Experience in Building a Cooperative Distributed Organization: Lessons for Cooperative Buildings[T]

Geraldine Fitzpatrick[2], Simon Kaplan[1,2] and Sara Parsowith[1]

[1]CRC for Distributed Systems Technology (DSTC)
[2]Department of Computer Science and Electrical Engineering
The University of Queensland
St Lucia 4072, Australia
Email: s.kaplan@dstc.edu.au
http://www.dstc.edu.au/wOrlds/

Abstract. This paper discusses a three-year experiment to build a distributed research group, equipped with state-of-the-art computing facilities, spread over three cities in Australia. Despite the provision of the sorts of facilities to be expected in cooperative buildings, such as high-speed networks and videoconferencing, significant synergy (i.e., closely-coupled collaborations) among the distributed subgroups did not develop. This was not only due to the problems of distance, but was exacerbated by several political and organizational issues. An important lesson is that successful 'cooperative buildings' will depend not just on the technology but also on an appropriate managerial, organizational and political climate in which these resources can be meaningfully exploited. The paper outlines the experiment, discusses why synergies did not emerge, and points to implications for cooperative buildings and design paradigms based on the notion of pattern languages.

Keywords: cooperative buildings, locales framework, social worlds, cooperative work, distributed workgroups, serendiptious interactions, organisational structure, patterns

1 Introduction

The development of 'cooperative buildings' will afford new possibilities for people to work and play together at a distance. These affordances will be based around computing, networking and advanced user interfaces. Examples of such advances include:

[T] This work has been supported by the US Defense Advanced Research Projects Agency (DARPA) under grants F30603-94-C-0161 and F30602-96-2-0264 administered by the US Air Force, and by the Cooperative Research Centres Program through the Department of the Prime Minister and Cabinet of the Commonwealth Government of Australia. The views and conclusions expressed in this document are those of the authors and should not be interpreted as representing the official policies, expressed or implied, of the Defense Advanced Research Projects Agency or the U.S. Government. We would like to thank the members of IEU for their openness, assistance and friendship during the course of this study.

In Streitz, N., et al. (Eds.), Cooperative Buildings - Integrating Information, Organization, and Architecture. Proceedings of the First International Workshop on Cooperative Buildings (CoBuild'98) February 25-26, 1998, Darmstadt, Germany. Lecture Notes in Computer Science 1370. Springer: Heidelberg, 1998, pp. 66-79

- Members of a distributed design group work together to evolve the design of a complex artifact, using a combination of physical and virtual media;
- Grandparents talk and play with their grandchild from their house half a continent away;
- A manager moves from room to room talking to members of his group. The building tracks his location using signals from his mobile phone. His computer workspace is continually ready-at-hand;
- Joe notices Bill in his San Diego office, 'leans over' from Sydney and initiates a discussion.

Traditionally, buildings housed groups of some kind – organization, division, firm, family, department. In the examples outlined above, the notion of 'group', 'organization', 'family' being housed within a single building falls down. In future a distributed group spread around a network of smart, cooperative buildings might well come to see themselves as being in 'the same' location[1]. Although the buildings and groups are physically distributed, the practical impact of the affordances built into the cooperative buildings will be to break down or eliminate the barriers of distance[2].

We believe that the very notion of cooperative buildings must co-evolve with learning to take advantage of new affordances. It is possible, for example, to conceive of a cooperative building *not* as physically bounded by the external skin of a physical building, but rather as a virtual entity that could potentially span (parts of) several, widely distributed physical buildings.

But it is unlikely that technology alone will bring about this change. In 1994 an experiment began in Australia to build a distributed, but integrated semi-commercial research group, the Internet Exploration Unit. This group spans three cities, groups and sites from two different organizations, and shares a common purpose, viz. investigating how to deal with resources (particularly information) on an internet-wide scale. The groups had access to advanced computing resources, many of which are of the type we might expect in cooperative buildings, such as high-speed networks, video-conferencing and a range of computing hardware. However, three years later we can clearly see that closely-coupled inter-group synergies did not develop, although there was some degree of black-box sharing of prototypes.

