Chapter 1
Connecting art and technology: background considerations

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One of the key concerns of the eSCAPE Project is the exploration of the relationship between art and the design of virtual spaces. One rationale underlying this motivation is that both endeavours - artistic production and the design of virtual spaces - are not necessarily bound by 'normal' conceptions and perceptions of spatiality and representation.[1] In the case of artistic production, the conventions of production can depart from, even violate, 'normal' conceptions of spatiality and representation and, indeed, very often this is their point. In the case of virtual spaces the affordances offered by the electronic medium means that, to a significant degree, the ordinary constraints of space – and time – can be transcended. However, this is to state a set of problems rather than offer a solution.

The bringing together of these artistic traditions with both technological development and the understanding of the social represents in itself a major methodological challenge. In this chapter we will set out some of the background considerations which bear upon the connection between art and technology and how they have been worked through in the eSCAPE Project. In significant respects it is a retrospective document reflecting upon work of the project to date.[2] In particular, it will set the scene for the more substantive considerations that entered into the design of the electronic landscapes which are discussed in Deliverables 4.1 and 4.2 and the construction of the technologies reported in D5.1.

[1] Of course, it is a moot point as to just what 'normal' conceptions of spatiality and representation might be given that these are, to a degree, culturally and historically variable. However, this does not detract from the point being made. See Ihde (1990) for a Phenomenological approach to the ways in which 'normal' conceptions and perceptions have been mediated by scientific knowledge.

[2] This chapter draws on the working paper Hughes, Crabtree and Murray (1999).

To begin the discussion we will review some general considerations relevant to the evaluation of artistic productions for system design.

General considerations

One of the problems of characterising the relationship between art and the design of technologies is that, typically, the question is posed as a general and highly abstract one rather than one to consider in an everyday practical sense. This is often conveyed by capitalising **A**rt and **T**echnology so inviting us to address the issue as a deep and fundamental one about profound and sublime matters. It also suggests that what we are seeking is a single answer, a truth, which would express *the* relationship between these two domains. While having a role to play in developing an understanding of Art and Technology we would argue that this construction of the problem fails to meet the need of those involved in the construction of new electronic landscapes. Essentially, in our experience we have found this way of posing the issue unhelpful for the purposes of design and in the rest of this section we wish to consider some of the reasons for this view.

Some concerns about general formulations

The general concerns about considering the relation between Art and Technology as a theoretical issue is a broader worry about the problematic nature of general formulations in the everyday practical work of design. However, the problem of generalisation here is even more acute as the general formulation of the relationship presupposes that Art and Technology each denote, relatively unproblematically, homogeneous domains. However, while it is always possible to formulate some general characterisation of what the various arts have in common - just as it is always possible to formulate some general description of ‘work’, ‘leisure’, ‘democracy’, etc. - this will leave open for further consideration and deliberation ‘just what’ the general characterisation amounts to in connection with specific kinds of artistic productions. The general formulation presupposes that, despite their variety and multitude of definitions, ‘the arts’ have some common quality or property which makes them what they are and not, say, scientific endeavours, sports, or even technological endeavours.

There are further considerations immediately relevant to this point. Our complaint against general concepts and characterisations such as this is not against general concepts as such. After all, in ordinary language we sensibly use them. However, their sense is contextually furnished in that what we say, the sense of what the meaning is, depends upon the *occasions of use*. For example, ‘British’ can be construed as a general category but the specific sense of what it might mean depends upon the circumstances in which the term is uttered. It might mean one thing if a passport is being applied for, another if responding to a

query as to where one is from, and yet another if discussing political devolution.[1] This is not to say that the different uses are unconnected; it is to suggest that the connections between them are, in Wittgenstein's terms (Wittgenstein, 1958), more of a 'family resemblance' than due to any common property from which the term gets its meaning. By this he means that the sense of general terms within ordinary language derives from the many interconnections that may be found in much the same way that the members of a family may show various similarities with other members. A nose may look like a mother's, while the ears look more like those of the father, hair colour shared by cousins, and so on, rather than any one all-encompassing alikeness.

Once again, we need to reaffirm that the point we are making here is not one against the use of general formulations but, rather, to recognise that their sense, their import, is contextually furnished and that when we ask such general concepts to perform analytic work as if their sense were independent of some context, then we run into difficulties.[2] If we apply these principles to the category 'Art', then they recommend that we do not try to look for common elements which, as it were, brings together all the members of the collection as if they had some thing, some one thing, in common.

Wittgenstein's remarks were addressed to philosophical accounts of meaning and served as reminders to philosophers of the sense which ordinary usage already has. One of his main points was that when philosophers try to detach a word from its ordinary usage they tend to produce non-sense.[3] While Wittgenstein's remarks were directed to philosopher's attempt to provide theories of language, they also have relevance to our own concerns about the way in which the general question as to the relationship between art and technology is formulated.

