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Alternative Group Technologies and Their Influence on Group Technology Acceptance

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Abstract There is a long history of study to understand why work groups do or do not adopt new collaboration technologies. However, research has focused on only one technology. The underlying assumption is that work groups can adopt or not adopt that one technology based on that technology alone. In making this assumption, many researchers have failed to realize the importance of alternative technologies in the adoption process or the fact that groups can adopt more than one technology. To address this issue, we examined an attempt by a scientific research organization to have its work groups adopt a particular group-collaboration technology. Although the target technology was more than appropriate for the task and the organization provided all the resources needed for work groups to adopt the technology, it largely failed. This was in large part because of two alternative collaboration technologies that acted as substitutes.

Keywords: *collaboration technology, group technology adoption, teamwork, technology acceptance*

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1. Introduction

The understanding of why work groups do or do not adopt new collaboration technologies has a long history in several communities. Although work in the field of information systems has been more quantitative while work in other communities such as computer-supported cooperative work (CSCW), human factors in computing systems (CHI) and organizational science has been more qualitative — e.g., [1] versus [2] — several systemic themes can found across all communities. Studies on the adoption of collaboration technologies can be divided into two topics: (1) the impact of work group members' attitude toward the collaboration technology, e.g., [3,4]; and (2) the interplay between the technology and the teams' social structure, e.g., [2,5]. The results from these studies indicate that attitudes related to ease of use and usefulness associated with the technology are important predictors of adoption and that collaboration technology can both influence and be influenced by the team's social structure [1-7].

However, another line of research suggests that to understand the adoption decision of one technology you must include the potential influence of other technologies [8]. This research implies that other technologies can influence the adoption of the intended technology. In this paper, we define "alternative technologies" as substitute technologies that can be used to perform the same tasks as another technology. We use the term "adopting technology" to represent the technology the organization intends the work group to use.

Despite the potential importance of alternative technologies on the adoption process of collaboration technologies, their influence remains vastly understudied. Work has focused only on the adopting technology [1,3,7,9,10]. The underlying assumption is that work groups can adopt or not adopt the intended technology. Although this approach made sense early on when the only source of collaboration technologies for work groups was organizations, this is not the case today. Work groups have access to free collaboration technologies that are available for personal use through companies like Google. Once exposed to these free collaboration technologies these work groups' attitudes toward the adopting collaboration technology are based on comparisons with these previously used alternative collaboration technologies. In these circumstances, attitudes toward familiar collaboration technologies can be just as important to understanding the decision to adopt a particular collaboration technology as the attitudes toward the adopting technology itself.

The exclusion of alternative collaboration technologies limits our understanding of why work groups adopt or do not adopt a particular collaboration technology in several ways. First, by only examining one technology researchers could fail to realize that attitudes toward a given collaboration technology are relative to alternative technologies and are not absolute. Second, even if researchers fully understood both the attitude toward the adopting technology and the group structures, they might still fail to understand why groups adopt or do not adopt a given technology. Taken together, the current approaches often focus too much on the adopting technology while failing to acknowledge the influence of alternative technologies.

To address this limitation in the literature, we examined the influence of alternative collaboration technologies on the adoption of an organization-sponsored collaboration technology. To accomplish this, we examined an attempt by a scientific research organization to have its work groups adopt a particular group collaboration technology. The decision to implement a new collaboration technology was in response to issues related to a changing funding model. This scientific research center recently decided to move away from long-term funding (referred to as "hard money") to grant research projects from government agencies. To comply with government requirements for funding the administrators in the scientific research firm wanted to centralize the institutional repositories and monitor the workflow of their scientists by creating audit trails.

Organization leaders chose SharePoint as the organization's sponsored collaboration technology. Although SharePoint was more than "good enough" and the organization provided all the resources needed for work groups to adopt the technology, it largely failed. Work groups used SharePoint sparingly. This was in large part attributed to alternative collaboration technologies. The scientists' personal and professional use of their own Google Apps provided an anchor or reference point as a comparison to SharePoint. Work groups compared SharePoint to their personal Google Apps in terms of ease of use and usefulness. In both cases, SharePoint was seen as lacking. This also led to work groups adopting an enterprise version of Google Apps called Google Apps for Government as an alternative to SharePoint.

