

Exploring Obstacles: Integrating CSCW in Evolving Organisations

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ABSTRACT

Integrating CSCW systems to organisations is highly complex. This paper examines the co-evolution process involved in tailoring a CSCW system to fit in with the current organisational structure, whilst concurrently adapting the working practices to enable the system to support collaboration. A study is presented which analyses the various obstacles and inequities that ensue when a multi-user system is implemented in a company. To facilitate the management and resolution of the emergent problems, a preliminary conceptual framework is outlined. Finally, a case is presented for involving intermediaries in helping companies customise CSCW systems and adapt their work practices.

KEYWORDS: CSCW systems, implementation, evaluation, situation use, conceptual framework, field studies.

INTRODUCTION

CSCW systems, by their very nature, are more complex than single-user systems. An obvious implication is that a greater understanding is needed of the different types of people and their interdependent work activities that such systems are intended to support (i.e., the use situation). For example, Grudin [9] argues that developers will have to gather more information about users than ever before. To address this problem, several researchers have stressed the need for more active user participation in determining collaborative system requirements and evaluating prototypes [e.g., 6]. Others have turned their attention to examining and facilitating the design process itself [e.g., 1].

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CSCW 94- 10/94 Chapel Hill, NC, USA
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In addition to striving to improve and better support the design of CSCW systems, it is also important to consider how they are going to be integrated into organisations. In particular, the ability of CSCW systems to engender better coordination and collaboration will depend largely on how they fit in with the working practices currently in place in organisations. No matter how well a CSCW system is designed, if the company that has bought it is ill-prepared for the necessary changes required to use it, then it is likely that it will fail or be used sub-optimally.

In contrast to the introduction of single-user systems, where users learn and co-adapt software systems individually [12], a quorum of users are needed to learn together and accept how CSCW systems are to be used within the collective work practice. This requires collaboration both to modify the system (i.e., enhancing and customising the system) and to change the working practices. This distributed process of co-evolution, however, is likely to be very complex, encountering numerous obstacles and resistances in its path. In particular, the problem of how to tailor a new CSCW system to fit in with existing work practices, whilst also changing the organisation to adapt to the new system, is likely to be much more difficult to manage than for single-user systems. It is highly probable that many companies will become overwhelmed by the influx of distributed decision-making and problem-solving activities that will need to be carried out when changing over to a new multi-user system.

The aim of this paper is to examine the co-evolution process and to consider how it can be better facilitated. It focuses on the obstacles that manifest themselves when change is projected and instigated, and how they are currently dealt with. It is hoped that a greater awareness of the likely obstacles that can arise in the intensive transition phase can help others in explicating and better managing them. Such findings are also relevant to the design and re-design of CSCW systems. As stressed by Bannon [2], design and use should be seen as “interleaving and interpenetrating practices” rather than as “distinct steps in a linear development process that moves from analysis to design to implementation then use.”

EXPECTATIONS AND OBSTACLES

The current wave of “information sharing” groupware (e.g., Lotus Notes™, Windows for Workgroups™) and workflow management software (e.g., Staffware™) have been much heralded as the new panacea for organisational collaboration. A general buzz of excitement is rippling through the business world, resulting in many companies contemplating and purchasing this kind of groupware, with the hope that it will rapidly and markedly solve many of their day-to-day communication and coordination problems [14].

Such enthusiasm is very encouraging for groupware developers. However, whilst there have been several informal reports of success stories where Notes has been implemented in organisations¹, the few systematic studies that have been carried out so far that have evaluated the implementation of groupware in organisations suggest that the reality has been far more disappointing. For example, in an extensive five-month study of how Notes was introduced into a large services firm, Orlikowski [15] found that it did not live up to the manager’s expectations and instead was used sub-optimally. In particular, the employees used the groupware more as a personal tool, to enhance their own productivity, rather than to share information and collaborate with others in the company. The reason for this failure was attributed primarily to the company having an inherently competitive culture that was not geared towards engendering cooperation amongst its employees.

Grudin [7,8] has also outlined a number of reasons why multi-user systems and applications² in general are failing to be used in the way intended. These include (i) an unequal distribution of additional workload to manage the groupware, where those doing the extra work tend not to be the ones who benefit the most from the use of the application, and (ii) the disruption caused to the existing social dynamics and conventions of the working group. The disparity between the costs and benefits accrued by different users is often overlooked by designers and managers alike. Whilst being able to consider other users in relation to themselves (the “if I like it, then the others

¹Marshak [12] cites a number of cases where the experience of using Notes has been positive. These include its installation in Manufacturers Hanover Trust and Price Waterhouse. Press [14] also cites how the manager of Texaco Oil, was “generally pleased” having got 1500 of his employees to become Notes users. In both instances, however, it is difficult to discern the nature of the benefits, since both appraisals are general impressions.

