Cultivating Practice & Shepherding Technology Use: Supporting Appropriation Among Unanticipated Users

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ABSTRACT

Previous work has shown that the successful appropriation of technology into practice depends heavily on users’ understandings and narratives around the technology’s use. Who drives the successful appropriation process is still ill-defined within the literature. In this paper, we present a case study conducted in a research university, using interviews to understand staff practices and technology appropriation within their work contexts. We found that the successful appropriation of collaborative IT relies on the invisible work conducted by those people within groups who formally or informally aid their colleagues in the successful ‘cultivation’ of practices and sensemaking around technology—people we call shepherds. We draw parallels to other work that suggest the need for similar types of agents and close with a dialog concerning the challenge of establishing shepherding practices within large organizations.

Author Keywords

Appropriation; ecologies; practices; training; collaboration.

ACM Classification

H.5.3 [Information Interfaces and Presentation]: Group and Organization Interfaces – Computer-supported cooperative work.

General Terms

Human Factors; Design.

INTRODUCTION

The adoption and subsequent use of collaborative information and communication technologies (ICTs) have long been topics of interest to CSCW since its inception. A number of studies have explored barriers to the success of CSCW tools within organizations [17,18,19,33]. Such barriers include critical mass [17,19] and the disparities between those who will benefit from applications and those who must do additional work to support its use [17,18]. CSCW has also examined how technology plays a role in a number of different contexts such as traditional workplace settings, online communities (e.g., Reddit), and social networks (e.g., Twitter, Facebook, etc.).

Of particular interest in this current research is the way in which technology is successfully incorporated into everyday practice (appropriation) within large organizations and identifying the key players who support this process. Specifically, this work explores the appropriation of two collaboration toolsets that support collaborative activities among administrators and office workers within a university setting. The first system, CTools, is a learning management system (LMS) that had been unexpectedly appropriated by the staff population. The other toolset was the Google suite of collaborative tools (primarily Docs/Drive and Sites), where staff were anticipated users. In uncovering why and how these systems were appropriated, a theme emerged—that certain individuals who would be influential in the process of adoption, cultivation of practices, and leading others in using (and learning to use) IT in the workplace would emerge.

Given the very different natures of the two systems’ arrivals into the university at large and the vastly different circumstances for staff’s appropriation of them, we use these two systems as parallel case studies for exploring the appropriation of technology and identifying the key agents in appropriating technology. We base our work in the appropriation literature—particularly that of Orlikowski [36, 37] and Draxler [10-12]—as well as through Nardi & O’Day’s information ecologies framework [33], which frame our findings of limited appropriation practices due to the lack of system knowledge and training, revealing a lack of social agents to discover and promote alternate practices. Our findings reveal the need for leaders in the appropriation process (which we call shepherds). We discuss parallels between our own work and Orlikowski’s work [38] over two decades prior to this paper, showing that shepherding and knowledge about IT continue to be issues in the appropriation of technology into practice for both target users and unanticipated users. We close by generalizing the issue of shepherding to other contexts and asking questions about who should be tasked with the creation of shepherds and how we might assist users of ICTs in becoming knowledgeable in re-appropriating their tools.
RELATIVED WORK

Interpretive flexibility [37,40,41], which suggests that users are in control of creating narratives around the use of technology, results in the observation that all objects are open to interpretation. One example of interpretive flexibility comes from Madge et al. [31], who describe multiple possible interpretations of Facebook among educators, researchers, and students. Specifically, it can be interpreted as a potential environment to support teaching/learning. However, the authors found that college students interpreted it as a space for social interaction and not as a desirable learning space.

Compared to rigid technologies, flexible ones lend themselves to multiple interpretations and thus potential and existing users’ interpretations of this technology may lead users to create narratives about its use—in turn, these narratives may lead to ICTs being implemented in ways that evolve over time [2,7,21,23,49] or in ways that may not even be those intended by designers [7,11,36,37]. Appropriation is a term that has been used to capture the ways in which these interpretations result in end use.

Draxler et al. [10] described appropriation as both as “an entangled, cooperative process of searching, becoming aware, installing, configuring and learning how to use new tools” (pg. 2835) and as “the social process of incorporating objects into one’s life, including changes to the objects caused by modes of using it” (pg. 2835). Thus, appropriation focuses on the ongoing cycle whereby people adapt technology to their contexts while they themselves adapt to technological change—an act that is sometimes referred to as mutual adaptation or co-evolution [7,8,9,16,29,45]. As a result of the agency the people exert on technology use, appropriating technology is partly a matter of enacting practices and structures through technology use [39]. In this paper, we focus on appropriation as a process of emergently adapting the use of technology. This process keeps technology relevant to emergent contexts while also acknowledging the agency of the people using technology. This process also results in appropriation by unanticipated users [43] and bystanders [13], users whose appropriations emerge despite not being the primary targeted user.

Though there are benefits to being able to adapt technology and practices, doing so requires effort on behalf of ITC users and stakeholders. Kling and Lamb assert that articulation work [25] is needed to make IT work and that users conduct this work, acting as social agents within their organizations [27]. Draxler and colleagues have similarly shown that the configuring and re-configuring these systems is a form of collaborative articulation work that occurs tangentially to the actual work being done and that these activities are an important part of appropriation [10-12].

What remains unclear from the points above are the necessary pre-conditions to successful appropriation and who plays the primary roles in ensuring appropriation work is occurring. The lack of clarity is due to two issues in the problematization of the appropriation process: first, there is an unclear definition of successful/unsuccessful appropriation. The second issue are the numerous, conflicting, and sometimes overlapping characterizations of actors that various researchers in CSCW and IS have proposed as crucial to appropriation work.

