Chapter 7

PATTERNS FOR DEPENDABLE DESIGN

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1. INTRODUCTION: DESIGN AND THE SOCIAL SCIENCES

The argument for the involvement of social scientists in dependable socio-technical systems design reasons is that, to be dependable, systems need to be appropriate both for the application domain and potential users. Before designers can solve a design problem they need to understand some basics - such as what they are designing, who should use it, how often and in what circumstances (Scherer 2002); social analysis of settings where systems are deployed can expose subtle interactions and practices that are crucial to achieving this understanding but which are not revealed by a more structured, technical analysis.

This 'turn to the social' recognises a new kind of end-user, a 'real time, real world' human and social scientists can provide designers with insights and sensitivities, to inform design. The use of observational or ethnographic studies has been a feature of our work over the past 10 or so years as we have attempted to inform the requirements and design of dependable, cooperative socio-technical systems through studies of 'real world, real time' work. (Hughes et al 1997) Over the years, we have generated a consider-able corpus of workplace studies in a range of settings from control rooms to local government offices. As this corpus continues to develop, the issue becomes one of how this material can contribute to the formation of general concepts and principles of systems design. Despite being strong advocates and supporters of ethnographic methods, (Hughes et al 1994) we

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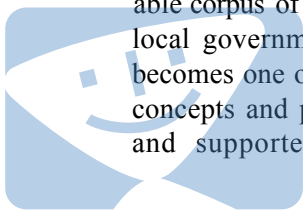
acknowledge persistent problems in determining how these particular studies, and the growing corpus of ethnographic work, can best be utilized, or made useful, for design. As Bannon argues;

".. a critical issue for research lies in determining ways of transforming the ethnographic material in such a way that remains sensitive to the practices of designers themselves and thus can readily be used by them in the design process." (Bannon 2000: 250)

We also acknowledge that, given the pressure on time and resources in the system design process, it is unlikely that prolonged ethnographies will become a standard part of design practice. We therefore need ways of allowing the results of workplace studies to be reused in new and different situations. This requires a balance to be struck between the need for the emergence of general principles and the central importance in ethnographic studies of detailing everyday situated practice. If we are to provide more general design principles, we need techniques to facilitate generalization from ethnographic studies and to allow the results of such studies to be married with more general statements of design.

This chapter proposes the use of patterns of interaction as a partial solution to the problem of designing systems that can seamlessly integrate with the practices and activities of the workplace. We suggest that patterns provide a way of representing knowledge about the workplace so that it is accessible to the diverse, multi-disciplinary team that is involved in design. Patterns provide a framework within which work and design issues can be discussed and generalized. If dependability is a product of careful design then patterns may provide a method whereby designers may come to understand something about how work gets done. They attempt to provide some sense of, and some sensitivity to the activities that occur within the workplace, and the problems, and workarounds of everyday working life, with which any new design may have to be aligned.

Furthermore, As Erickson notes: "Design is becoming increasingly interdisciplinary. Neither 'designers' nor 'end users' are homogenous groups; they lack common disciplines, practices, and conceptual frameworks. All that we can realistically expect those involved in design to share is access to the situation for which they are designing. As a consequence, pattern languages, with their emphasis on embodying design knowledge as a network of concrete prototypes, have the potential to serve as a lingua franca for workplace design". Our Patterns of Cooperative Interaction highlight similarities in research findings across ethnographic studies related to particular socio-technical configurations. They begin to address the question of how we might generalize from ethnographic studies to provide guidance for system designers and other users.
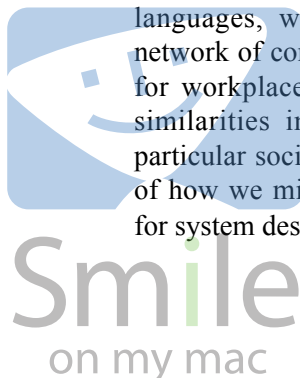
2. DESIGN AND THE PROBLEM OF GENERALISATION

Our observational research studies within the DIRC project, such as a long-term study of hospital managers, document, describe and analyse work and activity as it actually occurs. The general conception is, therefore, a focus on the everyday accomplishment of work, concerned with how the order of work is socially produced – i.e. how this order is achieved, maintained and repaired. They are concerned with the role that action and interaction, between personnel, and with technology, have in the production of order, and how the ecology of settings and the design of artefacts relate to the way work is carried out. We have now reached a stage where it is important to reflect on what the collection of studies tells us as a body of knowledge, going beyond topics that serve as orienting and organizing devices (which are described below), to discuss how the actual details of work in particular settings relate to one another. For instance, are certain work configurations similar, and do they lead to similar activities?

Furthermore, we need to present this knowledge in a manner that is useful and usable for a variety of professionals working in the field and with an interest in the findings of such studies. As experienced researchers, we are aware that our widespread knowledge and experience benefits us when describing and analysing work in new settings. Furthermore, it helps in making what we find and document useful for software engineers or systems designers. We are also aware that to others, as a corpus, these studies can appear like a disparate collection, united by method and orientation but with findings peculiar to each particular setting. The designers' or software engineers' problem, here, has therefore been one of seeing how particular findings in diverse settings may provide useful background for characterising and understanding work in different settings.