In the end, the work groups decided to use all three collaboration technologies to varying degrees: SharePoint, Google Apps for Government and personal Google Apps for some overlapping and non-overlapping tasks. This was in large part because certain tasks required the use of SharePoint. However, the goal of the administrators to centralize the institutional repositories and monitor the workflow of their scientists by creating audit trails largely failed. By only examining the characteristics of SharePoint, we would have failed to understand the dynamics that led to that situation. This study provides new insights into our understanding of group collaboration technology adoption.

2. Related Work

2.1. Adoption of Group Collaboration Technologies

After the emergence of groupware in the 1980s, adoption of collaboration technologies became an important topic. Scholars in information systems research devised models to understand and predict the adoption of technologies by individuals and groups [3]. Because we were primarily interested in explaining underlying mechanisms of technology adoption in a group context, research at a societal level — including innovation diffusion theory and network externalities of communication software adoption — is not considered in this paper.

Prior research examining team members' attitudes toward the adopting technology was largely based on Davis' Technology Acceptance Model [11]. The Technology Acceptance Model argues that perceived ease of use and perceived usefulness associated with a specific technology drive technology adoption [11]. Perceived ease of use refers to the perception of difficulty associated with the use of a given technology, while perceived usefulness refers to the perception of positive outcomes associated with using the technology [11]. In particular, perceived ease of use and usefulness were associated with the intention to use the technology, and intention was associated with actual use of the technology. The Technology Acceptance Model has been updated and extended by Venkatesh et al., who developed an integrative model called the Unified Theory of Acceptance and Use of Technology [12]. In the Unified Theory of Acceptance and Use of Technology model, the perceived ease of use and usefulness as defined in the Technology Acceptance Model are relabeled as effort expectancy and performance expectancy, respectively. Although these models have been used to predict individual technology adoption, these models have been extended to predict the adoption of collaboration technologies by groups. Brown et al. [1] found that performance expectancy (i.e. perceived ease of use) and effort expectancy (i.e. perceived usefulness) helped to predict group adoption of collaboration technologies. Authors Robert and Sykes [13] also clarified the role of control beliefs in the adoption of technology.

In another line of research in information systems, Sarker and Valacich [3] introduced a concept called "group valence," which is an aggregate measure of the group's feeling toward a technology. This feeling could be relatively positive or negative. Sarker and Valacich [3] found that when groups had a positive feeling toward a collaboration technology they were more likely to adopt that technology. Although they focused on group valence rather than perceived ease of use and usefulness, their research only examined attitudes toward the adopting technology and did not consider alternative technologies. More recently, You and Robert [4] examined the impact of emotional attachment toward robots on the performance of groups working with robots. Taken together, research in the field of information systems that has examined the adoption of collaboration technologies has not taken into account the role of alternative technologies.

Adoption of collaboration technologies has received attention within the CHI, CSCW and organizational science communities as well. Building on Orlikowski's [2] socio-technical approach, these studies focused on the resultant changes in social structures and work practices of groups and organizations from new collaboration technologies [9,10]. A study of group calendar systems highlighted that the relationship between the technology and the social environment is reciprocal and co-evolutionary [14]. Although Grudin did not employ the Technology Acceptance Model as a theoretical framework, through several studies he also found, like studies on the Technology Acceptance Model, that productivity benefits or usefulness found in new collaboration technologies encouraged the adoption of group collaboration technology [6,9,15]. Dourish [16] in 2003 focused on the materiality of the collaboration technology as an important factor of adoption. More recently, Voida et al. [17] identified the issues associated with collaboration practices and multiple digital identifiers during the adoption of collaboration cloud-based services.

Taken together, researchers examining collaboration technologies in the field of information systems have not included the influence of alternative technologies; however, researchers in other fields have included the influence of other technologies [18,19,20,21]. In particular, Turner et al. [6] showed that employees use complementary communication technology tools to accomplish their work. The authors showed that users adopted multiple technologies for different tasks. Although this line of research did not focus on collaboration technologies and examined complementary technologies rather than alternative technologies, we believe that the underlying logic is applicable to understanding the adoption of collaboration technologies.

