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Loose Coupling and Healthcare Organizations: Deployment Strategies for Groupware

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Abstract. Healthcare organizations are often organized in a modular, loosely coupled fashion where separate and semi-autonomous work units specialize in different areas of care delivery. This partitioning allows each unit to adapt to emerging practice standards in its area of expertise and to adjust to its local work environment. However, organizational loose coupling can limit the flow of information within organizations and can make it difficult to coordinate services when patients' care is dependent on professionals from more than one unit. Groupware systems have the potential to improve coordination and information access in healthcare organizations. However, modularity and loose coupling make it difficult to introduce new systems when they span more than one unit, since authority is not always centralized and since perceptions and frames of reference on new deployments differ across units. In this paper, we define a groupware deployment framework for loosely coupled healthcare organizations that has two parts: a set of deployment challenges and a set of deployment strategies. The deployment challenges include: difficulties centralizing deployments, perceptions of inequity, role conflicts, and problems achieving critical mass. The deployment strategies outline a preliminary set of approaches for addressing the difficulties of deploying CSCW systems in loosely coupled healthcare organizations. We illustrate the framework by presenting a case study of a groupware deployment in a home care setting.

Keywords: Loose coupling, healthcare, human service organizations, groupware deployment, deployment planning

1. Introduction

The demands of healthcare delivery influence the structure of healthcare organizations. Unlike other types of organizations that have strong central control, healthcare organizations are often divided into smaller autonomous units that focus on a specific area of care delivery (Hasenfeld 1983). For example, a health organization may have separate departments that deliver different types of patient care such as orthopedics, neurology, and pediatrics. In part, this partitioning is due to recent increases in the quantity of health information and the demands of managing evolving practice considerations (Wilson 2001). Role and work unit specialization allows professionals to become highly trained in one area of care and minimizes the burden of keeping up with new guidelines and research findings in other areas of expertise.

Work unit autonomy places control of the unit in the hands of local managers who are familiar with the operational demands of providing care within the unit's mandate. This results in loosely coupled relationships *between authority structures and operational units*, and administrators may have limited abilities to direct daily activities in the operational units (Weick 1980). Similarly, loose interdependence is also often seen *between operational units* (e.g. orthopedic departments, general practitioner offices) since each unit deals with a different set of operational constraints (Weick 1976, p. 6). This allows work units to adjust to local demands, and collaboration between units is often a matter of discretion rather than of necessity. Furthermore, loose coupling can enable continuous change and flexibility within the organization since each unit can tailor its actions and internal structure to meet changing demands. According to Spender and Grinyer (1995, p. 909), "tight coupling might lead to punctuated change while loose coupling facilitates continuous change."

Loose coupling also often exists *between individuals* in healthcare organizations since many workers are highly trained professionals who have significant autonomy in directing their activities (Scheid-Cook 1990). This loose coupling may be seen at the horizontal level between peers, and at the vertical level between workers and management. For example, an oncologist is highly specialized and self-directed, and even though she may collaborate with other health professionals, she is the expert in her area of practice and is able to direct care in most instances without first consulting others.

One of the results of healthcare modularity and loose coupling is that the flow of information in the organization may be limited. Patient information that is maintained in one part of the organization may not be shared with other operational units, even though access to that information might potentially be valuable in directing a patient's care. Additionally, decentralization and loose coupling has the potential to limit communication and coordination of services in organizations, and workers may have difficulties in directing services so that they are complimentary since they have a limited awareness of others' activities.

Since CSCW systems can help improve collaboration and information access, there has been significant interest in deploying these technologies in healthcare organizations. For example, many healthcare organizations, developers, and researchers are working toward implementing electronic health records (EHR) and clinical information systems with the goal of improving information flow and coordination between workers, regardless of their temporal and physical distributions. However, at this point there are many challenges in developing these and other types of CSCW systems for healthcare settings, and many deployments have met with limited success or have been rejected outright by target organizations (e.g. Littlejohns et al. 2003; Williams 1992; Dean 1993).

The very factors that drive the need for CSCW technologies in healthcare—that is, autonomy and physical separation of work units, and the complexity of modern health organizations—also make it difficult to successfully deploy new technologies. Loose coupling between organizational units, between professionals, and between professionals and their supervisors shapes the way individuals in healthcare settings will approach and

interact with new technologies. Loose coupling also makes it difficult to introduce new systems by mandate since authority structures have less power than in other organizations; in addition, the decentralization of work units poses many challenges in managing the deployment process in a way that leads to successful adoption of new CSCW technologies. Similarly, the separation of work units and the differences in their goals and frames of reference means that perceptions of the value of the deployment may vary significantly within the organization, and can adversely impact the adoption of the system.

The challenges inherent in introducing new CSCW systems to loosely coupled healthcare organizations make new implementations a considerable risk. For example, Littlejohns et al. (2003) estimate that approximately 75% or hospital information systems are considered failures, in part because of social and organizational issues that are not addressed by those managing the deployment process. This rate of failure shows that there is a significant risk in introducing new information technologies in healthcare organizations. Decision makers are often unable to dependably count on a solid return from their investment. Similarly, clinicians often are unable to depend upon new systems since organizational loose coupling often makes it difficult to secure a critical mass of users that is needed to make the system useful, and adoption is often uneven in the organization.

Many CSCW deployments have the potential to improve the dependability of healthcare delivery in several ways—by improving patient safety, by improving the overall responsiveness of the healthcare organization, or by improving the overall effectiveness of care delivery. In some instances, the benefits of healthcare deployments have been empirically evaluated under ideal circumstances, and vendors are able to provide concrete examples of how they will improve the care delivery process (e.g. improved patient safety through better prescribing practices (Tamblyn et al. 2003)). However, when system adoption occurs unevenly within the organization (i.e. one unit uses the system and others do not), or when the system is only partially used, these benefits may not be achieved.

In this paper, we consider the deployment issues that face practitioners who deploy new CSCW systems for loosely coupled healthcare settings. Our main objectives are to investigate how loose coupling, both at the individual and organizational levels, shapes deployment considerations for healthcare organizations, and to identify issues that make introducing CSCW in healthcare different than deployment in other types of organizations. We present a framework for understanding these issues. The first part of the framework is a set of four deployment challenges: difficulties centralizing the deployment, perceptions of inequity, role conflicts, and problems with critical mass. The second part of the framework is a set of strategies for introducing new CSCW systems in loosely coupled healthcare organizations. The framework is the first attempt to characterize deployment issues for CSCW systems in loosely coupled healthcare organizations. The assistance that the framework provides for developers to understand the context into which they will deploy their systems, and the specific guidance that the deployment strategies provide, make it much more possible that the first hurdle in dependability – that is, acceptance and buy in – can be accomplished.

With the wide variation seen in healthcare delivery across the world, we acknowledge that it is unlikely that loose coupling is seen in all healthcare settings. Furthermore, a North American and European bias is seen in the English language literature that we reviewed when compiling this paper. We specifically note that we are making a general case in this paper, and that, even in North America and in Europe, all health care organizations are not organized in a loosely coupled fashion. However, we feel that there is enough supporting evidence to conclude that loose coupling is common in many healthcare organizations (Scheid-Cook 1990; Burns et al. 2001; Scott 1985; Pinelle and Gutwin 2003), and that it can play a key role in the adoption and utilization of CSCW systems (e.g. Littlejohns et al. 2003; Williams 1992; Dean 1993).

In the next two sections, we present background material on loose coupling in healthcare, and on CSCW deployments in healthcare settings. We then present the first part of the framework: a set of groupware deployment challenges seen in loosely coupled healthcare organizations. Next, we present a working example of principles from the framework by presenting a case study of a groupware deployment in a home care setting. Finally, we present the second part of the framework: a set of deployment strategies for introducing new groupware systems into loosely coupled healthcare settings.

2. Human service organizations and loose coupling

Healthcare organizations are *human service organizations*. Hasenfeld (1983) defines human service organizations as the "set of organizations whose principal function is to protect, maintain, or enhance the personal well-being of individuals by defining, shaping, or altering their personal attributes" (p. 1). He points out that two characteristics distinguish human service organizations from others: 1) people are the "raw material" of the organization, and the organization's purpose is to shape their attributes; and 2) the organizations are mandated to promote the welfare of the people that they serve. Examples of human service organizations include hospitals, medical centers, mental health centers, social service agencies, public health agencies, public schools, universities, nursing homes, police departments, correctional institutions, employment services, and probation departments (Kouzes and Mico 1979, p. 453).