3. PATTERNS AND PATTERN LANGUAGES

Recent emphasis on patterns in design can be traced to the work of the architect *Christopher Alexander* outlined in two books, A Timeless Way of Building and A Pattern Language (Alexander 1979; Alexander et al 1977). Patterns are attempts to marry the relevant aspects of the physical and social characteristics of a setting into a design; they provide a facility to share knowledge about design solutions and the setting in which such a solution is applied –

"..every pattern we define must be formulated in the form of a rule which establishes a relationship between a context, a system of forces which arises in that context, and a configuration which allows these forces to resolve themselves in that context"(Alexander 1977)

Patterns are then a way of conveying to designers some sense of the application domain. They are,

"..ways of allowing the results of workplace studies to be reused in new and different situations. .. ways of representing knowledge about the workplace so that it is accessible to the increasingly diverse set of people involved in design.."(Erickson 2000)

While inspired from Alexander's original work, the notion of design patterns has moved from the original conception suggested by Alexander to something that is more prescriptive. We wish to exploit patterns in the much looser spirit suggested by Alexander's original work where familiar situations were used to convey potential architectural solutions. In fact, the observed recurrence of familiar situations lies at the core of our argument for patterns. Designers often encounter similar situations and one justification for this focus on patterns is a particular take on notions of re-use - where the emphasis is on drawing from previous experience to support the collection and generalization of successful solutions to common problems. As Alexander suggests;

"each pattern describes a problem which occurs over and over again in our environment, and then describes the core of the solution to that problem, in such a way that you can use this solution a million times over, without ever doing it the same way twice".

Another rationale behind patterns is Alexander's notion of 'quality' ('The Quality Without A Name') and the idea that "a pattern is a solution to a problem in a context".   Here 'quality' refers not to some mystical characteristic but to features of systems that ensure that they 'really work', that they fit with the social circumstances of use. Interestingly this is also part of the rationale for the turn to ethnography in systems design (Crabtree et al 2000) and is also clearly intrinsic to dependable socio-technical design.

The discovery and presentation of patterns provide a way by which the important findings of different studies are highlighted and presented in a manner that is more accessible to designers. In the following sections we outline our own efforts to uncover and present patterns of cooperative interaction derived from the growing corpus of ethnographic studies. In identifying patterns we were describing grossly observable phenomena in ethnographic studies with reference to their context of production and seeking a way to present them using a standard framework.
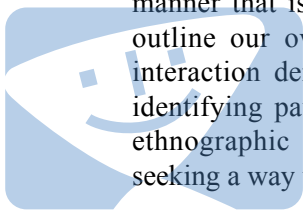
Principles of Pattern Generation

Patterns, as we have said, encapsulate commonalities that occur in different settings and a fundamental criterion in identifying patterns is that these should come from practice. That is, they are not academic abstractions but we have drawn them from field observations taken from our corpus of ethnographic studies. Trying to uncover descriptive patterns within the field studies soon highlighted the need for some set of guidance. Although we were focusing on grossly observable features as the core of the genesis of the pattern it was unclear what sorts of features provided a set of readily understood patterns and what features were of most significance. To provide a focus on the issues of importance to designers, we turned to our previous work in outlining a presentation framework for ethnographic studies in order to develop a set of generative principles (Hughes et al, 1997a) These principles are based around three main workplace characteristics.

Spatially oriented features that focus on the physical nature of the work and the observable arrangements within the workplace.

Work oriented features that focus on the principles of social organization used to structure and manage the cooperative work.

Temporally oriented features that focus on the temporal nature of the work and observable sequential arrangements within the workplace.

Focusing on these concerns is a means of highlighting aspects of work that seem important in considering dependability as a feature of design.

Spatially oriented features

These concerns seek to emphasize the observable arrangement of work and physical nature of the work setting. Three key features are of particular importance and can be expressed as key questions

- **Resources** – what are the various resources in the setting used to support the work taking place and how are they shared.
- **Actors** – who is involved in the cooperative work taking place and how do they orientate to each other.
- **Activitie**s – what are the main observable techniques for structuring activities and how are these represented?
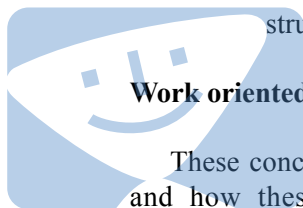
Work oriented features

These concerns seek to emphasize the socially organized nature of work and how these is manifest in practice within particular settings. For

simplicity we have again focused on three key features drawn from previous work on a framework for presenting fieldwork.

- **Awareness of work** – how and through what means are those involved in work aware of the work of others, how do they exploit this awareness and how do they make others aware of their work?
- **Distributed Coordination** – how do those involved in the work coordinate their activities and what practical techniques do they use to do this?
- **Plans and procedures** – what techniques do those involved in the workplace use to orient their work in practice to the formal plans, procedures, representations and artefacts of work?

Temporally oriented features

These concerns seek to emphasize the observable temporal arrangements of work settings, how aspects of timeliness and sequentiality enter into the accomplishment of work. Two key features are of particular importance and can be expressed as key questions

- **Sequentiality** – is work accomplished in a particular order or sequence? How do actions relate to previous actions and preface future activities?
- **Routines and rhythms** – is the observed orderliness of work and interaction a product of and productive of observable routines and rhythms of activity?