The goal of our study was to examine how alternative collaboration technologies can influence the adoption of an intended collaboration technology. We found no studies directed at understanding the influence of alternative technologies in the literature on collaboration technology adoption. Yet the topic seems extremely important to understanding why work groups do or do not adopt collaboration technologies. Specifically, we examined the challenges faced by an organization in encouraging work groups to adopt SharePoint in the presence of alternative technologies like Google Apps. In order to study these challenges, we relied on anchoring and adjusting as a theoretical framework.

2.2. Anchoring and Adjusting

Anchoring and adjusting is a psychological heuristic first mentioned in 1974 [22]. The heuristic describes the process by which individuals create a reference point, an anchor from an initial experience. Information from new experiences becomes an adjustment from this initial anchor. Usually, final decisions remain biased toward the anchor or initial experience [22,23].

Anchoring and adjustment has been used as a theoretical framework by a number of researchers studying technology adoption. Venkatesh [24] used anchoring and adjusting as a theoretical model to study how initial assessments of perceived ease of use of a particular technology anchored future assessments of perceived ease of use associated with that technology. Joshi [25] built on [24] to create profiles for users in emergent economies, showing that initial attitudes toward a technology could anchor future attitudes and decisions about adopting that technology irrespective of actual later experiences with that technology.

We used anchoring and adjustment as a theoretical framework for this study as we examined the adoption of a new collaboration technology in the workplace. We assert that work groups' experience with personal collaboration technologies acts as an anchor for their perceptions of new workplace collaboration technologies. We further assert that the use of personal alternative collaboration technologies can influence people's attitudes toward and ultimately use of collaboration technologies in the workplace. These claims are highlighted in Figure 1.

Claim 1: Perceived ease of use of previously used personal collaboration technologies alters the perceived ease of use of the adopting collaboration technology in the workplace.

Claim 2: Perceived usefulness of previously used personal collaboration technologies alters the perceived usefulness of the adopting collaboration technology in the workplace.

Claim 3: Previous use of personal collaboration technologies influences the use of the adopting collaboration technology in the workplace.

3. Method

3.1. Fieldwork Site and Methods

The research site was a science center that is part of a federal agency in a mid-size Midwestern city. The center has a number of affiliated field stations throughout the Midwest. The center employs 124 full-time workers and a number of contractors. We were allowed to have an office on-site at the center near the time SharePoint was being implemented. Participant observation started in November 2012. The Google Apps for Government implementation was started in December 2012. The authors were allowed access to organizational documents and attended meetings related to the implementation of SharePoint. All interviews were completed by March 2013.

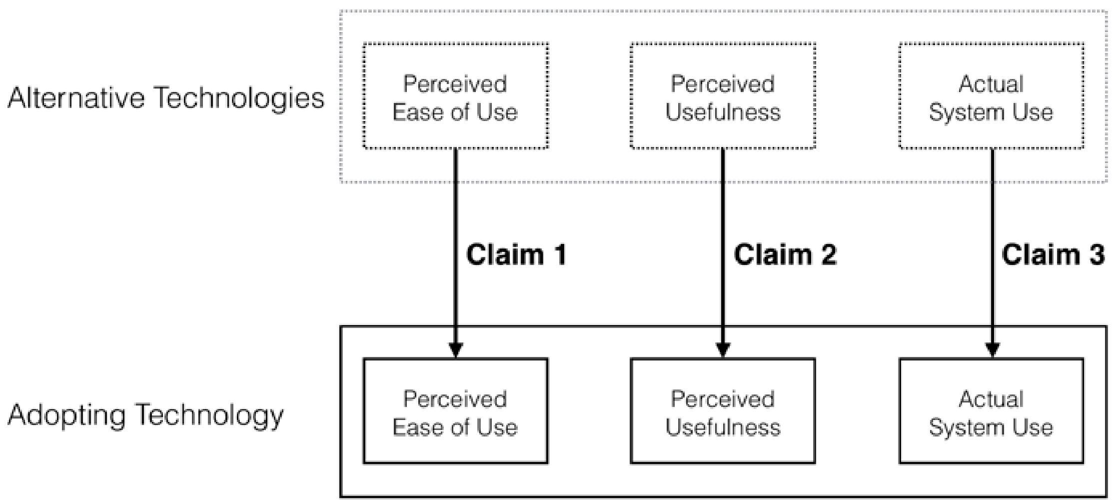

Figure 1. Alternative technology use on technology adoption

3.2. Participants

The major groups in this organization are: (1) scientists, who carry out research at the center; (2) administrators, whose function is to assist the scientists in carrying out their work; and (3) science managers, who are scientists promoted to be part of the administration. Scientists, much like engineers and others employed in highly innovative and technical positions, seek autonomy in the organization [26,27,28].

