

Social, Individual & Technological Issues for Groupware Calendar Systems

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ABSTRACT

Designing and deploying groupware is difficult. Groupware evaluation and design are often approached from a single perspective, with a technologically-, individually-, or socially-centered focus. A study of Groupware Calendar Systems (GCSs) highlights the need for a synthesis of these multiple perspectives to fully understand the adoption challenges these systems face. First, GCSs often replace existing calendar artifacts, which can impact users' calendaring habits and in turn influence technology adoption decisions. Second, electronic calendars have the potential to easily share contextualized information publicly over the computer network, creating opportunities for peer judgment about time allocation and raising concerns about privacy regulation. However, this situation may also support coordination by allowing others to make useful inferences about one's schedule. Third, the technology and the social environment are in a reciprocal, co-evolutionary relationship: the use context is affected by the constraints and affordances of the technology, and the technology also co-adapts to the environment in important ways. Finally, GCSs, despite being below the horizon of everyday notice, can affect the nature of temporal coordination beyond the expected meeting scheduling practice.

Keywords

Groupware Calendar Systems, ethnography, CSCW, calendars, diaries, time, sociotemporality, meeting scheduling

INTRODUCTION

Groupware offers a challenge to both design and deployment. Intended to support coordination over multiple people, groupware must be useful to single users as well, and have consonance with the norms and practices of its use environment. Unfortunately, groupware applications are frequently masterminded by developers who base a design on their own experience, without testing these designs. Although a *technology-centered* perspective

has fewer up-front costs, it can often yield technology that is not usable nor useful in practice.

The field of human-computer interaction (HCI) arose in reaction to this technology-centered perspective, and has had a positive impact on the quality of individual-user software available today [13]. However, the problem of groupware design continues to elude, even when user-centered design techniques are used [4]. *Individual-centered* approaches have difficulty addressing multiple-user technologies because they cannot be evaluated in a lab.

The field of Computer Supported Cooperative Work (CSCW) has broadened design perspectives still further by addressing the social and organizational contexts of technology use. Examination of work practice, institutional incentive and control structures, the production system of the enterprise, and other aspects of social organization is important because these factors can impact groupware use in unexpected ways. To this end, design may be expanded to include deployment and training issues. However, in an effort to identify and understand these factors, a broad *organization-centered* perspective introduces its own challenges: Turning observations into groupware design implications as well as accounting for technological constraints and individual variance are difficult to do.

Technology-, individual-, or organization-centered perspectives each have their limitations (albeit to varying degrees) when used in isolation to inform groupware design. In an ethnographic study of Groupware Calendar Systems, a synthesis of these perspectives was used to yield a more holistic understanding of groupware technology use to inform design and deployment strategies.

MULTIPLE PERSPECTIVES

Groupware Calendar Systems (GCSs) highlight the need for multiple, convergent perspectives. GCSs appear simple in function, but become complex in execution. Conventional paper calendars support people in idiosyncratic, personally customized ways (Figure 1, arrow 1). GCSs replace conventional calendars, requiring that they be used simultaneously for both personal use *and* social

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coordination. These dual functions of groupware calendars introduce new challenges and opportunities for interpersonal communication (arrow 2). Additionally, GCSs publicly display the use of "personal" and "company" time, which has implications for both individual users and the function of the system in the business enterprise more broadly. In an effort to make meeting scheduling more efficient, GCSs indirectly affect much more fundamental issues of information sharing and temporal coordination. In this critical position, the social environment and technology co-evolve and co-adapt (arrow 3).