The attributes of human service organizations often differ from those seen in business and industrial organizations. According to Kouzes and Mico (1979), the underlying goals and motives differ between these two organization types, as do the organizational structures and processes. They point out that goals in business and industrial organizations are often clearly defined, and are motivated by maximizing profit for the shareholders or owners. In human service organizations, transformation occurs through staff-client (or patient) interactions, making outcomes somewhat ambiguous and difficult to assess. For example, it can be difficult to accurately measure improvements in a patient's mental status or in a patient's overall functional status. While profit may be a consideration in some human service organizations, the well being of the client is also a primary concern.

One of the main characteristics of some human service organizations is that they are often organized in a loosely coupled fashion. Loose coupling describes relationships between elements in social systems, and in human service organizations it indicates the level of autonomy and interaction that is seen between workers and work units. When elements are loosely coupled, interdependence between the elements is reduced (Weick 1976), and interaction between elements is usually infrequent (Hasenfeld 1983, p. 150), uneven (Staber and Sydow 2002, p. 417), indirect (Weick 1982, p. 380), and occasional (Weick 1982, p. 380). Reduced interdependence also often means that few formal coordination mechanisms are in place, so when intense coordination is needed, it can require extra effort (Pinelle and Gutwin 2003). This can cause loosely coupled elements to prefer mechanisms that have a low cost in the required level of time and effort. For example, low cost mechanisms such as mutually understood roles, task partitioning, and low-level awareness may be preferred over more costly mechanisms such as mutual negotiation and formal meetings (Pinelle 2004).

Weick (1976) describes loose coupling in human service organizations by providing an example from education:

> By loose coupling, the author intends to convey the image that coupled events are responsive, but that each event also preserves its own identity and some evidence of its physical or logical separateness. Thus, in the case of an educational organization, it may be the case that the counselor's office is loosely coupled to the principal's office. The image is that the principal and the counselor are somehow attached, but that each retains some identity and separateness and that their attachment may be circumscribed, infrequent, weak in its mutual affects, unimportant, and/or slow to respond. Each of those connotations would be conveyed if the qualifier *loosely* were attached to the word *coupled*. Loose coupling also carries connotations of impermanence, dissolvability, and tacitness all of which are potentially crucial properties of the 'glue' that holds organizations together. (p. 3)

Several researchers have considered why loose coupling is common in human service organizations. Meyer and Rowan (1977) state that loose coupling is often adopted in organizations that rely on adherence to external "myths" for legitimacy (such as a government mandate, as is the case in many human service organizations). Loose coupling allows work practice to be carried out according to the needs of the organization and to be carried out with minimal inspection, since external myths may be ambiguous and may not promote rational work practice. Hasenfeld (1983, pp. 156-157) also identifies factors that contribute to loose coupling in human service organizations. According to Hasenfeld, the autonomy of frontline staff members plays a central role in the adoption of loose coupling for four reasons:

1. Organizational activities are initiated through staff-client interactions rather than through directives from an organizational chain of command,
2. The visibility and observability of staff-client interactions is highly limited, and interactions are not open to inspection by management and other staff members,

3. Staff members control the information about staff-client interactions that is passed on to the organization and also control information from the organization that is passed on to the client,
4. Interactions between staff members and clients are not easy to coordinate centrally, due to variable work contexts—that is, different staff members interact with clients for different reasons, and the locations and times vary.

Researchers have considered different types of loosely coupled relationships in human service organizations. For example, Hasenfeld (1983) describes relationships between individuals in organizations, and Weick (1976) describes relationships between organizational units. These findings suggest that loose coupling can exist at four main levels: 1) between administrators and work units, 2) between managers and workers, 3) between work units, and 4) between workers (Pinelle and Gutwin 2005). The first two types of relationships are *vertical relationships* and involve an authority structure and a subordinate structure; the second two relationship types are *horizontal relationships* that occur between peers (see Figure 1).

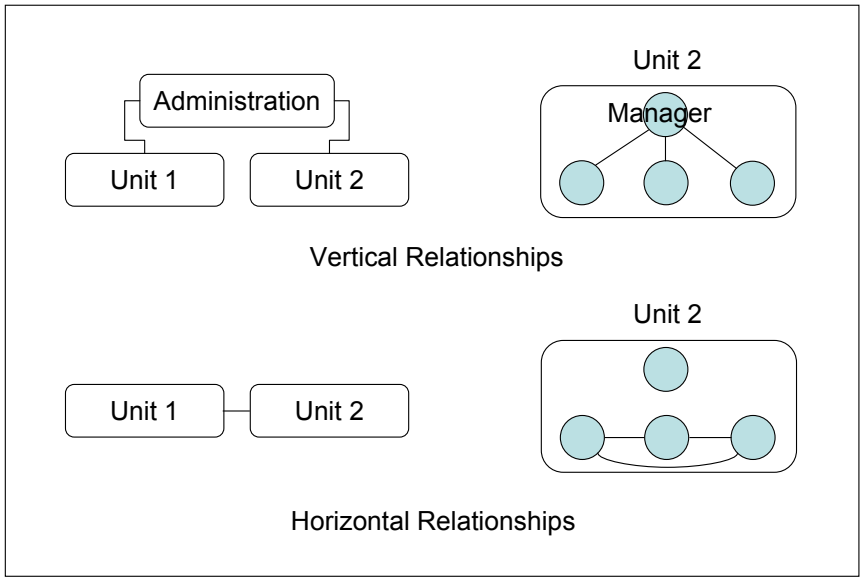

Figure 1. Relationship types in human service organizations.

Pinelle and Gutwin (2005) proposed an operational definition for loose coupling in social systems. The definitions are general and can be used to describe relationships between a range of system "elements", which can include organizational units, groups, or individuals. The definition uses three dimensions: interdependence, distinctiveness, and integration. Interdependence describes the strength of linkages between system elements. Interdependence refers to "the extent to which the items or elements upon which work is performed or the work processes themselves are interrelated so that changes in the state of one element affect the state of others" (Scott 1987, p.214). Integration indicates the level of coordination seen in interaction patterns between system elements (Bertrand 1972, pp. 26). Distinctiveness indicates the degree to which elements are well defined and semi-autonomous (Orton and Weick 1990).

Loose coupling. Loose coupling exists between two or more elements when:

1) *Low interdependence*. Each element's actions affect the other elements weakly and/or infrequently.

2) *High differentiation*. Elements are distinct, logically separate, and self-contained.

3) *Low integration*. Interaction to manage interdependence does not take place regularly between elements.

The differentiation described in the definition can operate at different levels. For example, when the elements are two people, differentiation can indicate well-defined roles that give a logical separation to the work of each individual. When the elements are groups, high differentiation can indicate separation of function or purpose between the groups.

Several researchers provide examples of loose coupling in healthcare settings. Scott (1985) discusses mental health systems, and states that tight coupling is seen in funding flows, but that loose coupling is seen in the service delivery elements. Scheid-Cook (1990) presents a case study of community mental health centers, and reports that loose coupling is seen in the lack of inspection and evaluation of professionals' work activities (both by peers and by management), and that members of the organization operate according a "logic of confidence and good faith" that others will fulfill their work responsibilities. Pinelle and Gutwin (2003) present a case study of multidisciplinary home care teams, and they state that team members are autonomous, are weakly interdependent, and collaborate infrequently. Kindberg et al. (1999) studied the relationships between primary and secondary care during the provision of care to diabetic patients, and they state that loose coupling is seen between the organizational units, and that collaboration and information exchange is often limited.

Even though loose coupling is common in healthcare settings, this does not mean that it is necessarily a desirable outcome. According to Scott (1987, p. 254) the value of loose coupling depends on the specific circumstances confronted in a work situation. In some settings, loose coupling may be well suited to the needs of workers, groups, and the organization. However, in other settings, it may not be conducive to meeting goals in an efficient and effective manner.

One of the main advantages of loose coupling is that under certain circumstances, it allows social systems to achieve certain desired outcomes more effectively than more tightly coupled work arrangements. Loose coupling has been identified as an effective approach for achieving five types of outcomes. First, it is useful in reconciling incompatible expectations between external myths and operational demands (Meyer and Rowan 1977; Scheid-Cook 1990). Second, it can help reconcile internal conflicts between administrative units and professionals who expect to function with significant autonomy (Kouzes and Mico 1979; DiTomaso 2001). Third, it is considered an effective approach for dealing with complex and unpredictable environments since each worker and/or work unit can adapt to their local work situations (Perrow 1999; Aldrich 1979). Forth, since coordination, communication, and administrative oversight are usually minimized, it reduces the costs and difficulties required to coordinate work (Sanchez and

Mahoney 1996; Scott 1987, p. 254; Weick 1976, p. 8). Fifth, recent research suggests that loosely coupling may foster innovation at the operational level (Damonpour 1987; Brusoni and Prencipe 2001).