The importance of sensemaking and knowledge in the appropriation of technology is highlighted both by sensemaking successes and failures that impact the ways in which ICTs are appropriated. MacLean [30] gives an example of an organizational success, where the existence of a ‘tailoring culture’ encouraged tailoring activities and the sharing of expertise, thereby allowing the system to be appropriated by users at many levels of expertise. Implicit in this finding is that users in the organization understood the system and thus were able to appropriate it. Okamura [35] proposed that users who act as mediators can successfully affect organizational use of ICT when they adapt a new collaborative technology to a context, modify the context, and support ongoing changes to the technology and context over time.

One example of an organization facing barriers to successful appropriation work is described in Orlikowski’s study [37] of a group in an organization that adopted Lotus Notes. In this work, Orlikowski shows the importance of users’ understanding of the system in their ability to appropriate it into their practices, describing both cognitive and structural barriers to its successful appropriation. She described cognitive barriers to appropriation—that the group she studied knew very little about Notes and why it was being implemented—a result of the lack of communication from the key decision-makers and implementers to the employees. As a result, these employees had formed weak understandings and thus appropriated Notes according to these weakly developed technological frames. She wrote, “If people have a poor or inappropriate understanding of the unique and different features of a technology they may rest using it, or may not integrate it appropriately into their work practices” (pg.364). The appropriation of the toolset was also negatively affected by the lack of appropriate types of training, which only reinforced disincentives to devising ways of appropriating technology that leveraged its capabilities.

The case study presented by Orlikowski demonstrates, among other things, the importance of people who are able to develop and cultivate practices around new technology. Other research has highlighted the importance of such local expert users in the context of tailoring activities [42]. Expert users are important for appropriation by target users and unanticipated users alike, though whether such experts exist among unanticipated user populations is questionable. Unanticipated appropriators could be experts at deciphering
IT, but it is just as likely that they are at a natural disadvantage to deciphering it. In the former case, users are able to interpret technology beyond the limits of design intent despite the lack of training; in the latter case, users may not know how to re-interpret IT due to a lack of official training. Because unanticipated users are unexpected, it is also questionable whether there are local agents in formal roles who are able to undertake the kind of training work to teach technology use and cultivate practices.

In establishing the role of users in establishing technology use and practice, Nardi & O’Day [33] identified a type of user that performs mediation work—gardeners. Gardeners are defined as informal actors who “translate concepts and mechanisms back and forth between the domain of work…and the technology itself” (pg.141), often informally training others in technology use, answering questions, setting standards, etc. Gardeners, through their tinkering spirit, might also spark change and lead others through the turbulence of transitions and sensemaking about technology. In their description, Nardi & O’Day relegate their work to the realm of the invisible, work that is an aside to the main missions of group work and that is unrewarded. Given these descriptions, gardeners would be aptly equipped to assist groups in the appropriation of collaborative technologies and social media by virtue of their expertise and local knowledge of the work that occurs within their groups. In previous work, Gantt & Nardi [14] distinguished between local developers (in formal positions) to gardeners (informal positions).

In a review of Information Ecologies, Ranney [43] highlighted what was perceived to be an oversight made by Nardi & O’Day, the importance of technical communication in technology and knowledge transfer. She discusses that the concept of gardeners overlaps with the field of technical communicators, practitioners who are involved researching and documenting various technical processes and products and sharing this knowledge to some audience. Technical communicators, in essence, have the power to design the kinds of human-human or human-information interactions that will help users in appropriating technology.

It is important, when considering users—either target users or unanticipated ones—to consider the process of appropriating technology as one that is collaborative and conducted by its users when they act as social actors within their organizations, exerting their agency while limited by structural components of the organization [27]. In their capacity as actors, users of collaborative systems appropriate these systems collaboratively, whether through single-user appropriations permeating throughout an organization, through designated group members, or anywhere in between [12]. This work explores both how users appropriated workplace technologies and those organizational actors who affected (or did not affect) the process of appropriation and end use of these ITCs.

**RESEARCH SETTING**

This research is concerned with unanticipated users and their appropriation of workplace technology. Of particular interest is technology use and practices among staff at a large research university, the University of Michigan. Within the University of Michigan, staff work in a ‘social world’ (borrowing the term from Strauss [48]) that co-exists with faculty and student worlds; each of these worlds has its own goals, practices, and structures in place. Staff’s work situates them in a space that supports the research and academic missions at the university with the implication that they cross boundaries between the staff, student, and faculty worlds. Staff also work in positions dedicated to the administrative needs that allow the university to function.

Staff also work within communities of practice [28,51]—communities that are at times defined by their purposes (academic, research, or administrative support) and at other times defined by their academic or non-academic departments (locally called units). These layers of membership result in a complex set of boundaries that are continually crossed as part of daily responsibilities and practices. ICTs play a substantial role in staff’s ability to work both within and across organizational boundaries.

**CTools & Project Sites**

The motivation of this research was centered on the observation that a large number of staff at our research site, University of Michigan, had adopted and appropriated a learning management system (LMS) known locally as CTools. CTools was designed to support teaching and learning in classroom settings between students, faculty, and teaching/learning content by creating a course-specific website for central course needs. The extent of staff’s mass appropriation of the CTools platform came mostly as a surprise given the design intent underlying the course management system. Only a small subset of staff was considered to be potential users—those engaged in research or helping faculty to create their course sites—and even their use was expected to be relatively minimal. In that sense, staff were unanticipated and their use is similar to that of bystanders who became secondary users [13]. Since the discovery of staff’s adoption, staff consistently outnumbered faculty in terms of the number of users and the amount of use, resulting in staff being the second largest group of users. Because of the extent of their use, staff are situated somewhere between primary and secondary users.

Within the CTools system, staff appropriated a toolset called Project Sites, a feature that allows any individual or group with university credentials to create a website that provides groups with access to the same tools found in Course Sites (shown in Figure 1, next page). Project Sites (and Course Sites) are flexible and customizable in that users are able to create a central site to meet a variety of...
needs, are able to select the tools they will use to achieve those ends, and because a number of the tools offer further options for customization.