² Multi-user systems are those that include the hardware and software developed to support group activity such as an inventory control system. Multi-user applications refer to software (and sometimes hardware) developed for integration with an existing system (e.g., shared information, editing and drawing tools). Both are considered here as different kinds of CSCW systems.

also will” attitude), Grudin points out how difficult it can be for designers and managers to shift from a single-user perspective to a multi-user paradigm. As a consequence, it is problematic for them to foresee the kinds of inequities that can emerge between different users of the same system.

Another obstacle that can prevent groupware from being used in the way anticipated is the misplaced “folk sociology” attributed by managers to what is wrong with the existing means of communication or working practices in their company. For example, Harper and Carter [11] discuss how a manager of an architectural company was concerned that there were too many delays and slippages occurring in responding to briefs in the company. He assumed that the reason for this was that there was a communication problem between the engineers and architects working on the same projects. This was thought to be partially the result of the two groups being located in separate parts of the building, resulting in infrequent opportunities to meet casually. The manager also became aware that a newly emerging technology, in the form of a video link, could help overcome the perceived problem by providing enhanced communication facilities. The video link was subsequently installed by the researchers. Unfortunately, the anticipated solution did not materialise; it was only after further study that the real problem became clear—namely, that the engineers were over-committing themselves in an attempt to keep up good working relationships with the architects. Providing novel ways of enabling the engineers to meet with the architects more regularly, therefore, was the last form of support they needed, since as became apparent, “effective negotiation, like a game of poker, is sometimes achieved by hiding or disguising things.”

A further problem is the level of tolerance and flexibility that the new multi-user system or application allows for, once installed. Whilst a group of users may initially accept the additional workload required of them to collaborate via the system (e.g., maintaining their part of a shared to-do list), it is likely that they will, at various times, lapse into “productive laziness” [17]. By this is meant the transitory suspension of an agreed coordination procedure (e.g., updating an electronic calendar) or shared housekeeping activity (e.g., maintaining and storing files) that an individual perceives as not necessary to carry out at a particular point in time, or, alternatively, that an individual is prevented from doing because of competing demands. Depending on the tolerance threshold of the system and the nature of the work, slippages in maintaining agreed-upon procedures can easily slide into a breakdown of collaboration.

Such discrepancies between the expectations about how groupware and CSCW systems can transform organisations and the obstacles and resistances that arise when they are implemented in organisations are clearly

worrying. A research implication is that there is need of a better understanding of how such systems are introduced into organisations, in terms of the struggle those organisations encounter when managing the multiplicity of changes required to co-evolve their work practices and the technology.

CONCEPTUAL FRAMEWORK

In examining the co-evolution process here, two main themes are explored: i) what the local and global consequences are for various user when a CSCW system restructures the working procedures of another set of users, and ii) what kinds of interactions and conflicts emerge when different users seek to change the system and their working practices, and how these interactions and conflicts get resolved. To pull together the detailed analyses of the various obstacles, tensions, and subsequent resolutions, two related conceptual frameworks, which originally were developed for designers in HCI, are outlined. These are: *distributed knock-on viscosity*, adapted from Green's [5] cognitive dimension of viscosity, and *the gradient of resistance* taken from Bowers and Pycoc's [3] metaphorical description of the resistances and forces that are present in the design space. In the context of CSCW, the notion of distributed knock-on³ viscosity is used to describe the additional activities required to be performed by one or more users that are extraneous to their goal-directed work and that are brought about through the CSCW system being configured in a certain way in order to enable another person or group to carry out their work in a more efficient or less constrained manner. The gradient of resistance refers to the problems that designers face when asked to make modifications or to add new features to a prototype or a system--namely that they can be too expensive, difficult or infeasible to do--together with the need for varying degrees of legitimacy, to justify the acceptance of such changes. In other words, the deeper the gradient of resistance, the more fixed the design; hence, the more difficult it is to make changes to the prototype or system that is being designed. In the context of integrating CSCW systems in organisations, the concept is applied to obstacles that can manifest themselves in the co-evolution of situation use and system reconfiguration. For example, the more established a working practice has become, the more resistance there is to changing it. Likewise, the more radical a change proposed to adapt a CSCW system, the more resistance there is to accepting it.

In analysing the initial use situation for CSCW systems, in terms of different forms of viscosities and resistances, the aim is to provide conceptual leverage on the complex co-evolution process. It is hoped, too, that the nascent conceptual framework may provide the beginnings of a tool that could be of use to third parties (e.g., consultants

and researchers), who are becoming increasingly involved in customising CSCW applications for organisations.

THE STUDY

This study followed the events that occurred when a travel centre attempted to integrate a new multi-user system into their workplace. The approach adopted was both observational and proactive: I took notes and tape-recorded the activities and conversations that took place between the people in the company whilst also partaking in discussions, providing feedback, suggesting recommendations, and facilitating the gathering and consolidation of information. Visits were made to the company, which was based in London, on a one-day-a-week basis, for four consecutive months.