While loose coupling can be beneficial in some organizations and in specific contexts, it can also lead to uncoordinated and disjointed work processes (Hasenfeld 1983, p. 158). Since coordination is often voluntary and at workers' discretion, interdependencies may not be managed effectively since organizational practices are not in place to guarantee strict cooperation between workers. Jones and Hinds (2002, pp.372-373) point out that when the level of interaction between collaborators is not adequate to address interdependence (as is seen in distributed work), work processes can be disjointed, and collaborators can fail to meet their goals. The relative benefits and drawbacks of loose coupling are largely determined by the organization, environment, tasks, and people that are found in any given work setting (Weick 1982).

3. Healthcare and CSCW systems

The decentralization and loose coupling that are seen in healthcare organizations can result in fewer acts of explicit collaboration between loosely coupled elements (Hasenfeld 1983; Pinelle and Gutwin 2003; Kindberg et al. 1999; Scott 1985), often leading workers to operate according to a "logic of confidence and good faith" that others will fulfill their work responsibilities (Scheid-Cook 1990). Patients often receive services from several health professionals that work out of different offices or clinics. This physical separation of workers means that workers may have limited access to information stored in other units. In many cases, healthcare organizations still rely on paper-based recordkeeping, restricting access to those on site unless extra steps are taken to mail or fax documents (Bates et al. 2003). In some cases, information may be stored electronically, but it is still uncommon for organizations to have full integration of their information system infrastructures so that the information is instantly accessible across work units.

The need for improved coordination and information access has led to the development of a range of CSCW systems for healthcare. Some of these have been relatively successful (e.g. pagers, email, mailing lists, picture archiving and communication systems), while others have often met with more limited success due to problems with design and adoption of new technologies (e.g. telemedicine systems, electronic patient records). Examples of CSCW systems that support collaboration in healthcare settings include:

- *Email*. Email is an oft cited means of communicating between clinicians, and email support can be provided as a stand-alone application (Acuff et al. 1997; Wagner et al. 1998) or can be integrated into larger clinical information systems (Gomez 1998).
- *Mailing lists*. Email mailing lists allow health care workers with common interests or similar areas of expertise to request and share information (Worth and Patrick 1997).

- *Cooperative document systems*. Cooperative document systems allow clinical documents to be jointly managed by all disciplines that treat a patient (e.g. sharing goals, diagnoses, assessments) (Schoop 1999; Schoop and Wastrell 1999).
- *Indexing systems*. Indexing systems allow users to look up people by their area of expertise so that they can identify those who can provide needed information and advice (van Mulligen et al. 2000).
- *Picture archiving and communication systems (PACS).* Radiological telemedicine systems allow distributed physicians to share high-resolution radiological images and usually provide audio- and video-conferencing features to allow real-time communication (Handels et al. 1997; Gomez et al. 1998; Gomez et al. 1996).
- *Telemedicine systems*. Other types of telemedicine systems allow distributed users to carry out consultations using audio- and video-conferencing, shared files and documents, and other collaborative tools such as shared editors, group calendars, and shared address books (Makris et al. 1998; Goldberg 1998).
- *Electronic patient record (EPR) systems.* EPRs are electronic versions of patient records that can contain clinical information, billing information, and administrative information. They can also provide other additional features to support worker collaboration, such as communication tools, alerts, and coordination tools (Fitzpatrick 2000; Dick and Steen 1991).

In spite of the promise of CSCW systems and information systems to improve coordination and information access in healthcare, many deployments have met with costly failures where systems are only partially utilized or are completely abandoned by the organization (e.g. Littlejohns et al. 2003; Williams 1992; Dean 1993; Massaro 1993,). For example, May et al. (2003) describe how telemedicine systems that allow remote physicians to consult one another about a patient's care have largely failed to endure and have not become embedded in daily clinical practice. They discuss several problems in introducing new telemedicine systems, including: "1) the intra-organizational and inter-professional politics of service definition and delivery and 2) the establishment of appropriate knowledge and practice" (p. 600). Furthermore, they point out the difficulty of "building and sustaining networks of actors that can organize services in parallel to existing patterns of service delivery."

The findings of May et al. illustrate the difficulties that can arise when new technologies change work practices in healthcare settings. This is a particular concern since systems that support clinical work have the potential to interfere with workers' interactions with patients. In a study of three telemedicine deployments, May et al. (2003, p. 601) indicate that remote physicians found it difficult to communicate with patients and to carry out clinical assessments using the systems. Similarly, others have pointed out that new systems can add extra work for clinicians, and can take time away from direct patient care (Ash and Bates 2005, p. 9). When clinicians perceive that a system has a negative impact on their workflow, they are likely to resist using it since time is often one of their most precious commodities (Bates et al. 2003).

4. Framework part 1: Deployment challenges

Many of the issues facing those developing CSCW systems for healthcare arise from the loose coupling seen in health organizations—that is, work units are often autonomous and decentralized, and many employees are professional knowledge workers that operate with a high level of autonomy.

Loosely coupled organizations often exhibit persistence, or an overall resistance to change when it is instituted from outside the operational unit (Orton and Weick 1990; Weick 1976; Glassman 1973). Since administrative elements may be loosely coupled with operational elements (e.g. Meyer and Rowan 1977; Scheid-Cook 1990), it is often difficult to institute changes throughout a loosely coupled system from the administrative level (Horne 1992). Spender and Grinyer (1995) contend that changes are possible in loosely coupled systems, but they tend to be adopted slowly: "tight coupling leads to punctuated changes while loose coupling makes for more gradual changes" (p. 909).

Recent studies suggest that persistence is a significant challenge when introducing change to healthcare organizations. Burns et al. (2001) found that even when efforts are made to integrate the structural units of hospitals, as is seen in managed care efforts in the U.S., workflow integration lags far behind, and they hypothesized that structural integration and work process integration are only loosely related. Furthermore, Kitchener and Gask (2003) studied mergers in the mental health sector, and found that "the persistence of 'loosely coupled' practices and structures restricted improvements in collaboration and service co-ordination." They also found that senior professionals attempted to buffer the work of their colleagues from the effects of the merger so that their work practices would not need to be altered significantly.

In the next sections section, we present the first part of the deployment framework: a set of four challenges that are seen when introducing new CSCW implementations in loosely coupled healthcare organizations. Many of the problems that we outline here are difficult to directly observe since they can involve several workgroups or several departments and organizational units. Therefore, the main use of this part of the framework is to provide a sensitizing mechanism for those who are considering how to approach and plan a deployment, and to alert them to potential pitfalls. This part of the framework is based on literature from health informatics, CSCW, and organization research. The four challenges are: difficulties centralizing deployments, perceptions of inequity, role conflicts, and problems with achieving critical mass. The challenges are the result of loose coupling in both vertical and horizontal relations, and they are summarized in Table 1.

While some might argue that some healthcare organizations may benefit from an overall organizational change to a more tightly coupled structure (an unresolved argument), our intent here is not to provide a framework to help decide whether these coupling changes are warranted. Instead, our focus is on examining the challenges in deploying new technologies in loosely coupled organizations.

Table 1. Summary of deployment challenges

Challenge	Description
Difficulties centralizing deployments	Work units are autonomous and authority is decentralized, so it is difficult to centrally direct groupware deployments
Perceptions of inequity	Specialty roles, and separate and distinct work units can magnify users' perceptions that the benefits and drawbacks associated with using a system are unfairly distributed
Role conflicts	Groupware can bring loosely coupled workers with different and incompatible perspectives into more direct contact, and can cause conflicts between individuals and between groups
Problems with achieving critical mass	Workers are autonomous, and perceptions of systems can vary across units and roles, so it can be difficult to achieve a critical mass of users needed to make a system useful

4.1 Difficulties centralizing deployments

Authority structures in healthcare organizations often allow work units to function in an autonomous fashion, and workers and work units may be insulated from those structures that have formal authority over them. Hasenfeld (1983) states that even when formal lines of authority exist, authority structures may be weakened by the difficulty of effectively sanctioning subordinates. Staber and Sydow (2002) describe authority in loosely coupled organizations as decentralized, and Lorsch (1973) suggests that these organizations are more egalitarian (p. 135).

The autonomy of work units can make it difficult to deploy a new CSCW system, since each unit is able to determine how and if the system will be used, and is able to place demands on those managing the deployment process. This resistance to change is often referred to as "persistence", and is recognized as a common outcome of the adoption of loose coupling (Orton and Weick 1990; Weick 1976; Glassman 1973). Since administrative elements may be loosely coupled with operational elements (e.g., Meyer and Rowan 1977; Scheid-Cook 1990), it is often difficult to institute changes throughout the organization from the administrative level (Horne 1992). Spender and Grinyer (1995) contend that changes—such as the introduction of a new CSCW systems—are possible in loosely coupled organizations, but they tend to be adopted slowly: "tight coupling leads to punctuated changes while loose coupling makes for more gradual changes" (p. 909).