The variety of artistic production

The presupposition that the category 'art' denotes some property which all members of the collection possess has the problem of formulating what this common property might be in light of the variety of the things which can, and are, included as art. Poetry, drama, sculpture, painting, novel writing, ballet, opera, music are among the activities conventionally nominated as among the arts. But what about architecture, film, rock music, folk song and folk dancing, calligraphy not to mention the many 'hybrids' such as body sculpture and even interactive art? Do we include these as arts? If not, why not?

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[1] See Schegloff, 1972 for a discussion of matters relevant to this point.

2 This is essentially the point that Wittgenstein makes in his attack on philosophy and its predilection for taking words out of their 'home' context of ordinary usage such that their sense is lost. Garfinkel (1967) and Sacks (1995) make a similar point in connection with 'natural language' and its relationship to sociology.

[3] Wittgenstein does not mean here that they produce unintelligible gibberish, but that the accounts of the words would have no use and distort the sense they have in ordinary language.

These questions nicely illustrate some of the difficulties alluded to in the previous subsection. Which artistic activity are we to take as the inspiration for system design? Of course, what is often at stake here is not so much an issue of whether or not folk song or rock music, say, are rightly described as arts as if this was a matter of finding the correct way to describe these activities. A matter, so to speak, of discovering qualities in the activities which have been hitherto unseen or unrecognised. Rather, what is going on is an argument about how these activities should be valued and appraised. In the course of such arguments no doubt reference can be made to various qualities of the product and / or the performers, such as their skill, their artistry, their popularity, their innovative character, and so on. However, the point is that the issue here is not so much a matter of discovery as persuasion. A matter of persuading others that calligraphy or rock music, or whatever, have qualities that ought to be taken seriously and ranked alongside other activities which are taken seriously in this way. Artistic appreciation and evaluation is inextricably bound up with appraisal; that is, with making judgements about the relative worth or merit of some production or artefact.

The search for common properties

While the previous section has presented significant reservations about an overly general consideration of the relationship between Art and Technology we still wish to acknowledge the promise of a generic set of lessons. In this section we wish to consider what properties of artistic endeavour we may wish to exploit in the development of new technologies and how sustainable such an migration may be in practice; leaving on one side the issue of which to include or exclude as arts that arises from any general relationship we set out with technology. Clearly, if we are looking for some common quality that Art possesses, then this would have to be, to a significant degree, independent of the medium; independent, that is, of whether the art was embodied in painting, in sound, or in the written or spoken word. This brings us to the techniques and properties of art itself and a consideration of how we may migrate these properties to the world of technological development. The first of these surrounds the general issue of aesthetics.

Aesthetics

Perhaps the major candidate for a common quality underlying art is to be found in the notion of aesthetics. Simply put, aesthetics is that branch of intellectual endeavour concerned with inquiries into beauty or taste. However, and not surprisingly, putting it simply does not really take us very far given that it can have philosophical, psychological, linguistic and social dimensions, and each of these introducing manifold complexities.

It was probably Plato's theory of forms which placed on the agenda of aesthetics the notion that aesthetic terms, such as 'beauty', 'ugliness', when applied to artefacts or to aspects of nature gained their meaning and sense from their reference to qualities which inhered in the object or the scene; qualities which provoked a particular and distinctive experience in the viewer. More recently, this idea of a distinctive experience was talked about in terms of the 'aesthetic attitude'. This is held to be a style of perception concerned neither with facts or with practical use but with the qualities of the contemplative experience itself and works of art, (or, indeed, natural objects), human creations designed to stimulate this kind of attention (Beardsley, 1958; Scruton, 1974).

What is fairly clear is that the attempts to identify a quality, such as 'beauty' or 'sublime feelings' as the defining characteristics of art failed to carry the day. While not dismissing aesthetic expressions as senseless, it was clear that their meaning could not depend on reference to some substantive quality that objects might possess. However, the demise of this view also seemed to deliver the quietus to the notion that aesthetic judgements could be objective giving credence to the view that aesthetic judgements were subjective and akin to expressions of taste worth hardly any more than expressions of taste regarding ice cream or pints of beer (Ayer, 1936). Aesthetic judgements, in other words, are subjective expressions of personal preference and no more than that.

One serious implication of this view is that it makes no sense to compare aesthetic preferences other than to say 'I like this' and 'You like that'. In the absence of any objective quality against which to measure aesthetic judgements they can only be matters of personal taste or preference and not rankable in any sensible way. Accordingly, there can be no experts in artistic judgements since there is no expertise to acquire other than the capacity to express personal taste.

Not surprisingly, such a view has its stern critics and, what is more, seems to fly in the face of the fact that throughout recorded history human beings have discriminated among artistic artefacts in terms of their quality and, what is more, such discriminations have often become institutionalised and presented as exemplars of aesthetic achievement. In which case, it is difficult to see such achievements as simply the exercise of personal tastes. Something more must be at work; the task is to specify what this 'something more' can be.

It is arguments such as this which direct attention to the social dimension of artistic production and seeing the aesthetic as rooted in society and culture.

