

Discretionary Adoption of Group Support Software: Lessons from Calendar Applications

Leysia Palen

University of Colorado, Boulder

Jonathan Grudin

Microsoft Research

Although the World Wide Web, Internet, and organizational intranets have made computer-mediated collaboration possible for many people, adoption of collaboration technologies in business environments still presents challenges and is often slower or less widespread than anticipated. Technologies focused on supporting groups fall between strictly single-user applications and enterprise systems. Single-user applications are designed with a 'discretionary use' model. In contrast, for large enterprise systems, upper management support is considered crucial for smooth deployment and adoption. Which applies to technologies that support group work? The relatively low cost of an application such as a shared calendar lowers its visibility in an organization, reducing management attention to it. However, some argue that the complex social dynamics surrounding such technologies still necessitate a managerial mandate for use to occur—the large system approach. Interview studies of electronic calendar adoption in two large organizations found successful, near-universal use achieved without managerial mandate. Versatile functionality and ease of use, associated with discretionary products, were factors leading to individual adoption. Other factors leading to 'bottom-up' adoption included the presence of an organization-wide infrastructure, integration with email, and substantial peer pressure that developed over time.

Introduction

Technology adoption by individuals, informal groups, workgroups, and enterprises

Many opportunities for computer-mediated collaboration are available today on the Internet. People participate in on-line chat rooms, games, and auctions, and they do so at their discretion. However, as recently as a few years ago, the only opportunities most people had for using collaborative information technology to support group activity were at their places of work. There, many found adoption and use of "groupware" to be problematic, and failed efforts abounded. A key question arose: Could a group support application succeed if employees were free to choose whether or not to use it ('discretionary choice') or would it be necessary for management to insist on its use to obtain a collective benefit ('managerial mandate')? This issue arose as large mainframe systems came to be complemented by applications supporting individuals and groups.

An organization's technology acquisition decisions had been the responsibility of upper-level management, perhaps guided by technology support personnel. Large enterprise systems were expensive and designed to support key business functions. Large systems affected many people, even when the technology didn't suit some individual work practices particularly well. Since local culture and office politics can discourage use in the absence of a mandate to use a system, the expense, visibility, and known difficulties faced by enterprise systems led to strong recommendations for managerial mandate (which still did not guarantee success).

In contrast, similar to single-user applications, many collaborative applications are relatively inexpensive and easy to acquire. They are not tailored to specific business practices. For these, the path to widespread use is not always obvious. Will they follow the discretionary choice model that often works for single-user applications and some Internet-based collaborative applications? Or, as some have argued, do they require a managerial mandate because of the complexities surrounding the social relationships they are intended to support?

Some of these complexities are discussed in Grudin (1994). Often, group support technologies require additional work from all members but selectively benefit only some, and the collective benefit to the group is not fully appreciated by those who do not benefit personally. In addition, no one person may have the understanding to anticipate impact on the work practices of everyone involved.

Even when everyone will benefit once there is a 'critical mass' of users, reaching that tipping point may be difficult. Markus and Connolly (1990) examined social factors in the adoption of 'groupware tools' and concluded that mandated use or other top-down measures appeared necessary. In a widely-cited case of one such collaboration technology adoption (Orlikowski, 1992), a high-level mandate to use LOTUS NOTES received a mixed response, but use did continue.

However, conflicting signs are present. An interesting aspect of Orlikowski's study is that the technical support staff were under no mandate to use NOTES but did so before the consultants who were its intended users. Markus (1995) studied mandated use of electronic mail in one organization and found that *how* email was used was highly discretionary and varied. And email use has often spread without high-level mandate, although it is risky to generalize from email to other collaboration technologies.

By examining factors that underlie cases of successful adoption of a group support technology, our study addresses the tension between the recognized importance of high-level support for large systems and the lower visibility that collaboration technologies generally receive.

Defining deployment, adoption, success, failure and collaboration technology

Understanding of this topic is hindered by the lack of agreement on the definitions of key terms. The disciplines of Human Computer Interaction and Information Systems in particular share several terms but use them very differently (Grudin, 1993).

Writers with an organizational focus use 'adopt' to mean 'acquire' or 'decide to use,' whereas writers with a user-centered focus are more likely to use 'adopt' to mean 'begin to use.' To the former it would be possible to say an application was adopted even when no one used it, to the latter adoption implies use. In this chapter we use 'deploy' to cover the process of making software available and 'adopt' to refer to decisions by individual employees to begin using the software.

However it is labeled, the distinction is important. We argue that management support is often critical in acquiring and deploying group-support applications, but adoption by users is often bottom-up and unaffected by management attitude. The 'management mandate' to use collaboration technologies is often not forthcoming and not a major factor in adoption. In the organizations we observed in the 1980s and 1990s, deployment of electronic calendars was widespread or universal, but adoption did not occur in the 1980s and did occur in the 1990s. This chapter focuses on adoption, the factors leading to initial use after deployment has occurred.