Developing a Descriptive Pattern Language

These basic concerns provide a key set of concepts to drive the identification and highlighting of descriptive patterns. Our framework for presenting the patterns combines their different features to produce an agreed pattern language:

Cooperative Arrangement: The cooperative arrangement details, in very basic terms, the *actors* and *resources* that are involved in the pattern of interaction: the people, the number and type of computers and artefacts, the communication medium(s) employed and the basic *activity*.

Representation of Activity: This describes how the activity is represented, for example, on a technology or as a plan and may address the relationship between the activity and the representation. This is related to *plans and procedures.*

Ecological Arrangement: This has the form of one or more pictorial representations of the pattern. For example this may include *abstract representations, plan views, information flows, copies of paper forms, screen*

shots or photographs. There may be good reason for these to be fairly abstract as the real detail may be found in the referenced studies themselves if this is desired. This explicitly addresses the *spatial* characteristics.

Coordination Techniques: This details the type of practices, procedures and techniques employed in carrying out the activity/interaction and how, and in what way, coordination is achieved. This is related to *awareness and distributed co-ordination.*

Community of Use: This is related to an idea of domain, but instead seeks to capture something about the user group. For example, is it customer-customer or a small team of co-workers in a control room?

For each identified pattern a set of illustrative examples drawn from the field studies is presented. This arrangement is designed to promote comparison across pattern examples drawn from different field sites.

4. PATTERNS OF COOPERATIVE INTERACTION

Patterns of Cooperative Interaction provide a basis for abstraction and generalization of findings from ethnographic studies, for the purposes of comparison and re-use in new design situations. They are descriptive in nature but can be put to generative use. By thinking about how the patterns relate to a current design situation the researcher can gain analytic leverage on systems design problems.

Patterns were discovered through studying the fieldwork corpus, and looking for examples of phenomena that were similar across at least two different studies. We now have a collection of ten patterns each presented with a front-page summary description, with access to further pages in which specific instantiations of the pattern are documented. These are presented as 'vignettes' that show details of the pattern from specific studies. Thus, the pattern as a whole is composed of specific vignettes as well as an abstracted 'front page' description that unites the vignettes.

On the front page, we provide an abstract description that pulls together the vignette examples, discussing what makes them similar and what differentiates them. It also contains hyperlinks to access the specific vignettes, a short paragraph on why we drew attention to the pattern ('Why useful') and some design and dependability considerations that arise from the pattern (in a section termed 'Design for Dependability')[6]

At the 'deeper' level of vignette, each vignette has two major components. The first component is a textual description (and sometimes a pictorial representation) of a socio-technical configuration of people and
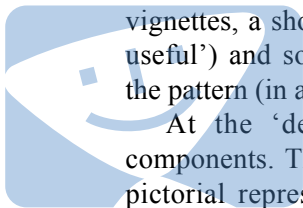
artefacts in a particular setting. The second component is a description of the social practices by which work is achieved given that configuration.

The Patterns Collection

Our Patterns collection, presented via a series of web pages, provides access to the corpus of ethnographic studies by placing *findings* as the entry point into the material rather than through the studies themselves. The full list is currently as follows:

1.   Artefact as an audit trail
2.   Multiple representations of information
3.   Public artefact
4.   Accounting for an unseen artefact
5.   Working with Interruptions
6.   Collaboration in Small Groups
7.   Receptionist as a hub
8.   Doing a walkabout
9.   Overlapping Responsibilities
10.   Assistance Through Experience

Each pattern name is a hypertext link that takes the user to a front page for the pattern in question. This includes the high level description under the heading 'The Essence of the Pattern'. Below this, there are three more sections entitled 'Why Useful?' 'Where Used?' and 'Dependability Implications?'. These detail why we have chosen to draw attention to the pattern; the specific fieldwork settings where we have found examples of the pattern; and some comments about what the identification of the pattern may mean for certain questions concerning 'good', usable, dependable design. The specific examples on screen serve as hypertext links to the vignettes and a greater level of detail.

All of our patterns focus on work practices and interactions and how various work and technology configurations give rise to these, facilitate or constrain them. Some patterns focus particularly on different *artefact* designs and placements and their relationship to work practices and interactions (Public Artefact, Multiple Representations of Information, Artefact as an Audit Trail, Accounting for an Unseen Artefact). Other patterns are less focused on specific artefacts but on how 'work' and 'job' design are related to actual practices and interactions given certain configurations (Working with Interruptions, Collaboration in Small Groups, Receptionist as a Hub, Doing a walkabout, Overlapping Responsibilities, Assistance Through Experience). We present an example from each 'sub-group'. The first is "Working with Interruptions".