Administrators see themselves as supporters for the scientists, whose work is the raison d'être of the organization. Although the high-status administrator might have a central position in the organizational chart, he or she still works for the scientist [29]. Administrators do not have training in science but instead typically hold degrees in administration (e.g., a master's degree in business administration).

Science managers occupy the zone between administrators and scientists [28,30]. Thus they act as bridging agents within the organization. Their embeddedness in both the scientific and administrative social networks provides access to information and control [31,32]. By bridging the two disparate worlds of scientists and administrators, research managers become increasingly more important in the functioning of the agency. The most important aspect of their position is that they act as a buffer between the complex inter-organizational dimension (funding from the federal government) and what is perceived to be the core competency of the center, doing science [33].

Using information from organizational documentations and observations, we constructed questions for semi-structured interviews. We conducted 25 interviews, including 18 scientists, five administrators and two science managers (Table 1). The interviews lasted 30 to 120 minutes.

Table 1. Breakdown of Employee Interviews

Employee Category	Number of Interviews
Scientist (S)	18
Administrator (A)	5
Science Manager (SM)	2

The interview format was semi-structured and we started interviews by asking respondents about their work at the organization. Then we asked about the collaboration technologies they used to conduct their work at the center. If the respondent did not mention a particular collaboration technology, we asked follow-up questions.

We recorded interviews with the interviewees' permission and then transcribed and coded the interviews using NVivo. At first we coded interviews to account for general themes. Later, we deduced fine-grained themes by traversing the interviews again [34].

4. Results

4.1. Prior Technology

Before the implementation, scientists used several collaboration services that had been added to the center incrementally.

4.1.1. Lotus Notes

Lotus Notes was used in the organization for instant messaging, email and calendaring. It was also used for reserving meeting rooms. There was a very limited use of Notes in collaboration and sharing. This is in line with Orlikowski's [2] findings that the most-used features of Notes are those that users are most comfortable with, especially with their former experience, namely the single-user applications such as Microsoft Word and email.

There was an attempt at using Notes Bulletin Boards as a collaboration space to include a number of forms, standard operating procedures, and scientific proposals. This attempt was short-lived. It lasted about 6 months, after which those documents were not updated. When inquiring as to why the board had not been updated since late 2007, we were told that an administrator was in charge of posting and updating the documents. Scientists would email their documents to her, and she would upload them to the Notes board and update standard operating procedures and other forms. When this administrator left to work at another post, her task as gatekeeper [35] was not continued by any other administrators, which meant that the board was not maintained. Scientists reverted to sending required documents to their designations through emails. Forms and standard operating procedures were stored on local hard disks, network drives or as attachments on scientists' emails.

4.1.2. MyIntranet

For collaboration purposes, the center used an intranet tool called "MyIntranet" (pseudonym). This tool was used to share documents among members of teams. It was also used to make sure that important documents and forms could be found in a central location by all users (a site on the intranet). Although the scientists adhered to the use of MyIntranet more than other groups, some of the sites fell into disuse. If scientists wanted to share information with scientists outside their organization using this method, a special request would have to be sent to allow the external scientist access to the information.

Although scientists were supposed to share documents using MyIntranet, they regularly shared documents by sending them as attachments on emails or via network drives. However, this created a multitude of versions of the same document, which became quite difficult to manage. In addition, scientists also started sharing files (especially larger documents) over cloud-based services using personal Google and Dropbox accounts. This allowed them to avoid the process of requesting that external scientists be granted access to their information.

4.1.3. Personal Google Apps

Not only did scientists use their personal Google account to share large files, they also used the calendar functions to schedule work group activities. Therefore even when Notes was intended for calendar use, a number of scientists used their personal Google calendars in order to access them from their cell phones when out in the field.

Active directory limitations seemed too restrictive when dealing with the Notes Calendar. This is more of a geographic limitation to the use of Notes in the center.