Because the technologies we are describing are primarily commercial software products, 'success' and 'failure' can refer either to commercial success or failure of a product (and thus its continued market existence or disappearance) or it can refer to the success or failure of a group's or organization's particular effort to use it. The latter is often more difficult to determine, since a particular effort may be regarded by some as a success, by some as a failure, and others may perceive a mixed outcome, given that an application is rarely used precisely as envisioned. And these assessments can change over time.

Most group support applications and features have been commercial failures from the vendor perspective, but most are adopted and used satisfactorily by someone, somewhere. We use 'success' and 'failure' to refer to the usually less ambiguous commercial outcome.

By 'collaboration technology' we focus on features and applications that support groups working together, such as chat systems, instant messaging, email, electronic whiteboards, meeting support systems, shared calendars, document highlighting and annotation, application sharing, desktop conferencing, newsgroups, workflow systems, and virtual worlds. The software may be widely available in an organization, but it is adopted by groups to support their work together. The term 'groupware' was used for the first stand-alone applications; today most software incorporates features to support communication, information sharing, and coordination, so the term

'groupware' is losing currency even as the technology category has become more important.

Our focus: shared calendar use

Collaborative electronic calendar applications have had recent successes that stand in contrast to early, documented failures.

Not everyone keeps a calendar on-line and not everyone with an on-line calendar allows others to access it, but paper calendars are familiar to everyone. Familiarity with paper calendars can create special problems when people turn to electronic versions. People know what to do with paper calendars, which are generally private places to record professional and personal information. Electronic calendars move all that information into a potentially public realm. Although access to information can be controlled with privacy settings, doing so can require an effort to change or make exceptions to default settings, and changing privacy settings can conflict with the benefits of making calendars into collaborative objects. Facilitating the scheduling of appointments and meetings through shared access to information is a major appeal of calendaring applications.

Public use of a once private object makes the issue of discretionary or mandated use even more of a concern. How does an organization encourage adoption of electronic calendars? Scheduling features are only useful with a critical mass of users, which argues for a mandate. However, calendar-keeping is an idiosyncratic practice and has always been discretionary. Can an inherently discretionary activity be mandated? Are there other trajectories for adoption?

About 20 years ago, commercial office systems began to provide meeting scheduling features with electronic calendar applications. Computer-assisted meeting scheduling represented an appealing technical solution to a clearly identified problem: People spend a lot of time arranging and rearranging meetings. Nevertheless, it was difficult to find successful use of the software, even in the development organizations and research laboratories that produced the software and provided widespread access to it. In fact, Grudin (1988) used meeting scheduling to illustrate factors that contribute to the lack of widespread adoption of some groupware applications.

Today, use is more widespread. Electronic meeting scheduling and calendaring occurs in environments similar to those where it did not a decade ago. In this chapter we review the findings of the mid-1980s, then describe two detailed interview studies conducted in environments much like those examined a decade earlier, in which on-line meeting scheduling had become routine. What changed, in the software or in the environments, that contributes to current use? What was the adoption process? The actual or potential presence in other settings of such factors, once identified, might

signal the usefulness of this or other collaboration technology and suggest adoption processes to expect or encourage.

Early Computer-Supported Calendaring

By the early 1980s, many organizations had installed office systems that provided word processing, spreadsheets, email, and on-line calendars. In settings in which on-line calendars are widely available, the concept of computer-assisted meeting scheduling is simple: A person scheduling a meeting identifies the participants and the application checks each person's calendar, finds a time when everyone is free, and schedules a meeting or issues invitations. The potential utility was clear: The time spent scheduling and rescheduling meetings is substantial. Opportunities lost through inefficiency in meeting scheduling had been identified (Ehrlich, 1987a).

However, a study conducted by a company that had developed an early electronic calendar identified factors that contributed to a lack of use of the meeting scheduling feature (Ehrlich, 1987a; 1987b; Grudin, 1988). Electronic calendars were used as communication devices by executives, managers, and their secretaries, but only by about one in four individual contributors. The latter, if they kept any calendar at all, found portable paper calendars more congenial—available in meetings, for example. To maintain an on-line calendar would require more work of individual contributors, but the direct beneficiaries would be the managers and secretaries who called most meetings. In addition, although most employees had computer access, not all were networked tightly enough for the software to connect them. As a result, meetings were scheduled by traditional methods, despite the presence of the software on everyone's desks.

Research papers described new approaches to meeting scheduling that did not fare much better. Woitass (1990) designed a system to address the access problem. Based on a distributed agent architecture, it consulted the electronic calendars of those maintaining them and engaged other users directly. Although a technical success, Woitass reported that the system was not used for much the same reason: It required work from those who did not see the benefit of using it. Beard et al. (1990) developed a priority-based visual calendaring system that performed well in controlled experiments, but in field tests encountered a range of problems. Users were reluctant to use the publicly visible priority mechanism because it was easy to offend colleagues whose meetings were ranked less than high. Lack of integration with users' desktop applications also inhibited use. A 1991 survey of groupware use was sent to "empirical researchers, system developers, and end-users of CSCW (computer supported cooperative work) products and systems" (Butterfield, Rathnam, and Whinston, 1993). Respondents indicated that group calendaring systems were the

most widely available of 10 groupware technologies by a substantial margin, but were judged to be the least likely to have a significant impact.