The social shaping of the arts

One of the hallmarks of artistic production, and one which stands out after even only a slight acquaintance, is the variations in styles. And this is so for most if not all of the arts, painting, sculpture, poetry, novels, the theatre, and so on. Accordingly, it should be no surprise that efforts have been made (from a variety of human studies disciplines), to periodise and describe the various movements in artistic creation relating these to features in the wider culture, religion, politics

and even economic organisation. Indeed, from a sociological or history of ideas point of view, the character of art has much to do with the nature of the society and the culture in which it is embedded.

As Norman (1998) points out, there are aspects of art which are a product of European history and the changing role and status of the artist in society. The relative autonomy of art and the artist is, historically speaking, a relatively recent innovation. Prior to this, artistic creation and production was treated very much as a craft and artists, in terms of social status, treated very much as artisans. Until the eighteenth century the peak of artistic creation was seen as the Classical Age of Greece and, to some extent, that of Ancient Rome and which could never be superseded.

However, it was in the eighteenth century that the attempt was made to treat as a whole painting, the theatre, music, literature, poetry and dance. During the Enlightenment, especially in France and Germany, distinctions were starting to be made between the 'fine arts' of music, poetry, painting, sculpture and dance and mechanical skills, a domain to which the arts had hitherto been consigned. In Germany, Baumgarten (who invented the term 'aesthetics' in the 1750s), Moses Mendelssohn, and Immanuel Kant placed a theory of beauty and the arts on a par with the theory of truth and goodness and established the arts as a distinct area of philosophical inquiry (Brewer, 1997).

Though these ideas did not dwell exclusively on artefacts but included discussion of the way in which nature could provoke feelings akin to those evoked by a work of art, they effectively created a category of what Burke called 'works of the imagination and the elegant arts'.[1] Of course, and as the Enlightenment philosophers recognised, ideas and writings about beauty and sublimity dated back to at least antiquity, but until this time, and as indicated earlier, the arts had not been given this special collective identity.

The reasons for this shift in the characterisation of the arts are, not surprisingly, complex. According to Brewer (1997) the rethinking of knowledge provoked by the scientific discoveries of Galileo and Newton drew a distinction between the arts and the sciences. Equally important were changes in the arts themselves. In the eighteenth century they ceased to be the preserve of royal courts and moved out toward a larger public:

> This more commercial and less courtly culture was to be found in coffee houses in Venice, Amsterdam, London, Paris and Vienna, clubs and reading societies in Germany, academies in provincial France, literary and philosophical societies in provincial Britain, commercial theatres of London, Paris and Lisbon, art dealers' shops and auction houses in Naples, Rome and Amsterdam and at professional concerts performed in London, Paris, Frankfurt, Berlin and Vienna (Brewer, 1979: xvii).

This massive increase in the public consumption of the arts was sustained by printers and publishers, engravers and printsellers, who were linked together throughout Europe. Although the influence of the courts, especially in theatre

[1] Quoted in Brewer (1997: xvi).

and music, remained strong the arts became more commercial and less courtly because they were more urban. Artistic taste was considered a sign of refinement, cultivation and politeness, qualities which were believed to be nurtured best in towns and cities.

Taste also became the attribute of a new type of person who was literate, able to talk about art, literature and music and displayed his refinement through polite conversation. This new type of person did not include the urban poor or the peasantry who, in any case, lacked the wealth and leisure to enjoy such tastes. While women of the appropriate status were also seen as capable of belonging to this community of taste, they were excluded from some of its institutions, notably clubs and associations. Their domains were of the drawing room and salon rather than the taverns or the coffee-houses. Emphatically, taste was not confined to the aristocracy. All over Europe artisans, merchants, shopkeepers, farmers, lawyers, doctors and more bought books and prints, and attended plays and concerts. The fine arts, in short, were viewed as one of the characteristic features of the modern commercial and urban society.

Interestingly from the point of view of the relationship between art and technology, the growth and spread of the arts was seen as intimately tied to the practical and technological improvements of the new commercial society and a sign of how civilised a nation had become. The same age which produces great philosophers, generals, poets and painters also produces skilful craftsmen. However, while the period enables a literate and urbane class to enjoy the unprecedented supply of artistic creation, it also marginalised forms of popular expression such as ballads, folk song, woodcuts and seasonal festivals. These were viewed, on the one hand, as the primitive expressions of an earlier stage of social development and, accordingly, as society advanced would vanish and, on the other, as insufficiently refined so that they were condemned as vulgar.[1]

Of course, it was to be some decades before the full realisation of these changes was to become firmly institutionalised. Even during the eighteenth century, modern English painters were highly marginalised figures dismissed as ‘mechanics’ performing a ‘servile’ art. Writers, too, were little better off and widely regarded as ‘drudges of the pen’. Nevertheless, the longer term consequences of these changes which were to work themselves through over the next century or more, were to be profound for the current ways in which we think about the relationship between art and technology.

However, such an approach seemingly relegates ‘the aesthetic’ also to being a social construction, rendering aesthetic judgements as if not exactly expressions of personal taste then expressions of cultural preference and, as such, a happenstance of history and social conditioning. Finding Mozart’s Requiem moving is as much a cultural preference as is a liking for fish and chips. Both are contingent on being a member of a particular culture and society.