The analysis reported here focuses on several conversations that took place, at different times, between the company's four directors (managing, marketing, financial, and sales), the departmental sales managers, the sales consultants, the accountancy staff, and me about the problems with the new system. These included: discussions of the perceived costs and benefits for the different groups using the system, and the merits and drawbacks of pursuing a radical versus evolutionary change when seeking ways of improving the use situation.

The Work Practice and Computer Support

The travel centre (RTW⁴) is a medium-sized company (approximately 50 staff members) specialising in transatlantic, long-haul, first- and business-class flights and overland tours. The work is very labour-intensive. It involves several people developing the same product--a client's booking--at different stages. A computerised multi-user booking and ticketing system (C-Base⁴) is used to create a client's booking. This also interfaces with the airlines' database. The sales consultant downloads information about a booking from the airlines' database into a client file and types in other information about the particular client's itinerary. The consultant also has to make numerous calculations (e.g., working out gross and net prices, taxes, special deals) and to check that a range of requirements have been met (e.g., the need for visas, inoculations), when constructing a booking. However, because the consultants are always involved in multi-tasking (often dealing with two or more clients in parallel), it is easy for them to make mistakes. For example, when filling in a client's itinerary, the phone can ring, which results in the consultant having to commence another booking. In having to switch continuously between tasks and conversations with clients, it is easy for the consultants to forget where they are in a booking and subsequently they may fail to add the necessary information or type in incorrect information.

³ A "knock-on" effect is a secondary, indirect or cumulative effect.

⁴ The names of the company, the people working there, and the computer systems have all been changed.

To ensure that the mistakes are detected and that they do not progress on to the next stage of development (where it becomes more difficult and takes more time to rectify them), the client files are checked by the departmental sales managers. This involves scanning through all the booking and itinerary details. Having been approved by the managers, the client files are given authorised status and are then passed over to the staff in the ticketing department, who use the booking details to create tickets. At various stages throughout the development of bookings and tickets, staff in the accountancy, hotel, and tours departments may access the client files to add further details, check that money received tallies with the price quoted on the booking forms, and so on. Meanwhile, the sales consultants, who created the bookings, need to monitor how they are doing.

The nature of the work is highly interdependent. The product is collectively constructed by several people, involving many different forms of interaction. Communication, therefore, is crucial for keeping the different consultants, staff, and management informed of how the various client files are progressing.

Shared Memory Facilities

To facilitate the construction of bookings and tickets via the distributed editing and creation of shared files, C-Base provides shared memory facilities. Attached to the client files are diary entries that the consultants fill in to remind themselves and the other staff of what still needs to be done and when (e.g., check with the customer if he has still not paid up in full by certain day, check with airline for availability of seat if client is on waiting list, make sure that ticket is raised by day specified in the booking). Each day a print-out of the file numbers and client names that need attending to is distributed to the respective consultants so that they know which of their client files need to be dealt with on that particular day.

Client notes can also be attached to the files. These allow the consultants to write personal details about particular clients (e.g., this client is difficult but is a good customer and so needs delicate handling). As the consultants have to work with numerous clients at any one time, it can be difficult for them to remember what sort of client they are dealing with. Such notes, therefore, can provide handy reminders for the consultants about how to deal with special clients.

Changing Over

As part of RTW's decision to expand, the directors had decided to purchase a new multi-user booking and ticketing system. A number of reasons were explicated. These included the need to break away from their parent company, to which the existing system was linked⁴; the need to expand incrementally, which was not allowed by the current system; and the need for better accounting and marketing facilities, which the current system did not provide. The primary motivations for changing over to a

new system, therefore, were related to privacy and the need for more flexible ways of manipulating information about clients. The issue of whether the coordination of the various interdependent activities could be improved, or that they might even be impeded through obtaining a new computer system, was not addressed. Moreover, everyone at RTW reported on how much they enjoyed using C-Base, finding it very easy to use and work with.

As is common with many small- and medium-sized companies, the new system was selected based on a supplier's demonstration of its extensive functionality, together with the willingness of the suppliers to strike a deal. In particular, the directors were very impressed by the system's (Gecko⁵) top of the range facilities, which could enable them to extract a range of statistical analyses and financial reports. They immediately saw how this kind of information could provide them with more effective management and marketing strategies. At no point during the "shopping trip," however, did anyone ask whether Gecko would support their existing work practices. Moreover, none of the potential user (e.g., the consultants, the ticketing and administrative staff) were involved in the evaluation of the new system. Instead, the directors assessed the new system in relation to their primary objectives. They naively assumed that, given time, the consultants and staff would adapt to Gecko. It did not occur to them that its usability would become a major concern.