Collaborative calendaring applications were not unique in requiring additional work (in this case calendar maintenance) from people who saw no benefit in their use. Most large systems and major applications face this challenge when introduced. To overcome this, management often hired support staff such as system administrators and data entry personnel, changed staff job descriptions, and encouraged or even mandated use. But collaboration technology is often not large or expensive—as with calendars, it can be a small application or just a feature in an individual productivity tool. In such cases the collective benefit is not as evident, it does not have the visibility that an expensive system does, so it is unlikely to get the same degree of management support. In sum, managers in the environments examined in the 1980s did not mandate that individual contributors maintain on-line calendars solely to facilitate meeting scheduling, nor were secretaries asked to maintain the on-line calendars of individual contributors.

Upper management advocacy is a key element in large system deployment and adoption. In contrast, the use of individual productivity tools or single-user applications has more often been discretionary; an application must offer each user a tangible reward. Collaboration technology is caught in the middle: It often must appeal to all group members, yet can expect little in the way of long-term, top-down advocacy. Collaboration technology such as calendar applications can benefit from managerially mandated *deployment*. This insures that all members of the organization know that their colleagues at least have access to the technology, which lowers the barrier to begin using its collaborative features. An organized roll-out can also eliminate incompatible competing applications, reducing the support burden for IS groups. However, although widespread deployment is an important step toward widespread adoption, access does not insure use.

But the situation around calendar adoption was never deemed hopeless: “The conclusion is not entirely negative. Automatic meeting scheduling could be targeted to environments or groups making the most uniform use of electronic calendars. Their value can be enhanced by adding conference room and equipment scheduling...” (Grudin, 1988). “Focus on improving the interface for those who receive less direct benefit... this may seem obvious but is very difficult” (Grudin and Poltrock, 1990).

It is difficult to focus interface design on “incidental” users because an application *must* appeal to its principal beneficiaries. A meeting scheduler that does not appeal to the manager or admin who calls meetings has no chance. Interface development is usually directed toward those who will benefit most from using an application, not those who benefit least (Grudin, 1994).

Ehrlich's (1987a) data suggested one way to target existing calendar users. She reported a higher incidence of secretary-supported calendar use among managers and executives in the development organization she studied. Electronic support for scheduling meetings of managers was therefore feasible and has been reported. For example:

“PROFS is the single most used office system in the company. Most people with PROFS accounts do not use its calendar. Almost all managers/supervisors use the calendar, and secretaries maintain the calendar for 2nd level managers and higher... They collected data in (a group of managers and secretaries) and found very large time savings and cost savings due to the on-line calendar.” (Steven Poltrock, personal communication, 10/3/94.)

Obstacles hindered the wider use of this system in the company:

“In my [group] most people use an on-line calendar, but our calendars are not shared—we are not using PROFS.” (Ibid.)

Several years after the early meeting scheduling features were marketed with little success, a new generation of calendar applications began to be widely adopted in engineering environments very similar to those which had rejected them previously.

Computer-Supported Calendaring in the mid-90s

Electronic calendar applications that appeared in the early and mid-1990s were much more sophisticated than those from a decade earlier. They began to include more features to support the private, idiosyncratic information management aspects of calendars (albeit less than perfectly). These electronic calendars predate the advent of mobile computing, so adoption still faced the obstacle of being mostly anchored to desktops, precluding electronic access outside the office and work hours.

In some workplaces, notably engineering environments, use of shared electronic calendars was gaining ground. Use elsewhere was far from commonplace, but it made sense to study the early adopters, especially because it was precisely in such engineering environments that calendars had not made headway ten years earlier. Our research questions included:

- How widespread is calendaring and meeting scheduling at these sites?

- Who uses them?
- Are new application functionality or interfaces factors in adoption?
- Has the collective benefit of use been made more salient?
- Is adoption the result of top-down encouragement or mandate?
- How does adoption proceed over time?

Method

During a three month internship in a Microsoft development division, the first author observed and used scheduling activities in her day-to-day work. During this time, she also conducted five formal interviews on the topic of meeting scheduling. This experiential and interview data informed a set of 40 questions used in twelve interviews conducted over a 3-day period at Sun Microsystems. We had learned of widespread use of electronic meeting scheduling at these sites and sought active users, as well as some non-users. Our interest was in identifying possible factors that led to such high adoption rates; the specific adoption contrast that frames this paper emerged during the analysis.

Later, based on the findings from these two sets of interviews, we designed site-appropriate surveys comprised of 20 questions that were administered to about 3000 people by email at each of the sites. These surveys were intended to validate our interview findings and extend the inquiry to employees across different business divisions of the corporations.

Our interviews and surveys queried subjects about their use of paper and electronic calendars. Questions covered procedures and protocols for arranging or responding to meeting invitations, privacy, granting calendar viewing access, peer pressure, managing one's calendar when away from the computer, using calendars for structuring work, and using calendars for handling resources such as conference rooms and equipment.