[1] There was a reaction to these sentiments and doubts about the beneficence of wealth. See Brewer (1997) for further details.

Revisiting the aesthetic

A sociological view on art would seem, on the face of it, to put the final nail in the coffin of views which have attempted to bring some objectivity to aesthetic judgements through trying to identify some property or quality possessed by artistic productions or natural objects. If art is subject to wider social and cultural influences, as indeed is aesthetics itself, this also seemingly implies that aesthetic judgements are subjective in being expressions of cultural taste. Aesthetic judgements are relative judgements and no more than that.

However, for us such a conclusion misconstrues the logical grammar of aesthetic judgements and, moreover, misconstrues the force of social constructionism by elevating it to an ontology rather than a methodological point of view.[1] Although a fuller discussion of the issues here would take us too far away from the concerns of this Deliverable, suffice it to say, by way of summary, that what is ignored is the sense that aesthetic judgements have in ordinary language use and, as part of this, the place they have in the orderly affairs of the members of society.

Aesthetic expressions, to use this rather general phrase, invoke standards of appraisal. Standards, which are conventional in the sense that they are not, so to speak, given in nature but are public. They constitute the publicly available grounds upon which appraisals and judgements are exercised in social activities ranging from games and sports, to legal decisions, to morality and, our special concern, art.[2]

An analogy here might help. The rules of soccer, for example, are conventional in that they could have been otherwise – and in the past have been otherwise and, no doubt, will be in the future. But the results of a soccer match are objective in any reasonable sense of the word. The rules of the game, the conventions, do not determine the outcome, as it were. This is a matter of how well the game is played and in the context of the application of the rules. So it is with aesthetic standards. The application of a standard, in whatever domain, cannot simply be a matter of personal preference or taste in the sense described earlier. It makes sense to discuss and debate, argue over, disagree with, etc. some particular judgement as to the merit, or otherwise, of something to which a standard applies.

Accordingly, aesthetic standards are public matters which can and are used to evaluate artistic productions. The fact that such standards may be rather less precise than the rules of soccer does not affect the argument. Having said this, however, there are one or two points that are worth mentioning about aesthetic standards since they are germane to the discussion.

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[1] The notion of 'logical grammar' here is derived from Wittgenstein's views on ordinary language and what it makes sense to say. It has little or no relationship to logic as this is commonly understood or to grammar as this is understood in traditional linguistics.

[2] See Goodman (1968).

Aesthetic standards, like moral standards, are not the sole preserve of artists of whatever medium but can be invoked by anyone and in any context. As expressions of taste and appraisal they are statements of 'where one stands' in terms of something's beauty, attractiveness, charm, splendour, sublimity, etc. It is to state an attitude toward something in terms of its aesthetic qualities. It is, of course, open to others to disagree, and to disagree with reason. That is, to adduce support for the judgement by invoking whatever qualities the proponent might deem relevant. How successful this might turn out to be would depend on the persuasiveness of the arguments and how effectively they are put. However, in the end, if persuasion is not effective and agreement on the aesthetic worth of something is not forthcoming, then it will remain a matter of having different tastes as to what it is one appreciates.

The point of drawing attention to and reinforcing this feature of aesthetic appraisal – and it is not unique in this – is that despite the fact that there are no 'objective' standards in the sense in which these are typically required, it still makes sense to agree, disagree, argue over, dispute, change one's mind, etc., in reasonable ways. In other words, aesthetic appraisals are not merely matters of taste in the way that is often implied in saying that whether one likes vanilla ice cream or not is 'just a matter of taste'.

However, unlike moral standards, where there are no experts, art is, typically, produced through the exercise of skill and expertise gained after a long period of training and apprenticeship. In other words, it can be said that acquisition of the skill and expertise gives such persons a special license to understand and evaluate what some artistic production involves and what an achievement it might constitute. It is considerations such as these which introduce the possibility – and again it is not unique to aesthetic judgements – of judgements being 'ill-informed', or 'failing to understand what the artist is trying to convey ', and so on. However, what this suggests is that 'aesthetic judgements' are something more than expressions of liking or taste even though this may well be a response, and a legitimate one at that, to some artistic production. 'Aesthetic judgements', we might say, require that the judgement be an informed one with this relevant to how seriously the judgement is to be taken.[1]

Learning from artistic traditions

Given the problematic nature of uncovering common properties of Art that are of utility for design it is worth focusing on the process through which different artistic endeavours have been undertaken and what we may learn from this. In fact, this very reflection on the nature of artistic production provided a theme of the work of the first year of the project and is reported in the field studies of the work of ZKM reported last year. In this section we wish to reflect on these

[1] Of course, how well the judgement is 'informed' and by what may well be an issue for appraisers and part of the debate about some work of art.

traditions as a potential candidate for providing a bridge between Art and Technology.

Earlier we referred to the way in which, around the eighteenth century in Europe, artistic production began to gain an autonomy it had not had previously. One result of this cultural shift was to bring to the fore the extent to which distinct artistic endeavours had their own traditions and conventions which, though not unconnected to the wider society and culture, to a significant degree possessed their own internal impetus. By this we mean that other artists work figures significantly in the undertaking of artistic work.