For example, Southon et al. (1997) discuss deployment problems that arose when a hospital attempted to deploy an information system in several autonomous divisions. Each unit was responsible for delivering healthcare services, and had significant discretion in determining how the services were provided. The deployment of the information system was centrally directed by administration. When the system was deployed, the loose coupling of the administrative structures allowed divisions to resist using the system and to demand changes to the system to bring it in line with their operational needs. However, this demand was contrary to administration's goal of installing the same system within each of its hospitals, so significant conflict arose within the organization.

4.2 Perceptions of inequity

The large number of specialty roles and the distinctiveness of work units in healthcare organizations mean that workers may have different perceptions of the usefulness of new CSCW systems, and they may feel that the benefits of using the system are unfairly distributed within the organization. Some may feel that they are burdened by extra tasks, while others profit from the work that they put into supporting the system. Grudin (1994) discusses inequity in groupware deployments in general—however, in healthcare, loose coupling, the wide divergence of roles, and the division of workers between separate and autonomous work units has the potential to magnify perceptions of inequity.

Joshi (1991) developed the Equity Implementation Model (EIM) to provide a theoretical foundation for understanding users' resistance to accepting new information systems. The model states that users' acceptance of a new deployment will depend on their perceptions of how fairly the system's benefits and drawbacks are distributed. Users attempt to determine equity in three ways: 1) by examining benefits and drawbacks from their own perspective, 2) by considering fairness of changes in relation to their employer, and 3) by considering the asymmetry of changes in relation to other users and other groups. Lauer et al. (2000) used EIM to assess users' reactions to the deployment of a medical scheduling system, and they suggest that equity perceptions can play an important role in the adoption of health information systems.

It is not uncommon for systems to add work in one part of the organization, and for other work units to realize the benefit. Recent studies have shown that those that feel that their workload is increased through the introduction of a system tend to have negative perceptions of new deployments (Massaro 1993; Lehoux et al. 1999). Berg (1999, p. 393) cites an example where a system that supports the ordering of medication was introduced into a healthcare organization. Nurses were forced to meticulously maintain their orders using the system, expending extra time and effort. However, the benefits of the nurses' additional work were seen in the pharmacy where workers were able to maintain closer control of their stocks.

According to Westbrook et al. (2004, p. 1324), the organization of professional cultures within an organization can significantly influence users' perceptions of new deployments, and their willingness to use a system. They discuss the adoption of Information Communication Technologies (ICTs) in healthcare organizations, and state that:

> Given that ICTs impose standardized work practices, their reception is likely to be highly dependent on the extent to which professional sub-cultural differences and tensions can be addressed, negotiated and if not overcome, then at least put in abeyance in the form of a 'contingent inter-polar balance.'

Another commonly cited theme is that new implementations often primarily benefit management or administration, and add extra work for clinicians (Berg 1999, p. 396). Southon et al. (1997, p. 118) illustrate this point by describing problems that arose when a patient administration system was introduced to clinicians in a hospital setting:

> A task that previously took about 20 seconds was now taking several minutes and was causing considerable frustration. It took a lot of time for people who

> used it frequently, and it was difficult to master for those who used it infrequently. There did not appear to be any significant gain for medical staff, and any gain that could be argued was mainly in enabling management to monitor clinical activity…It was not too surprising, therefore, that there were strong complaints by medical staff, leading to collective protests in several cases.

4.3 Role conflicts

The autonomy implied by a loosely-coupled system allows members of an organization to maintain different views of how work should be carried out, and the reduced interaction between units means that divergent opinions and frames of reference often go unchallenged. Hasenfeld (1983) indicates that loose coupling allows the organization to accommodate different and incompatible "moral and ideological systems" (p. 156) between staff members. According to Hasenfeld, these incompatibilities are often seen between different professional groups who are socialized separately and have different views of the means that should be used to achieve goals. Weick (1982) supports this claim: "Loosely coupled systems are often characterized as systems in which there is low agreement about preferences and cause-effect linkages. When people see things differently, their efforts will be only loosely coordinated and they will share few variables" (p. 384).

The introduction of CSCW systems can bring workers into more direct contact with each other, and differences in opinions may not be easily put aside since increased interaction may force these differences to the forefront. Similarly, since new systems can lead to a re-delegation of roles and responsibilities (Berg 1999, p. 396), some user groups may seek an advantage through the implementation to the detriment of others (Schneider and Wagner 1993).This has the potential to cause conflicts between workers that fill different roles in the organization, conflicts that can have a negative impact on the work process and on adoption of the CSCW application. Furthermore, some researchers (Davies et al. 2000; Harrison 1992) point out that rivalry and competition between professional groups can be a key part of the organizational culture in healthcare, and Davies et al. (2000, p. 113) state that "health care is notoriously tribal in this respect."

Since CSCW systems can change responsibilities and add new tasks to users from different groups, role conflicts can arise as different user groups vie for outcomes that favor them. Moore (1996, p. 58) discusses problems with introducing new information technologies in healthcare, and he quotes Hodge (1990):

> Another thing that we discovered, sometimes the hard way, was that you need to be sensitive to the cultural roles that are traditional in hospitals and healthcare. I've had doctors tell me, for example, that "…entering orders is a nurse's or a ward clerk's job, it's not my job. You have a secretary; she does your typing. I have a nurse; she enters my orders."

According to Moore, these role perceptions interfere with one of the common goals of new IT implementations in healthcare, which is to collect information and support activities at the point of care. Since new information systems often challenge these

traditional roles, there is potential for conflicts between professional groups, and potential for resistance when the responsibilities associated with their roles are challenged.

May et al. (2003) provide an example of role conflicts that were seen when a telemedicine system was introduced in a healthcare organization. The system involved general practitioners and remote consulting specialist physicians. According to May et al. (p. 600):

> There was considerable divergence of views between specialists and general practitioners about the most appropriate role for general practitioners in real-time triadic tele-consultations. The nature and extent of general practitioners' involvement was a contentious issue between these professional groups for the duration of the trial and caused considerable tension and dissatisfaction among clinicians.

The introduction of new CSCW systems also has the potential to introduce social and political problems that can create conflicts within the organization (Grudin 1994). According to Berg (2001, p.144), new implementations can provide an opportunity for user groups to seize a political advantage over others. He cites two examples of this, including insight into others' working patterns or access to their information resources. This has the potential to introduce conflict between groups, and negatively impact the adoption of the system.

4.4 Problems with achieving critical mass

CSCW systems are designed to support collaboration between groups of people. However, some systems are not valuable to the target user group unless enough people use the system to allow them to realize the promised collaborative benefits. Otherwise, the value of the system can be limited, leading users to reject a new deployment (Grudin 1994). In loosely-coupled settings, critical mass can be a particular problem. CSCW systems often affect multiple work units and can involve workers from several different disciplines, and so the system's long-term success can depend not only on a critical mass of participants within each unit, but also on other people across the organization. However, in healthcare organizations, workers have considerable discretion in directing their work activities, and are often able to determine their own level of participation when a new system is introduced. This can lead to uneven adoption, since people outside a worker's immediate peer group can only exert very limited influence on others' work practices. As a result, the pressure to use a system can be minimal, and this can make it difficult to achieve the critical mass of users needed to make the deployment successful.

Workers' perceptions of a system's deployment and their satisfaction with the system often varies across professional disciplines, and this unevenness contributes to the critical mass problem. In healthcare settings, different professional groups and work units often have different training, socialization, and work experiences "which influence their perceptions about the goals…and about the means through which these goals ought to be attained" (Hasenfeld 1983, p. 156). These differences are seen in the findings of O'Connell et al. (2004) who studied an electronic health record (EHR) deployment in an ambulatory clinic. The EHR was shared by residents from two different medical

specialties—pediatrics and internal medicine. While the deployment was overall successful and system usage responsibilities were the same for both groups, users' satisfaction with the system varied significantly between the specialties.

Building critical mass may be easier to accomplish when a system is limited to a single work unit or professional group since colleagues are often able to influence behavior more easily than outsiders. As Gremy et al. (1999, quoted from Kuhn 2001) point out, workers are more willing to accept systems when the deployment is directed from within:

> As long as innovation is brought in and promoted by colleagues, identified as an internal process belonging to the profession, it is felt as a bonus for personal values and as a support for professional interests…on the other hand when change occurs from an external origin…it is felt as a coercion.