These sites can be created for any reason and support user-content, user-process, and user-user interactions. Previous work [43] used log analyses and a values survey work and suggested that staff’s appropriation of the Project Sites toolset had focused primarily on the use of the toolset for creating group repositories for their administrative kinds of activities. This research builds on this past work, further exploring both the role that the toolset played in staff practices and who was influential in the way it was appropriated—both formally and informally.

While Project Sites are flexible and tailorable to staff’s given contexts, they are vastly different from the types of tailorable systems most commonly studied by researchers—systems that require end-user development or direct tailoring through plug-ins [10-12] and components [e.g., 52]. Instead, Project Sites lies somewhere in the middle of the tailorability spectrum, where customization of its features and applicability to various work contexts are possible, but changes to the tools themselves are not. Configuration of Project Sites happens outside of the system, through interactions and decisions made in the social milieu, rather than being supported within the system.

Ecological Transition
During the initial phases of this research, the university made the decision to shift a number of its services to Google after a central deliberation process between the university administration and the Information Technology Services (ITS) to assess a number of options—a process that had been started by the central administration as part of a strategy for growing the university IT infrastructure and which resulted in an announcement of the transition on October 26, 2012. The transition officially began on March 5, 2012 and concluded on August 31, 2012.

The ‘migration’, as it was called locally, meant that the university-supported email services would be supported by Google and the previous email interfaces would be replaced by Gmail though the university community would still be using the university-assigned credentials and email address, with the parallel effect that ITS would no longer support Outlook or Apple’s Mail client, as all users would then gain access to the Google Calendar system and all other Google tools through their pre-existing university credentials. The number of tools that were made available to the campus community at large was extensive and included (but was not limited to) Google+, Google Docs/Drive, Google Chat, and Google Sites. Because Google’s emergence into the university ecosystem was recognized as having a direct effect on the staff population, staff were in the group of anticipated users and there was a visible movement to provide training for staff.

Given the similarity between the systems’ affordances and the differences in both the conceptualization of staff as intended users and how implementation occurred, Google proved to be an opportune comparison case to Project Sites. Much like for Project Sites, we aimed to discover those formal and informal influences on how Google’s tools would be appropriated as well as uncovering the way in which these tools are interpreted.

RESEARCH PROBLEM & QUESTIONS
Project Sites and Google’s collaboration tools are similar in that they support collaboration and were optional to adopt. The difference between the two toolsets, however, stems from their transitions into appropriation, where Project Sites was appropriated in a haphazard transition that was not uniform across the university compared to Google’s tools, which emerged as options as part of a mandatory shift and a very visible campaign from ITS. The difference between the two cases suggests that staff have different degrees of knowledge prior to the appropriation process. Different people would also influence technology use and practices between contexts. These two cases highlighted the appropriation process among the same staff population from both the anticipated and unanticipated user perspectives, leading a number of research questions:

RQ1 How were Project Sites’ and Google’s toolsets interpreted and appropriated?
RQ2 How did knowledge about the two toolsets prior to the appropriation process explain how they were appropriated?
RQ3 Who were the influential people who drove technologies in the ecosystem?
RQ4 Who were the influential people who create knowledge regarding the toolsets and perform the

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1 In fact, the tools are themselves tailorable, but not from the users’ end. Tools can be changed only through intervention from its university-level developers.
appropriation work that makes sense of technology and drives its use?

METHODS
We conducted semi-structured interviews with staff at University of Michigan. Because of the size of the staff community (over 20,000 staff), we found it necessary to narrow down the scope of this study and chose to focus only on staff in office and administrative roles—staff who were critical to supporting the university’s mission to support teaching/learning and the conduct of research. As a result, we excluded staff from health-related units (Medical School, Hospital, etc.). We had also excluded staff from the Libraries/Museums as well as staff in research and IT-related job roles because prior research had indicated very little use among these staff.

We collected interviews from twenty-four (24) participants across a number of units and roles. Participants were predominantly women (19 female, 5 male) and most participants were Caucasian (19 Caucasian, 4 African-American, 1 Asian-American). While we did not collect information pertaining to age, most participants were over the age of 40. The demographics we collected suggested that our sample was representative of university demographics, thus reducing the risk of potential biases.

We collected data from roughly equal numbers of staff from academic (N=13) and non-academic units (N=11). The staff we interviewed came from Office/Clerical (N=10) and Administrative positions (N=14). All of the participants had been at the university for at least 2 years.

Analytical Framework & Analysis
Interviews were recorded and transcribed. Transcripts were analyzed using a combination of coding techniques from a coding scheme that, among other things, was sensitive to activity theory and the ecological metaphor described by Nardi and O’Day, paying attention to the concept of *keystone species*—particularly the keystone species they call *gardeners*.

Because of the influence from Nardi & O’Day, Activity Theory (AT) was used to describe the entire system of work and activities beyond the individuals we interviewed. Activity theory, according to Bryant et al. [6], addresses activity in a sociotechnical system as 6 elements that can be summarized *subjects* in a *community* engaged in activities towards a set of *objectives* that are supported by *tools, rules, and, the division of labor*.

The final coding scheme used codes that were sensitive to the above frameworks by looking for tools, tool affordances, processes being supported, influential people (formal and informal), knowledge of tools (as well as inaccuracies in this knowledge), training, and obstacles in adopting or appropriating tools.

Thirteen interviewees had opted to participate in the think-aloud task. All interviewees’ transcripts were coded for accuracy (correct understanding of tool functions) and for signs of guessing at tools’ functions.