Pattern: "Working with Interruptions"

This pattern is concerned with the commonplace situation where personnel have to interleave computer and paper based work in the face of multiple interruptions. How staff deal practically with interruptions, what the problems are and what works well is detailed. Such workplace arrangements are familiar and the pattern and vignettes provide a resource for thinking about design in situations where similar issues are pertinent.
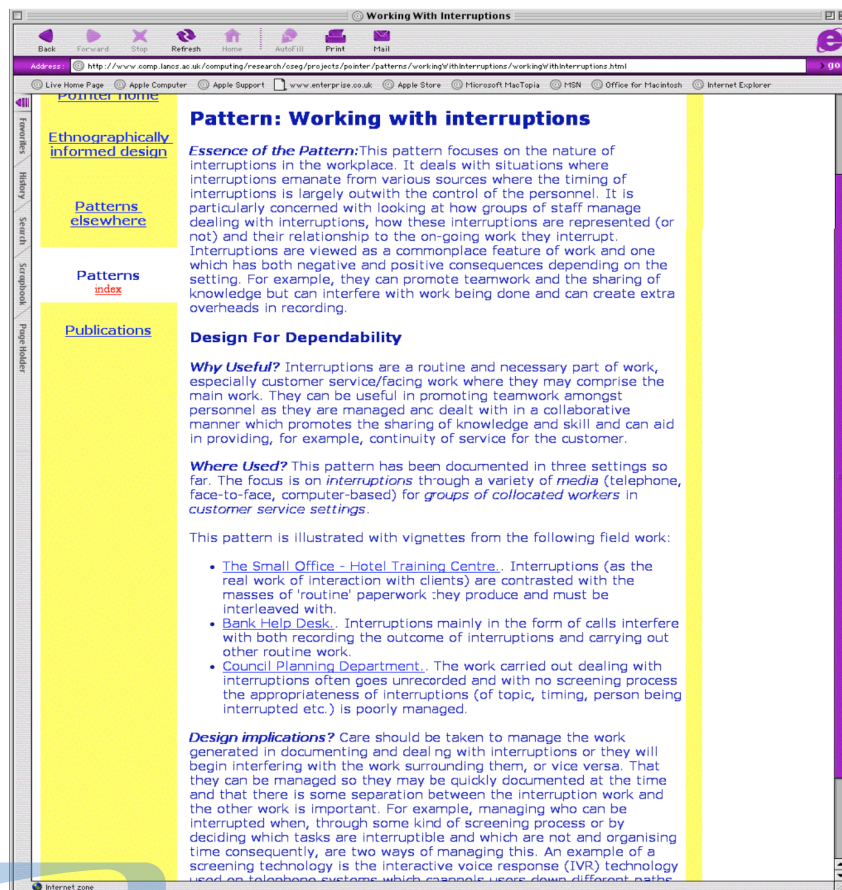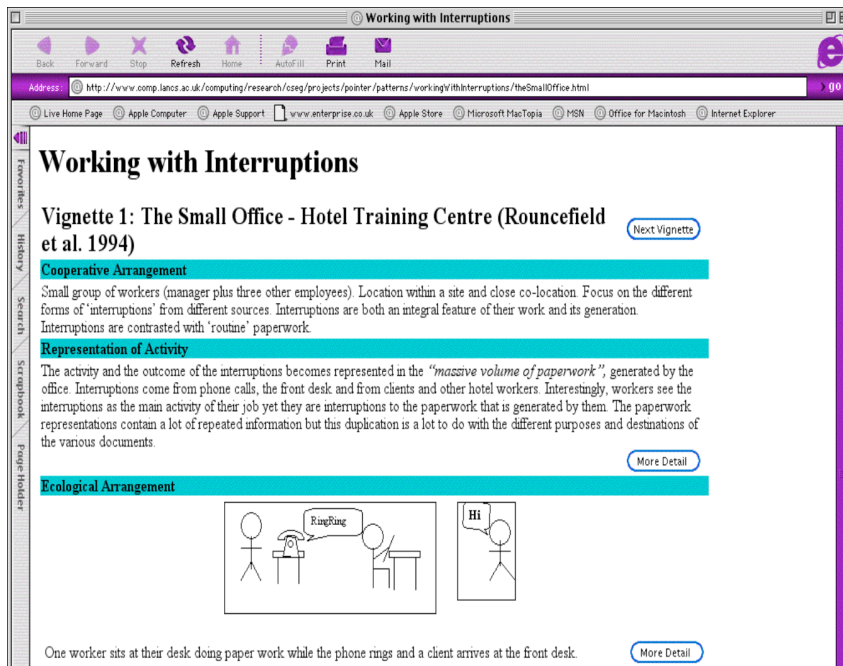

Figure 1: Front page for 'Working with interruptions' (small detail missing)

The first vignette comes from Rouncefield et al (1994). It focused on how frontline reception work (face-to-face and over the phone) became a set

of 'interruptions' that had to be managed skillfully in order that organizational paper work could be successfully completed.