5. Case study

In this section, we examine the first part of the framework using a case study of our experiences in deploying a groupware system with home care teams in Saskatoon Health Region (SHR). Home care in SHR provides a working example of loose coupling in healthcare, and it exhibits many of the characteristics discussed in the previous sections. For example, most workers are autonomous professionals and have loosely coupled relationships with their supervisors and peers, and the departments involved in care delivery have separate management structures and function as autonomous units.

Our case study is based on a project where we designed, developed, and deployed a groupware system to improve information access and awareness within teams of mobile home care clinicians. Our main goal during the project was to investigate how groupware systems can best be designed to support workflows and collaboration in loosely coupled teams. Initially, we carried out a detailed qualitative study of home care work practices, and then we designed and developed the system. We deployed the system during two limited field trials, and during that time we unexpectedly encountered many of the problems that have been discussed in section 4. In the next sections, we provide an overview of the home care setting, and then we discuss our experiences with each of the issues from the framework in the real-world home care situation.

5.1 Case study setting

We began our project by carrying out an in-depth qualitative study of patterns of work, collaboration, and organization in home care in Saskatoon Health Region, a government funded agency that provides healthcare services in Saskatoon, Saskatchewan, Canada. We briefly summarize the data collection process here—it is described in more detail elsewhere (Pinelle 2004; Pinelle and Gutwin 2005; Pinelle and Gutwin 2003). Early in the project, we had several meeting with administrators in the health region. These meetings were focused on investigating the feasibility of the project and on developing a deeper understanding of how home care is organized within the larger organization so that we could identify key stakeholders that should be involved in the project.

Once we identified the main organizational units involved in the home care process, we met with the managers of each unit. These meetings were unstructured since we were

attempting to develop a basic understanding of the way that home care delivery was organized in the district. We focused on identifying the role that each unit played in care delivery and in how the units usually interacted with each other. In this section, we briefly summarize the results of this data collection process.

The set of community-based workers who share a common patient are called a home care treatment team, and SHR teams can include members from as many as seven different disciplines, including occupational therapists, physical therapists, nurses, dieticians, social workers, case managers, and home health aides. Since each worker treats more than one patient during a workday (usually 6-15 depending on the discipline), and since teams are formed around patients, each worker is usually a member of several teams.

Three different administrative units are involved in delivering home care services, and each unit functions autonomously and is loosely coupled with the others. The units are: Home Care, Coordinated Assessment Unit, and Community Services. Home care clinicians are assigned to units based on their professional disciplines. This partitioning of clinicians into separate units, each of which has a separate management structure, influences the patterns of work and collaboration that are seen in home care teams.

The Coordinated Assessment Unit (CAU) employs client care coordinators (C3s) who are responsible for providing case management services for patients in the community. C3s are relatively autonomous professional workers (most are trained as social workers), but are ultimately accountable to the CAU manager (see Figure 2).

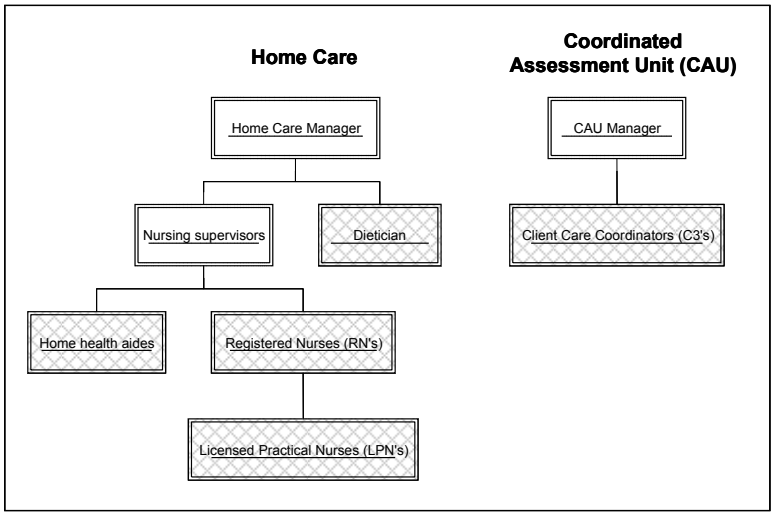

Figure 2. Home Care and Coordinated Assessment Unit organization charts. Shading indicates those workers that provide services in the community

The Home Care unit employs workers from four different clinical disciplines. These include: registered nurses (RNs), licensed practical nurses (LPNs), home health aides, and dieticians. Each Home Care discipline has different levels of autonomy. RNs and dieticians are professional employees and are autonomous in planning and managing their work activities. Home health aides and LPNs are quasi-professionals, and are more tightly supervised. Ultimately, every worker in Home Care is accountable to the Home

Care manager (see Figure 2). The Home Care manager directly supervises the dietician and four office-based nursing supervisors. The nursing supervisors are responsible for overseeing the work of the home health aides and the RNs. RNs directly supervise LPNs.

In Community Services, workers from three clinical disciplines share common clerical support and are housed in close physical proximity with each other, but they are not a formal administrative unit. Instead, workers from each of the three clinical disciplines are overseen by separate clinical departments that are responsible for providing services throughout the health district. These departments include: Occupational Therapy, Physical Therapy, and Social Work. District wide, all OT, PT, and social work services are overseen by the professional leader for that department, with community-based workers making up only a small number of the workers that they oversee (see Figure 3). Within Community Services, workers from each discipline are overseen by a senior worker that carries a caseload, and additionally performs supervisory duties. Workers in each department are autonomous professionals that have significant discretion in managing their workday.

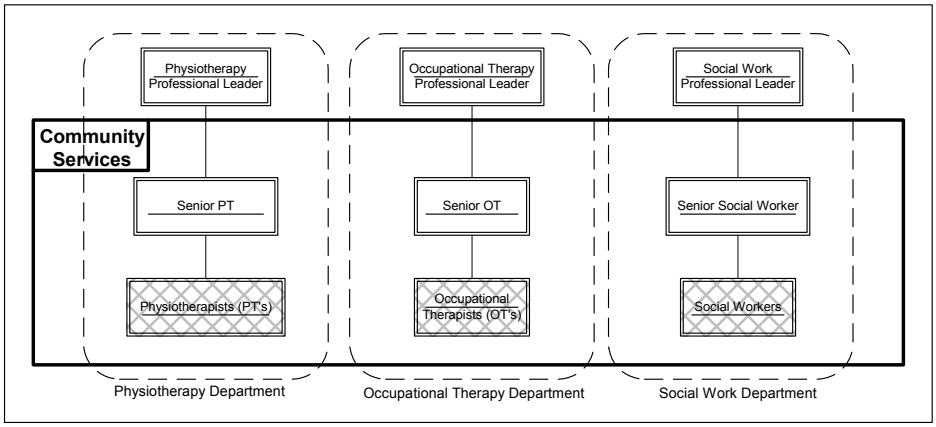

Figure 3. Community Services organization chart. Cells with hatching represent workers that provide services in the community

Workers' offices are divided between two separate buildings across the city from each other. Community Services offices are located in a university hospital wing, and Home Care and CAU offices are several kilometers away on the second floor of a building in the downtown area. At the hospital site, workers' desks are located in a room with other members of their discipline. At the downtown site, CAU and Home Care share many common work spaces, such as meeting rooms, break rooms, and mail and photocopying areas, and they also share many of the same support staff members. With the exception of home health aides, each Home Care and CAU clinician has a desk in a common room with other members of their discipline.

5.1.1 Home care treatment teams

We investigated patterns of work, collaboration, and organization in home care treatment teams by carrying out a series of interviews and field observations with workers from each clinical discipline. We conducted four rounds of interviews. Each round consisted of 7-8 interviews, one with a member of each clinical home care discipline. The participants

for interviews, and for field observations, were selected by health district managers, and participants varied in interview rounds in order to give a range of perspectives from each discipline. The first round of interviews was informal and exploratory in nature and focused on developing a general understanding of organizational issues and basic work patterns. The second round focused on identifying current information utilization practices in home care, including documentation practices, information sharing practices, and communication practices. The third round was used to follow up on the findings from the first two rounds, and to discuss issues in further detail.

In addition to the interviews, we spent approximately 60 hours carrying out field observations with home care workers to develop a detailed understanding of workers' day-to-day work activities. A full workday was spent with a member of each clinical discipline. A total of seven workers were observed. The clinicians were observed while they carried out their daily work activities, with observations taking place in the office, in workers' cars, and in patients' homes. In this section we briefly summarize the main findings of this data collection process (see Pinelle 2004; Pinelle and Gutwin 2003 for more details).