RESULTS
Overwhelmingly, staff described that their positions were highly collaborative and required substantial amounts of communication, knowledge creation, and knowledge sharing. With regard to information sharing, they were limited to centrally-supported core systems for university records and had many choices of platforms. Among the many tools that helped staff in these practices, the CTools Project Sites and Google toolsets filled roles that supported collaboration both within and across organizational boundaries by providing central spaces for work. The following sections describe how the tools were appropriated into practice and how knowledge served as a foundation, highlighting differences in the results of appropriation that were due in large part to knowledge about the systems and being target/unanticipated users.

Appropriation of Project Sites & Knowledge

*Appropriation of CTools Project Sites*

The interviews showed overwhelmingly that staff had appropriated the CTools Project Sites toolset as a repository, supporting their ability to store and share information and documents with collaborators. Staff most often described that Project Sites supported their storage and sharing activities within the context of working in committees, groups of staff in similar roles, groups defined by their unit affiliations, and (to a lesser degree) groups that included members who were outside of the university.

In working as a central location for sharing and storing information and important documents, Project Sites were reported to have removed the burden of finding ways to share information across intra-organizational boundaries mainly because access was (and continues to be) guaranteed as long as collaborators were also affiliated with the university. Staff often noted that a CTools feature (‘Friend Accounts’) supported the crossing of inter-organizational boundaries by allowing these users to invite non-university collaborators. Other sharing media—such as servers and intranets—failed to support sharing practices when staff needed central space for sharing and storage across their unit-defined boundaries. Thus Project Sites functioned as spaces that supported the flow of information without the limitation of boundaries.

Across the interviews, it was evident that staff had been using the toolset almost exclusively for the Resources tool, the main tool that supports uploading and downloading documents through a folder-based, hierarchical structure. The hierarchical and static nature of the file systems that the Resources tool created led to three of the participants comparing sites to a ‘filing cabinet.’
Given that there were so many other available tools within the Project Sites toolset, the manner of its appropriation—which favored one tool and ignored the others—was striking. Some of the barriers to their adoption were organizational or professional—e.g., the use of the Chat tool being seen as unprofessional or the lack of critical mass to continue using a tool (such as the Schedule or Wiki tools). We similarly found that some non-tool features, like the ability to invite non-university collaborators to a site were not being used even though staff expressed their need for the features, suggesting inadequate system knowledge.

Staff were prompted to elaborate on the reasons why their appropriation of the toolset did not make use of other tools and features within the system. For the most part, staff felt that most of the other tools were not useful to them. This revealed two things: 1) this belief was held without understanding the tools and features, and 2) their belief that many of the tools were irrelevant to their needs—a belief based on a literal interpretation of those tools by their given, academically-oriented labels, not on potential uses.

Staff appropriation of Project Sites was also affected by their shortcuts in the site-creation process. Usually, staff reported that they purposefully ignored the list of tools while using and creating their groups’ sites, choosing to only consider the Resources tool. In other instances, staff had learned to ‘clone’ an existing site, which had the effect of skipping the site set-up phase, a phase that opens opportunities for experimentation. In very rare occasions, staff reported looking briefly at help documents or tinkering with the tools, but this almost never resulted in other tools being adopted. Along a similar vein, staff did not conceive of appropriating tools because of a common perception among interviewees that many of the tools were specifically designed to serve faculty and students in a classroom setting (e.g., Assignments, Syllabus, etc.).

It was not the case that all staff interviewees were unable to experiment or find ways of appropriating the system to leverage its other features. There were rare cases where staff experimented with other tools. Those tools had usually either remained in disuse, were used inconsistently, or had been abandoned. One example was the use of the Schedule tool, which a few participants had experience with; two of these participants noted that they reduced the frequency with which they updated the calendar because they were unsure whether it was helping their coordination; another participant noted that she had stopped using the tool altogether for the very same reason.

While there were general barriers to appropriating the system in ways that leveraged other tools, a minority of participants reported successes. One participant, P06 (a research administrator) noted successful use of the calendar and wiki to create an intranet for research proposals. In two other participants’ groups, they were able to successfully appropriate the Wiki tool for intranets for collaborators spread across the university.

The appropriation of Project Sites as a repository also resulted from staff’s perception that the intended use was in the classroom setting. In comparing that purpose to their own needs, staff distinguished their work and roles in the university as separate from those of faculty and students, while also confirming that they were not unanticipated users. This observation resulted in a narrative that prevented staff from appropriating Project Sites’ features that they deemed incompatible because they had never been considered outside of the classroom. Regardless, staff had uncovered a common Project Sites configuration that used only the one tool that was unanimously believed to be compatible with the design intent and their needs. The appropriation of Project Sites as a repository worked well for staff because it successfully supported key file-sharing practices. However, in misunderstanding or not knowing about these other features, staff reported wishing for functions and tools that already existed. In this sense, the appropriation of Project Sites was not as effective as it could have been.

Developing Knowledge of Project Sites

The filing-cabinet interpretation and configuration persisted for a number of reasons, but the root of these reasons could be attributed to the knowledge that staff had about the system. Because the system was not designed for their use, staff’s knowledge about Project Sites was mostly influenced by the people who exposed them to Project Sites in the first place. Throughout the interviews, staff described that they had learned about Project Sites through word-of-mouth interactions with each other and with faculty. These interactions emphasized that staff could place documents on their group’s site using the Resources tool, but underemphasized (or completely ignored) the other tools as well as other potential possibilities for use.

To further aggravate matters, staff denied receiving any other communication for new ways to appropriate Project Sites, which they suggested could improve their use of the toolset. While there was training available through ITS, staff did not realize this, thus they missed opportunities to learn to appropriate it in other ways. Staff’s appropriation of Project Sites could have grown had they experimented with or learned about the tools. However, their knowledge was limited by a lack of information-seeking. Staff reported that they did not seek out information, particularly assistance in the form of technical communications that could teach them about the tools and diversify their use of the toolset because of time pressures and the perceived lack of incentives to conduct this appropriation work in their jobs.