Cost/Benefit Disparity Between Different User Groups

Gecko was installed in the first and business class department, which had also been moved to a new building as part of the expansion plan. The first week of operation was beset with the "usual" range of technical and teething problems. Whilst these gradually were ironed out, usability problems became more evident. Considerable resistance began building up amongst the sales consultants, who had

⁵ When setting up the company, the managing and sales directors had decided to purchase a computer system that they were familiar with and that had been developed and customised for the "parent" company they had previously both worked for. The main advantages were that the directors were very experienced with using the system and that they could have immediate maintenance, from the parent company, via a modem connection. The disadvantage with this arrangement, however, was that it meant that the parent company also had access to RTW's client files. In the beginning, this was not considered to be a serious problem. But as RTW have expanded over the years, they have become large enough to be in direct competition with the parent company. To keep a competitive edge with RTW, the parent company has had to devise promotions and deals that are more attractive than RTW's. Obviously, having access to all of RTW's files meant that they could develop marketing and sales strategies that could upstage RTW's special promotions and deals. Such a situation was obviously undesirable to RTW, especially in view of the fact that they did not have the same access to the parent company's client files.

been designated to use the system. The main problems that were raised were that Gecko was cumbersome, inflexible, and tedious to use. In addition, the sales consultants soon determined that the advantages of the new system were heavily biased in favour of management (whereas C-Base was not).

The sales consultants experienced various conceptual difficulties. For example, several had problems understanding why it was necessary to have two numbers for each client: one for a booking and another for the client's account. From the system's perspective, having both account and booking numbers enables multiple bookings for a single account to be constructed. The advantage of having this form of classification is that all the bookings that have been made for one client can be accessed. While this is beneficial for accounting and marketing reasons, however, it makes no difference to the consultants as they work with individual bookings.

The aspect of Gecko which the consultants did like was a new communication function and better shared memory facilities. An electronic messaging facility, allowing them to broadcast information and personal messages to each other, was considered useful, especially in view of the fact that the company was becoming more physically dispersed (because of their expansion). Also, the diary entries and clients notes were considered to be much easier to edit and view than those provided with C-Base, making the activity of checking up on existing files easier.

The advantages, however, were heavily outweighed by the new constraints that Gecko imposed on the way the consultants were required to create bookings. In particular, one of the main problems (and one which frustrated them) was not being able to easily amend fields in bookings that had been transformed from provisional to firm (the change of file status that occurs when a booking is authorised). For example, consultants like to be able to change the final payments date, especially if the client is late sending in their money. With C-Base, they could be able to make these kinds of amendments very easily. With Gecko, however, it is much more difficult to change firm bookings, requiring the consultant to delete the existing file and create a new booking.

Restricting amendments to firm bookings assists the accountancy staff, who deal with the client files later on in their development. In particular, the accountancy staff can be assured that the details in a booking will remain fixed after they have checked them against payments received. This was not true with C-Base, where it was easy for consultants to make amendments to the client files at any point. Hence, the accountancy staff could never be sure whether further amendments had been made after they had checked them--unless the sales consultants informed them. The sales consultants, however, would often forget to pass on such information because of the interruption-driven and

multi-tasking nature of their work. Indeed, one of the main complaints from the accountancy department was the "bad practice" that the sales consultants had developed with making and amending bookings using C-Base.

As a consequence of the consultants' "bad practice," the accountancy staff frequently spent considerable time backtracking through the client files and asking the consultants which clients files had been altered since they had last been checked.

The restrictive practice of creating and amending files imposed on the sales consultants when using Gecko, as well as the additional workload, therefore, makes the work of the accountancy staff much easier. Furthermore, it also enables a variety of accounts and marketing reports to be created. The consultants, understandably, became very disgruntled on discovering that Gecko was heavily biased towards making the work of the accounts department easier, but at their expense.

DISTRIBUTED KNOCK-ON VISCOSITY

The above is an example of making a design decision that makes the tasks of one group of users easier, but in doing so, constrains those of another group using the same system. Constraining how a multi-user system is to be used for the benefit of some but at the detriment of others is described here as a form of distributed knock-on viscosity. Green [5] originally used *knock-on viscosity* to describe, for single-user systems, the situation where performing one goal-related action makes necessary the performance of a whole train of extraneous actions. The reason for this is due to a constraint density: the new structure that results from performing the first action violates some constraint, which must be rectified by the second action, which in turn leads to a different violation, and so on. An example that occurs for the single-user application of word-processing without widow control is the action of inserting a sentence at the beginning of a document. The consequence of this action for the user is that the user must then go through the rest of the document to check that all the headers and bodies of text still lie on the same page. In other words, the first action has a knock-on effect, causing the user to carry out other actions that are extraneous to the primary task.