We believe there are some interesting lessons from this case for the emerging cooperative building community. In essence they underline the importance of organizational, political and sociological factors in the success of distributed workgroups – factors that are well-known from the CSCW community (Grudin, 1988)– and point to the need to consider the application of technological advances in the context of their use. We contend that technology alone won't make smart buildings work – it is the creation of the appropriate organizational and sociological context within which to deploy these technologies that will make the difference.

---

[1] Or adjoining locations… notions of 'the same place', 'adjoining place', etc., will change radically.

[2] There is another way of thinking about cooperative buildings that need not have anything to do with distributed groups – rather they have to do with the notion of having the virtual artifacts and media needed for work 'ready-at-hand' through ubiquitous, embedded computing systems and interfaces. This kind of use should be taken as implied when reading this paper.

To discuss this case study and its implications for cooperative buildings, the paper is structured as follows. Section 2 introduces some analytical preliminaries, while Section 3 tells the tale of our case study. Section 4 then draws some implications for the design of cooperative buildings and points to possible design paradigms, based on Alexander's notions of pattern and pattern language (Alexander, 1977).

2 Analytical Preliminaries – Social Worlds and Locales

Before discussing the study itself, we first introduce the Locales Framework used in its analysis. The Locales Framework (Fitzpatrick, Kaplan et al., 1996) evolved to address the problem of how to account for complex dynamic domains of work, both physical and virtual, and the design of cooperative systems to support/augment work in such domains. The framework is based on three key notions. The first is that actions and interactions are continually evolving; the emergent situated nature of work is therefore a central premise. The second is that social worlds are the prime structuring mechanism for interaction. A social world is a group of people who share a commitment to collective action, bounded by the limits of effective communication. These first two notions are drawn from Strauss (Strauss, 1993). The third notion is that people creatively use and evolve any available features of a domain to get their work done. There are currently five high-level aspects to the Locales Framework. While presented as if distinct, they are in fact highly interdependent and overlapping, each providing a different perspective into the life of a social world. They should be used by the designer as a sensitizing, rather than prescriptive, analytic device. The five aspects are:

Locale foundations: There are two components of locale foundations. The first is to identify the social world of interest and its associated members, rules, roles, conventions, group processes etc. The second is to identify the locales or places the members use to get their work done. This includes the inherent features of the domain, and the relevant artifacts, tools, resources, work objects, etc. (Cooperative buildings can be seen as providing the places and resources for social worlds.)

Civic structures: Civic structures looks to understand the social world of interest and its locale in a global context. Hence it is about identifying other related social worlds and locales, and understanding the relationships, interactions and influences among them. For example, this is where external influences such as organizational, legislative, professional, political etc., can be considered, as well as the issue of how social worlds emerge and dissolve.

Individual views: This aspect accounts for the fact that groups are made up of a heterogeneous collection of individuals. Each individual will likely have their own view of the group locale based on their current level of interest or involvement. Further, each individual will probably belong to multiple social worlds and work on many different tasks at once, with varying and shifting degrees of intensity. They are likely to maintain an idiosyncratic view across some collection of locales, dynamically negotiating varying levels of focus and participation.

Interaction trajectory: Trajectory looks at all the temporal aspects - past, dynamically emergent present, and imagined future, the rhythms and cycles, etc., - of

the group's locale and its associated people and entities. In understanding the social world and its members in action, we hope to understand how the locale of work and civic structures enable and constrain the moment-by-moment doing of work.

Mutuality: Mutuality draws explicit attention to the possibilities for, and actualization of, presence and awareness in a locale for the purposes of maintaining a sense of shared place and action. Awareness refers to the information about any entity, person or object that another entity chooses to focus upon. For example, can you see who is working on a task? What they are doing? What is the current state? With what degree of granularity? Presence is the reciprocal of awareness and concerns the aggregation of personal information (identity, functional and interactional possibilities, current activity etc.) that an entity makes available to the shared place of work.