This lack of knowledge about tools was also reflected in the talk-aloud/card-sort task. Aside from the Resources tool, staff’s knowledge of the rest of the toolset was limited to those they had used (or attempted to use) previously—Chat, Announcements, Wiki, Calendar. The lack of knowledge and experience with tools resulted in staff having to guess
the functions of the majority of the tools. Interestingly, once engaged in the think-aloud activity, staff were somewhat accurate with their hunches about tool use with only a few exceptions—the iTunesU, Podcast, News, Modules, and Test Center tools—all of which, coincidentally, are named in ways that favor literal interpretation into intended use by students and faculty. A few staff found ways of appropriating tools while sorting and thinking aloud. P07 and P19, for example, considered using the Assignments tool to create work assignments as a way of keeping track of progress within her group.

In summary, staff’s lack of understanding of the Project Sites toolset can be attributed to the fact that they were unanticipated users who, once discovered as a dominant user group, were not adequately educated and trained in its use. Because there were no cultivators of new practices, staff remained uninformed. Even when information existed to address potential use, staff either failed to recognize that this information existed or they were too consumed in their actual work to engage in appropriation work. As a result of staff’s lack of knowledge and lack of new practices, the appropriation of Project Sites, never evolved.

Appropriation of Google & Knowledge

Appropriation of Google Tools

At the time of the interviews, most staff were still recovering from the disruptions that rippled through their units and work groups as a result of the Google email migration. Regardless, most of the staff had strong inclinations about whether they would be adopting the optional Google tools (Docs/Drive and Sites) and a number of staff had already appropriated them into their everyday practices. All staff had at least some minor exposure to Google Docs (either creating a document or receiving an invitation to one in the past), whereas only two users had started using Google Sites.

Although staff reported knowing about the existence of Google tools prior to the transition, the potential to use them became much more tangible as a result of the email migration. As staff elaborated on the affordances and benefits of the tools, they mentioned that the Google tools provided staff with lightweight office applications with the additional benefits of supporting collaborative editing and sharing as well as easy access from their email.

Drive allowed for the creation of a cloud-based drive where users could share both Google Docs and other file types. The fact that Google Drive mimicked the affordances of the Resources tool was not lost on staff, yet its adoption was limited for a number of reasons, which included the lack of familiarity with the tools, that collaborative editing was not always desirable, and because sensitive/confidential information could not be kept in cloud-storage. When staff had adopted Drive, they had appropriated it into practice as a space for storing and collaboratively editing documents. None of the staff likened Drive to a filing cabinet, like they had with Project Sites, because Drive was perceived as a dynamic space as opposed to a static space—a distinction of instability versus stability. Because of this dynamic nature, it was only reportedly appropriate for work that was in progress.

Even towards the end of data collection (2 months after the migration), many of the interviewed staff still had lingering questions about Google Docs/Drive given that these tools still felt new. Of the relatively small number of active users in our sample (less than half), it remained unclear whether staff had yet to configure Drive for creating structured repositories. A number of staff reported that their focus remained on recovering from the email and calendaring changes and that this recovery period prevented them from learning about the applications and exploring ways to appropriate them.

We expected that the tool that most mimicked Project Sites, Google Sites, was going to replace or pose a challenge to Project Site use, resulting in the latter’s disuse. Surprisingly, there were only five staff who recognized the tool and three who used this tool. The other two staff were familiar with the tool, but did not use it in their own work. The rest of the staff we interviewed either had no idea that the tool existed or they only had very vague or incorrect understandings of what Google Sites afforded. Those relatively few staff who adopted the tool, were still in the beginning stages of deciding on how to appropriate it.

Developing Knowledge of Google, Pre- & Post- Migration

Because the migration to Google was anticipated to affect the entire institution, ITS included staff as a target user group. By including staff as target users, ITS intended to consider the broader impacts on staff. In doing so, ITS developed assistance for staff for the email migration and, to some extent, training opportunities for the broader set of tools. Interestingly, this was lost on many staff, who expressed a lack of knowledge concerning how to appropriate the various collaboration tools, both pre- and post-migration. When prompted about their use of the Google tools, the two common methods were trial-and-error and hearing about potential uses from colleagues.

As part of the transition, staff were assisted in migrating their previous email to the Gmail client both by their local IT teams and by ITS. ITS went so far as to provide ‘Google Assistants’ to visit units for a day to help staff in the migration process. However staff noted almost unanimously, that they were only assisted through the email migration—a process that aided them in the technical aspect of changing tools, but which failed to both cultivate new email and calendar practices and ignored the adoption and appropriation of the rest of the tools (including the calendar tool). P07, a Research Administrator who had yet to participate in the email migration, described her upcoming support for the transition as consisting solely of the email migration with the possibility of some calendaring help.
P19 commented that the kind of training his unit received—again, email and calendar—did not address most of the issues work groups would actually face once the migration was complete, saying that

“... That one day, you were just getting organized and all your questions didn’t come up until a week later when you’re actually trying to start to use it; and by then, they were gone and I didn’t know what to do.”

According to P19, ITS attempted to alleviate problems during the transition by assigning mediators in his unit who would be able to help them through their growing pains. P19 stated that these ‘Google Reps’ were staff who had received extra training in order to help their units in the transition, but who proved to know very little more than the staff they were supposed to assist. P19 describes his disillusionment with Google Reps:

“They had assigned one or two Google Reps, which were people here who had gotten a little extra training, but they’re not IT people and they’re not computer experts, so it was more like I would ask them and they’d be like, “Oh, let’s see,” and then they would start pushing buttons and I was like... Well, I can push buttons myself.”