Figures 2. & 3. Vignettes for 'Working with interruptions
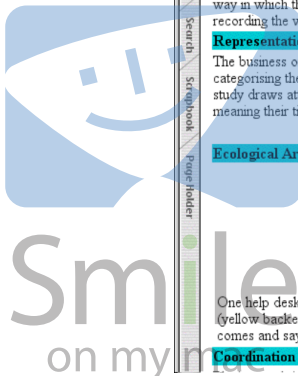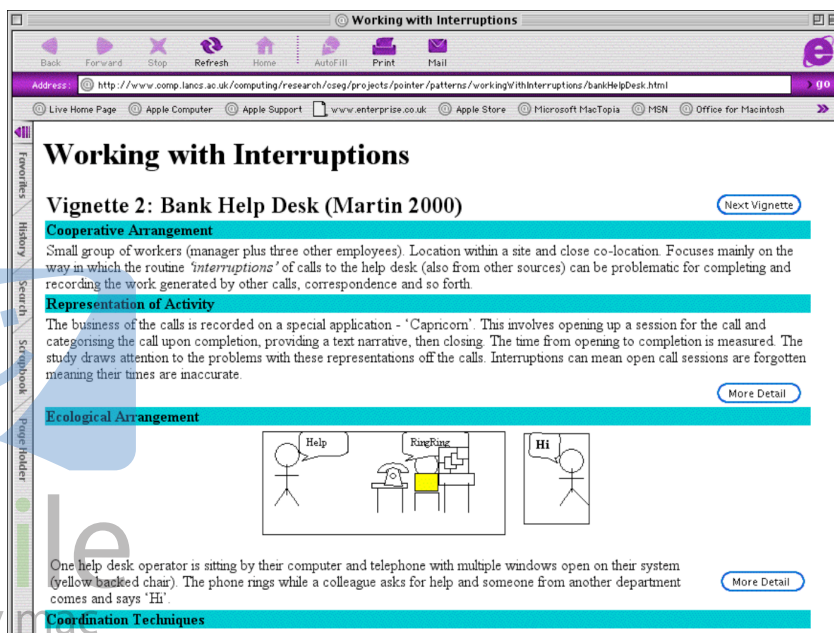
The second study focuses on the work of a software help desk in a bank. Again the concern was with the management between the work required to deal with the interruption and the work it produced. Here, however there was quite a strong focus on the call recording system and the requirement to record calls in various ways.

Figure 4. Third vignette for 'Working with interruptions'

The third vignette is derived from a UK local government council planning department. Here there was a contrast between interruptions from

an inside source and those that were external. Inside source interruptions were often positive in that they could be negotiated and often were about sharing knowledge and expertise. External interruptions were unpredictable, often inappropriate or directed to wrong staff member but still had to be dealt with.

Taken as a whole the pattern provides design and dependability considerations for such service work settings. For example, designers should concern themselves with the separation or interleaving of other work (e.g. paperwork) with the work of dealing with interruptions - what is interruptible, what needs to be separated, should there be a separation of jobs, or by shift or whatever? Furthermore, it raises questions on the utility of rigorous interruption (call) recording procedures and suggests organizations may gain from screening and filtering interruptions. With this pattern we have tried to provide a flavour of what we are trying to achieve - building up a collection of findings where similar phenomena are grouped together, certain issues and problems are highlighted; providing a useful design resource when encountering a novel situation with similar features.

Pattern: " Accounting for an Unseen Artefact "

Our second example is "Accounting for an Unseen Artefact" (figure 5). Here we only provide the front page for reasons of space. This pattern deals with the now fairly familiar set up where an operator interacts with a system while dealing with a customer or client over the phone. Such a set up is routine in call centre work across various service industries as well as control centre work.

The pattern focuses on the 'role' of the system in the interactions between operator and client, considering the ways in which it guides the interaction, how operators communicate aspects of the system, its informational requirements and so forth. It also details how the caller orients to the system and system use. The two vignettes present contrasting cases. The first provides examples where system use is skillfully embedded within the interaction between operator and caller in telephone banking. It is not that difficulties never occur, but rather that operators employ techniques to orient callers to aspects of the system and its required interactional sequencing such that over repeated contacts callers are seen to configure their talk to achieve business smoothly. Here operators reconcile diverse customer perspectives with the required organizational process. This situation is contrasted with Whalen and colleagues (1998) analysis of a call to a 911 emergency line where the operator is seen to orient more to the requirements of the system to the detriment of managing the business of the call - providing a swift

response to a medical emergency. This leads to a tragic outcome as the call is prolonged. By contrasting a dependable socio-technical system with a more problematic arrangement the pattern provokes issues concerning support system design, operator skills and training (e.g. concerning how the system is made accountable (visible and reportable) within interaction) and the need to understand caller characteristics.
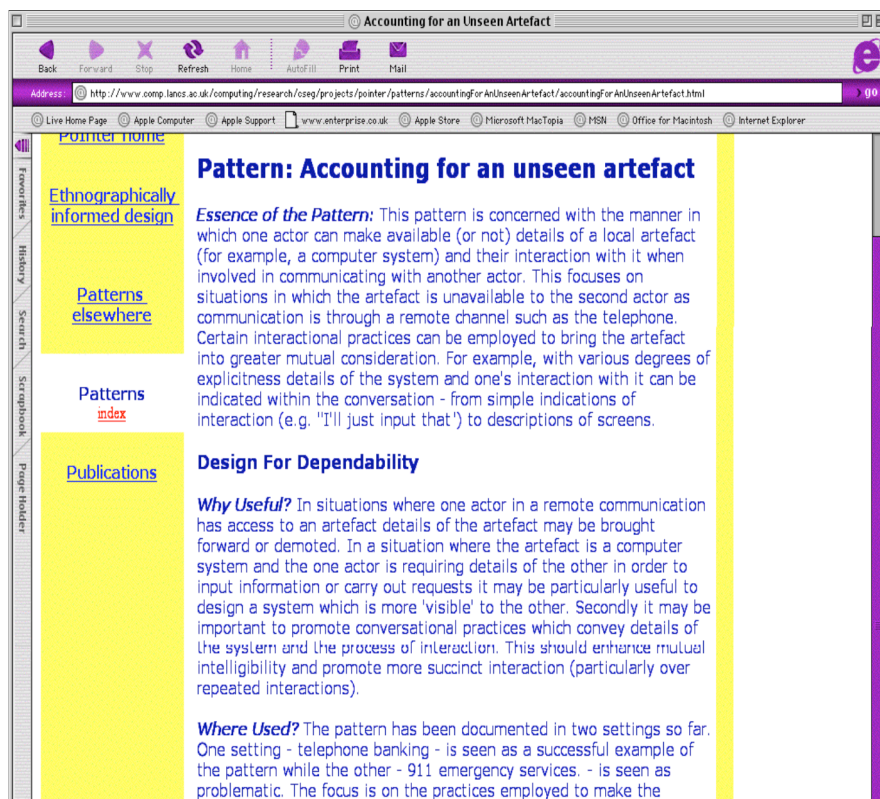