The dominant motif of artistic practise is what Norman (1998) refers to as 'reactive switches in thinking' in which artists and schools succeed one another largely through a process of reaction to previous artists and schools.[1] Norman (1998) notes that even in the brief period of western art history, definitions and practices vary considerably, and in ways which amount to 'reactive switches'. Thus, and to use her own examples, the English Romantic loners of the 19th century were succeeded by Ruskin's and Morris's ideals of anonymous arts and craft workers. Parallel to this movement, in France the academicians were supplanted by a group of anti-academic outdoor enthusiasts who launched the Impressionist movement.

This not only means that aesthetic standards, and hence judgements, can change but also that there are standards which are very much internal to the traditions themselves and which cannot be easily understood outside of them. Indeed, there is more than a little truth in the adage that artists tend to produce their work for other artists rather than for the general public.

Such 'reactive switches' have much of the character of what Kuhn refers to in the entirely different context of scientific change as a 'paradigm shift' (Kuhn, 1970).[2] That is, a major change in the fundamentals of existing practise. In other words, it is open to artists to abandon 'received wisdom' and challenge what is to count, for any particular art, as an artistic achievement. Indeed, it is plausible to regard 'interactive art', which is of especial interest here, as challenging 'received wisdom' in just this way by mediating the experience of art and immersing the spectators in the artefact so that they are not longer 'mere spectators'. The analogies between this shift and the use of the term 'paradigm shift' in technology is more than a passing resemblance. Much of the revolutionary rhetoric of new technological innovations has considerable similarities to those observed in the emergence of these new artistic traditions.

[1] See, for example in interactive art, Shaw's (1998) account of the genesis and rationale of The Legible City.

[2] The arts may well vary in the extent to which they are prone to such 'reactive switches'. Impressionistically, it seems that the plastic arts are more prone to these than literature or drama.

Revisiting art and technology

As should be clear so far from the discussion, while we have no quarrel in principle with the ambition to establish closer links between the art worlds and that of design, there are aspects of this which leads us to cavil with some of the presumptions behind the way in which the issue is typically posed, some of which have already been aired above. Moreover, our doubts are not sheer academic pedantry but, as we hope to show later, important for realising the ambition which the initial question sets out. We might say that one of the important tasks here is trying to get a clearer sight of just what the question amounts to *as a practical endeavour* rather than remaining as an abstract intellectual puzzle.

The original question posed about the relationship between Art and Technology contains a further presumption, namely, it assumes that there is an issue here, a problem which needs a solution. It presumes, to put it another way, that there is currently a separation between these two domains and that this is something to regret. Hence, the idea that ways should be found in overcoming the distance between them to their mutual benefit. However, as discussed previously, it was the eighteenth century, in Europe at least, which saw, on the one hand, a growth in the consumption of the arts and a consequent elevation in the status of the artist and, on the other hand, a developing sense of the arts as a distinct sphere of cultural activity. As we pointed out, it took some decades for these processes to work themselves out to their fullest extent, but our major focus here is with the sense of the arts as a distinct field of activity divided from other activities, especially science and technology.

There are strong echoes of this current preoccupation with a similar issue that emerged during the 1950s and 1960s in regard to science and art. C.P. Snow's, *The Two Cultures and the Scientific Revolution* (1959) was seminal in setting out what came to be seen as a major problem of our age, namely, the separation of art and science to the detriment of science especially. In brief, the argument was, and it has been reiterated in various forms since, that science needed 'humanising' to better serve the interests of society rather than the narrow ones of science and technology. At the time the argument was a persuasive one and, in the United Kingdom for one, resulted in none too successful curricula experiments to broaden the outlook of science students.[1] Irrespective of whether or not encouraging scientists and technologists to read novels, visit the theatre and art galleries, or attend courses in Jane Austen would ever have the desired effect of 'humanising' these disciplines, the point is that it reflected a strong feeling that art, and science and technology, were worlds apart and that this was to be regretted and, if possible, changed. A similar sentiment, we suggest, lies

[1] Efforts to broaden the outlook of arts students by making them more aware of science were even less successful.

behind the kind of question about the relationship between Art and Technology that prompts this and other research initiatives.

However, for our part, we find that the issue and its proposed solutions, have an air of unreality about them, although having said this, its importance as a widespread sentiment within our culture is not to be gainsaid. As we have already outlined in the previous sections, this is a state of affairs which has been inherited from the changes which gained momentum in the eighteenth century. To describe it as a problem, of the way we happen to think about art and technology, is not to minimise it. It ought, however, to encourage us to look rather more closely at the relationship.

In an earlier section we suggested that Art and Technology were glosses for a tremendous variety of activities, a point at that juncture of the discussion mainly to do with the logical grammar of general formulations.[1] Here we want to focus more on the consequences of acknowledging this variety of activities giving special attention to art and technology-in-use. The use of the term 'technology-in-use' is intended to encourage a look beneath, as it were, the idea that the cultures of art and technology are distinct and separate domains. In doing so we hope to bring out the extent to which art and technology are already, and have always been, intimately associated.