Site, Participant & System Descriptions

Microsoft Corporation

At the time of this investigation in 1994-1995, most of Microsoft's then 15,000 employees were located in the Seattle area, where the interviews were conducted. The

average employee age was 34, low for a large software company. For many, Microsoft was their sole or principal work experience. Most employees had their own office or shared with one other person, and every employee had ready access to a common platform computer that was linked to a company-wide network.

The five interviews were conducted with people in different job positions and in different workgroups across the development divisions. All had been employed at Microsoft before the electronic calendar application was introduced, with an average of about 5 years' service. Listed in increasing order of time spent in meetings, they were a developer, visual designer, program manager (project leader), development instructor and first-level manager.

The follow-up on-line survey was administered to approximately 3,000 employees over distribution lists, with a response rate of approximately 30%. 47% of respondents were software developers and testers, 20% were project leaders or first-level managers, 8% were technical writers and visual designers, 7% were marketers, 4% were mid- or executive-level management, 4% were interns, 3% were administrative assistants, with the remaining 7% in other positions.

Their calendar application used at the time of this investigation was Microsoft's SCHEDULE+ running on Windows PCs. With SCHEDULE+, calendars resided on the client machine with frequent updates to a central server. Users viewed a calendar by specifying its owner's email alias or name. SCHEDULE+ was developed in-house but was a commercial product, intended to support meeting scheduling in a range of organizational cultures. All employees could download the application from a server.

Sun Microsystems

At the time of our investigation, about half of Sun Microsystems' then 13,000 employees worked in the San Francisco Bay Area, with about 3,000 in the engineering departments where our interviews took place. The average age of Sun employees was 38. Most employees had private offices or shared with one person, except for administrative assistants ("admins") who were typically in centrally located cubicles. Employees had workstations connected to a company-wide network.

Eleven electronic calendar users from ten engineering groups and one non-user in corporate marketing were interviewed. They had been at Sun over five years on average; two arrived after the electronic calendar was introduced. Three participants were or had been on the CALENDAR MANAGER product team and provided technical implementation information, an historical account of the product's introduction, and data about their personal use. Listed in roughly increasing order of time spent in meetings: two administrative personnel, two technical writers, three developers, two

human interface designers, one product marketer, one manager, and one corporate marketer.

The follow-up on-line survey was administered to approximately 3,000 employees over distribution lists, with a response rate of approximately 50%. 22% were developers or testers, approximately 20% were engineersⁱ, 13% were first-level managers, 9% were mid- or executive-level managers, 9% were administrative assistants, 7% were marketers, 4% were salespeople, 4% were customer support representatives, 3% were technical writers and user-interface designers, 3% were system administrators, 3% in business administration support, with the remaining 3% in other positions.

At the time of our investigation, CALENDAR MANAGER ran under OPENWINDOWS and CDE on SPARCSTATIONS, and was available as a standard desktop tool. Calendars were maintained on their owner's host machines. Viewing other calendars required specifying user names *and* the host machines, a deliberate action that seemed to reduce casual "surfing" of calendars. Host names were listed in an on-line corporate rolodex of employee information which made browsing across the corporation possible, however.

Description of Use

Adoption Levels

Adoption of the electronic calendar applications was widespread at both sites. Since we had sought informants who used on-line meeting scheduling for the interview portion of the data collection, it was not surprising that high usage was reported in 16 of the 17 interviews (i.e., 15 of the 16 groups). The exception was the Sun corporate marketing representative, a former user, who frequently met with external contacts, people not accessible through the system.

Survey data revealed more information about adoption levels. Although we encouraged users and non-users alike to complete the survey, we assume that non-users were less likely to respond. For that reason, we do not estimate adoption levels based on user/non-user responses. Instead, we asked respondents to estimate how many people with whom they worked used the electronic calendar. Based on these responses, we conservatively estimate adoption to have been at least 75% at both sites at the time of investigation.

ⁱ This number is approximate because a survey omission required respondents to use the "Other" category and manually write-in their job positions.

Furthermore, users tended to use the application regularly and keep their calendars highly up-to-date. Specifically, 81% of Sun survey respondents said that they recorded *at least* three-quarters of their appointments in their calendars. 75% of the Microsoft respondents said the same.

Despite the widespread adoption of the calendar applications across the two corporations, their extensive use was not perceived as remarkable by employees. The calendar applications existed below the horizon of notice, perceived simply as tools in the conduct of mundane activities of work. However, electronic calendars were clearly important to employees, and the integration of electronic calendars into everyday work was essentially complete: When queried, interview informants could not imagine life without them.

Privacy Setting Defaults

Electronic calendars are surprisingly diverse in the kinds of collaborative uses they afford. Privacy setting defaults seem to significantly dictate how an electronic calendar application can be used socially: Users tend to maintain the defaults and a culture of use grows around that deployment decision, further reinforcing adoption of the default settings (Palen, 1998 & 1999). In single-user applications, users tend not to change default settings (Mackay, 1991). As the cases of Microsoft and Sun illustrate, the same tenet applies to collaboration technology, even in high-tech environments with knowledgeable users, affecting use on a large scale.