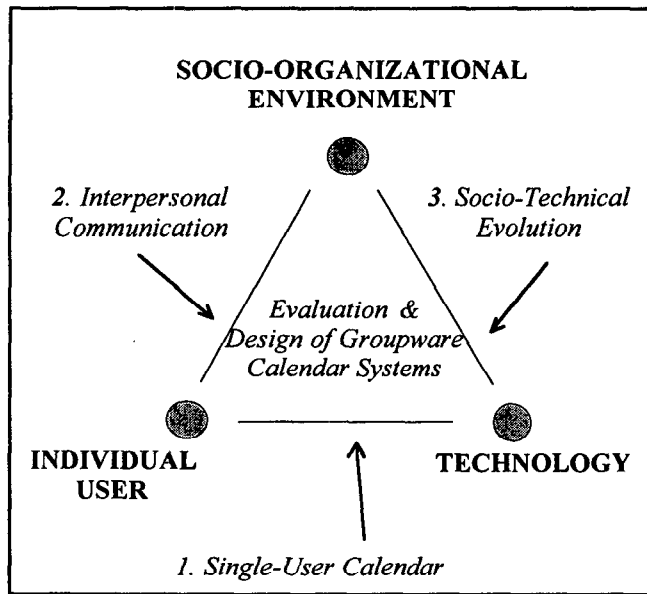


FIGURE 1: Convergent Perspectives

GROUPWARE CALENDAR SYSTEMS

What are Groupware Calendar Systems? While specific features vary, GCSs are systems of on-line calendars that can be shared across a network. Individual users keep their own calendar on-line, and allow various degrees of access to other GCS users. Some GCS applications allow for non-person entities to "own" a calendar, such as conference rooms or equipment resources. Collaboration is supported by simple sharing or viewing of other people's calendars, or by sending special meeting invitations through the GCS. The primary site for this research uses a GCS in one of the most open ways possible, where individuals' calendar information is read-accessible to other users by default (an "Open" Model GCS). Other GCSs may reveal only blocks of free and busy times by default (a "Restricted" Model GCS), while still others may reveal no information to other users on the network by default (a "Closed" Model GCS).

GCSs have been available since the late 1970s, making them one of the earliest groupware technologies to emerge. Cited illustratively in discussions of groupware, GCSs are sometimes described in a way that implies simplicity in function, trivialized as generic groupware without the complexities that other collaboration support systems have.

Limitations of Existing Calendar Research

Despite the ubiquity of conventional calendar artifacts and the steady proliferation of electronic calendar systems, relatively little empirical research has been conducted on either conventional paper-based calendars or new electronic calendar technology. Kelley and Chapanis [8] did early empirical work on conventional calendar artifacts to inform the design of the then-emerging electronic, but not networked, calendars. Subsequent studies focused on electronic calendars primarily for individual use [9, 16], although Payne did point out the challenge of the dual nature of networked calendars [16]. Still other studies on electronic calendars emphasize feature design [1,5], although Beard et. al. do address the impacts of particular features on calendar sharing [1].

S.F. Ehrlich [2, 3] was the first to address the social impacts of calendar systems, and insightfully described them as communication devices. Grudin [6] subsequently pointed out important adoption issues around groupware, with meeting scheduling as the focus of these observations. Subsequent work by Grudin and Palen [7] on GCSs identified a set of socio-technical factors that contribute to widespread adoption of groupware, but with less of a focus on the impacts of the calendaring functionality itself. Mosier and Tammara [12] examined some of the interactions between personal and social use of GCSs in a small, short-term trial. Among other findings, they found that if insufficient use is made of one's calendar by others, maintaining an on-line calendar may not be worthwhile.

THE STUDY

Sun Microsystems has used an internally developed GCS — "Calendar Manager" (CM) — for about a decade, with GCS deployment matching rapid corporate growth from hundreds of employees to over 20,000 today. Although more companies are using GCSs with increased success, Sun is unusual for two reasons. The GCS has been in wide deployment for a long duration (estimates of a 75% deployment rate), and allows for the highest degree of information sharing compared to other commercial GCSs. Specifically, the contents of each user's calendar are readable by default by everyone on the internal network. Although employees can customize and change their access settings, over 80% of the users maintain the defaults.

Data were collected through a combination of ethnographic techniques including interviews of multiple members of workgroups selected across the organization (for a total of over 40 subjects). In-office observation was conducted, including some video recording. Subjects' work environments were photographed, and hardcopies of on-line calendars were collected. In cases where subjects also used paper calendars, samples of these were collected as well. Other documents were collected, including orientation training materials, internal web pages on calendar help, and usability "bug" reports. Additionally, a survey was administered to about 3000 employees over an email distribution list, with a 50% response rate. The survey questions were informed by qualitative interview data collected in an early phase of the study. The purpose of the survey was to assess GCS use demographics, and to

determine how broadly findings from the interviews applied across the company. In general, qualitative and quantitative data sets were highly consistent.

SINGLE-USER DEMANDS (ARROW 1)

The activities of calendaring and scheduling underpin the use of GCSs. Designers will sometimes try to use metaphors from the physical world to assist in design. In general, this would seem to be a good heuristic for developing useful systems, but can fall short if superficial assumptions are made, which can be easily done for "everyday" artifacts like calendars.