The only real exceptions to the lack of Google knowledge and training came from a fraction of the interviewed staff—one who belonged to a unit that was already using Google tools prior to the university-wide transition, one who was exposed by her colleague, and the four staff who were from the School of Information. P06, a research Administrator in this unit, described that the local IT experts held training and Q&A sessions for staff, where she was able to learn enough about Google Sites to pursue them; she was able to learn the rest on her own.

**Cultivators of Practice – Types of Gardening**

As part of our research questions, we sought to uncover the people who were influential in the cultivation of practice within the staff world and differences in appropriation in the case of Project Sites and Google that could be due to membership unanticipated and target user groups. Specifically, we expected to see staff themselves as the social actors to cultivate practices within Project Sites and a mix of both formal and informal actors in the context of Google.

As Nardi & O’Day suggested, there are people in sociotechnical ecologies that cultivate practices by virtue of their technical expertise—gardenerers. Under the ecological framework, gardeners are technologically savvy technical experts who experiment with technology, introduce it to their colleagues, walk them through technology usage, and create new practices. Gardeners differ from the literature’s various iterations of intermediaries between designers and users (e.g., mediators [35] and handymen [30]). Instead, they are portrayed as deeply embedded in what we’ve described as appropriation work. Of course, these experts may also perform mediation work as part of their activities.

From this perspective, gardeners can be any person who has any skill in technology and is involved in we’ve called appropriation work. Nardi & O’Day, like Draxler equate gardening activities as informal, invisible, thankless work to cultivate practices around technology and information.

Our results showed that gardening behavior among the interviewed staff and their groups was rare. Instead, staff were mostly focused on their activities and used technology to support them and in developing practices. Because appropriation work was perceived among this community as unrewarded and tangential to their jobs, only those staff who truly felt invested in cultivating new practices were involved in this type of work.

One reason why Project Sites had not been appropriated to leverage its capabilities was due to the narrative of use that had diffused through the staff world, but the reason why this narrative persisted is because there were no gardeners to cultivate new practices and to provide new examples of ways to reconfigure Project Sites. In the transition to Google, the lack of gardeners again led to staff’s inability to engage in appropriation work. Without clear leadership, staff put off learning about new tools or used them in ways that were easily understandable to them.

Despite the widespread issues in appropriating collaboration technologies, there were a few examples of cultivators that could be gleaned from the interviews and we describe these below, also introducing new terminologies for describing formal vs. informal help and making further differentiations between those people who sparked change and those who do the invisible work of leading their colleagues through technological change. Specifically, we built on the idea of gardening as a type of appropriation work by refining it into distinct types of work—specifically, the introduction of tools (catalyzing) and guiding others in creating new practices around tools (shepherding). We also introduce formal farming as an extension of both developers and stakeholders at the organizational level.

**Gardening as Catalyzing Change vs. Shepherding Use**

Our data pointed that out that the lack of consistent guidance through the process of appropriating Project Sites and Google’s collaboration tools resulted in poor knowledge about the tools which further inhibited the ability of staff to appropriate the tools sets. However, there were glimpses of people in local ecologies who were able to cultivate practices via gardening. Interestingly, these people emerged in the appropriation of the Google tools and no examples emerged concerning Project Sites.

P06, a research administrator, was clearly the leader in the adoption and appropriation of the Google Sites feature in her immediate work group and showed potential as a future
leaders to help groups make sense of the tools and develop practices around them, the tools were abandoned.

**Farmers - Formal Influencers on technology**

Aside from end users involved in their own processes of appropriation, there were those people in ecologies whose jobs entailed deep involvement in the process of introducing and supporting IT use—specifically, IT staff and the university’s central IT Office (ITS). In keeping to the Nardi & O’Day’s metaphor of gardeners, we call these formalized influencers *farmers*. Farmers are related to technology champions in that they can introduce technology at the organizational level. Farmers are also closely related to technical communicators in that they have the power to impart technical knowledge either interpersonally or through documentation. Unlike programmers [14], farmers don’t produce code, but rather produce decisions and support the ecology structurally and make it evolve. In describing farmers and farming work, we drew an important distinction: farmers are dedicated to technology and are involved in ecologies at a level that is separate from the work of end users. Their appropriation work, unlike gardening, is not invisible because their primary role consists of supporting and evolving ecologies.

Because the university is large and decentralized, there were both farmers who were local to their units and those who were central to the entire university ecosystem. The difference in how staff described these players was a matter of proximity and ability to understand their work and processes. The difference, then, can be seen as one between farmers supporting local ecologies versus those supporting the entire organizational ecosystem.

Throughout the interviews, there was no mention of farmers (local or organizational) who were involved in cultivating practices around Project Sites among staff, though a few staff noted that they could reach the ITS Help Desk or their local IT personnel for technical problems. The previous observation that staff never realized training opportunities and never referred to help documentation points to the farming work that supported Project Sites use was ineffective at cultivating practices.

Staff identified the roles of the university’s central administration and ITS as the main drivers of the shift in the ecology that led to the inclusion of Google tools, thereby equating them with Beath’s concept of *technology champions*, visionaries who drive evolution of the ecosystem and who act as conduits for organizational change [4,5]. In terms of cultivating practices, however, staff perceived no intent at the organizational level to aid them in the adoption and appropriation of the Google tools.

Every participant noted support from their local IT staff with the migration to Google’s email and calendaring tools, yet very few of these local farmers addressed use. From the participants we interviewed, only a few—all from the School of Information—received support that extended...
beyond the changes of email and calendaring and that delved into the other tools that staff would have access to. It was unclear whether the information sessions held by the IT groups actually resulted in shepherding, but the one participant who seemed the most affected by their guidance pointed to them as a catalyst for her further exploration of the Google Sites tool. Her description of how her interaction with this group of IT personnel helped motivate her in exploring technology overlapped with technical communicators. However, we found that in most cases staff had felt that technical communication was lacking. This particular group of local farmers point to the possibility that local formal IT experts can successfully take part in the appropriation work cultivate practices above an beyond any work they may do that catalyzes organizational change.