Survey results indicate that 81% of Microsoft's SCHEDULE+ users and 82% of Sun's CALENDAR MANAGER users maintained their privacy setting defaults. However, the default privacy settings were different between the two applications (and remain different over five years later). At Microsoft, the default settings restricted the amount of calendar information that could be shared with others: only free and busy times could be viewed, with no other appointment detail available. We refer to this as a Restricted Access model calendar.

In contrast, Sun's CALENDAR MANAGER is an Open Access model because its privacy setting defaults would allow everyone on the network to read the full contents of others' calendars, including appointment time, appointment description and even any additional notes entered by users. Descriptions of private appointments, such as job interviews and medical appointments, must therefore be individually locked.

Determining Availability & Scheduling Meetings

The differences between the default settings had remarkable consequences on the applications' uses in practice.

With so much information available about their colleagues' activities, Sun employees used CALENDAR MANAGER not only to schedule meetings, but also for general coordination activities. Participants explained that being able to see the content of calendars was very useful: They could infer whether colleagues are in their offices, or learn where they are and when they might be back, if they could be interrupted, or which planned meeting might be more easily rescheduled in case of a conflict, and so forth. For example, colleagues could infer that a meeting that occurs across town requires a half-hour commute, even if that time is not allocated in the calendar. The ability to make these inferences can lead to more efficient scheduling than a built-in "auto-pick" feature. We found that the auto-pick feature has a place in scheduling very large meetings, but automatic meeting scheduling was otherwise not a part of normal scheduling practices.

People unfamiliar with Open Access calendar environments often wonder whether it might lead to abusive surveillance or "micro-management." In practice, the coordination benefits just described are so great that abuses rarely or never occur. The value would disappear if harsh practices made people reluctant to maintain their calendars. In fact, subsequent research on Sun's use of their Open Access model calendar system revealed that CALENDAR MANAGER was (and still is) used as a kind of distributed information system that significantly supported coordination beyond meeting scheduling. These findings are presented in Palen (1998 & 1999).

To initiate a group meeting, Sun employees would typically send regular email listing a possible time after viewing colleagues' calendars. Many were either unaware of the various ways the calendar system can generate a "template" that recipients can drag-and-drop into their own calendars, or they found them hard to generate. The ease with which people could infer colleagues' availability with the open calendars, combined with the work required to use these meeting templates, meant that Sun employees were more likely than Microsoft employees to bypass the system to set up a small meeting. However, Sun employees generally entered such appointments in their calendars after scheduling them.

In contrast, at Microsoft, employees would typically schedule a meeting by checking the availability of others and sending SCHEDULE+ mail with a proposed time, allowing the recipients to accept or decline with a keystroke. This accepted approach, with no informal prior negotiation of time, can strike outsiders as very blunt when it involves, for example, initiating a one-on-one meeting with someone one does not know and who is not expecting the meeting request. Because no additional information other than when someone is free or busy is available, employees would take more of a hit-or-miss approach to finding an agreeable time.

Planning a meeting when away from the office required the evolution of special scheduling practices. Since this investigation predated mobile technology, calendars

could only be viewed on desktop computers. Given this context, surprisingly few people reported making hardcopies of their calendars. In fact, only 32% of Sun respondents and 13% of Microsoft respondents reported that the printing feature was of value to them.

Instead of relying on hardcopies to schedule meetings when away from their desktop machines, users would tell colleagues to wait until returning to their offices. A shorthand language emerged in support of this practice: At Microsoft, phrases like “Sched plus me” or “Plus me” were commonly used. At Sun, the feature name for viewing calendars was adopted, so phrases like “Browse my calendar” or “Browse me” were often heard in response to a meeting request.

Resource Scheduling

Both sites used the calendar applications to schedule resources, although SCHEDULE+ supported conference room scheduling more systematically than CALENDAR MANAGER. At Microsoft, all conference rooms were allocated their own calendars, allowing the conference rooms to be “invited” to meetings.

A competing calendar application at Sun, SchedRoom, kept conference room scheduling out of the domain of CALENDAR MANAGER, essentially requiring users to schedule a meeting using both applications (for more discussion on the co-evolution of these two applications, see Palen, 1998). However, Sun employees used CALENDAR MANAGER for scheduling other kinds of shared information, including groups’ vacation schedules.

Factors Contributing to Successful Adoption

Interviews and surveys, and inferences drawn from them, provide only a partial view of the adoption process: They rely on retrospection and memory of practices. That said, a pattern of discretionary adoption and a set of factors contributing to it did emerge that differed from those prevailing ten years earlier in similar environments. In summary these include:

- changes in infrastructure, including networking, support, and behavior
- expanded application functionality
- improved graphical interfaces that provide versatility and ease of access

With respect to the central question of how groups reach a critical mass of use, we found that high-level management mandate was not a factor. In a few cases a group

leader strongly encouraged group members to adopt. We interviewed one self-described calendar evangelist. Most often users reported bottom-up adoption abetted by peer pressure. Peer pressure had technical and behavioral aspects:

- features and functions of calendar software, notably its integration with email, that remind non-users of use by others and benefits they might be missing
- a bottom-up pattern of adoption, with use spreading from individual contributors to managers and administrative assistants (“admins”). Pressure on holdouts, sometimes mild and sometimes less so, could eventually come from every direction—managers, admins and peers—and adoption became nearly universal.