3 Our Experiment: The IEU Social World

As we indicated previously, the Interaction Exploration Unit (IEU – all proper and organizational names are pseudonyms) was set up as a joint project over three sites, with two major organizations involved. Several technological affordances were put in place to support interaction among the members of the two groups, videoconferencing, and a high-speed ATM network was also promised. However, these groups did not form a synergistic whole, although each of the groups independently was both productive and successful. To understand why, we begin by employing a social worlds-based description of the IEU and its activities.

Our groups of concern are Tony, Mike and Zak from Future Generation Systems Centre (FGSC) and Adam, Scott, Gail and Rita from the Scientific Research Group (SRG). Tony is the nominal project leader, while day-to-day leadership of the group is split between Tony in Brisbane from FGSC and Adam in Melbourne from SRG.

We focus on a nine-month period starting about 2.5 years into the life of the IEU. Visible and successful collaboration among the teams and team members was seen as critical and the team members felt under pressure to improve their collaborations after an unofficial management directive. Until this time, in effect the major strand holding the two groups together were funding and reporting requirements, together with a loose shared interest in common research issues. We started a qualitative study of this group because we are interested in CSCW in action, knew this group had significant technological affordances at their disposal, and were interested to see how, and what kinds of, collaborations emerged.

3.1 IEU Civic Structures

Several other social worlds have an impact on or interest in the operation and success of the IEU. Examples include the organizations that contribute resources (funding, equipment and additional seconded staff) to the project, the standards bodies to whom IEU members Tony and Zak contribute, and other social worlds within FGSC and SRG. For example FGSC runs a major research integration project, and this depends in part on IEU producing leading-edge tools, concepts and systems that they can use in their integration effort. Furthermore the peer communities of other researchers who

meet at scientific meetings and overlap with IEU membership also form social worlds that may have some influence on, interest in, or relationship with IEU. The civic structures identified here ultimately played a significant role in fostering certain collaborations and discouraging others.

3.2 IEU Locales and their Resources

The FGSC and SRG personnel of IEU are physically distributed across three cities spanning approximately sixteen hundred kilometers across Australia. Space at the FGSC is at a premium. Zak, Mike and a visitor share one office, while Tony and other visitors share the other room. Each person's space consists of a desk, workstation, bookshelf, notice board and telephone. There are also shared white-board and shared bookshelves. In the SRG office in Melbourne, Adam and Gail have adjacent office spaces separated by partitions. Scott has his own closed office on the other side of the floor. Rita works on her own in Sydney, roughly halfway between Melbourne and Brisbane.

Their shared virtual locales both within and across sites consist of a number of different technologies. Each full-time person has access to email and postal mail as well as the telephone. A range of group information is available via WWW pages, which Tony is diligent in maintaining. All three sites have dedicated video-conferencing machines. These are in Zak and Mike's room at FGSC, and in a separate meeting room at both SRG sites. Obviously, when all the members gather for a workshop, the workshop location becomes a shared physical locale for the duration of the gathering. The Internet, which provided email, web and other facilities, ran to each member's desktop. Unfortunately, the installation of the ATM network was greatly delayed by factors outside the control the IEU, FGSC or SRG, and was never realised.

It became evident that the physical separation of work locales had a significant impact on mutual availability. This in turn hindered the emergence of new collaborations and is in contrast to physical co-location or close-location; being temporally and spatially close-by means that people have easier access to the conversations and activities of others should they choose to.

3.3 Summary Observations of the IEU Trajectory

As it happened, no strategic cross-group collaboration came about during the nine-month course of the study. More interestingly, though, the FGSC members of IEU became involved in a significant collaboration with people from other FGSC units during this same time period, a collaboration of the type that was desired between FGSC and SRG. We will return to this later. However there were numerous instances of other smaller scale collaborations both between and within IEU sub-groups.