In the context of CSCW, the concept of viscosity is extended to describe the distributed knock-on effects that can occur across users who are supported by the same system. More specifically, the system may be designed to enable one group of users to carry out their tasks in a flexible and unconstrained manner (i.e., low viscosity), but which has consequences that are propagated to other users, requiring them to carry out extraneous work or by constraining them to work in an inflexible way (i.e., high viscosity). Hence, in the study, the system was configured to be highly viscous for the consultants, making it difficult for them to make amendments to the client files, but providing management and the accountancy staff with a highly flexible support environment.

Such redistributions of workload are likely to happen when the design of CSCW systems are based on a particular view of the work process, rather than how they are going to be used in different work contexts. The use situation, therefore, should be a central concern when configuring levels of distributed viscosity across users. This raises the question, however, of whether a utilitarian solution is attainable. In particular, is it possible to optimise the levels of viscosity to allow everyone to carry out their work in a flexible way, but not lead to undesirable knock-on effects for others up- or downstream in the interdependent work activities?

ADAPTING TO CHANGE

A problem of predicting how workloads and constraints should be distributed when designing CSCW systems is that often the viscosities manifest themselves only when the systems are actually implemented in the work setting. The situation confronting organisations, therefore, is how do they, themselves, deal with emergent viscosity problems? Management can sit tight in the hope that the employees will resign themselves to the differences. Alternatively, they can seek ways of articulating and changing the system to be more equitable. It is likely that little will be done in organisations where a new CSCW application is not central to the main work [8]. On the other hand, organisations are likely to take action if they have made a big investment and consider the CSCW system to be central to their work practice. This is what happened at RTW. However, the process of trying to optimise the system for different users was a long, drawn-out affair.

Adapting the System Versus the Organisation

Management's initial response to the complaints made by the consultants about Gecko was that they were experiencing teething and training problems, and that it would only be a matter of time before they got used to it. A very different picture, however, was emerging from the shop floor. As the consultants and staff in the accountancy and ticketing departments began using Gecko more, they noticed more problems with it. The swapping of "gripes" spread rapidly through the various departments, including those not using Gecko. Furthermore, when the directors eventually started using Gecko, they also had difficulties. For example, the financial director experienced several problems when trying to display and print out financial reports because it was not obvious from the information provided on the screen how to access and print off all the available reports.

The pervasiveness of the problems became increasingly disruptive to the well-being of the company. Concomitantly, a growing discontent began to surface amongst the consultants. Within a month, two long-standing consultants, who had been assigned to the first and business class department, had left. A major organisational problem was developing. The directors realised something had to be done.

The initial plan was to improve the usability and functionality of the system. The financial director negotiated an arrangement with the developers of Gecko, whereby they would design enhancements to the software that RTW considered necessary. The requirements engineering process, in which the various enhancements were articulated and negotiated, and in which the cost for these fixes was agreed upon with the developers, is reported elsewhere [see 18]. Of interest here is the attention given to one particular enhancement, which was the need to improve the authorisation procedure. The method provided by Gecko was considered grossly inadequate. In particular, the sales managers complained bitterly that Gecko did not provide them with sufficient information when authorising, as the following talk between the sales director (BB) and me illustrates:

YR: So their reasoning for giving you only a select view is assuming that the person authorising only wants to see certain things!

BB: Yer, that's right. I don't think they realise when you're authorising you got to see the whole lot. You got to see everything, otherwise you're not adequately authorising.

YR: That's really slowing the process then to go in and out all the time.

BB: There's no point in authorising.

Gecko has been designed for the same person to create and authorise a booking. It is one step in a sequence of tasks. It is assumed that the consultant will have progressed through the different stages of making a booking and, on selecting the authorisation option, will only want to make the file firm. In its current form, therefore, Gecko is not designed to have another person to take over a file for authorisation. Hence, the sales managers did not receive sufficient information to perform their task. The possibility that RTW consider changing their procedure, so as to allow the sales consultants to do their own authorising, was considered implausible by the financial director (GG):

YR: I was meaning if you got the consultants to do the authorising themselves. Or do you need someone else?

GG: Oh yes, definitely need someone else, definitely!

YR: That's because there are so many transactions? It's easy to[

GG: It's easy for mistakes to be made. It's because prices can be misquoted. Um, because it's very busy during the day. They jump from one file to another file. They put something in there that is wrong. It needs that trained eye to check.

Hence, the sales consultants' frenetic, largely interruption-driven and multi-tasking method of working is explicated as the reason why there is a need for someone else--with more expertise and authority--to check over the client files they have created. Making mistakes is accepted as being inevitable, owing to the fragmented nature of the consultants' work.

GG and BB both find it difficult to understand how other travel companies can work with the authorisation procedure set up in this way. Indeed, they find it very amusing that a rival company, the staff of which appears to be happy with Gecko, have a very superficial and inferior authorisation procedure when compared to theirs.