To a large extent the approach to the question is obscured by the social and cultural changes alluded to earlier. If we return, for a moment, to the period prior to the eighteenth century we can perhaps obtain a clearer picture of the relationship between art and technology. Then, and again we are speaking of European experience, the status of the artist was of craftsman, artisan and belonged not so much to an independent domain of art but to trade and the 'commoner' activities.[2] The acquisition of the skills of a craft was through a prolonged apprenticeship, often closely controlled and regulated by guild associations. Not only were the skills acquired those of the relevant trade but were also closely intertwined with what we would now describe as aesthetic elements. Nor was this surprising given that the main market for the output of the craft was, in the main and prior to the development of mass markets, aristocratic patrons, the court, the church and the municipality.

In other words, no sharp distinction was drawn between the artist and the craftsman. (Indeed, the lowly status of the artist can be traced fairly directly to the fact that he – and they were mainly male – was a craftsman and had to earn a living by using these skills). The medieval master builder, for one example, was responsible not only for realising the building as a construction, but also for whatever aesthetic qualities it came to have. Indeed, the kind of specialist divisions between, say, engineering, craft, technology, artist, etc., that are so familiar to us would be difficult to apply in quite the same way to earlier periods of our history. The point is that from the point of view of the activities involved,

[1] On glosses see Garfinkel and Sacks (1970) and Heritage and Watson (1977).

[2] For an excellent discussion of relevant issues to the changes in the status of the arts, see Hall (1998).

it would be difficult to identify, and separate out, those activities which were artistic and those which were technical, to put it simply.

Certainly, and again from the point of view of technology-in-use, it is not difficult to appreciate the craft elements that not only must have gone into the production of art but continue to be so. From the beginning, for example, painting has had to develop tools and technological knowledge of, to mention but a few, the creation of pigments and colours, understand how to reproduce the effects of light and shade, and sculptors discover ways to work marble, stone or clay, use heat to bend metals, and more. The history of artistic endeavour is as much a history of technology as it is of aesthetic production.

However, as we have already pointed out, we cannot dismiss the distinction between art and technology as entirely without point or substance, as merely some cultural misconception. The social changes already described as well as others involved in the move of European societies toward industrialism have wrought significant changes in the place of art, engineering, technology, and science in our society and our culture. For one, the perceived division between the arts and the sciences discussed earlier does have its institutional expressions, not least in the education and training of the respective practitioners. Engineering cannot now be mastered through an apprenticeship but requires a high degree of theoretical knowledge as well as, sometimes, practical experience. It has become a discipline – or set of disciplines – no longer a craft. The training of artists, though more variable than in the case of engineering, is also more 'professionalised' and though inevitably retaining important craft elements does not require routine exposure to engineering theory as a requirement for the practise of the artistic endeavour.

An important change which needs to be noted is that with the growth of mass markets and mass consumption, artistic products, to use this clumsy term for the moment, have become more available than ever. This has not only involved an expansion of the number of artistic consumers of books, prints, video, museums and galleries, etc., but also an increase in the number of producers as well as the domains which are now seen as among the arts. Film, television, and radio, for example, are just the more prominent of the media which can now be included among the arts. People training in the arts are also involved in a variety of industrial and commercial activities in advertising, TV production, manufacturing of all kinds, architecture, theatre design, fashion, and so on. Despite this unprecedented extension of talents and skills which can plausibly be regarded as involving the aesthetic, the distinction between 'high' and 'low' taste with regard to art and its products remains: a distinction which can be instantiated in so many ways and which both reinforces and complicates the divide between art and technology as distinct spheres of activity.[1]

[1] It can also create tensions within organisations where it is often difficult for artists and engineers to work together while retaining a strong sense of their own identity. See Norman (1998) for a discussion of such issues.

The ‘aesthetically decorative’ and ‘aesthetically informed’

In the last years exploration of the relation between art and technology, Norman (1998) draws a distinction between the ‘aesthetically decorative’ and the ‘aesthetically informed’. Essentially, this is a difference, which is to do with the contribution of the artist. An example would be the case of engineers developing innovative computer tools and seeing the artist as someone ‘adding value’ to the product by differentiating it from that of competitors. This would be to regard art as ornamental or decorative rather than an integral part of the development process. It is a form of window-dressing helping to make what might otherwise be dull, austere, obscure, etc. more accessible and palatable. While by no means unimportant, such a role is *not* the one envisaged for eSCAPE.

Norman (1998) goes on to support the conception of the artist’s role as that of a ‘poetic interpreter’ of life’s mysteries cultivating an awareness of those aspects of human existence which are prone to radical transformations. The most important quality here is that of creativity and ‘interpretative energies’. Unfortunately, it is this role which is the most incomprehensible to non-specialists, including potential technological collaborators. The ‘aesthetically decorative’ is much more approachable and understandable than is the radically challenging. Be this as it may, for eSCAPE one of the important themes is to try to gain experience, and derive lessons from, bringing the challenges that can be posed by the ‘aesthetically informed’ to bear on the conception of electronic landscapes.