As a group, significant effort was expended to try to facilitate closer collaboration between the FGSC and SRG members of IEU. Prior to the directive being given, cross-site collaboration mainly involved Tony and Adam. Although all members of the group had access to telephone and fax, direct and group email, and the WWW as a repository of shared group information and shared tool access, they rarely used them. After the directive, Tony and Adam established a weekly group videoconference between Melbourne and Brisbane, and a fortnightly session between Brisbane and Sydney, so that people could become more familiar with each other's work.

After some months of this, they also held a 2-day workshop to develop a coherent research strategy for the next twelve months. While the workshop did result in a shared vision of an abstract system architecture, it failed to identify clear points of collaboration between individual projects. The researchers returned to their separate work sites and continued working on their own projects. The workshop did, however, lay the foundations for exploiting future collaborative opportunities and for members moving their work in line with the architecture.

3.4 A Potential Collaboration

Two months later, a promising opportunity was identified during one of Tony's visits to the Melbourne site. He was explaining to the group at SRG what Mike was planning to do back at FGSC in the next work period when Adam realized that he was essentially working on the same issue from a different angle. Adam had already known from the videoconferences that Mike was looking at this particular issue but had never understood why.

Over the next few months there were various contacts between Mike and Adam to explore their common interests. This primarily consisted of discussing and documenting a common abstract model of the problem domain. Adam wrote a draft document explaining his ideas. Through email, Mike made constructive comments on the model. Adam would then revise the model, and more email discussion would follow. Occasionally they talked by phone. If they had been able to complete the work, Adam wanted to institute a system of regular phone calls. Mike however preferred email for more technical discussions because he felt he was able to contribute more after having time to reflect on his responses rather than give off-the-cuff responses on the phone. However a promising opportunity was lost when SRG management abruptly moved Adam away from IEU to another (competing) SRG project.

3.5 Collaboration in Practice

While collaborations at the scale or level of strategic importance wanted by management did not emerge, or failed to progress when they did emerge, there were many other instances of ways in which members of IEU worked together on smaller, short-term or less-strategic scales. The following vignettes give a flavor:

Co-Management, cross-sites, assigned: Tony and Adam worked closely together especially for the major reporting and strategic planning activities required of the unit. They tried to phone each other twice a week at pre-set times, co-authored documents using the web as a shared document repository, and acted as the conduits for much of the information passed on to the rest of their on-site colleagues.

Paper co-authoring, cross-sites, emergent: Rita and Gail, both SRG employees but in different cities, worked together to write a conference paper, and Gail installed Rita's prototype tool. They recognized a potential overlap of interests when they had an opportunity to talk face-to-face at the workshop. At Gail's instigation they wrote a paper exploring these ideas, having decided on a structure and allocated sections to write. Though the paper was subsequently rejected, they gained a much deeper understanding of each other's work and Gail later started to integrate Rita's prototype with her own. However, their work together was stalled when both were given non-IEU work by their SRG management.

Working together on a shared project, same room, mix of assigned/emergent: Zak and Mike, sharing the same room, worked closely together on a particular project. In the early stages and whenever technical details had to be worked out, they would use the white-board between their desks. They also used the white-board to write up the project goals and task allocations. When the work was settled enough to be divided into parts, their interactions tended to be around larger granularities of work, such as the review of a draft document. Occasionally they used email for project issues. Now that they are working on separate projects, they no longer use the white-board for shared work-related notes and both keep their own private to-do lists.

One develops, another uses, cross-site, assigned: Scott developed a tool in Melbourne and Mike was asked to install it in Brisbane so that FGSC staff could test it. Mike ran into lots of problems while trying to install the tool and, after various attempts, gave up as he found the task too difficult. He moved on to other projects and the prototype remained uninstalled, particularly as it was critical to no-one's work in Brisbane. However, towards the end of the study a new IEU employee needed Scott's prototype for a new contract and, with remote help from Scott, eventually managed to get it installed. This was typical of successful cross-group collaboration: interaction at the interface of prototypes rather than communal work on a shared problem.