Diversity in Calendar Form & Function

Consider the diverse formats and locations of paper-based calendar artifacts, and the functions afforded as a result. Kelley and Chapanis found that over 150 unique published calendar formats are available through stationers [8]. Daily, monthly, and weekly formats afford different functions and "views" on information. Other formats include appointment calendars, which use a much finer granularity of time, such as 15 minute units. Reference calendars are intended to keep track of days, and have comparably little additional space to record information. Journal-type calendars devote a whole blank page per day, rendering them all-purpose.

Location of calendar artifacts can signal appropriate access by others. The hallway project planner may be intended to communicate important events and deadlines to workgroup colleagues; everyone may be invited and even encouraged to read it, but perhaps social sanctions limit its content and authorship. Desk organizers naturally have more access restrictions; although, again, the social sanctions may deem it appropriate for an officemate to quickly browse the organizer to find the whereabouts of the owner.

"Calendar Work"

The ways in which people interact with calendars extends beyond the activity of meeting scheduling. I call the range of activities for which calendars are employed "calendar work." In brief, calendars support:

Temporal Orientation. Like clocks, calendars orient us in time. Instead of hours, we refer to them to determine the day, month, and year. We also use them to orient to events in time that are relevant to us but may have no relationship to the Gregorian calendar. For example, relative to the current date, one can figure the number of days left until the summer holiday or to prepare for an upcoming meeting.

Scheduling. Scheduling is a complex task of balancing constraints and priorities. Scheduling appointments involve managing competing requirements, priorities, and constraints, meaning that appointments are often juggled and moved around. Scheduling is less an "optimizing" task and more often a "satisficing" task, where, because of the complexity, the appointment is typically made as soon as the requirements are met.

Tracking. Where scheduling is an activity of advanced planning, "tracking" records events that happen in the present, typically for reference later. Contacts, medical conditions, and spending habits are among the examples of things that are tracked.

Reminding. Calendars assist in reminding users of future events. Users may also include non-appointment information to aid memory, such as recurring anniversary-types dates, and "to-do" lists — information that exists only to remind, in fact. Reminding can be opportunistic as well — when scheduling an event, one may be reminded of some other deadline that occurs on that same day. Or, in an example Payne provides, one event — "appointment with director" may remind a person to do some related but unrecorded task like "press suit this evening" [16, p. 92].

Note Recording/Archiving. Calendar artifacts may be used to record notes (like meeting notes, product information, etc.), often with the intention of associating them with a particular point in time for possible retrieval in the future.

Retrieval & Recall. Temporal association of information can assist in retrieval and recall. Some information may be deliberately recorded in calendars for later retrieval, but retrieval may be opportunistic as well. Several subjects said that they will sometimes look through their calendars to locate the spelling of a name or a lost phone number that they previously recorded.

Reconciling Calendar Needs & Design Affordances

Discussions of technology adoption are often restricted to aggregates of users. Although a broad view of the social organization is important, adoption is ultimately accomplished one user at a time. One of the major hurdles in GCS adoption, then, is a reconciliation of individual calendar demands with the affordances of GCSs for calendar support.

For heavy calendar users, this reconciliation is of particular importance. For those whose calendar work habits extend beyond discrete appointment entries, electronic calendars can be poor substitutes. Finding ways to work-around or relocate supplemental information about meetings and business contacts and to-do-lists, for example, are often part of the decision to participate in a GCS. One of the risks for heavy calendar users is *competition between calendar artifacts*. Attracted to the benefits of the GCS but still needing other kinds of calendar support, some people will attempt to employ multiple calendar artifacts. While this approach can be successful, maintenance of multiple artifacts is rarely without some struggle, and often one calendar artifact loses the battle.

For infrequent or erratic calendar users, the requirements for adoption are different. GCSs must make calendar maintenance simple and attractive to users who are not in the habit of keeping paper calendars.

Discretionary Appeal

Electronic calendars have the potential to hold great appeal [7]. Much of calendar work is repetitive: by their very nature, the time-based representations of calendars are cyclic on daily, weekly, monthly and yearly bases. Computer automation suits some tasks superbly: the ability to perform a single one-time entry for weekly staff meetings, anniversary-type dates, pay-days, for example, is attractive. Additionally, automatic reminders (in the form of email, beeps, and dialogue boxes) generated by these entries are

repeatedly cited as helpful; in fact, Sun survey subjects cited "reminders" as the most important CM feature.

Recurring appointment settings and automated reminders represent long strides toward making calendaring appeal to low-use users in particular. Some people are infrequent users because they do not have many appointments to attend; these users do not need to check their calendars frequently to enter appointments, which greatly reduces opportunistic reminding of other appointments.