Although there are problems about the distinction especially if pressed too strongly – such as how we might systematically distinguish the ‘aesthetically decorative’ from the ‘aesthetically informed: is a reproduction picture of a Van Gogh in someone’s living room merely decorative? – nonetheless, as a thought provoking couple of phrases they do take us forward.

What is being suggested is that an important aspect of artistic work is to challenge existing conceptions whatever these may be – the ‘poetic interpreter’, as it were. There needs to be some caution exercised here in that we are using a highly general category without specifying the kind of art. However, and it is an important point, these inspirations often have their sense from *within* artistic traditions, and artistic traditions alone.

The aesthetically informed and interactive art

Artists, in most if not all domains, have never been slow to make use of new technologies and media. One has only to take note of film, radio and television, the use of acrylics and plastics and, earlier, photography and printing not to mention the untold technological innovations throughout the history of art and artistic production. So, it is no surprise that artists should turn to the computer as the latest technology for exploring the means of artistic expression and for ‘poetic interpretation’.

However, an argument can be made that the networked computer represents a very different technological medium than previous technologies in its very flexibility and ubiquity for imaginatively exploring the limits of human experiences in much the same way that earlier printing did. It is the possibility of creating virtual worlds which has been seized upon by many cultural commentators as likely to become the defining feature of the 'post-modern' age. Such possibilities putatively challenge the very foundations upon which our 'modern' experience is built by creating conceptions of space, time, identity, subjectivity, community which owe nothing to the world built out of the hard won visions of the Enlightenment.[1]

Placing on one side the hype which infects much of this kind of thinking, it does appear that there is an interesting coalescence of one of the main objectives of art and technological possibility which makes, perhaps, for a closer affinity between art and the design of technologies. The task is to explore, and work through, what this can mean.

Conclusions

In this chapter we have reviewed some background considerations relevant to the eSCAPE strategy which will be elaborated more fully in the following chapter. Much of the review has concerned itself with issues to do with the nature of art and what relevance it might have for the design of technological systems. While expressing serious doubts about raising the question of the relationship between Art and Technology as a general question requiring a general answer, we have tried to move toward being able to state a more specific but practically realisable position which neither denigrates artistic endeavour nor technological design. We do not pretend in what follows that we have, once and for all, resolved all the problems here. After all, all that we are attempting to achieve here is to set out the strategy that has emerged in the course of conducting the project and in addressing the contingencies that arose in doing so.

In addressing the contingent practical problems engendered in the course of this particular project's execution, there are a number of caveats we need to mention. The first is that within the practical realisation of the project, the team has been dealing with a specific collection of artworks, namely interactive art works, so there needs to be some hesitancy in generalising from the studies to be reported. Second, and we will discuss this a little more fully in the next chapter, we shall not be making aesthetic judgements about particular works of art. These, from our point of view, are matters for the artistic traditions themselves. Third, we are not subscribing to a point of view which sees art as the only source of

[1] Again, a great deal of caution needs to be exercised when considering such claims. As Button (1991: 4) reminds us 'theories about the cultural transformation of society, may challenge existing bodies of thought, but they do not challenge the very foundational act of theorising. Findings may be challenged but the methodological foundations through which those findings are generated remains intact'. *Ergo*, under the auspices of 'post-modern' inquiry, the foundations of the 'modern' project remain intact.

creativity in the design of innovative virtual reality systems. Few artists, we are confident, would subscribe to such a view. Though artistic production offers a possibly unparalleled opportunity to explore experience in ways which would not, typically, be open to the technical designer, this is as much a comment about the kind of attentiveness required by the respective work roles as it is about imagination.

Chapter 2
The View from Design

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In the preceding chapter we focussed on the general issue of the relationship between art and technology and reviewed some of the problems involved in gaining a practical purchase on the problem of *relating artworks to the design of new technologies* in general and electronic landscapes in particular. In this chapter we want to approach much the same general issues but this time from the point of view of system design itself.[1] So what are the problems of design for the emerging generation of electronic environments and what use can designers make of both the social and the artistic in terms of this design challenge?

From a design perspective, the invention and design of VR technologies involves two interrelated problems. First, in situations of invention the a-priori requirements of a system can be viewed as radically indeterminate.[2] Certainly in this case, and as we pointed out in the previous chapter and in the deliverables from last year, we are not designing for specific and relatively easily specifiable activities and information processes, such as in the work-oriented design popular within domains such as CSCW. In this case there are considerable debates about the extent to which we can specify and predict the nature of the work to be supported and the extent to which the development of systems can be informed from understandings gained from studying that work.

Somewhat in contrast to the more familiar world of everyday work we are faced with uncertainties as to just what the potential activities and processes might be. We might have ideas about what these might be but these will remain, for the foreseeable future, more or less interesting possibilities to explore. It is this inherent uncertainty which makes more traditional requirements capture and specification phase of limited viability and even calls into question some of the

[1] Much of this chapter is based on Crabtree *et al.* (1999) which is attached as Appendix 1.