Treatment teams members work together in a loosely coupled fashion. Since team members share a common patient, their work is interdependent. However, work practices are not organized to facilitate interaction within teams, so collaboration is infrequent. Most workers are professionals, and they exercise significant discretion in managing their workday. With the exceptions of home health aides, management has limited direction over workers' daily activities—they do not monitor workers closely, and they rarely sanction them except under unusual circumstances.

The flow of information between different professions on a treatment teams is often limited, even though workers could potentially benefit from improved information sharing. Each discipline currently maintains a separate set of paperwork for each patient, and this paperwork is carried with workers in the field so that they can access it at the point of care. The paperwork is readily available to other members of the worker's own discipline (e.g., when treatments are provided by workers across different shifts, or when two part-time workers share a patient); however, paper is not usually shared with workers from other disciplines.

Team members from different disciplines interact with each other infrequently. Workers are mobile, maintain different schedules, and work out of different locations. This often makes it difficult for them to determine others' locations and availabilities, and it can require significant effort for them to initiate contact with others. Workers may occasionally see each other in their offices, but these meetings are often sporadic since there are no fixed office hours, and since some disciplines begin visiting patients earlier than others. When workers do initiate communication with other team members, the need is often urgent, and they usually only involve those team members that are needed to resolve an issue.

5.1.2 Mohoc: a groupware system for home care teams

Mohoc is an asynchronous groupware system to support work and collaboration in home care teams (Pinelle and Gutwin 2003). The system's design goals were to support autonomous work, provide workers with information about the activities and decisions of other workers who treat shared patients, and provide workers with low-effort tools for explicit communication. Mohoc supports common autonomous home care activities including scheduling visits with patients, managing clinical documentation, and planning treatments. It makes the information that is generated by these features available to other members of the treatment team so that they can coordinate their work more effectively. It also provides teams with a group discussion tool and with a sticky note feature so that team members can leave messages in the shared workspace. The system was developed in two versions: one for laptops and another for handheld computers (see Figure 4; see Pinelle 2004 for more details).

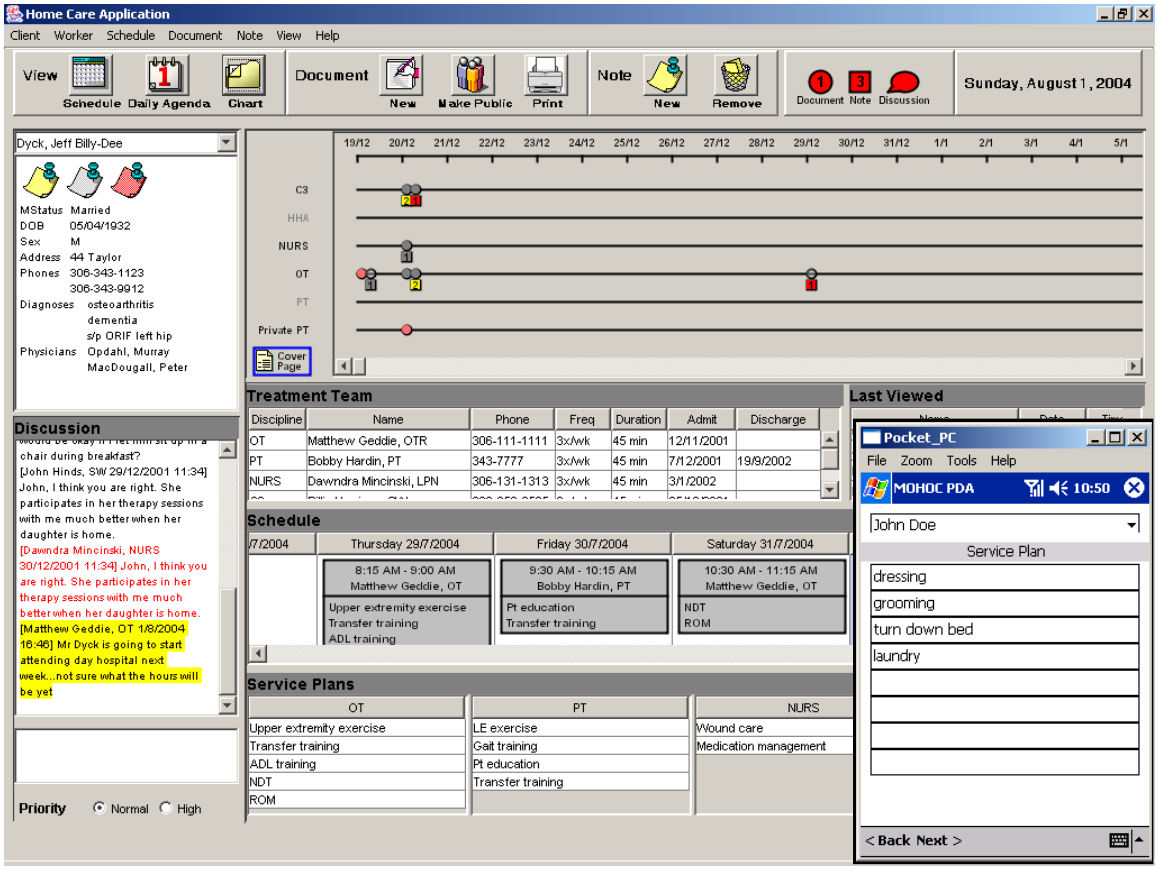

Figure 4. The Mohoc system: laptop version (left), handheld version (inset, lower right)

5.2 Case study findings

We conducted two field trials of Mohoc where the system was used by home care workers to support their daily work activities. The first field trial lasted 2 ½ months, and the second lasted 3 months. We were solely responsible for the design, development, and deployment of the Mohoc system, and for supporting the users during the trials and evaluating the outcomes of the deployment. Managers and front line workers participated in the planning of the deployment, but they served primarily in an advisory capacity.

Prior to initiating the field trials, we provided workers with a computer with a wireless modem, and we trained them on using the hardware and on using the Mohoc application. Our main data collection process focused on gathering information on the design of the system and on usage patterns, and during the field trial we collected data using system logs, interviews, and questionnaires; however, we do not discuss this data in detail here (see Pinelle and Gutwin 2005)—instead we report our experiences with deploying the system in the health region.

We encountered a number of unanticipated difficulties when planning and conducting the trials. Since these problems often occurred under unexpected circumstances (e.g. during training, during phone calls) many of these fell outside of our normal data collection process. For example, we received calls from field trial participants complaining about unfair allocation of work, or we encountered difficulties during training sessions when people reported that they were unhappy with the way the deployment was being directed. Many of the difficulties we encountered were related to the loosely coupled organizational structure seen in the work setting. In this section, we describe our deployment experiences. Each reported problem is based on field notes that we took shortly after each occurrence. Table 2 provides a summary of the main points.

Table 2. Summary of field trial experiences organized by challenge type

Challenge	**Field trial experiences**
Difficulties centralizing deployments	▪ High overhead coordinating deployment between units ▪ Difficult to disseminate information to participants ▪ Bottom-up approach to get buy-in from participants
Perceptions of inequity	▪ Manager concerned about workload for her employees ▪ Nurses felt that they would have to do more work to support system than others
Role conflicts	▪ Territorialism between units over role in coordinating trials
Problems with achieving critical mass	▪ Limited peer pressure to use system ▪ Complaints during periods of low system use

Prior to conducting the trials, we consulted managers from each of the home care departments and units. This process involved discussions about research goals and how the research process should be tailored to address the needs and concerns of each interested party. However, our primary research contacts were in Home Care. This was largely due to the difficulties of contacting and conducting meetings with managers from all involved units. Since there were a total of five departments involved in the project, it was difficult to establish common meeting times, and it was difficult to keep all parties informed of routine developments. We spent more time meeting with Home Care managers than we did with supervisors from other units, and most of our research efforts were coordinated by nursing supervisors and support staff in the Home Care unit. We relied heavily on those individuals to help with determining how logistics of the trials could best be handled. For example, they selected patients and home care worker participants for the trial, and helped to set up training sessions and interviews with the participants.

One of the side effects of relying on a single unit for coordinating the trial was that we encountered difficulties with management from another unit who were unhappy that they were not in the lead role in the project. According to some of the workers, territorialism had been a problem in the past with the different work units, and we unwittingly ran into a few difficulties as a result of this. Our problems seemed to be the result of the autonomy of the work units and the peer relationships that exist between managers of each unit, which helped to foster competitiveness between the units. We were able to work around the problem by reassuring management in each of the units that we would continue to keep them informed of all developments and would address their concerns throughout the project.