Increased social coordination is another reason to participate in a GCS, even if users must make tradeoffs in personal calendar support.

INTERPERSONAL COMMUNICATION (ARROW 2)

Groupware Calendar Systems create new opportunities for social coordination. They also introduce opportunities for conflict, and challenge notions of personal privacy and control over information and time, especially openly configured GCSs like Calendar Manager

What are the special characteristics of calendar systems that impact interpersonal communication? On first glance, the primary issues appear to be about information disclosure and the mechanics of meeting scheduling. A closer examination of the function of calendars reveals additional coordination challenges and opportunities.

Artifacts of Temporality

Clocks and calendrical systems make time tangible and meaningful by imposing both natural and artificial boundaries on it — minutes, hours, days, weeks, months, years. In this sense, calendrical systems (like the Gregorian calendar) are themselves artifacts. Paper and electronic calendars contain these time system representations, which allow for the manipulation of time: exchanging one meeting hour for another, allotting time for a task, splicing events in between others. It is time-as-artifact that, in part, makes calendars useful.

Peer Judgment & Inference

However, with open calendar systems like Sun's, information about time use becomes public, creating the opportunity for peer judgment about time allocation. Open calendar systems also create the opportunity to use calendars to coordinate with colleagues by allowing them to make inferences about the *quality* of the time allocation. Employees can make inferences about others' workload not only by the numbers of appointments in their calendars, but also by the nature of the appointments. This issue is addressed in more depth later in the paper.

Interpersonal Boundary Management

Unpacking Privacy

Privacy regulation is central to the adoption of an open model GCS. Privacy is a broad term, often serving as a catch-all for more subtle meanings of disclosure and control. With respect to the domain of networked calendars, five primary privacy concerns are at issue. These privacy concerns can be further organized by matters of information- and time-based content.

Privacy Concerns about Information-Based Content:

- *Personal Privacy of Information:* Information considered totally innocuous to some is considered personally private to others (medical appointments are a good example of this).
- *Social Sensitivity of Information:* Information that could have implications for other people, but is not personally private to the calendar owner. A frequently cited example is the internal job interview, where the interviewer may unwittingly include the entry in her calendar making it possible for the interviewee's colleagues to see.
- *Company Security of Information:* Information that is proprietary or reveals undisclosed business strategy (via appointments with other companies, for example).

Privacy Concerns about Time-Based Content:

- *Personal Privacy of Time Allocation:* Concern about judgments made about one's use or allocation of time.
- *Control of Access to Time:* For some, open calendars relinquishes control of their schedules to others; some are more specifically concerned about relinquishing control of access to the self as represented by their schedule.

Managing Privacy

Ways of managing calendar privacy while participating in the open calendar system at Sun involve a combination of techniques utilizing built-in technical mechanisms and strategic uses of information.

Access Settings. Globally across the calendar or locally for each appointment, users can restrict what others see by explicitly using privacy settings. Options include displaying all appointment details, only free/busy times, or nothing at all. Using privacy settings explicitly controls interpersonal boundaries.

Cryptic & Context-Sensitive Entries. This technique allows appointments to be left readable while still protecting one's privacy. Calendar owners both deliberately and inadvertently control access by making entries context-sensitive, such that only restricted audiences understand the meaning. Listing one's daughter's name at 2pm, for example, sufficiently reminds the calendar owner to pick up his child from school, but also signals to immediate group members (who presumably know the child's name) that the appointment probably cannot be moved, and that their colleague intends to return shortly. The entry looks like a business appointment to everyone else.

Omissions. Users may simply omit appointments on their networked calendar that are private, recording them elsewhere or memorizing them. A foolproof way to control sensitive information, the interpersonal boundary unambiguously delimits personal information space.

Scheduling Defensively. Scheduling work time in calendars allows people to participate in the GCS while imparting a feeling of control over time. Time can be protected even further by using a fake appointment to disguise work time, and minimize the possibility of being asked to attend a meeting instead. However, at Sun, this practice is employed judiciously. Expectation by others to cooperate

within the groupware system caps excessive blocking out of work time, as does one's own investment in making the calendar accurate enough to act as one's proxy.