In contrast, the marketing director is struck by the possibility that the authorisation procedure could be done away with if the consultants were provided with more computer support. Having later talked with the developers about what other software modules Gecko has to offer, he discovers that a central component that RTW had not implemented is an automated farebase. This module provides the sales consultants with instant quotes on fares that can then be downloaded into a booking. The marketing director (AT) sees this as providing a way of lessening the consultants' workload whilst also reducing the risk of them making mistakes when constructing bookings. The connection is so clear to him that he makes several attempts to put this view across to the other directors:

AT: But if we had a farebase loaded in the system then you wouldn't need to authorise. Because downloading would be automatic, that would save a lot of work[

GG: Er...yer..I mean I agree. Provided that all we have to do is authorise the er farebase, well not authorise but ensure that[

AT: Make sure it is correct! Once it's correct then you don't need to authorise. So once the farebase is correct there is no need to authorise bookings. That would save a hell of a lot of time as well.

To the marketing director, therefore, it is obvious that Gecko has been designed to be used in conjunction with the automated farebase. Moreover, he is unable to understand why the sales and financial directors, who had been responsible for purchasing Gecko, had not bought the whole package in the first place.

The sales director (BB)⁶, however, sees the situation quite differently. To him, the authorisation procedure is central

to RTW's way of working and, in contrast to AT, does not see its connection with the automated farebase. The problems with the authorisation procedure and the introduction of the automated farebase are seen as totally separate issues, as becomes apparent in a discussion between AT and BB:

AT: ...But then again if we had the farebase we wouldn't need the authorisation program would we?

BB: Yes! The farebase is something completely different.

AT: Yes but if the fare is correct you don't need to[

BB: Ah! But it's not just. The authorisation, you're checking option dates, you're checking visa requirements, vaccinations, cancellations. So it's not just the fares.

AT: Ahhhh. So you're always going to have to authorise?

BB: Yes!

AT: You can't get round that?

BB: No!

At this point AT concedes that his original proposal of doing away with the authorisation procedure is not feasible when considered against the established way of creating bookings in RTW. However, he does not abandon the idea of introducing the automated farebase. Instead, he tries to persuade his colleagues of the benefits it would have for RTW. In contrast, the others are much more sceptical.

Radical versus Evolutionary Change: Multiple Perspectives

At the time Gecko was purchased, RTW already had a well-established method of providing fare quotes to clients. Each consultant has a large folder, containing sheets of paper displaying the prices offered by the various airlines. The sheets of information (known as memos) are regularly updated by the marketing director, who edits them on a separate word processor and then has them distributed to each of the consultants.

The consultants' perspective: To find a fare, the consultants flick through their folders--affectionately called bibles--and scan the memos to find the necessary information. It is a highly developed skill, and one at which they are very competent. When asked about the possibility of replacing their bibles with a shared automated farebase, most of them recognized the benefits

⁶ Unlike the sales director, the marketing and financial directors have not had the experience of being a sales consultant. They have been brought into the company to carry out the specific tasks of

marketing and finance. Hence their knowledge of the authorisation process is limited.

but also pointed out the disadvantages. These included the inflexibility of such a system. In particular, they all had organised their bibles to fit in with the kind of queries they typically were asked. The form of customising included placing the memos they use most frequently in a particular sequence, at the front of the bible and using various markers and place holders to allow them to move easily between alternative memos of airlines offering the same destinations. This ability to construct and manipulate their own view of the different airlines' information was considered important by all the consultants. In particular, it was essential for those working in the long-haul department, who were primarily involved in constructing round-the-world itineraries. The nature of their work required them to constantly collate, compare, and cross-check different airlines, so that they could work out the best combination of flights.

In addition to customising their bibles, the consultants had developed their own way of accomplishing their work. To switch over to using an automated farebase, therefore, would be problematic, as pointed out by one of the consultants (DB):

DB: It will be far more difficult for things like long-haul because we have a far more idiosyncratic way of doing things and making round the world fares...everyone has their own system.

For other departments where the form of quoting is more straightforward, however, a different view is projected:

DB:...[For] North America, it will work very well because it is essentially, it's just a lot of out and back stuff. And they have set prices.

The marketing director's perspective: As mentioned earlier, the marketing director considers the benefits of the automated farebase largely in terms of improving efficiency. In particular, he originally saw it as a means of removing the time-consuming authorisation procedure. It also occurs to him that it would provide a much more efficient way of distributing quotes to the consultants than the current method, since the fares would be placed and updated in a central database that would be directly accessed by the consultants.

At another level, he sees the introduction of the automated farebase as a stepping stone for quite radical changes to the company. Namely, if one form of information can be automated, then why not others, such as a tours database? Like the fares database, it would allow the consultants to find the cheapest tours simply by typing in a few keywords. Moreover, AT envisions Gecko enabling the diverse kinds of information residing in people's heads to be brought together into a form and place where others

could access it--in a way, a kind of organisational memory [cf., 16].