In this section we detail these five observations.

Infrastructure

Our principal sites, Sun and Microsoft, had organization-wide platforms supporting the same calendar and scheduling software to which all employees were networked. In other sites we examined, users could exchange email over a corporate network, but sometimes had incompatible calendars.

Ten years earlier, this was not true in large high-tech companies. Employees were variously supported by corporate mainframes, divisional minicomputers, and small clusters of PCs that were difficult to network. Email did not span these environments, much less meeting scheduling software. Members of a team often shared a platform, but many meetings included people from other groups; therefore the software could not routinely replace traditional scheduling methods. Francik et al. (1991) identified the fact that working group boundaries often do not match organizational chart units as a key obstacle to adoption.

In our study, our one interview subject who did not use an on-line calendar in corporate marketing had many of her meetings with people external to the company whom the software could not reach. Ten years earlier, most developers were in comparable positions with respect to other groups *within* the company.

Both sites also provided strong technical support in installing and maintaining the software. This arose in several interviews. Group calendaring over a large client-server network is technically challenging. The failure of two releases of CALENDAR MANAGER was attributed by one informant to reliability problems, and occasional losses persisted:

About 2 years ago < sigh/laugh >, I lost all my data. And they had no idea what happened, it just was gone. So I mean all my personal data was gone too...I felt so stupid that I had to go back and

call all these people. I lost all my birthday data, ... my work data ... I was lost, because I rely on my calendar to tell me where I am supposed to be and what I am supposed to be doing. I really was relying on it. When I lost the data, I had to go around and try to find it, or I'd get calls "where are you?" "well I am right here, where am I supposed to be?" So, you know it was an embarrassing time.

Clearly not much of this will be tolerated in a product.

Finally, although difficult to measure, behavior has changed. People are much more comfortable with technology and are heavier users of it now than was true ten years ago, even in engineering environments. Almost everyone in these settings could be counted on to read email regularly, one element of what Markus (1987) calls "message discipline," an important factor in promoting use. The casual use of phrases such as "Sched plus me" and "Browse me" is further evidence of structuration or an evolution of the culture around the technology. A "behavioral infrastructure" was also in place.

Functionality

Another change over the ten years is that the products matured, supporting many new functions. Unlike earlier products and research systems, these applications were strongly integrated with desktop environments, email and corporate on-line rolodexes. The tight coupling with email was singled out as a factor in early adoption. For example, 74% of the Microsoft respondents said that receiving Schedule+ email played a role in their decision to start using the system. Notably, 88% of student interns cited Schedule+ mail as a factor in their adoption of the system. Interns have little time to socialize to the organizational culture, and their experiences indicate how influential the technologically-abetted peer pressure could be.

Conference room availability was sometimes described as the most critical aspect of scheduling a meeting, so the ability to schedule rooms or equipment through the system is another example of a feature that promotes use. At Microsoft, where the only way to schedule a conference room was through Schedule+, 57% of all respondents cited this functionality as a reason for adoption. This feature was even more important to populations that schedule meetings frequently, such as group and first-level managers, and the administrative assistants who schedule meetings on behalf of higher-level management: 80% of admins and 77% of group and first-level managers reported that the conference scheduling feature was a very important adoption factor. (At Sun, a different system was used for most conference room scheduling, although when administrative assistants wanted control over a conference room, they "moved" the conference room to a Calendar Manager calendar, where only those who knew about its existence could schedule the room. For them, Calendar Manager was a useful tool for wielding control.)

Two seemingly minor features cited as most important by survey respondents were the diverse mechanisms for reminding oneself of an upcoming event and more flexible ways to define recurring meetings, such as ‘Mondays, Wednesdays and Fridays at 9.’ These features support individual work practice but proved important in achieving a level of adoption that allowed the application to support collaboration. In fact, at Microsoft, automatic meeting reminders appealed more to individual contributors than to other employee categories, considered important by 93% of developers but only 60% of admins and 70-75% of managers of different levels. (The data by job position is not available with the Sun survey data, although interview data suggests similar trends.)

At Sun the ability to view other people’s calendars was roughly equal in importance to these two individual productivity features. Although Microsoft employees felt that viewing other calendars was less important, they reported that value of using the system came when other people also used it. This difference may be accounted for by the way calendars were used at each site: at Microsoft, viewing others’ calendars was important for scheduling meetings, but little other information could be viewed to apply to other purposes. Sun employees’ use of others’ calendars, on the other hand, extended beyond meeting scheduling to support other kinds of coordination.