3.6 Romany: An Emergent Collaboration that Worked

An interesting contrast to the above study is an emergent cross-unit collaboration within FGSC called Romany, which evolved over the same period in which the FGSC and SRG members were supposed to be finding ways to work together more closely. Rather than being imposed or suggested by management, Romany grew up as a grass-roots initiative involving people from IEU and two other units of FGSC. A lecturer with West University, a partner of FGSC, and his researcher Susan were both associated with another FGSC unit, but worked in a separate building to FGSC on the same campus. They had taken on a masters student to investigate a particular research project. For some time previously, Zak from IEU had also been thinking of a distributed object approach to a related problem.

It was only after Susan mentioned the Masters thesis to researchers at IEU/FGSC during an informal visit that Zak and Susan started to talk together and evolve a more generalized definition of the problem and its potential solution than both of their original positions. Around the same time there was also a growing awareness in the larger international research community of the potential roles for the kinds of systems FGSC constructs. Susan posted a description of their approach to an international mailing list, and was inundated with expressions of interest. Not long after, Susan, Zak and some other members of IEU attended a workshop at which many of the same people from the mailing list were present. They spent a lot of time talking to people and, given the level of interest, the Romany project to implement their ideas was born.

At FGSC, Zak is the person nominally designated as working on this problem. In practice many other researchers from several units of the FGSC actively work with him. They have established their own internal mailing list which also includes many others at FGSC interested in the problem but only able to make a sporadic contributions to the work because other constraints. After some period of discussion, the core

group gathered together for a one-day internal workshop to scope the work. Some of the peripheral members were also able to drop in for short periods.

Following on from the workshop, a draft document was written. The ideas continued to evolve at regular face-to-face meetings. After each meeting, as summary was posted to the Romany web site, forming the basis for the following period's work and discussions at the next meeting. Zak anticipates that they will release a stable document once some revisions are complete. This should stimulate a further round of discussions with the international community, as well as prototype products and standards contributions, all of which are highly valued outcomes at FGSC.

3.7 Discussion

Why was the Romany initiative so successful when IEU attempts to create collaboration were comparatively less so? We briefly summarize some explanations here:

Grass roots evolution. The Romany initiative grew up in a grass-roots way on the part of the researchers. Although they had complementary interests, they found common ground and ways to support each other. The IEU collaboration was imposed top-down, existed in a competitive environment (between SRG and FGSC, and between researchers), and although the researchers shared common general aims it was hard to form and sustain networks of dependence among the members of the group.

Defined goals. The Romany group had fairly well defined, shared, short-term goals which evolved over time. IEU had shared interests but goals were individual, and substantial articulation work to try encouraging the emergence of shared goals was generally unsuccessful.

Organizational support & culture. FGSC members involved in Romany received active support from their management, in terms of diversion of resources to the project. This is in line with the culture at FGSC that encourages synergistic, relatively stable research groups. SRG, on the other hand, encouraged more individual research with highly opportunistic redirection of staff from project to project to meet their own commercial goals. A source of many of Tony's management problems within IEU arose from the conflicting organizational and political cultures in FGSC and SRG, especially in the interpretation of their relative commitments to group outcomes as defined by the major funding body.

Personal motivation. Romany involvement was personally motivated, whereas IEU involvement was directed from the top. SRG employees are permanent government employees, so their jobs are secure, whereas FGSC employees are all employed on 'soft money'. Ironically this seems to encourage the FGSC and its researchers to take a focused, longer-term view whereas the SRG researchers tend to have a more individualistic shorter-term view. This dissonance in motivation was another source of conflict within IEU.

Long lead-time. Romany germinated over several years in Zak and Susan's minds before more direct discussions led to it becoming a coherent project. The corporate activities of FGSC encouraged this evolution. The effective collaborative activities of IEU also took a long time to emerge. In this kind of research environment, forcing collaboration is problematic.

Stable core membership. The membership of FGSC is fairly stable, while SRG management moved staff around and reassigned researchers in response to short-term

contingencies. Lack of continuity of social world membership discouraged the growth of research programs in any case, and the effects of distance exacerbated this.