Calendar Reciprocity

Reciprocity plays a critical role in GCS use. People are strongly influenced by what others are doing around them: for most of Sun, calendar openness is reinforced every time someone browses another's calendar. Those who have different access settings — either more restrictive or less restrictive — often have immediate colleagues with similar access configurations. Willingness to keep a calendar open is in large part based on the security of knowing that everyone else keeps their calendars open, too. Restricted or closed calendars can challenge norms and expectations, and be perceived as unwillingness to reciprocate the trust others offer. In reaction, calendar openness may give way to closedness. Over time, pockets of users in the same social network develop their own norms. Some employees do not appear to realize that their groups handle calendars differently than the company-wide norm of open calendars, suggesting that some groups have long-entrenched local norms around calendar use.

Meeting Arranging

Many GCSs are touted as applications that can drastically improve the efficiency of meeting scheduling. CM at Sun is used as part of the meeting scheduling negotiation: 88% of survey respondents reported using others' calendars for the purposes of meeting arranging. However, CM is used for more than meeting scheduling: almost 70% of respondents also report reading calendars to locate a colleague. In addition to these survey responses, qualitative data indicates that shared calendars serve a variety of functions.

"Beyond Meeting Arranging"

Many Sun employees cannot imagine using GCSs where only free and busy times are visible, as other GCSs are designed. When given the choice, Sun employees will choose to view calendars so that the content details can be read, instead of viewing only the free/busy times.

With open calendars, a meeting arranger can assess the quality of what appears to be free time in someone's calendar. Examining what immediately precedes and follows a free hour can give some indication of what a colleague might be doing at that time. Does the following meeting require preparation? Is the preceding meeting being held across town, requiring the employee to travel during traffichours? Does the employee have a big deadline that will preclude any meetings that day? Employees frequently make these kind of determinations about others' schedules, and welcome others to do the same in the hopes of reduced interruption and negotiation overall.

At Sun, the GCS also functions as a distributed information system, around which people organize and synchronize their work.

Information Access

Distributed calendar information is used in several ways, reviewed here in brief:

Locating Someone & Assessing Availability. Some employees will even provide supplemental information, including contact information specifically for others to see.

Meeting Verification. An employee will sometimes browse colleagues' calendars to confirm meeting agreement.

Information Retrieval. Colleagues' calendars can also be used as resources for finding information like the location of meetings that went unrecorded in one's own calendar.

Organizational Learning. Open GCSs act as an opportunistically-created repository for an organization's "memory." A great deal can be inferred about the organization simply by reading calendars.

Synchronization. Employees can synchronize some aspects of their work by perusing calendars. For example, an employee who typically works at home sees upcoming deadlines and meetings that signal when to come to the office. "Schedule inheritance" is when actions or deadlines in one person's schedule are adopted by co-workers and put in their own schedules. The interdependency of schedules is made more explicit with open calendars, and is utilized to support coordination.

SOCIO-TECHNICAL EVOLUTION (ARROW 3)

GCSs are often below the horizon-of-notice for decision makers, and are also taken-for-granted by the users themselves. Because GCSs support an important part of business activity — meetings — and have the potential to support coordination beyond meeting scheduling, their technological constraints can affect use on a large scale. Likewise, the viability of such a technology depends on reasonable consonance with the organizational culture.

Orlikowski's "Duality of Technology" theory describes the process of co-evolution and institutionalization of technology and the behaviors around it. Orlikowski builds upon Giddens' theory of structuration, a social process of "reciprocal interaction of human actors and structural features of organizations" [14, p. 404]. Structural features include rules, procedures, norms — the intangible components of organizations. Employment of structural properties by human agents through the production of work institutionalizes the structures over time, continuing to legitimate their existence and the human agents employing them. For Orlikowski, technology is another structural property of organizations. "Technology is created and changed by human action, yet it is also used by humans to accomplish some action": this describes the duality of technology [14, p. 405].

Development Environment

Decisions about technology's early design and development arise out of one social context, such that the design choices are understood and resonate with the developers-as-users. Calendar Manager, now a commercial application, was developed in-house for Sun's internal use.

The early institutional properties of Sun provided a high degree of freedom for technology development by individual employees: operating under a code of "openness" and the need to develop useful functionality for a new platform, an

early calendar program was developed that helped set the direction for calendar sharing.

In such an environment, an open calendar model — where calendars are read accessible — was consistent with the early culture. Company growth did put new demands on its own technology, and also created a need to organize its available technology for commercial release. Calendar Manager was appropriated by the production system of the company for commercial value, while at the same time enmeshing itself in day-to-day business operations.

Impacts of Early Design Choices

Remarkably, the open calendar environment survived and deployment levels were sustained even as the company rapidly grew to over 20,000 people. Although Sun is a high-tech environment that has far fewer technological obstacles to overcome than other industries and institutions, it is no longer the small UNIX shop of a decade ago. Sun today is a large corporation with production functions that require a variety of job positions, with many new employees having no previous UNIX experience.