Both systems provided a broad range of privacy options. Informant attitudes toward privacy differed, so this flexibility is important, especially in environments that use technology that supports a high degree of information sharing. In the Sun case in particular, where the calendar is deployed with open default privacy settings, we found that the option to change settings was important, even if people did not act on the option. Giving total privacy control to users further encourages use of the collaborative technology.

One admin who had used CALENDAR MANAGER for six years to keep calendars for managers, but only started keeping her own for the last three, said:

[I started using it for myself] when I realized all the things it could do ... I don’t remember it being that sophisticated before ... I mean it is an incredible thing, I mean now you can show multiple calendars on top of each other. So it’s really just gotten so good, it’s become a valuable scheduling tool ... I would say that with all of the increased capabilities of CALENDAR MANAGER that a lot more people have started to use it and realized that it’s a very helpful thing.

Versatility and Ease of Access

In discretionary use situations, ease and enjoyment are powerful motivators. With the applications studied, many calendar and scheduling features were easily accessed and many tasks could be carried out multiple ways, with one or another way more natural depending on the context. With the earlier generation of schedulers, obtaining

information was too time-consuming to promote some of the casual uses of calendar information that we observed. Even when unrelated to meeting scheduling, versatile access and management of calendar information promoted the prerequisite on-line calendar use; they contributed to “calendar discipline,” the behavioral infrastructure.

We found evidence that for applications that are only indirectly tied to people’s principal work missions, interface transparency and efficiency were particularly important. Where a feature is even slightly obstructed, it can go unused. For example, CALENDAR MANAGER users greatly appreciated receiving invitations in the form of a “meeting template” which could then be dropped into their calendars. Yet, only 26% of the Sun survey respondents reported sending meeting templates regularly. One survey respondent reported: “I love it when people send the attachment that I can drag and drop, but I don’t do it (I haven’t figured out how to do it).” Furthermore, many message senders who did send templates did not use either of the ways to drop a meeting template into their invitation, each of which involves an extra step or two. Instead they took even more time to type an invitation character by character to conform to the message template. Another survey respondent explained: “I would do it more if the template was automatically generated for me.”

One developer pithily summarized his attitude: “walk arounds are work arounds.” If he felt blocked by the application, rather than looking for a way to work around the problem, he would arrange meetings “off-line,” on foot.

An interface change that was widely praised at Microsoft was allowing users to enter employee’s actual names, in contrast to their email aliases. At Sun, employees’ calendars had to be identified by name and host machine. The integrated on-line rolodex rendered this only a minor inconvenience; nevertheless, this was a common source of complaints, suggesting that small interface details are salient to users who may not be strongly committed to an application.

Universal Adoption and Peer Pressure

The only way that makes it useful is that everyone is using it.

—Product marketing representative

Use was almost universal in the groups sampled, with some people unaware of anyone who did not use it. Across the corporations, adoption was conservatively estimated at 75%, as indicated by survey results. A Sun developer remarked:

The numbers have gone up dramatically. I think now ... everybody uses it, anybody who has a workstation uses it. It’s hard to find someone who doesn’t use it ... It’d probably be the janitor or someone like that because they just don’t have

access to the equipment. Everybody ... even non-technical people use it.

How did use become so widespread? When asked directly, some reported that they felt peer pressure to keep calendars on-line. 50% of the Sun respondents and 59% of the Microsoft respondents said they felt at least some peer pressure to use the system. However, many who reported feeling no pressure said that was because *they* were the ones in their workgroups to deliver pressure:

I pressure managers 'considerably' to use their calendar manager! Every so often I end up with one who just WILL NOT use the tool, and it drives me nuts!

Still others felt that “pressure” was too strong a word to describe the expectation they felt from others to use the calendar system. A Sun survey respondent wrote:

I don't feel that there is explicit pressure, just a widespread expectation that everyone is using it. I am one of the people who raise eyebrows when I find out someone is not using it and it affects my work. I've stopped short of requiring each of my staff to use it.

Similarly, interview informants who said they did not notice pressure often contradicted themselves, in subtle or not so subtle ways, by also reporting clear frustration with non-users. For example, a Sun admin reported telling the only non-user he knows,

Everyone on the team is available at this date and time, except I don't know whether you are even in your office.

Similarly, a Sun human factors engineer who said that he didn't believe there was any pressure to use the calendar nevertheless expressed annoyance with non-users, a sentiment that is probably hard to disguise:

Where I find that things become annoying is that a lot of people will call for meetings without using the calendar appointment embedded in their message ... then I've got to go into the CALENDAR MANAGER and schedule an appointment and it seems like a waste of time. And that happens all the time.

In environments where “sched plus me” or “browse me” were common phrases to delay the scheduling of future meetings until users were back at their computers, non-users would quickly feel left out. In fact, non-users often missed meetings entirely that were scheduled without their notice. Furthermore, lists of “appointments” that included company holiday dates and colleagues' birthdays that

could be automatically inserted into electronic calendars further encouraged participation.