Currently, the process of working out a tour for a client involves the use of a diversity of resources, including the consultants' own experience of tours, a multitude of brochures, and recommendations from tour representatives. Often they will ask each other for information about particular tours that they know others have been on. Like providing quotes for round-the-world flights, knowing the best deals and being able to offer the client the best package is a complex skill, and each consultant will have developed their own particular method. Attempts to automate such knowledge, therefore, may come up against the same sorts of resistances that were projected for the automated farebase.

Nevertheless, on realising the potential that Gecko had and what RTW had currently installed, AT exclaimed:
It's like buying a car and driving it only in first gear.

For him, there was no looking back.

Resistance and Resolution

In contrast to AT, both GG and BB are against such radical changes. To them, a more evolutionary approach to changing the organisation is preferable. For example, during a subsequent discussion, GG goes to great lengths to point out how they should be adapting Gecko to fit in with their organisational structures, rather than the other way round. Both are also worried about the restructuring that would be necessary if they were to introduce an automated farebase. In particular, they are concerned about the additional workload that would be required to maintain it, who would be responsible, and whether the effort involved would be worth their while. The difference of opinion between the radical and the evolutionary approaches is emphasised below:

GG: My only problem is I don't think...no one at RTW has a job specification to do that day in day out... full time to do the database and the biggest problem really is once we go over to the system we are going to have to have a fundamental change in what we [

AT: [Yer, it is the centre of the company isn't it? The fares. It's the fares we sell.

GG: Yes I agree, but also we have to change the organisation. And you can't do that overnight and that worries me. I don't want there to be too many new things. Let's just move one stage at a time.

Later on in the discussion, GG reiterates his reluctance and his rationale. AT, however, is not convinced by this line of arguing:

GG: But I must confess the indecision so far has included me because I've always believed that if we try and change too many things at once then we're asking for trouble.

AT: Yes but you know[

GG: [No, what we'll do is put it in first and business and then it will go onto transatlantic.

AT: But why not straight away?

GG: But Anthony there are loads of fares! There's loads of fares!

AT: Get them on the files and then all there is, is amendments.

GG: Yer but you're seeing it from a marketing perspective. All I'm saying at the moment is let's see how we get on with the system. Let's not go in and overload the system. Who is going to keep going into Gecko and keep updating all the Australian fares?

AT: David?

GG: Who?

AT: David...I mean once it's on, it's on! And then there is just daily, or every other day. There's just amendments. I mean really all this fuss about transferring the bible from my machine onto that machine, there is hardly any problem at all, really...

Finally, after several more informal discussions, board meetings, and opinions sought from the consultants, suppliers, and me, it was agreed that RTW would go ahead and purchase the automated farebase module--but initially would only put North America fares on. In the meantime, Gecko had been enhanced to enable the authorisation procedure to be carried out in the way RTW wanted.

THE GRADIENT OF RESISTANCE

The notion "gradient of resistance" refers to the different forms of resistance that are encountered in the design process, where some are more severe than others [3]. In Bowers and Pycock's [3] words, "appreciating just where the hills and valleys are in design space is one part of assessing what is and what is not a plausible future development" This view of design is also applicable to the co-evolving process of adapting systems and working practices. Exploring and understanding the implications of radical versus evolutionary changes in a co-evolving environment provides a means of determining the most appropriate paths to take.⁷

⁷ Unaware at the time of writing this paper, I discovered subsequently that John Bowers [4] was also extending the

In the example analysed above, different forms of resistances were encountered: making small changes (e.g., amending the authorisation process) was met with shallow resistances as the need for change was considered central for the company to be able to function in the customary way. On the other hand, proposals for substantial changes (e.g., the implementation of shared automated databases) were confronted with steeper gradients of resistance. This was attributed to the many additional changes required to restructure the organisation so that the alternative functionality could be used in the manner projected. The resistances were also seen as interacting: a steep gradient could be offset by eliminating some of the smaller gradients. For example, introducing a radical new way of working was seen as a way of eliminating the need to make smaller modifications to the system.

The other aspect of Bowers and Pycock's metaphorical notion of the resistances in design is as the *forces* that are commonly manifested as rhetorical devices in the interactions that take place between designers and users. For example, when a potential user encounters a resistance that is expressed by the designer, or vice versa, they will try to counter it through either appealing to well-known design principles, generalising, listing reasons for why a modification should be pursued, or reformulating alternative suggestions. Similar forces were seen at play between the directors at RTW when negotiating changes to the work practices and adaptations to the system. In contrast with the largely indirect requests and disagreements that took place in Bowers and Pycock's study, however, the form of talking at RTW was much more emphatic and often confrontational. In many situations, the directors would be very explicit with each other, emphasising the reasons why they thought a resistance was so steep (e.g., GG's repeated "loads of fares" explanation to AT as to why it would not be appropriate for them to switch over to a fully-automated farebase). The stark difference in style of negotiation, however, is likely to be due to the very different settings; RTW is a highly charged working environment where "letting off steam" is an integral part of the culture. The study of the design space took place in an academic setting, where consideration and polite respect of each other's skills and ideas is more the norm.

