on help others to perceive usefulness and reduce hesitancy to use the system stemming from their form factor and location.

With all groupware applications, achieving critical mass is crucial to adoption [1]. Because LDGAs are generally less amenable to exploration and experimentation than desktop groupware, they are more likely to fall into disuse soon after deployment. Researchers who developed systems that were not very task specific found that adoption was aided by having a dedicated core group of users early in the deployment. This group, which often included the researchers, used the system regularly and encouraged usage by others after the initial burst of "novelty use" died down. Continued use by the core group ensured that displays remained dynamic and content fresh rather than stale. The perception that displays were being used and viewed encouraged further adoption into everyday use by a wider audience. Additionally, the core group advocated others' use by directly encouraging others to use the applications. For one application designed to share user-submitted items, core users encouraged coworkers to post information onto the displays that they had previously emailed to others. This encouragement was positive feedback to the senders of the information and helped lower initial hesitancy they felt about interacting with a new system, both technically and culturally.

FUTURE WORK AND CONCLUSIONS

The shared and public nature of LDGAs poses unique challenges for their design and deployment in addition to the challenges faced by conventional groupware. By surveying several systems, we identified some common factors affecting their success of adoption. Future work includes applying these lessons to our own LDGAs and refining our findings to better understand the dimensions, roles, and usage of these systems within workgroups.

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