Today, survey data indicates that 81% of users maintain the defaults for their access settings, leaving their calendars readable for the “world” of Sun. This practice can be explained by two factors: 1) user passivity for customizing default settings — as has long been established in HCI research [10] — and 2) a process of institutionalization of the technology [14]. Consider the very similar results of Microsoft’s use of Schedule+ (when studied in 1994): 80% of GCS users maintain their access default settings — except their defaults display only free/busy availability (a “restricted” model GCS)! Interestingly, the GCS in each company can be user-configured to work very much like the other, but are not because the majority of users maintain the defaults.

Social Impacts on Evolving Design

New conditions of the changing environment put restrictions on what the technology could do, which had direct impacts on the technology design. A fourth access setting — the “executable” setting that executed system commands at appointed times as entered in the calendar — was removed. As the company grew and becoming more heterogeneous with respect to job positions, the executable setting was seen as a risk to computer security and — by virtue of the business of Sun — was therefore seen as a risk to *company* security. More recently, a design proposal by engineers to limit the range of privacy access settings in an new incarnation of CM was met with user disapproval, and the full range of controls were reinstituted. Even though most employees do not use the specific controls proposed for removal, retaining the ability to technologically control access was important to them. Also, new features were gradually added. Time zone compatibility became more important as Sun expanded geographically, for example.

Deployment, Institutionalization & Niche-Creation

Catalyzed by distribution of the technology to specific employees — administrative assistants — who found the technology useful in conducting their jobs, awareness of

Calendar Manager spread throughout the company laterally and from the bottom-up. Mechanics of structuration appeared in iterative design feature inclusion and exclusion. Structuration also appeared in language, where users would invoke the name of the calendar read feature in everyday language as a directive to others — “Browse me.” However, the presence of another scheduling system with its own institutional momentum served to keep the room reservation function beyond the scope of Calendar Manager.

CONVERGENT PERSPECTIVES

I have examined the situated use of a GCS addressing the demands of single-users on calendaring technology (both paper-based and electronic), interpersonal communication and coordination over the medium of calendars, and the co-evolution and institutionalization of the technology and the organizational environment.

A final examination of the situated use of a GCS also requires consideration of the *interaction* between these perspectives. This final convergence of perspectives reveals how institutionally sanctioned “temporal autonomy” affects GCS interpersonal communication; how technological infrastructure helps regulate privacy; and how a combination of conditions result in primarily group-wise interactions over Calendar Manager, despite its highly public configuration.

Institutional Value: Temporal Coordination

Most Sun employees enjoy temporal autonomy, possessing a good deal of control over their work time. The work ethic stresses personal responsibility for quality and completion of work, with comparatively little attention to when the work is actually performed. Although expectations vary between groups, many employees arrive at and depart from work later than conventional business hours, or keep schedules that vary daily. Telecommuting is common, and employees sometimes attend to personal appointments during the work day.

These flexible schedules make requirements for coordination with colleagues different than in workplaces with conventional business hours. With conventional business hours, people can reliably predict when colleagues will be in their offices; greater concurrence of working hours increases opportunities to interact with colleagues. With flexible schedules, the window of time in a day or week that colleagues are co-present may be quite narrow. Calendar Manager plays an important role in supporting temporal coordination by communicating employee availability, enabling people to plan their interactions with others and reduce dependence on chance interactions. In this way, CM substitutes for and elaborates on traditional office in/out boards (and few in/out boards exist at Sun).

These demands for temporal coordination help propel adoption, which is supported by a two-way peer pressure delivery. In return for a great deal of temporal autonomy, employees must be responsible for conveying their availability to their colleagues: this is a source of peer pressure to individual employees to keep a calendar on-line. Likewise, by keeping a calendar on-line, colleagues are expected to refer to employees’ calendars to reduce

interruptions to calendar owners. Reciprocal peer pressure sustains GCS use.