Understanding the details. The close physical location of the Romany researchers encouraged the discussion of the rationale and details of work from which opportunities for collaboration were recognized. Several smaller collaborations also emerged from the workshop because of a similar understanding of details. However, the interactions between IEU sites, e.g., via email and formal video-conferencing sessions tended to encourage only high-level overviews.

Key advances face to face. While they used a variety of media for communication, key advances in the evolution of Romany were made via serendipitous or easily arranged face-to-face interactions. Similar patterns were also found in the IEU collaborations that were co-located. However, face-to-face encounters rarely occurred between the remote IEU projects.

Technological support. For the Romany group, technology was used to support physical interactions in a secondary capacity, using phones, email and the web. The case is similar for the co-located members of IEU. For the distributed members of IEU, technology was their primary source of interaction. This imposed restrictions on the styles of interactions that were possible between sites. It also imposed dissonances that were difficult to overcome, such as differences in the ways that the technology was used, either by personal preference or other constraints.

4 Implications for Cooperative Buildings

We turn now to drawing some implications from our study. We focus first on how *space* and *culture* shaped the IEU and Romany projects, and generalise from there to organisational implications more generally. This leads to a discussion of how we might conceive of designing cooperative buildings in the future.

4.1 Drawing out the lessons of the study

The major lessons of the study are that, while Romany – from a research perspective – 'worked', IEU didn't. By 'worked' here we mean that spontaneous, meaningful collaboration grew up among the individual researchers, and blossomed. We believe that Romany worked for a number of organisational and spatial (building-related) reasons, and that IEU failed for the same reasons. In our minds the two projects are almost flip sides of the same coin when viewed from this perspective.

There are several fundamental reasons why Romany succeeded: The organisational culture encouraged the organic growth of new projects; the spatial arrangements of the participants facilitated their interaction; communication media afforded rich and varied styles of interaction; and there was the right mix of complementary research interests. Romany started almost entirely serendipitously, from chance meetings in hallways and coffee-room discussions. The proximity of the West Uni researchers, and the physical layout of FSGC headquarters in Brisbane, with its tightly-packed, intimate rooms, close location of different groups, and shared kitchen/coffee spaces,

created a climate where this kind of interaction could flourish. Various levels of involvement were also encouraged because of the ease of 'dropping in'.

IEU, on the other hand, while experiencing similar phenomena locally within the sub-group based within FGSC in Brisbane, did not experience the same kind of growth of new, exciting, 'bottom-up' projects that spanned sites. The same reasons apply, but in reverse. This time, there were significant organisational barriers, imposed by problems between FGSC and SRG. There were differences in culture between FSGC and SRG – FSGC encouraged close, team-type research projects, SRG's culture discouraged such exercises. Spatially, FSGC researchers are packed together encouraging interaction, SRG's IEU researchers are isolated in individual. The virtual media employed – formal videoconference meetings, email – were insufficient to overcome the lack of other means for serendipitous and informal interaction such as coffee-room encounters. Interestingly enough, when IEU did establish a face-to-face environment, during their workshops, there were signs that this situation might improve, but organisational barriers prevented effective follow-through.

What has this to do with cooperative buildings? There are two ways to consider cooperative buildings – as a work environment enhanced with improved affordances for local work – this is the advanced war-room or trading-room model – or as a family of affordances built into the building to help overcome the negative effects of distance. A cooperative building could, of course, do both. Clearly it is the latter that has our focus in this paper. The point for cooperative buildings is to support richness and variety in social interactions. In particular, serendipity, informality, and easy availability to one another have a critical part to play in stimulating interaction among users of a building.

4.2 Services and Space in Cooperative Buildings

Winston Churchill once said "There is no doubt whatever about the influence of architecture and structure upon human character and action. We make our buildings and afterwards they make us. They regulate the course of our lives" (cited Brand, 1995). Our study brings out how Romany evolved because of the physical and organisational 'shape' of the FSGC, and how IEU failed to achieve long-distance collaboration because of failures of organisational shape, and the absence of meaningful substitutes for the lack of physical shape. It is the latter problem that we could have expected a cooperative building to overcome.