Figure 5. Front page for "Accounting for an unseen artefact"

5. THE PATTERNS COLLECTION: SCENARIOS OF USE

Researchers and practitioners may use our collection of patterns as an aid to understanding socio-technical considerations for dependable design. As such, reading through them should provide a good background understanding of some of the social design issues that arise. In this section, we expand on our remarks about use by providing a scenario to show how patterns might be used in a specific situation of design.

In describing these potential scenarios of use we have envisaged situations where an ethnographer, or socially oriented researcher may not be present. Here, we are thinking more about use by systems designers or requirements engineers. In these cases the patterns, to some extent, serve as a surrogate for not having an ethnographer available to carry out more detailed field studies.

Specific Use: scenarios and reflections

We envisage three possible scenarios of use of the patterns collection for specific design projects by requirements engineers or system designers.

- At the start of a project, the engineer or designer may scan the patterns collection to get an overall impression of what has been important in previous projects and hence what he or she might look out for during the requirements engineering or design process.
- During a project after some observations of work have been made, the engineer or designer may attempt to classify and organize these observations by 'fitting' them to the patterns in the collection. He or she is then prompted by the pattern language for the other relevant information about the situation (the representation of the activity, ecological arrangement, etc) that may be relevant to that situation.
- After a pattern has been discovered and located within the patterns collection, the general pattern information and the vignettes associated with the pattern tell the engineer or designer how the pattern is manifested in other settings and hence provide some clues as to the requirements that might be generated in this case

We will now illustrate the potential for use by engineers and designers with a small scenario that makes use of the *Working with Interruptions* pattern. Consider a situation where we are developing the requirements for a student information system. This system will manage confidential student information, collects information from a range of sources and is used by different users who cooperate synchronously and asynchronously. Many of these users work in public offices and have regular contact with faculty staff and students.

We always recommend that designers visit the setting where the system will be used and let us assume that a short period of observation has shown that interruptions are common. The *Working with Interruptions* pattern is consulted to discover the commonalities with other comparable situations and the questions that should be answered for that specific setting. From the vignettes associated with the pattern, the following questions emerge:

- What is the cooperative arrangement in the setting where the system is used?
- How is the activity represented so that users can 'start where they left off' when an interruption occurs?
- What is the physical arrangement of the office and how does it contribute to supporting the working practice?
- How do different users coordinate their work?
- Who are the users?

The answers to these questions do not generate requirements in themselves but provide an effective starting point for discussions with users and other stakeholders about the system.

Further examination of the patterns reveals that an important issue when dealing with interruptions is often finding the best person to deal with that interruption. This can be difficult when people work in physically separate areas and may generate a system requirement as follows:

- The system shall include a facility that allows users to discover other users who are making use of the system.
- The system shall support a 'query broadcast' facility that allows a user to broadcast a query to all other connected users and to receive responses from them.

While these requirements could be derived by a sensitive analyst, an approach that is simply based on work tasks (that is, the use cases of the system) is likely to miss this type of social requirement that can be identified through the use of patterns.
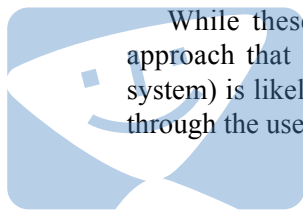
6. PATTERNS FOR DEPENDABILITY

The notion of organizational cultures of safety or dependability is widely recognised. In such organizations, safety or dependability issues are paramount and the everyday work practices have evolved to ensure that safety and dependability issues are given the highest priority. Our patterns are related to organizational culture in a fairly straightforward manner – they represent (partial) instantiations of organizational culture. Patterns of Cooperative Interaction have components that explicitly deal with these issues of system dependability. Since they are concerned with socio-technical configurations and attendant practices, the emphasis is on system dependability in a broad sense, not merely confined to technical system reliability but to the operation of the system as a whole, involving social and technical 'components' and the interactions between these.