Paths to learning and appropriation

When people appropriate technologies, they can draw from their own tinkering experiences (i.e., explorative learning [11]) and through the collaborative sharing of successful configurations [12]. As previously mentioned, staff neither experimented with tools nor did they refer to help documents because of the additional and unrewarded nature of appropriation work in this setting. As a result, staff declared their networks to be most efficient paths:

“...this again is me not going out and searching for it, but if it’s presented to me as a better way to do something, I would seriously consider it.”
– P08, Business Admin

“I think the only way is if somebody tells me... I think it’s going to be a word of mouth thing. That’s how I found Google Drive...”
– P19, Sustainability Rep

These finding mirrored what Orlikowski called ‘knowing in practice,’ or rather, that knowledge forms via practice [36].

DISCUSSION

Learning to use technology and establishing practices around it is labor definitive of appropriation. Users, functioning as social actors [27] within their own ecologies, make sense of technology and their needs while adapting to changes in their sociotechnical ecologies and ecosystems. Following Orlikowski [36], by engaging in practices with technology, people learn to use technology and come to ‘know in practice.’ Project Sites, our primary interest, had been adopted unexpectedly by staff and thus we anticipated that, in appropriating it, staff would have engaged the toolset as social actors, developing a number of narratives around its use and perhaps evolve its use that was not limited by design intent. Because they were unanticipated, we expected little formal intervention in their development of practices, thus practices would be user-generated. As a comparison, we used Google’s tools, which staff were expected to use and which we expected would have narratives around its use influenced by both staff and formal actors.

Staff suffered from a lack of knowledge in both cases regardless of their position as target or unanticipated users. Even though more than 20 years have elapsed between Orlikowski’s study of Lotus Notes [38] and our study of our local LMS and Google tools, we were shocked to find that many of the problems that Orlikowski found regarding effective appropriation in 1992 are still endemic to today’s organizations and the appropriation of technology. Orlikowski’s findings suggested that the successful appropriation of Notes was due to two cognitive elements—1) the lack of communication about Notes and 2) insufficient or incorrect types of training—as well as three structural elements—1) the lack of reward systems, 2) failure to formulate new work procedures, and 3) culture/work norms that did not favor cooperation and sharing. Of these five issues, we found the first four to explain why Project Sites and Google’s collaboration tools had been appropriated in a very limited way. Particularly, instead of finding that culture/norms prevented sharing of configurations of Project Sites, we found that sharing was inhibited by the fact that there were no local expert users [42] to cultivate new practices—a fact that emphasizes the extent to which appropriation by unanticipated user groups could differ from appropriation within target user groups. Specifically, it is not just that unanticipated users might have creative ways of interpreting and using technology, but that they may also appropriate technology without truly understanding it. The challenge is one of designing technology so that it can be appropriated by a wider audience of users aside from those that are anticipated—a challenge worthy of certain technologies and not others.

As Orlikowski noted, failures in training reinforced Notes’ users’ poor technological frames, thus their appropriation of the technology suffered. Among our staff, the perceived lack of training for Project Sites never challenged their frames of technology use, allowing staff to continue to follow the narrative of Project Sites as a repository, a narrative that persisted through word of mouth diffusion. Meanwhile, the Google training, which did not focus on the collaboration tools essentially led to the same outcome.

Much like the organization Orlikowski studied, staff at the university found that they lacked the reward for spending time on learning better techniques for appropriating the tools, primarily because of the added work. MacLean [30] had similarly noted that organizations have many people who are ‘workers’ who have little interest in technology and tailoring activities, focusing on accomplishing their tasks rather than the invisible and time-consuming gardening work [34] that establishes practices and impacts technology use. These assertions are akin to Grudin’s assertion that a barrier to groupware success is the disparity between those who will benefit from an application and those who do additional work to support the application [17,18]. That is to say, that the articulation work needed to make IT needs to both feel as part of the job and also benefit those involved in the work. To that end, MacLean’s
suggestion of ‘tailoring culture’ [30] as a part of successful adaptation of tool is useful. Yet, it is less clear how to create this culture among unanticipated users when potential ways of appropriating technology may run contrary to perceptions of the design intent and appropriate uses.

Staff’s appropriation of Project Sites was not poor per se, but it was not as effective as it could be because users did not understand the system they had appropriated as deeply as their faculty and student counterparts. This was particularly evident because so many participants wished that the system could provide affordances that were already built in. Their limited knowledge biased them away from other possible interpretations of the tools at their disposal and any potential benefits these tools could have were lost.

There were other potential barriers to multiple interpretations. For example, it is possible that these unanticipated users lacked the cognitive absorption [1], the psychological sense of ownership [15], or organizational reward structures [30] to pursue appropriation work. Yet, one might imagine different case with more expert users and engagement that could result in a wider variety of narratives and manners of appropriating technology. Thus, we continue to endorse the importance of expert individuals within organizations—much like Wulf [53] Pipek [42] and Draxler [10-12].

While this study did not uncover these types of expert users in the case of unanticipated users, comparing this case to one where the same population composed a target user group allowed these types of experts to surface in absentia. If we consider their broad definition of all the things a gardener might do, they include helping others with current technology, inciting change, and leading others in the creation of new practices in reaction to changes technology. We found that inciting change was not enough to change practices and appropriation by itself and that what was truly helpful towards appropriating technology was the type of technology leadership we called shepherding. Tyre & Orlikowski [50] note that there is a brief window of opportunity after implementation during which exploring and modifying technology happens. Shepherding, if done before narratives settle and become routine, can potentially improve the number of narratives that users can choose from and lead to more varied appropriations and higher adaptability.