Finally, the application design can itself contribute to social pressure. Recognizable appointment attachments reminded non-users of a benefit they may be missing. Calendar integration with email enabled users to deliver peer pressure to use the calendar easily via the technology. As a manager at Microsoft reported:

Some people don't look at my SCHEDULE+ [calendar] to see if I'm available. I will press decline, and say, "Please see my SCHEDULE+."

The recipient was left with little choice other than to use the software.

The Adoption Trajectory

No single adoption pattern fit every group. A few interview informants reported pressure from a manager or project leader. But more typical were those who reported that developers—individual contributors—were the first adopters, exerting pressure on peers and then on managers and admins, with pressure continuing up the managerial ladder. Once admins adopted meeting scheduling they could exert pressure in all directions. (It may be significant that admins now appear to wield more influence than did secretaries in the 1980s.)

People expressed a variety of perceptions about adoption. A Microsoft program manager said: "I resisted for six months. When I had people under me, I needed it. Now I can't live without it." A Sun corporate marketing representative, who initially used CALENDAR MANAGER but has since stopped, reported:

[In] Sun culture, engineers [say] 'You are not on CALENDAR MANAGER?' They're just shocked that you don't use your own technology ... I don't think marketing management uses [CALENDAR MANAGER].

A Microsoft trainer reported that "the first groups to get up to speed were the admins." Similarly, a Sun product marketing representative said:

I think that most people keep a CALENDAR MANAGER because of the browsing capabilities.... When we are trying to set up appointments, admins ... rely on being able to look at other people's calendars to see when they are available.

A Sun developer described a bottom-up adoption pattern:

Over time, they (managers) started to use it, they started seeing the benefit of using it ... but initially I can't say there were a lot of people using it. Initially ... it was mostly developers, then you start getting a scattering of managers, I bet you now

we could go and browse Scott McNeely's (Sun CEO) calendar if we wanted to, so now all the way to the top ... now everybody.

However, a Sun technical writer reported a different experience: "pressure was from management, not coworkers. The attitude is 'Get into the 90s.'"

Survey results support a largely bottom-up adoption trajectory: At Sun, 51% of the respondents felt that their immediate colleagues were a source of peer pressure, whereas only 29% reported feeling pressure from their management and 25% from admins. At Microsoft, 70% of the respondents said that pressure came from their colleagues, with 25% reporting pressure from management, and 7% from admins. Focusing on high-level management, 80% of Microsoft's managerial respondents reported feeling pressure from their colleagues, and 40% reported feeling pressure from their staff members. Only 23% of managers reported feeling pressure from *their* management.

Conclusion

We examined organizations in which calendaring technology was acquired by developing it and was very widely deployed as a natural consequence, although these decisions required high-level management involvement (see Palen, 1998 & 1999, for a discussion of Sun's development and deployment over a decade). However, deployment does not necessarily lead to adoption by employees, as we have noted.

Despite arguments that only mandated use of on-line calendars will insure the critical mass of use needed to facilitate meeting scheduling, this did not occur. Instead, a new generation of calendars was more useful and easier to use, supporting discretionary adoption. The calendars could be shared with virtually anyone in these organizations, and by the 1990s almost all employees used desktop systems.

In the 1980s, individual contributors did not keep calendars on-line. The applications of the 1990s added features that appealed to individual contributors, such as meeting reminders and invitations or appointment attachments that are easily dropped into a calendar. Integration with email meant that non-users received frequent reminders that the software was being used by others.

Instead of top-down, mandated decrees to adopt, we saw a common adoption trajectory: Some individual contributors chose to use the software to increase their individual productivity. Once enough people did so, the potential benefit of shared calendars became more evident. As people grew accustomed to using calendar applications to coordinate, the relative difficulty of scheduling non-users stood out, leading to peer pressure to adopt.

Initially, the collective benefit of easier scheduling translated into more work for individual contributors and more benefit for the managers and secretaries or admins who organize most meetings. The solution was not to mandate that the individual contributors do more work; rather, it was to reduce the work required of them by building better interfaces and features that they did value. This clearly seems desirable in principle, and in practice it was necessary because few organizations were ready to mandate the use of such a small, personal application as a calendar.

The use of collaboration technology may not always follow this pattern. For one thing, system-wide deployment may be a necessary prerequisite—a high-level management role can be important here. Vendors once hoped that groupware would be deployed one group at a time, but this has proven problematic due to the dynamic nature of workgroups, with membership distributed organizationally and changing over time.

However, factors that plausibly affect adoption of collaboration tools, such as their decreasing cost and visibility, have grown stronger. The core observations are likely to be general. For example, a recent study of the widespread use of NetMeeting within Boeing concluded “it is generally the users, and not management, who are the driving force in diffusing the technology across distance” (Mark and Poltrock, 2001).

Another path to adoption is seen in new enterprises that organize around collaboration technologies. Their employees form interaction conventions based on the software, rather than having to give up or change conventions established previously.

How will the observations of calendar use generalize to other collaboration technologies? With collaboration features proliferating and the cost of applications decreasing, most will have the low organizational visibility that suggests that widespread deployment followed by bottom-up adoption is likely to be the norm. This in turn will require features or processes of use that deliver benefits to most or all group members.

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