One of the problems with the co-evolving process of change at RTW was the length of time it took between exploring gradients of resistance and action being taken to implement further changes. The lengthy discussions over

"gradient of resistance" concept to understanding and managing change in "socio-technical" systems. Similar to the analysis presented here, he notes how projected changes to organisational procedures and the redesign of aspects of the system's interface, articulated by various members of the organisation, are met with variable resistances.

whether to adopt the automated farebase continued over a protracted period of several months. Whilst the marketing manager had clearly set his agenda, the other directors took turns articulating the various resistances. Furthermore, the sales, managing, and financial directors would often use each other as resources to stave off the many attempts by AT to get them to reach a decision. For example, the financial director would say that he agreed with AT, but then add that it was the sales director who was the one who was reluctant to accept the proposal. Meanwhile the sales director would attribute the indecision to the managing director not making his mind up and so on. Hence, a vicious circle would emerge, whereby the different players would separately appear to be in agreement with AT, but meanwhile would be pushing someone else to the top of the resistance gradient.

Procrastination in collaborative planning, where several perspectives are at stake, is a well-known phenomenon in organisations. Much time and energy is spent in "trying to discover, construct, and communicate interpretations of a confusing world" [13]. In managing day-to-day decision-making, the players have developed an impressive repertoire of resources. Problems can emerge, however, when the players become overloaded with a deluge of interrelated decisions that have to be made in a short period of time. Such a situation is likely to occur when a CSCW system is initially implemented into an organisation. The surge of real-time resistances and inequitable viscosities can be overwhelming. How can companies be helped in managing such sudden influxes of resistances and be able to adapt to the changes?

DISCUSSION

Companies need to be committed when introducing a new CSCW system or groupware application. They need, too, to have or be able to instil an open and cooperative culture [14]. This requires considerable time, effort, and financial investment, as well as a willingness to accept substantial and unexpected changes. Above all, the company needs to be able to make decisions and manage the emergent and interacting resistances and viscosities that multiply during the transition phase.

The employment of a third party can be very useful in mediating the co-evolution process. Indeed, having identified a need for change, many large organisations seek external help from management consultants. A recent trend has been to apply business process re-engineering. The main thrust of this approach is a radical "cutting and reseeded" of organisational structures, together with a complete overhaul of existing technical support with a view towards major substitution [10].

At a general level, such "nuking" may be effective in paving the way for a blurring of long-standing, institutionalised divisional barriers, and in doing so make it possible for better cooperation and coordination between

employees to emerge. However, such openings have to be realised through immense amounts of articulation work. Consultants and researchers could help at this juncture by getting involved in the numerous decision-making activities and facilitating active participation by the different people in the company. By mediating between people with different viewpoints, feedback can be provided on what the other players currently are experiencing, thinking, and envisioning. In doing so, consultants and researchers could accelerate and help legitimise the co-evolution process.

The approach advocated is very informal: researchers and consultants should move with the ebb and flow of obstacles and developments as they emerge, rather than trying to impose set procedures and direct courses of action. The use of a conceptual framework, such as the one outlined here, is intended as a metaphorical tool. The idea is to help identify and analyse the complex problems that arise and to explore their interconnectedness and implications for further change.

In the study, for example, the problem of restricting the way bookings could be created and amended by the sales consultants was conceptualised in terms of a distributed viscosity knock-on effect; in changing the operations of one set of users from low to high viscosity, it reversed the level of viscosity, from high to low for another set of users. Another example of this kind of reversal is the projected transformation that would take place if automated databases were introduced into the company. To transfer to using a shared database of "travel knowledge" would mean the consultants would have to learn new procedures for interacting with the database, procedures which are likely to be far more restrictive than their current practices. Moreover, they would be expected to keep adding their knowledge to update the system. In effect, this would be additional work. Hence, for the consultants, a low viscosity work environment would be transformed into a high one. On the other hand, the opposite would be true for the marketing director, insofar as he would have greater access to information that previously was difficult for him to obtain.

CONCLUSION

Presented in this paper was a study of the obstacles that emerged when a company attempted to change from using one multi-user system to another. Various problems were revealed and analysed through conceptualising them in terms of viscosities and resistances. Clearly, more studies are needed to analyse how other CSCW systems and ways of working are implemented and adapted, particularly when the systems are quite different from the existing set-up in organisations. In doing so, conceptualisations may evolve that could provide a basis for developing methods for evaluating those CSCW systems that are being designed for and in the use situation.

ACKNOWLEDGEMENTS

Thanks to Lydia Plowman for her comments on the paper.

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