> "I have used personally Google calendar, and that is what I readily get to, especially on my phone. In the past, you could not use the calendar on Notes when you were in the field. There was no consistently good VPN connection when you were in the field or at home, and that has invariably been my personal Google Calendar. So, I have been using Google Calendar for a while." (S4)

Scientists also used their personal Google Apps to overcome issues related to organizational boundaries. When using MyIntranet scientists were required to request access for scientists in other organizations. This was done for security reasons. However, many scientists saw this as an unnecessary barrier and used their Google Drive to bypass the security protocol and share data with scientists outside their organization.

> "Now, what I do is I use my own Google account and upload files to them, some of them quite large. The recent one that happened is some collaborators from Canada, I wanted to share a video with them and others from [our center]. So, I uploaded it to my personal Google Drive and shared it. I will then share it with collaborators outside the organization or even those within the organization who are not currently on their desks [in their offices]." (S15)

Personal Google Apps allowed scientists to share their files with scientists in other organizations, thus surpassing any controls set on their sharing files through collaboration tools provided at the center.

4.2. Adoption

4.2.1. Adoption of SharePoint

SharePoint is defined as a "business collaboration platform for the enterprise." It provides "document management and information sharing" [36] as well as enterprise content management. SharePoint can be used to consolidate other information systems used in the organization. SharePoint also provides tools to support workflow processes. Another important advantage of SharePoint is "strong integration with the Microsoft Office suite" [36], which is in heavy use at the center. SharePoint was adopted at the agency level. It was used to create a number of sites to coordinate the use of resources at different centers. SharePoint sites are websites that provide "a central storage and collaboration space for documents [and] information [36]."

When one of the scientists at the center required the use of agency-level scientific equipment, he was told that he could only gain access to the equipment through SharePoint. The scientist sent a request to the center information systems manager to set up access to SharePoint. Thus, the first SharePoint site at the center was implemented to support a cross-agency program collaborating with other centers over the SharePoint site. The site was used to coordinate equipment reservations by different centers at the agency.

One of the administrative managers, who had used SharePoint in his last position at a different agency, thought SharePoint sites would be a good opportunity to organize and centralize documents involved in workflows for contract research projects. He thought that centralizing these documents in one collaboration space would alleviate reporting problems and automate the workflow process. This was a typical view shared by many administrative managers. In essence, they envisioned that SharePoint would be an enhanced replacement for the MyIntranet system, which the scientists were supposed to use as a collaboration space.

A SharePoint implementation team was set up to start creating and populating SharePoint sites. Workflow sites were created to allow scientists to upload files, which would then be signed-off by administrators and science managers. Sites were set up sharing standard operating procedures and forms required for research applications, vacations, travel, equipment reservation, and contracts.

4.2.2. Adoption of Google Apps for Government

Google Apps for Government was an enterprise version of the popular personal Google Apps. Google Apps for Government was implemented in December 2012. Google Apps for Government is a cloud-based service employing Gmail, Google Calendar and Google collaboration tools. It is important to note that Google Apps for Government was installed with the intention of providing email and calendar services only. However, Google Apps for Government only allowed scientists to share their work with others within the same agency. Administrators were concerned about the security issues associated with cloud-based services. Literature has highlighted the security concerns associated with the use of cloud-based services [36]. Despite this, Google is trying to provide security assurances to its customers, in part to comply with the Federal Information Security Act (FISMA). Google has addressed some of these concerns by allowing granular permissions of some Google accounts.

4.3. Implementation

4.3.1. Implementation of SharePoint

Administrators understood the importance of training early in the implementation process. They provided a lot of training and technical support for the use of SharePoint. The training sessions included questions and answers on how scientists could use SharePoint for collaboration. Scientists immediately saw a role for SharePoint.

> "I have not used [SharePoint], but I went to the seminar last week. Through the Q&A, it became clearer what role it will have. I think it might be potentially useful. … As a tool, it looks like it is really interesting in that it can manage sharing the documents between different users. It would be great to get to reserve rooms through it as opposed to Lotus Notes." (S15)

One of the scientists saw SharePoint as similar to an information repository management system she had used in her previous position at a university. In light of that, she described the use of SharePoint.