Given that we—designers, researchers, and implementers of collaborative systems—know the importance of knowledge and leaders in the successful adoption and appropriation of technology, we are left with the challenges of creating knowledge and shepherds as part of the design and implementation process. We ask, who should bear the responsibility of establishing practice? Is it technical communicator? Or is it the responsibility of formally designated agents such as technical communicators or IT staff? We may consider people who informally distribute knowledge and initiate organizational change. We might place the responsibility with the people who are attempting to appropriate technology. Another remaining issue is creating informed, expert individuals and in them diffuse information in the context of unanticipated users.

In looking to our concept of farmers, it was evident that formal, dedicated technology experts in large organization may or may not be able to cultivate practice and perform appropriation work. Even formal, dedicated technology experts at the local level were unable to assist in appropriation work. This is especially true where the signal of top-down communication can easily be lost in the everyday noise of collaboration and work.

Lastly, appropriation work might be considered invisible work in that it is tangential to organizational goals. Though appropriation work is often invisible, it is not necessarily always the case. To the contrary, we found that appropriation work performed by gardeners was quite visible at the local ecological level when it was successful. On the occasions where gardening occurred and succeeded, those staff were recognized. The problem then becomes on of sharing the information outside to the greater organizational ecosystem.

Draxler et al. [10] posited support for appropriation work and making it visible to other users as design principles. We generally agree that facilitating appropriation and making the results of that work visible will aid in evolving technology use. Yet, it is also important to note in that in following such design requirements, assumptions are made about the willingness and ability of end users to utilize search features, to know they should be wanting to reconfigure their work systems, and to potentially publicize their work—all issues that might be interpersonal or organizational in nature, rather than design-related.

Limitations & Future Work
In our analysis, we ignored the greater part of the tool ecology, having focused on Project Sites and Google’s collaborative tools. As such, we omitted data that we collected about those appropriations as well as examples that highlighted the importance of catalyst, gardening, and shepherding work that form the greater umbrella of appropriation work. In other work, we are describing how the greater ecology works as a whole system of tools, appropriations, and social actors.

We also placed substantial weight on the importance of knowledge of the toolsets we studied and the lack of guidance (formal and informal) in the appropriation of ICTs. There were other barriers to developing different appropriation practices that were not discussed in this work—factors such as usability, convenience (or inconvenience), and critical mass. These issues would play a factor, for example, in the appropriation of new tools in Project Sites.
A number of staff at the university were excluded from the interview study because they were not related to the main missions of the university. Future work will address researchers, in particular, because they were conceived of as a small, but anticipated set of users. There may be interesting ways in which appropriation of Project Sites occurred for them as opposed to the other staff at the university.

Almost concurrent to the Google transition, the Hospital and Medical School made a transition in their medical records management system, which acts as a central patient-records information repository across all of the university’s medical sites. The appropriation Project Sites within this community is likely to differ greatly from the rest of the university and the new medical records system is sure to add an interesting layer to the evolving practices of doctors, nurses, medical billers, and other professionals.

In this study, the underlying research interests led to interviews to question staff about their technology use and influences through an ecological lens. As a number of findings suggested, staff perceived the absence of training and support from the formal IT groups (which we called farmers), while the authors of this paper have been well aware of the various resources from these groups—ITS in particular. Future work will involve interviews with staff from ITS and unit-level IT staff to determine what appropriation support was provided and to trace the breakdowns that created barriers in information being transmitted from the central and local IT groups to staff.

To address the second point of generalizability to other contexts, it was clear that the comparative case study of two systems at this academic research institution was unique to this context—both in terms of the systems investigated and the organization itself. The story of these two toolsets presented the opportunity to study the influences on technology use influences with more than one toolset. The interviews revealed striking similarities between this work and previous work by other researchers. Despite the potential differences between various types of organizations and between tools, the appropriation of technology and cultivating good practices around technology is a universal problem. If a point is to be taken from this work, it is about the universal importance of helping users to do the work of establishing practices around technology, whether this is a collaborative system, social networks, etc.

Another limitation of this work is that interviews were conducted in the months immediately following the transition to Google, which included the email migration—a time when staff were still recovering from the technological shifts in the university ecosystem and when they were still in a sensemaking process around how to appropriate technology. While this was a good time to detect and explore shepherds in this phase, the inability to find them might have been due to the timing of the study. Future work will follow up with staff about sensemaking since our initial interviews and may perhaps uncover people who have influenced the appropriation of the tools much later in the process.

CONCLUSION

This work began with the premise that all technology is appropriated as users enact their practices and structures through ICTs, further suggesting that successful appropriation of ICT requires that users understand the technology they are trying to decipher—whether through experimentation, local experts, or training. This work highlighted the lack of clarity in who should be tasked with creating knowledge and establishing leaders in the appropriation of technology, noting both that this work is often invisible and tangential to the actual work of the group. Using a number of frameworks, the research examined the appropriation of two different systems and discovered parallels to other research that suggest the importance of knowledge and training in developing better appropriation practices. This work builds on previous research by further exploring who is involved in appropriation work, building on and refining the concept of gardeners [14,34] and putting the social actors in the context of unexpected users.

Wulf et al. [53] wrote that “the research challenge is to design innovative ICT applications so that their appropriation leads to (desirable) impacts on the applying social systems” (pg. 505). With a host of design methods and good intentions, technology may still fail to yield ‘desirable outcomes’ in the way it is appropriated simply because of organizational issues and the knowledge users have about the technologies they are about to appropriate. The challenge, then, is not just to design innovative ICTs with tailorable system design principles (e.g., [10]), but to consider the appropriation work that occurs at the user-level—supporting good understandings of technology and cultivating practices around it. Such work is akin to establishing what MacLean [30] called the ‘culture of tailoring.’ We suggest that these sociotechnical challenges become even more problematic in contexts where there are unanticipated users.

REFERENCES