We carried out training sessions with each of the home care worker participants. The first trial included one patient and a treatment team of six workers from five disciplines: an occupational therapist, a physiotherapist, a registered nurse, a case manager, and two home health aides. The second trial was larger in scope and included three patients and ten workers from five disciplines: three home health aides, two office-based nursing supervisors, three registered nurses, a case manager, and a dietician.

Despite the planning that we carried out with managers, the professional workers requested changes in the way the field trial would be managed. During training, some professional workers expressed concerns that their participation would create extra work for them. Extra meetings had to be scheduled with four professional participants to try to address their concerns. One of their main concerns was that paperwork would be duplicated in the paper chart and in the groupware system. Since workers still had to comply with the standard documentation practices in their departments, they had to fill out paper-based forms for the patients that were supported in the trials, and entering documentation into the groupware system represented a duplication of work. To allay this concern, printing features were added to the system, and a laser printer with a USB cable was set up at the Home Care / CAU office site so that workers could plug in and print out their paperwork. Two workers asked us to print their documents out and to drop them off at their office, and we did this at the end of each week.

After we made the printing accommodations, nurses voiced concerns that they would be unfairly burdened by their participation in the trial, and that they would have to spend more time using the system than the other disciplines since their visits often occurred more frequently. During a training session that had been set up for a nurse in preparation for the second trial, two other nurse participants dropped by since they wanted to learn more about the Mohoc system. During the session, one nurse expressed concerns about the clinical documentation features that were included in the system. She felt that she would have to enter too much information in the system if she used the documentation features, and that using printouts from the system would add too many extra sheets of paper to patients' charts making them prohibitively thick. This led to approximately 20 minutes of discussion. Two nurses agreed that this would be a problem during the trial, but the third nurse did not feel that it would be a problem for the two patients that she treated. A compromise was eventually reached with the two nurses—they agreed to enter

progress notes (narrative notes that describe the patient's status and response to treatments) into the system, but not their medication checklists.

In a later training session, a nursing supervisor participant was concerned that the nurses would still be unfairly burdened by their participation in the trial. This presented some difficulties due to the authority of the supervisor. Fortunately, the training session occurred after the training sessions with the nurses. Since the nurses had already agreed to a compromise in the paperwork that they filled out using the system, the supervisor was willing to accept their judgment on the matter.

Unlike the professional workers who were able to insist on changes being made to the field trials, the home health aides, who had limited autonomy, were more willing to use the system. In training sessions, they were willing to use the system without requesting revisions in the way the system was deployed. During the trial, they used the system with more regularity than the other disciplines even though the visitation frequency did not always vary significantly from that of others. After the trials, they indicated that they used the system on a regular basis since their supervisors expected it. Unlike the professional disciplines, home health aides were tightly coupled with their supervisors.

Participants were members of different departments, so it was often difficult to communicate with participants during the trials. The number of work units involved made it difficult to develop a communication network within the health district to pass on news and other information. Similarly, different departments relied on different communication channels. For example, some of the workers had voice mail, while others carried pagers, and with some disciplines, messages had to be left with the office staff.

In most cases the participants did not work closely with colleagues that were participating in the trail. Therefore, the relationships between participants created little peer pressure to use the system, making it more difficult to achieve a critical mass of users needed to sustain the deployment. Since many of the system's features were designed to support autonomous work activities such as clinical documentation and scheduling, this did not lead to a failed deployment during our trials. However, some participants did complain during interviews about periods where other users did not use the system, or did not contribute content that was valuable for coordinating services, such as communications or narrative clinical documents that describe treatments and the patient's progress.

6. Framework part 2: Deployment strategies

Our deployment experiences in the case study lead us to develop the second part of the framework: a set of five strategies for introducing CSCW systems into loosely-coupled healthcare settings (see Table 3). This is the first effort to define CSCW deployment strategies for loosely coupled work situations, and although we consider the strategies to be preliminary, they are based on a wide variety of prior work and real-world experience, and we believe that they can improve the overall dependability of healthcare groupware systems. Furthermore, we do not suggest that these strategies should necessarily replace other user-centered design and deployment approaches such as participatory design and observation driven approaches. Instead, we feel the value of this part of the framework is

to provide a general set of guiding principles that can be used to help consider how potential pitfalls can be circumvented.

The success of these strategies depends somewhat upon the scope of the deployment. Systems that are targeted at a single unit or workgroup will not need to address the range of issues that are seen when systems are used by workers from several different departments. In limited deployments, the number of users is likely smaller, the user group is probably more homogeneous, and organizational complexities are minimized since inter-unit politics and consensus building are not involved. The strategies we present in the next section address the range of problems that are seen when groupware systems are deployed across organizational boundaries, but many of them also have relevance for the deployment of smaller departmental systems.

Table 3. Preliminary deployment strategies for loosely coupled healthcare organizations

Strategy	**Description**
Use focus groups	Use focus groups to bring representatives from different units to the table to confront differences and build consensus
Use bottom up deployment	Direct deployment efforts from the operational unit and not from administrative units or management
Identify local champions	Identify individuals in the operational units who can help build consensus among colleagues
Align roles and responsibilities	Collaboratively delineate roles and responsibilities to minimize role conflicts
Address inequity early	Employ user centered design and involve users in deployment planning sessions

6.1 Use focus groups

Focus groups are collections of users, usually including representatives from all the stakeholder groups, who can be called on to discuss system requirements and evaluate new designs (Nielsen 1994). Focus groups include a facilitator who steers the session and helps the group to stay focused on its goals. They are used regularly in usability engineering (Wood and Silver 1995), where they help designers to involve all key stakeholders in the design process.

While using focus groups is not a new technique, they can play an important role in loosely coupled healthcare organizations. When deployments involve people who fill several different roles within the organization, representatives for each type of role can be included in a focus group. When deployments involve several different groups or organizational units, representatives from each can take part. The importance of a focus group in a loosely coupled organization is that it helps to reconcile divergent perspectives. Regular focus groups provide a useful means of coordinating efforts by bringing representatives from different units together so that joint plans can be developed and conflicts can be preempted. Moderated focus groups also provide an opportunity for managers and key personnel to confront differences in opinion that may limit buy-in from key units, and offer an opportunity to develop solutions that are acceptable to all parties.

Similarly, confronting these differences in a group setting reduces the risk of departments and managers vying for favorable treatment that disadvantages other groups.

Our experiences with territoriality in SHR show the importance of involving people from all of the different departments in the focus group. Even though we were unable to conduct focus group meetings on a regular basis, bringing together the managers and supervisors from the different units and departments allowed us to build consensus on a course of action for the deployment. During the periods where we were unable to hold regular meetings, territoriality became a problem, and we encountered friction between the units that complicated the field trials.

6.2 Use a bottom-up deployment strategy

The coupling style seen between supervisors and workers in healthcare settings influences the strategies that can be used when deploying a groupware application. When tight coupling is seen in vertical relationships, it is much easier to deploy a system from the top, since directives can be issued from above and workers feel more compelled to participate. Loose coupling, in contrast, implies that workers have more autonomy in deciding their level of participation, and it can be more difficult to successfully deploy the system with a top-down approach.

During the field trials in our case study, these differences could be seen in two units: the home health aides, who are tightly coupled to the nursing supervisors; and the professional workers, who are loosely coupled to their supervisors. In both field trials, home health aides required few reminders and few accommodations to secure their participation, because they felt that the nursing supervisors wanted them to use the system during the work day. Since the supervisors are able to issue directives to the home health aides, workers considered using the Mohoc system to be part of the job duties that were assigned to them. In contrast, many of the professional workers required periodic reminders. Since supervisors could not compel their participation, they had a more active role in determining the direction of the trial, and extra time had to be spent to secure their participation in the deployment.

When the vertical relationships between group members and their supervisors are loosely coupled, it can be difficult to introduce groupware systems by mandate. Therefore, a bottom-up deployment strategy is needed. This approach focuses on tailoring and directing the deployment to the workers, rather than through the supervisors. This can potentially introduce significant complexity with large scale deployments where a significant number of people and work units are involved. Bottom-up deployment can challenge organizations since a significant number of personnel may be needed to coordinate the deployment process, and since competing interests may need to be reconciled. Ongoing training and support is needed to address each individual's concerns, and to help them understand how the system can fit their work processes.