The basic contribution of ethnographic research has been to furnish designers with an in-depth understanding of current socio-technical system operation. It highlights problem areas in socio-technical system operation, particularly in the interface between social and technical 'components'. This understanding helps avoid design errors that may come from considering work abstractly or hypothetically. Patterns orient to dependability in a similar fashion but serve as short-cuts, as examples of dependable operations can be compared against others that do not operate so well. Trade-offs in dependability can be examined by comparing and contrasting vignette examples. In this way the patterns are meant to serve as a resource for thinking about dependability issues in design.

Achieving dependability relies on both formal structures and informal working practices that have evolved in response to specific problems or weaknesses in the procedures or technology. Formal structures may be defined processes for cross-checking work, procedures and rules to be followed, sanctions against errors, etc. Informal practices or 'workarounds' are the everyday coping mechanisms that develop to deal with inadequacies or inconsistencies in the formal structures or the workplace technology. Patterns must consider both formal structures and informal practices, related to ensuring dependability and making issues of dependability visible. As part of the patterns project we have added a section 'Dependability Implications' to the front-page overview of each pattern. In this section we pick up on various aspects of the socio-technical configuration and attendant practices and discuss how they impact on dependable system operation, how they promote or inhibit dependability, and how such dependability might be maintained or altered by changes in the socio-technical configuration. Thus, for example, in the case of pattern 2: *Multiple Representations of Information* we state:
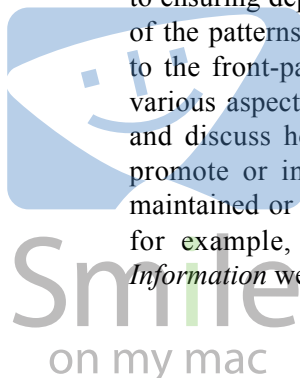
"In a situation, particularly involving a complex, real-time, dynamic task such as handled in a control room it is useful to employ multiple, different, representations of that unfolding task which may be both textual and visual. These can be designed to focus on different aspects of the activity or to present them in different ways.

This provides a resource for managing the different tasks involved in achieving the activity and builds necessary redundancy into the system making it more likely that failures will be spotted early or avoided. When these are made available to a small, collocated group as in the docu-mented settings this allows for the tasks to be solved collaboratively and builds in an extra level of redundancy in the personnel."

Multiple Representations of Information are therefore described as a way to promote collaborative work amongst small groups of personnel in control room type settings. Different views on the same information or problem assist in breaking down complex tasks and facilitate the identification of problems. Items and objects are replicated and can be viewed in different ways – one view may be useful for identifying certain problems while another, other potential failures.

The two specific examples come from control room settings – one from air traffic control (Hughes et al. 1992) and one from ambulance control (Martin et al. 1996). In both settings *Multiple Representations of Information* are presented in such a way as to try and promote dependability. However, in these cases, these (and other measures) do not seem to have been instituted specifically to counteract system failures that have occurred – that personnel, procedures, practices or technology could not be trusted. Rather we have two situations where individual failures can easily take on catastrophic proportions, where the organizational culture that is instantiated is one of high reliability. It is less that the systems are distrusted, more that procedures need to ensure no failures take place, hence the measures designed to provide redundancy, checking, overseeing and so forth.

Pattern 8: *Doing a Walkabout*, illustrates other features of dependability:

"In the consultancy firm doing a walkabout has specific benefits in the achievement of work. For individuals working closely together on a project it facilitates integration of the group, allowing collaboration and the sharing of expertise and knowledge. The small size of the group and the site is important, and notably collaboration with workers at a different site is less and has to be more structured.

In a hospital it is a necessary response to system information that is often not necessarily up to date and accurate for the purposes of the directorate manager. Where possible, design for such activities and collaboration can
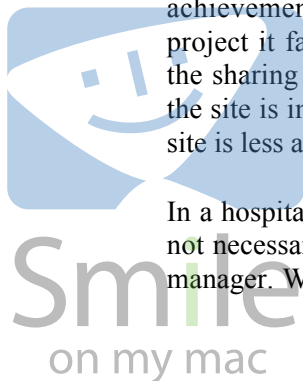
seek to design office layout and group constituency to facilitate such activities. In considering distributed settings one can consider a number of solutions for technical support of the activities of doing a walkabout. Shared access to computer systems that for example, allow access to other's work, local environment and so forth can be thought of as possible solutions, particularly when supported by different communications technologies. For example, the directorate manager is particularly interested in talking to the ward managers in relation to the public artefacts that are the bed boards (indicate bed allocation status) located in each ward.

Another important component is the face-to-face contact with the ward managers. Therefore any solution might seek to make a version of the bed boards available electronically in distributed locations as a shared application. This might be achieved through video snapshots of the wards and videoconferencing technology or by providing an electronic version of the boards along with some kind of audio communication channel."

With the examples contained in the *Multiple Representations of Information* pattern we can see that dependability is high on the agenda for both the organization and the workforce. Trust seems less of a salient issue here apart from the fact that they need to trust the system such that as close to zero failures occur. *Doing a Walkabout* illustrates how these issues play out differently in other situations.