> "We had a grant … at the university and we used a [common repository] site to apply to it. Our photo library is there. PowerPoint [presentations] would be there. We would send emails about meeting from there so that they are archived there. I sort of see SharePoint like that. That is what I got out of the training." (S10)

She, along with other scientists, found that there is an overlap between services provided by SharePoint and her personal Google Apps. This meant that they could use some Google Apps for Government services instead of SharePoint services. But there were certain services for which they had to use SharePoint.

> "A lot of these collaboration tools are also found in Google Apps, and so there is a lot of overlap between SharePoint and Google Apps. … And there are non-overlapping points…. It will probably be a project-by-project or task-by-task decision as to whether I should use a Google site or a SharePoint site." (S10)

Participant S10 saw SharePoint in light of collaboration software packages she had used before. Having used Google Apps, she drew on the perceived usefulness of Google Apps compared to that of SharePoint (claim 2). Internally, within the organization, access rights and permission control became an issue for most scientists. General permission for large numbers of files was not usually given; instead scientists were required to ask for access to specific content. The inconvenience of asking for access for each data set quickly became overwhelming. This caused some of the scientists to see SharePoint as a hurdle. An administrator discussed how setting fine-grained privileges led many scientists not to use SharePoint.

> "We … have very specific privileges for access that we had to keep an Excel sheet to keep track [of them]. When users start finding this patchwork of permissions when using SharePoint, they become discouraged [it] create[d] islands of access for the users." (A4)

This was in stark contrast to their own Google Apps, which allowed them to access any file at any time. As such, the access rights issues that users faced with SharePoint created a perception that SharePoint was not as easy to use or as useful as their personal Google Apps (claims 1 and 2).

Externally, SharePoint required users outside the organization site to use Extranets gateways to share data. This was required for anyone outside the firewall of the organization. Asking for access for other scientists who belong to other organizations was even more problematic. An administrator commented that scientists began to walk away from SharePoint as a vehicle to share and store data.

> "[Scientists] also started … use[ing] Google Docs since extranets are a hassle. It is much easier for them to just use their personal Google Docs." (A4)

In addition to finding it difficult to access files themselves, scientists discovered that it was also difficult to share files located on SharePoint with other scientists outside the organization. As a result scientists began to use their personal Google Apps to store their files instead of SharePoint (claims 1 and 3).

4.3.2. Implementation of Google Apps for Government

Although Google Apps for Government was implemented later for its calendar and email services, once it was implemented users immediately started to recognize the potential benefit of using it to share and store files. Google Apps for Government worked very much like their personal Google Apps. Many scientists had begun to use their personal Google accounts for collaborating with co-workers. As a result, they could see the performance benefits and did not anticipate the need to put a lot of effort toward learning how to use the system (claim 3).

As a result of their use of personal Google Apps for work group collaboration, most scientists had positive reactions to the implementation of Google Apps for Government, especially with regard to email and calendar use. Scientists also started using Google Apps for Government to share internal forms. Google Apps for Government provided the ability to create templates for all internal forms. Most internal forms needed to only be shared within the bounds of the organization with other internal employees. In addition, Google Apps for Government came with Google sites already set up to share documents (claim 3).

Scientists came to the conclusion that Google Apps for Government was a better choice for collaboration than SharePoint. Some of the scientists started talking about using Google Apps for Government in place of SharePoint.

> "I think we should just use Google [Apps for Government] tools and drop SharePoint. I do not see a real thing that SharePoint provides that Google Docs doesn't." (SM2)

> "I think we should just use Google [Apps for Government] tools. I really do not know, but it seems to me that we should just drop SharePoint." (SM1)

It is interesting to note that science managers were more interested in using Google Apps for Government than SharePoint. Perhaps because of their position, being scientists who care about the scientific imperative of the job as well as being part of the administrative team, thus understanding the importance of reporting to raise funds for the center, they chose to use Google Apps for Government, especially for sharing documents within the organization (claim 2).

Initially scientists thought SharePoint was easy to use. However, once they compared it to Google Apps for Government their perception of the ease of use associated with SharePoint changed. As a result scientists began to shift as many of their tasks as they could away from SharePoint to Google Apps for Government. For example, initially scientists used a SharePoint site to share resources at the agency level; however, eventually a Google Apps for Government site was set up to manage the use of equipment within the center (claim 1).