Of particular importance to us are the ways in which buildings provide services, and the ways in which the spatial layout of a building helps shape organisational interaction. The latter helps foster informal, serendipitous interaction, ambient awareness of what 'the other users in your space are doing', and so on, while the former is crucial to the development of cooperative buildings.

For example, the FGSC space is well-equipped with almost-ubiquitous power and network points, and a well-designed networking infrastructure, making services freely available wherever needed. Space is, as we have noted, at a premium, so groups tend to be crammed into very tight quarters which creates an intimate environment well-matched to an organizational culture encouraging experimentation. Interestingly, when a new service was added – ISDN for the videoconferencing – only one service point was installed in one of the IEU offices. The resulting lack of flexibility, com-

pounded by the general lack of space at the FGSC, made using the videoconferencing system for anything but occasional formal meetings impossible.

Cooperative buildings have the potential to radically alter the ways in which services and space interact and support organisations. Indeed, Brand (Brand, 1995) points to ways in which this is already happening, as advances of computer and networking technology require that buildings need complete rewiring for communications every few years. Cooperative buildings change the nature of services quite directly. They require the introduction of new services – such as large-wall displays, active-badge networks, stations and cells for wireless networks, more power points, more data points, increased wiring in conference and meeting rooms as well as open-plan and individual office spaces. They change the consequences of the evolution of services. For example, a large-wall display surface is a new kind of service, but using it changes the nature of the space into which it projects – interactions between changes to services and changes to space become enmeshed.

Cooperative buildings warp the nature of space. If one wall of my office is a large-screen display, permanently videoconferenced to your office across the continent, to a large extent these two rooms 'become the same space' (Dourish and Bly, 1992). There are a myriad of implications of this – limitations of space, structure and site can be overcome by enhancing the services properly, management can extend their organizational reach, groups can form and re-form more easily, with less spatial reorientation. But this assumes a level of sophistication in the services well beyond what is possible at the moment. Our studies – and common sense – point to the continued need for co-location, at least for some periods of time, as an essential element of intimate interaction.

4.3 Designing from the Sociology to the Structure: Applications of Pattern Languages

However, by far the biggest implication of our study is the *overriding importance of social and political factors*. This implies that we should conceive of cooperative buildings from the needs of the buildings' occupants. In a well-designed building, the needs of the users initially shape the space appropriately. Over time, as Churchill pointed out, the space then reshapes the users. In a cooperative building, even in their current nascent form (regular buildings with networks), we should rephrase this as: In a well-designed building, the needs of the users initially shape the space and services appropriately.

One possible way to design from this perspective is to look to design techniques that treat social issues and needs equally with structural and construction needs in building. We contend that the Locales Framework can give us a way of deconstructing and understanding the structure and dynamics of organisations and groups, thereby providing us with a powerful tool for identification of critical issues and problems. To carry this through to design, we believe it would be hugely profitable to draw on Alexander's work on patterns and pattern languages.

Alexander developed the notion that any building is constructed from a collection of *patterns*. These can be thought of as idioms of design and construction that capture the essence of a certain aspect of, e.g., a room, building, street or neighborhood. Individual patterns can be combined to form *pattern languages* that can in principle be

used generatively as a formative part of the design and construction process (Alexander, Silverstein et al., 1975; Alexander, Ishikawa et al., 1977; Alexander, 1979).

A pattern is *a solution to a problem in a context*. Grounded in practical experience, a pattern should articulate a problem, a context in which that problem arises, and a solution in that context. One of Alexander's famous patterns concerns *Alcoves*. The problem here is that, while family members like to interact together and be close, they also like privacy and need space for individual activities. The solution is to design communal living space so that it contains a collection of alcoves, which can be used by family members for private activities while not withdrawing completely from family activities. Note that the pattern captures the essence of a design idea but does not prescriptively indicate *how* to realize it (although suggestions or example can be offered as part of the pattern) – patterns should be used interpretively. Note also that the captured essence is to do with a social phenomenon and possible solutions through arrangement of space and services that ease the burden, not directly with physical layout. This is typical of almost all of Alexander's patterns.