6.3 Identify local champions

Bottom up deployment strategies have the potential to help improve the participation of loosely coupled workers that fill a range of roles and that work in different organizational

units. One technique for achieving bottom-up deployment is to involve interested workers within each unit as local advocates so that they can help to build consensus in operational work units. Since clinicians are more easily influenced by their close colleagues than they are by those outside their immediate work setting (Gremy et al. 1999), using local advocates for the system can help to influence workers to use a new deployment. This has the potential to avoid feelings of coercion when deployments are directed exclusively by units external to the operational unit such as by administration or IT units, and similarly can help prevent workers from "digging in their heels" and resisting the deployment (Ash and Bates 2005). According to Ash and Bates (2005), "if the impetus comes from the clinical staff, other clinicians may be more apt to adopt sooner, and readiness will be at a higher level" (p. 9). The role of management and of those directing the deployment is to identify champions that are enthusiastic about the project (Ash 1997) and to maintain adequate communication with champions so that accommodations can be made as needed.

The idea of using 'early adopters' as a way to generate internal interest and trust in a new system has been seen several times before in the context of software acceptance more generally (e.g. Grudin 2003). However, it is of primary importance in a loosely-coupled deployment situation because of the relative insularity of the different work units. According to Mark and Poltrock (2001), early adopters can be influential in convincing the "late majority" to use new CSCW systems. In healthcare deployments, influential early adopters that work in operational units have the potential to play an important role in the success of the deployment in disparate work units.

6.4 Align roles and responsibilities

When healthcare workers have well defined roles, but work autonomously, possibly with separate departmental affiliations, the introduction of a new system can cause problems when responsibilities are not mutually agreed upon. Responsibilities associated with each role need to be carefully delineated in order to minimize the conflicts and misunderstandings. By explicitly negotiating responsibilities associated with using a system, internal conflicts can be reduced by limiting users' opportunities to seek roles that favor them over others. Similarly, roles and responsibilities should be understood by all parties so that users can make the proper inferences about what they have to do and about what others will do for them (Southon et al. 1997).

According to May et al. (2003, p. 602), the successful adoption of telemedicine systems that allow remote consultations rely on a clear definition of roles and responsibilities: "Translation of telemedicine technologies into clinical practice depends on the enrollment of heterogeneous actors into relatively cohesive, cooperative groups, in which functional identities are negotiated and established a priori and powers relatively well defined."

6.5 Address inequity early

User involvement in the design and deployment of new CSCW systems is needed to help guarantee that affected workers will not be treated inequitably and that they will feel that their needs are adequately and fairly addressed by the system. User feedback and

involvement is a key component in participatory design approaches (e.g. Greenbaum and Kyng 1991; Muller 1991), and can help to guarantee that the design is well suited to the needs of a disparate group of people. However, most of these techniques focus on system design and not on the equitable allocation of responsibilities post-deployment. Our findings from SHR suggest that our user centered design process, which involved interviews, field observations and direct feedback from workers on partial prototypes, was useful in developing a groupware system that was overall well received by workers during the field trials. However, nurses were concerned about how the trial would be managed and felt that they would have to put more time into using the system than other professional disciplines since they visited patients more often. We were able to reach a compromise during training sessions so that they could contribute without feeling unduly burdened, and without fostering resentment that could have negatively impacted their level of participation.

Lauer et al. (2000) go so far as to suggest that those deploying a system in a healthcare organization should formally assess equity perceptions so that they can address perceptions of inequity. According to Lauer et al., the Equity Implementation Model can be used as a basis for identifying perceptions of inequity, and when they are identified, strategies can be developed for increasing the benefit of the implementation to affected user groups and for decreasing stress. As an example of how this can be approached, they state: "improved system design….and better designed training programs that reduce learning effort" (p. 101).

7. Discussion

All healthcare organizations are not necessarily loosely coupled, but there is strong evidence in the literature to suggest that this is a common form of organization in the western world. This provides a basis for examining groupware design and deployment for healthcare based on organizational patterns—both in terms of the horizontal and vertical relationships that are seen between work units and individuals in the organization. Similarly, healthcare is a human service organization, and literature in this area provides insights into how organizations that provide services to clients, and that promote the welfare of the people they serve tend to structure work.

Unlike other work situations that have centralized control (e.g. banking, manufacturing), loosely coupled organizations are decentralized, and workers and work units operate with significant autonomy. This work arrangement has the potential to offer significant benefit, since it allows work units and workers to adapt to local work situations (Scott 1987; Weick 1976). However, when planned change is needed—as is seen in an initiative to introduce new CSCW systems—loose coupling can pose significant challenges to those managing the deployment. This does not necessarily pose significant problems when a system is restricted to a single unit or a single workgroup since organizational complexities may not come into play. However, CSCW systems in healthcare often bridge organizational boundaries, and must contend with the challenges of dealing with separate management structures and separate work cultures that exist in the different units. This poses significant challenges, and calls for new strategies for managing deployment in a way that does not lead to uneven adoption or rejection.

The difficulties of deploying systems that bridge organizational boundaries pose a major challenge for healthcare organizations. Lessons from hospital information systems are informative here, since they include a large number of professional groups and departments. According to Littlejohns et al. (2003), approximately 75% or hospital information systems are considered failures. In a study of a failed deployment in South Africa, Littlejohns reports that social and organizational issues played a key role in the demise of the system, and that organizers did not consider professional cultures and did not adequately manage the expectations of the users. The deployment was centrally deployed, and failed to make inroads at the operational level.

Our findings suggest that strategies that use a bottom-up strategy that focuses on building consensus in the operational unit can help to improve adoption of systems in loosely coupled healthcare settings. For groupware designers, this means using user-centered design approaches that include user research and direct user participation in the design process. For those directing the deployment, this means that processes need to be put in place to involve users from different professions and work units in deployment planning sessions so that expectations can be managed and so that concerns can be addressed. Similarly, it is important to foster participation in units and professional groups by identifying local champions, and by enabling them to take an active role in the change process.

One main drawback of the bottom-up strategy is that it has the potential to require a significant amount of manpower, both from those managing the deployment and from other involved workers. For example, managing focus groups, and spending time in different work units talking with workers can be time consuming, and can require more personnel than is needed to manage a top-down deployment. Similarly, when employees of the healthcare organization take a more active role in the deployment process by attending focus groups or by becoming local advocates for the system, the time they could spend carrying out their regular job duties is decreased. However, failed deployments can result in a staggering loss of money for an organization, and processes that improve the odds of success may be worth the expense.

8. Conclusions

One of the main promises of CSCW technologies in healthcare is to improve the dependability of the care delivery process—by improving patient safety, by improving the overall responsiveness of the healthcare organization, or by improving the overall effectiveness of care delivery. By improving the flow of information within the organization, and by improving overall information access by practitioners and key decision makers, these technologies have the potential to improve the overall level of care that is provided to patients. However, a significant number of healthcare deployment fail, as shown by Littlejohns et al. (2003) who estimate that approximately 75% or hospital information systems are considered failures, in part because of social and organizational issues that are not addressed by those managing the deployment process. This rate of failure shows that there is a significant risk in introducing new information technologies in healthcare organizations.

One of the main challenges in introducing new technologies is that healthcare organizations are often organized in a modular, loosely coupled fashion where separate and semi-autonomous work units specialize in different areas of care delivery. This partitioning allows each unit to adapt to emerging practice standards in its area of expertise and to adjust to its local work environment. However, organizational loose coupling can limit the flow of information within organizations and can make it difficult to coordinate services when patients' care is dependent on professionals from more than one unit. Groupware systems have the potential to improve coordination and information access in healthcare organizations. However, modularity and loose coupling make it difficult to introduce new systems when they span more than one unit, since authority is not always centralized and since perceptions and frames of reference on new deployments differ across units.

In this paper, we introduced a groupware deployment framework for loosely coupled healthcare organizations in order to help practitioners to understand and manage the issues inherent in introducing new groupware systems. The framework is based on our deployment experiences in home care in Saskatoon Health Region, and it synthesizes knowledge from literature in several areas, including health informatics, organizational research, and CSCW research. The framework has two main parts: a set of deployment challenges, and a set of deployment strategies. The deployment challenges describe four issues related to loose coupling that make it difficult to deploy new systems: difficulties centralizing deployments, perceptions of inequity, role conflicts, and problems achieving critical mass. The deployment strategies describe a preliminary set of guidelines that can help system designers to understand the realities and constraints in introducing a system into a healthcare setting, and include: use focus groups, use bottom up deployment, identify local champions, align roles and responsibilities, and address inequity early. The assistance that the framework provides for developers to understand the context into which they will deploy their systems, and the specific guidance that the five strategies provide, make it much more possible that the first hurdle in dependability – that is, acceptance and buy in – can be accomplished.

In future work, we plan to use the framework in deploying further versions of our system in the home care context. We plan to increase the scope of future field trials, and to include additional organizational units so that we can consider more heterogeneity and organizational complexity.

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