One administrator quickly noticed that scientists preferred to use Google Apps for Government rather than SharePoint when they could. This placed administrators in a tough position of trying to address the concerns of scientists while at the same time trying to promote the use of SharePoint.

> "Someone comes to me and shows me that they can do the job so much easier on Google Apps [for Government] and then I am forced to take a decision as to whether or not they can go ahead and do [it] anyway on Google, you know using Google Forms and Sites, or whether they should be on SharePoint." (A1)

Although the scientists found Google Apps for Government to be better than SharePoint, they did find some limitations associated with its use. When scientists thought of migrating their personal Google drives to the new Google Government drives, they met two barriers: (1) lack of means to transfer their personal drive contents and (2) inability to share documents available on Google Government drives with collaborators outside the organization. This caused many scientists to reassess the usefulness of Google Apps for Government when they compared it to their personal Google Apps.

"We have not used the Google [for Government] drive a lot. I have personal [Google drive], and we had some projects on it. You cannot move it to the new one. You have to figure out a way around it. I could have moved everything to my new Government drive. [But even if I could] … I would not be able to share with people outside the [center]." (S7)

"What is bewildering is that we have SharePoint and Google [Government] drive and neither allows us to share stuff outside the [center] where our collaborators are. Neither of those enhancements are good ways to collaborate." (S12)

As a result, scientists continued to use their personal Google Apps for sharing large files within the center and between organizations (claims 2 and 3).

4.3.3. Post-implementation of Google Apps for Government and SharePoint

Despite the attitudes of scientists toward both SharePoint and Google Apps for Government, administrators still saw the introduction of both as an advantageous change for the center. They still thought that SharePoint would be utilized for collaboration while Google Apps for Government would be employed for email and calendar services.

"The changes that we are seeing recently such as SharePoint and Google Apps [for Government] are going to facilitate what the center does and how we collaborate within and without the center; they will allow us to do our jobs in a much better way. Google Apps [for Government] is much better than Lotus Notes could have ever been, the messaging and calendaring you can use with it much better than it was in Lotus Notes. We had an internal tool, MyIntranet, and it was meant to be an intranet for sharing and collaboration, and SharePoint is much better in providing." (A3)

Nonetheless, the work groups' use of both SharePoint and Google Apps for Government did not match the administrators' expectations. Table 2 lists the expected versus emergent use of each of the collaboration technologies. The scientists used SharePoint only when they had to; otherwise they used Google Apps for Government for sharing internal documents within their organization and their personal Google Apps to share data internally and externally with collaborators.

Table 2. Scientists' Emergent Use of Adopted Systems

Information System	Intended Use	Emergent Use
Share Point	Sharing forms & standard operating procedures, SharePoint sites & blogs, sharing files with collaborators inside and outside center, reserving meeting rooms, reading meeting minutes	Reading meeting minutes and reserving rooms
Google Apps for Government	Email, chat and calendar,	Email, chat, calendar, sharing forms and standard operation procedures, Google sites only in organizations
Personal Google Account	None	Calendar, sharing files primarily outside organization

In doing so, scientists in work groups avoided both the internal and external security protocols set up by the administrators. Taken together, work groups adopted a trio of collaborative technologies. Each collaboration technology addressed a specific need. Nonetheless, this undermined the attempt by administrators to create a common repository to help track and monitor the workflow of scientists. In fact, the original goal to create an audit trail through the ability to aggregate information largely failed. Previous use of collaboration technologies in their personal lives affected the manner in which scientists used the adopting collaboration technology SharePoint (claim 3).

4.4. Summary

In order to centralize the information repository in the center, the administration decided to adopt and implement SharePoint. Scientists quickly began to compare it to the personal Google Apps and decided that SharePoint was not as easy to use or as useful as their personal Google Apps. Later the scientific organization implemented Google Apps for Government to provide email and calendar services. Because Google Apps for Government was similar to their personal Google Apps the scientists immediately thought that SharePoint was less easy to use and less useful than Google Apps for Government. The downside for the scientists using Google Apps for Government was their inability to share files and collaborate with scientists in other organizations. As a result, the scientists eventually switched back to using their personal Google Apps for sharing files and used SharePoint sparingly.