The pattern is illustrated with examples from a consultancy firm and a directorate manager in a hospital. In the consultancy firm example, we note that the activity of doing a walkabout facilitates various types of *ad hoc* collaboration that is fruitful for the achievement of work. The walkabouts do not seem to make the system more dependable or to promote trust (except through personal bonding). We can contrast this with the walkabout of the directorate manager that is occasioned by a situation in which the bed occupancy figures cannot be trusted. The bed occupancy figures that the hospital directorate manager receives every day are known to be 'approximate' or 'inaccurate within certain limits' yet the fact that they cannot be trusted to be accurate is unproblematic unless they reveal a shortage of beds, in which case the manager needs more precise figures to reveal whether there is a 'real' shortage and if so more accurately what this is, where it is and so forth. The walkabout is specifically occasioned for clarification in specific instances.

In the case of pattern 9: *Overlapping Responsibilities* we state:

"Designing a work organization in settings such as this, where workers in tightly inter-linked roles have overlapping responsibilities, attempts to build in dependability to the socio-technical system. For work design this

seeks to promote supervision, redundancy and the ability of the group to respond to various dynamic contingencies within their environment. As with the related pattern, *Career Trajectory through Different Roles*, we may firstly consider how such a work organization design might promote dependability in similar situations. Clearly there may be a concern with designating in which ways responsibilities may overlap, however, the point to note, is that in the situations described here, the demarcation or delineation of these is always an on-going accomplishment. For technical design, the consideration could be one or a number of the following:

Can technology be designed to enhance the monitoring/supervision possibilities created by such work organization? For example, by providing access to other's work, sounding/showing warnings concerning other's tasks.

Can technology be used to provide cooperative opportunities where face-to-face access is not possible? Clearly audio channels already provide links but can we enhance this with other, e.g. CMC technology.

Can technological support be provided for enhancing/facilitating fluidity of roles, group organization, doing two things at once? For example in the naval navigation case, can instruments be accessed remotely and their readings be relayed to the charthouse electronically, allowing easy access to carry out different tasks from one location?

Can technical support be provided to help deal with complexity, ambiguity, failure recovery and so forth that characterises these systems when problems or crises occur, the situations that require more intense cooperation, fluidity of roles and so forth?"

The two studies from which this pattern is drawn are the ambulance control room and a case study of naval navigation (Hutchins, 1991). In both these cases we focus on a workplace design whereby co-workers have responsibilities, job descriptions and skills that overlap. The contention is that such 'formal' organizational design is specifically instituted to promote a more dependable system in safety critical situations.

7. CONCLUSION

"If pattern languages can assist design teams in communicating effectively with their users, noticing connections between activities and artefacts that would have been
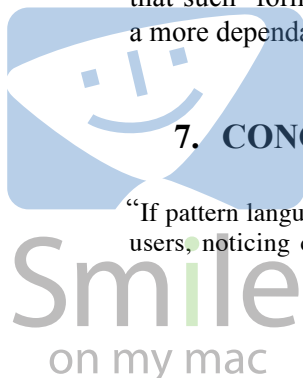
otherwise missed, or simply decrease the time between encountering a workplace and being able to ask useful questions, they will be a boon to design". (Erickson)

In this chapter we have introduced our collection of Patterns of Cooperative Interaction. These Patterns are derived from ethnomethodologically-informed studies of work and technology and focus on extracting comparable socio-technical configurations and the work practices that exist given those configurations.

Design teams faced with all the usual constraints and contingencies of 'real world, real time' design have pragmatic needs. They need information that can be mastered quickly, applied to new situations, and used as a basis for creating a dialogue with their users. We believe that patterns provide some of the information that design teams need if they are to take a socio-technical and not merely a technical perspective on complex systems.

Our patterns are designed for a multidisciplinary design audience, provide concrete instances of socio-technical systems in use and are intended to facilitate communication and generalization across settings. As Erickson notes, the modularization of workplace knowledge instantiated in patterns, makes it easier to apply to new domains. They serve as a resource for analysis and design that focus on social aspects of design. They can act as intermediary tools for a variety of practitioners to bridge the gap between 'rich descriptions' of current work practice and the design considerations that may arise from them. We have provided a number of examples that seek to demonstrate how these descriptive Patterns may be used in a generative fashion – to think about various design considerations in new settings and how they may be used to generate considerations for dependable design.

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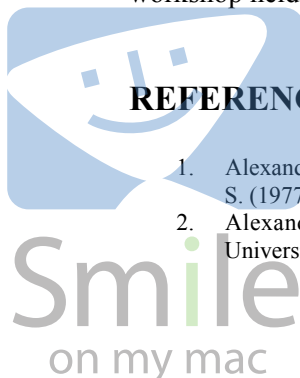
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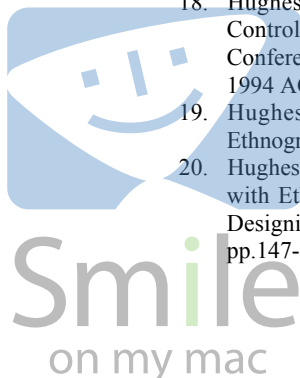
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[16] Now that our collection is of a reasonable size we are keen for our resource to be more widely used and contributed to. As part of this we have cloned the main website onto wiki web pages http://polo.lancs.ac.uk/patterns)