Technology Constraints Affect Social Interaction

Technological constraints indirectly regulate privacy to further enable the widespread practice of “world” readable calendars at Sun. The technological infrastructure that supports CM limits easy calendar access. An early design decision that suited a much smaller Sun scales up in way that requires users to be quite deliberate about specifying the calendars they browse — calendars cannot be “surf-ed” like Web pages. Connection to remotes calendars use the convention `user@hostname`. Another example of structuration, this design decision was influenced by the early socio-technical environment. Although there are reasons to consider this design legacy problematic, I believe that it has instead helped continue to make open calendars viable in the face of rapid corporate growth. In the early days, when Sun was a mere fraction of today’s size, hostnames could be almost as easily remembered as usernames. Today’s 20,000 employees have at least one workstation each: therefore, for every user name specified, an equally unique machine hostname must be specified to locate the calendar. Even though an on-line company rolodex contains all the necessary information to locate a calendar, doing so requires a few extra steps. Although certainly no obstacle to the persistent, these additional steps have been repeatedly noted by informants as requiring just enough work to reduce rampant browsing.

Group-wise Interactions

In addition to deliberate privacy regulation strategies, socio-technical conditions indirectly control privacy in this highly open calendar environment as well. The technological infrastructure, as noted above, restricts calendar “surfing.” Calendar reciprocity means that one’s immediate colleagues are more likely to share calendars in the same way. Finally, social anonymity helps control access. Although 20,000 people can read one’s calendar, only a few people in the company are actually known to everyone. Employee names are needed to retrieve calendar addresses to in turn read calendars. Privacy breakdowns certainly do occur, but far less than one might expect. Additional treatment of these issues are available in [15].

Despite being “world” readable, Sun’s on-line calendars are used for mostly group-wise interactions. In fact, keeping calendars world readable supports group interaction. Open calendars allows group membership boundaries to be fluid, without vigilant maintenance of access lists.

GROUPWARE DESIGN & DEPLOYMENT IMPLICATIONS

Designing for Individual Support

Goodness of Fit with Work Practice. GCSs bring into relief individual user demands even for multiple-user support applications. With expectations for integration into fundamental aspects of work practice, groupware technologies need to pay attention to the functions that physical analogues perform.

Adoption & Discretionary Appeal. Additionally, discretionary appeal is important for adoption by satisfying individual users to sustain them long enough until a

critical mass of users is achieved. Once achieved, groupware benefits commence [7, 11].

However, a potential tradeoff exists between maximizing individual support and privacy regulation in a groupware system. The more GCSs support personal work, the greater the chance that openness might be threatened. Imagine if Calendar Manager — which supports some calendar work very well, and others not at all — was more closely modeled after a paper organizer: would open sharedness be nearly as widespread or successful?

Building “Group”ware

The seemingly small design decisions and features have largest impact on groupware functionality. Access setting defaults — possibly accidents of design — constrain the range of possible behaviors around a GCS. Through a combination of user passivity and institutionalization of the technology, particularly for internally developed applications, defaults settings are rarely changed.

“Heavyweight” groupware features have lower importance, and only become useful after the central norms and practices around the groupware have been established. For example, features supporting meeting invitations that are sent from the GCS to one’s inbox can be useful, but the nature of their use is determined only after the degree of information sharing is established. Compared to other companies with other GCSs, Sun users prefer to read the details of each others calendars to make informed invitations to meetings; other companies with other systems more likely send hit-or-miss meeting invitations because colleagues cannot see the details of each others’ calendars.

Deployment & Socio-Technical Adaptability

Groupware is not one-size-fits-all; groupware design must be adaptable. An overlooked but important design decision that can affect the fundamental model of collaboration are default settings. Companies acquiring GCSs or other groupware must consider the impact of default settings, and make decisions about their configuration upon initial deployment. Software developers have obligations as well. Mackay notes: “A Software manufacturer should also seriously consider the impact of delivering a poorly-conceived set of default values when the first version of the software is shipped. Unlike many features that can be fixed in subsequent updates, decisions that affect individual patterns of use are likely to have long-term effects” [10]. Furthermore, software developers must make it *possible* for companies to modify deployment default settings to suit conditions. A seemingly trivial requirement, many applications cannot be modified for large-scale deployment.

SUMMARY

Calendar Manager (CM) has grown to be a quiet but important part of day-to-day business operations at Sun. Not a high-profile networked application like others in the Sun environment, CM nevertheless sits in a fundamental substrate of social organization — the “sociotemporal order” [18]. In addition to supporting meeting scheduling, CM supports temporal coordination more generally. Early design decisions configured access setting defaults for maximum sharing of calendar information. Over time, the

benefits of an open system became clear: in an environment where employees enjoy temporal autonomy, CM fills a need to communicate one's whereabouts and availability. It is this need that stimulates bilateral peer pressure to adopt and use the openly-configured groupware calendar system.