5. Discussion

The purpose of our study was to examine how alternative technologies can influence the adoption of an intended collaboration technology. To this end, we examined the adoption of SharePoint in a scientific research organization. By interviewing employees in different positions and observing the interactions and challenges associated with SharePoint, we discovered that Google Apps for Government and users' personal Google Apps ultimately influenced the perceptions of ease of use and usefulness associated with SharePoint. In the following section we discuss implications for theory, research, and design.

5.1. Implications for Theory and Research

The results of this study have several implications for theory and research. First, the anchoring and adjustment framework [22] provided a valuable lens in understanding the impact of alternative collaboration technologies on the adoption of intended collaboration technologies. In our study, the use of personal Google Apps created an anchor from which users had to adjust when adopting new collaboration technologies in the workplace. The wider the gap between the anchor (i.e. personal Google Apps) and the adopting technology (i.e. SharePoint), the more the adjustment needed and the less likely the groups were to adopt SharePoint. Future research on the adoption of collaboration technologies might benefit from incorporating anchoring and adjustment as part of their theoretical framework.

Second, perceived ease of use and usefulness are not absolute judgments based on one particular technology. Instead, users make judgments about both by comparing alternative technologies against the proposed collaboration technology. For example, when adopting SharePoint, users made it clear that they could just stop using SharePoint because Google Apps for Government seems to cover most functions that SharePoint promises. That is, perceived usefulness of SharePoint was determined by another collaboration technology — Google Apps for Government. The comparisons continued when users held Google Apps for Government up to their personal Google Apps accounts. There again users reassessed their attitude toward Google Apps for Government and decided that its usefulness was limited when compared to their personal Google Apps accounts. The same was true for ease of use. Current approaches to understanding collaboration technology adoption put both ease of use and usefulness front and center as important constructs to understanding the adoption of technology. Yet research has normally examined only one particular technology. Based on our study it appears that users often make such assessments across alternative technologies not solely based on one particular technology.

Therefore, this study also highlights the importance of considering the influence of alternative technologies and recognizing that the outcome of the adoption process could lead to multiple technologies being adopted. Recent research still focuses on only the single adopting technology. This is true for more recent models of technology adoption in general (e.g., the Technology Acceptance Model and the Unified Theory of Acceptance and Use of Technology) [37,38] and recent models of collaboration technologies specifically [1,39]. In addition, such models span different domains and types of collaboration technologies including education, engineering, and medicine [40,41,42,43]. Future research should consider developing models that include multiple technologies.

5.2. Implications for Designers

Designers of collaboration technologies should be mindful of previously adopted technologies. Development of collaboration technologies should take into consideration the relationship between new and previously used technologies. Designers can make the adoption of collaboration technologies easier by mimicking workers' personal technologies. For example, designers can extract common features from popular public tools and apply them to collaboration tools. Indeed, cloud-based collaboration services such as Google Apps have been adopted at a number of universities [44,45,46,47] and they are also used rather extensively by the general public [48,49]. Designers should take this into consideration when designing collaboration technologies.

5.3. Limitations and Future Research

Our study has several limitations. We only examined one organization. The organization we studied specializes in a specific type of knowledge work and employs only highly educated individuals who are considered to be experts in their scientific field. As a result, scientists in our study might have had more autonomy in adopting new technologies than employees at other organizations. We chose to focus on the role of alternative collaboration technologies, but alternative theoretical approaches or models could also be used.

Robots – intelligent systems that can sense, reason and engage in virtual and/or physical-embodied actions – are being adopted as collaboration technologies [4]. Despite this, little research has been done on understanding the factors that hinder or promote their adoption by groups [5]. It is also not clear whether or how much of our current research on group collaboration technology is applicable to the adoption of robots. For example, robot personality and human–robot similarity are strong predictors of human and robot interaction [50,51]. It is not clear whether the personality or similarity of non-robotic technologies is also important. Therefore, future research should explore both the theoretical gaps and design spaces in this area.

6. Conclusion

Future theoretical models of technology acceptance by groups must consider the impact of competing or alternative technologies. Our study demonstrates the important role that alternative technologies play in the group adoption process. Results of this study also suggest that the role of alternative technologies should be included in broader theoretical models (e.g., TAM, TAM2, UTAUT) used to predict technology acceptance by both individuals and groups.

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