The concept of pattern languages has also been applied to other domains, for example, organisational structure and dynamics (Coplien, 1995). Coplien's pattern language identifies ways of ensuring that software development organisations work as seamlessly as possible. One of Coplien's famous patterns – Conway's Law – points to problems with communications breakdowns in software development organisations whose organisational structure and product architecture are not well-aligned, and suggests ways of reorganising to reduce these impedances. Again, note how an organisational, social problem, is the issue, and the pattern identifies ways of reshaping to overcome the problem.

Recall that a pattern is a solution to a problem in a context. We suggest (and studying Coplien and Alexander bears this out) that the 'problems' are almost invariably social or interactional. Further, we believe that the problems identified in these pattern languages are *invariant*. Changing from physical to virtual space, introducing new technologies, or any of the other technological affordances of cooperative buildings *will not change these problems or make them go away*. What might change is the solutions. For example, Alexander's solutions are almost all cast in terms of ways of conceiving of structuring space, Coplien's in terms of structuring organisations. It's possible that, as we move to cooperative buildings with richer services, some of the solutions will change, but the problems never will. For example, several of Coplien's patterns suggest physical relocation of groups to improve communication and remove problems; in a cooperative buildings universe, other solutions to do with changing communications services might solve these problems equally well.

We believe that a synthesis and reinterpretation of these different pattern languages can lead to a powerful, abstract model capturing the essence of the critical issues in the design of cooperative buildings in the future. As pattern languages are of necessity based in experience, this is a hypothesis that we will attempt to prove in the next several years.

5 Conclusions

Although blessed with a substantial nugget of advanced communications and collaboration technologies, the IEU failed to build a meaningful, synergistic, distributed group structure, degenerating instead into several smaller, independent units. The reasons for this are mostly organizational and political rather than a reflection of failures of the technologies alone. We believe there are salutary lessons in this for the cooperative buildings community. No one will ever use a co-operative building for its own sake. Rather, advanced constructions of this kind will be taken up because they afford significant advantages to their user communities. It behooves us to ensure that we take serious account of how we facilitate this along with the evolution of the buildings themselves. The question of how to design cooperative buildings to do this remains an open one. However we suggest that the kinds of approaches and sensitivities to social and interactional issues as driving forces that Alexander pioneered in his work on pattern languages and design processes are the basis for a fruitful beginning.

6 References

1. Alexander, C.: *The Timeless Way of Building*. Oxford University Press, New York (1979)
2. Alexander, C., Ishikawa, S., Silverstein, M., Jacobson, M., Fiksdahl-King, I. and and Angel, S.: *A Pattern Language - Towns, Buildings, Construction*. Oxford University Press, New York (1977)
3. Alexander, C., Silverstein, M., Angel, S., Ishikawia, S. and and Abrams, D.: *The Oregon Experiment*. Oxford University Press, New York (1975)
4. Brand, S.: *How Buildings Learn: What Happens After They're Built*. Penguin, New York (1995)
5. Coplien, J. O.: A Generative Development-Process Pattern Language. In: *Pattern Languages of Program Design*. J. O. Coplien and D. C. Schmidt (Eds.). Addison-Wesley Publishing Company, New York (1995) 183-237
6. Dourish, P. and Bly, S.: Portholes: Supported awareness in a distributed work group. In: *ACM Proceedings of CHI'92*, ACM Press, (1992) 541-547
7. Fitzpatrick, G., Kaplan, S. M. and Mansfield, T.: Physical spaces, virtual places and social worlds: A study of work in the virtual. In: *CSCW'96*, Boston, MA. ACM, (1996) 334-343
8. Grudin, J.: Why CSCW Applications Fail: Problems in the Design and Evaluation of Organizational Interfaces. In: *ACM Proceedings of the Conference on Computer Supported Cooperative Work*, Portland, OR. ACM Press, (1988) 85-93
9. Strauss, A.: *Continual Permutations of Action*. Aldine de Gruyter, New York (1993)