The role of calendar artifacts in work is integral to understanding CM's place in the sociotemporal order. "Calendar" is a kind of non-digital technology that depends on the artifactual representation of time for its function. Personally- and socially-significant information are contained and made public in calendars. CM is conceived as a system of individuals' distributed calendars; to use the GCS, users must modify their existing calendaring practice to suit the electronic medium. In addition, users must modify their calendaring practice and calendars to suit a public forum — a potential conundrum for things as idiosyncratic and personal as calendars.

Behavioral and technical mechanisms are employed by individual users to delineate privacy boundaries in an environment where their calendars are open to the "world" of the company network. These, together with features and customs of the social environment (like calendar reciprocity and social anonymity) and affordances of the technological infrastructure, influence how people handle their calendars as personal artifacts in a social space. These conditions conceptually constrain the space in which their calendars are truly accessible. It is in this way that CM, with its read-accessible defaults, is viable on such a large scale.

CM has an institutionalized role in the organization studied, where users depend on its function as a distributed information system in support of coordination. Subtle peer and institutional pressure to keep calendars open in support of these benefits creates an environment protective of liberal interpretations of privacy.

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REFERENCES

1. Beard, D., Palanlappan, M., Humm, A., Banks, D., Nair, A. & Shan, Y-P. (1990). A Visual Calendar for Scheduling Group Meetings. *Proceedings of the ACM CSCW'90 Conference*, 279-290.
2. Ehrlich, S.F. (1987a). Social and Psychological Factors Influencing the Design of Office Communication Systems. *Proceedings of the ACM CHI+GI'87 Conference*, 323-329.
3. Ehrlich, S.F. (1987b). Strategies for Encouraging Successful Adoption of Office Communication Systems. *ACM Transactions on Office Information Systems* 5(4), 340-357.
4. Francik, E., Rudman, S.E., Cooper, D. Levine, S. (1991). Putting Innovation to Work: Adoption Strategies for Multimedia Communication Systems. *Communications of the ACM* 34(12), 52 (12 pages).
5. Greif, I. (1984). The User Interface of a Personal Calendar Program. In Y. Vassiliou (Ed.) *Human Factors and Interactive Systems: Proc. of the NYU Symposium on User Interfaces '82*. Ablex, 207-222.
6. Grudin, J. (1988). Why CSCW Applications Fail: Problems in the Design and Evaluation of Organizational Interfaces. *Proceedings of ACM CSCW'88 Conference*, 85-93.
7. Grudin, J. & Palen, L. (1995). Why Groupware Succeeds: Discretion or Mandate? *Proc. of European CSCW (ECSCW'95)*, H. Marmolin, Y. Sundblad, K. Schmidt (eds.), Kluwer Academic Publishers, 263-278.
8. Kelley, J.F. & Chapanis, A. (1982). How Professional Persons Keep Their Calendars: Implications for Computerization. *Journal of Occupational Psychology*, 55, 241-256.
9. Kincaid, C., Dupont, P. & Kaye, A. (1985). Electronic Calendars in the Office: An Assessment of User Needs and Current Technology. *ACM Transactions on Office Information Systems* 3(1), 89-102.
10. Mackay, W.E. (1990). Users and Customizable Software: A Co-Adaptive Phenomenon. *Dissertation, Sloan School of Management*. Cambridge, MA, MIT.
11. Markus, M. L. & Connolly, T. (1990). Why CSCW Applications Fail: Problems in the Adoption of Interdependent Work Tools. *Proceedings of the ACM CSCW'90 Conference*, 371-380.
12. Mosier, J.N. & Tammaro, S.G. (1997). When are Group Scheduling Tools Useful? *CSCW: The Journal of Collaborative Computing*, 6, 53-70.
13. Myers, B. (1998). A Brief History of Human-Computer Interaction Technology. *interactions* 5(2), 44-54.
14. Orlikowski, W. (1992). The Duality of Technology: Rethinking the Concept of Technology in Organizations. *Organization Science* 3(3), 398-427.
15. Palen, L. (1998). Calendars on the New Frontier: Challenges of Groupware Technology. *Dissertation, Info. & Computer Science*, Univ. of California, Irvine.
16. Payne, S.J. (1993). Understanding Calendar Use. *Human Computer Interaction* 8(2), 83-100.
17. Schwartz, B. (1968). The Social Psychology of Privacy. *American Journal of Sociology* 73(6), 741-752.
18. Zerubavel, E. (1981). *Hidden Rhythms: Schedules and Calendars in Social Life*. Univ. of Chicago Press.