[2] There is a danger of treating this as a tautology arising from the meaning of the word 'invention'. However, if we avoid taking this step then this remark can be treated as a matter of degree. For example, the Internet was an invention but the engineers knew what they wanted to do and were able to assemble known technology into a new form (though 'just what' that new form amounted to was the emergent product of years of development practice and could not have been specified in 'just what' detail prior to the accomplishment of invention activities).

iterative approaches to design already established in the development of systems to support cooperative work.

Even in the case of immature and emerging technologies such as electronic environments some understanding of the potential nature of their use and application is essential. This understanding is key to the shaping of the technologies and techniques that will be used to form these future electronic environments. In fact, consideration of situations and activities of use is essential to invention since design will, in significant respects, depend not simply upon engineering issues but also upon what might constitute the use context of the new technologies (Grint and Woolgar, 1997). Such issues are firmly concerned with the activities the new technology should support and in what ways.

It is clear that a tension exists in the emergence of virtual environments between the indeterminacy of specifications satisfying design objectives and understanding possible future contexts of use. This tension must be resolved in practice during the everyday course of the design process itself. Essentially the problem is how to understand the practical use of a technology in advance of its actual use, by people other than those involved in its development. The challenge set out to design, given the limited viability of a requirements specification phase in situations of such uncertainty, is how are end-users and practical circumstances of use to be brought to bear in constructive ways on the design and development of new technologies?

Attention to the context of use has for long been a concern of technology design across a wide spectrum of research domains. Recognising that activities of technology development depend as much on an adequate appreciation of contextual issues as technical ones – that technology and use context are irredeemably tied – has led to efforts to incorporate contextual perspectives oriented towards the practical circumstances of end-users into the design process. (Floyd, 1987; Grudin, 1990; Hughes *et al.*, 1992; Grønbæk *et al.*, 1997; Kensing and Simonsen, 1997; Christensen *et al.*, 1998). Although 'quick and dirty', 'concurrent' and 'parallel' social studies (Hughes *et al.*, 1994; Crabtree, 1998), and 'experimental' approaches to user-involvement (Grønbæk *et al.*, 1993; Mogensen, 1995) have enjoyed some, not insignificant, success in work-oriented contexts of design, integrating ethnographic and cooperative techniques into activities of invention and technology development has proved to be no easy task (Rogers & Belloti, 1997; Grudin, 1993).

One of the main reasons underlying the particular problems we face in the eSCAPE project (and in light of the general remarks above) is that empirical knowledge of 'the way the world is' – of end-users and practical circumstances of use – does not drive design as such, even though such knowledge enters the design process in many ways and at many crucial points. Such 'information' is not a free good and nor is it always easy to deal with once gathered. Whatever the circumstances of design, constraints of cost and time make the production of contextual knowledge subject to the 'economics of information' (Sharrock and Anderson, 1994). As we say, this does not mean that end-users and circumstances

of use do not figure in design. As Grint and Woolgar's (1997) study of a commercial design company shows, designers employ a stock of 'company knowledge' about users in the invention and development of new technologies. Similarly, Sharrock and Anderson (1994) describe 'just how' end-users figure in design practices and characterise this as a 'scenic feature' in design reasoning:

> 'Sometimes when the designers were trying to work out some particular detail, reference would be made to just who the potential user might be. Thus, for instance, it might be suggested that the user might be a secretary, or a manager, or a key operator. Having designated these kinds of users, it was possible to introduce sets of expectations about what they might be trying to do, what they might know about the machine or process in question and how likely they were to initiate one or other sets of routines. In the terminology of Schutz (1974), "secretary", "manager", "key operator" are *personal types* associated with which are constellations of roles and relationships. In addition to these types, our designers also employed what Schutz called *course of action types*. Here the defining characteristic is not social identity, gender, organisational position or role, but an envisageable course of action which is being undertaken. It was around what could reasonably be said about such courses of action that "the user" entered the design decision making process.' (Sharrock and Anderson, 1994: 12)

As 'scenic features' in design end users and contexts of use are treated as distinct types of persons and commensurate courses of action. This common-sense knowledge of types and activities constitutes the 'stock of knowledge' designers routinely invoke and draw upon in their design activities. Largely, it is only late in the design process that the 'way the world is', to put it this way, enters the invention process and normally under the auspices of usability trials.

The main purpose of usability trials is to determine, and thereby make explicit, whether or not design conceptions are valid or, better, worth pursuing further, and determine ways in which the design may be refined. Central to the conducting of usability trials is the "enactment of the users' context" and "construction of natural users". That is, considerations to do with the selection of appropriate locales and users for testing. Should beta-sites or real-world settings be used? Should users be specialists – expert computer users, psychologists, managers, etc. – or novices, 'coal-face' workers, dis-interested parties, and the rest? Or should users be combinations of various competences? Whatever the choice, 'the way the world is', and (thus) the context of use, invariably enters design through observation of the performance of usability trials in the invention and development of new technologies. Observation of the ways in which users accomplish the activities set for them; of the practical problems they encounter in doing them; of the confusions that arise in the doing; and the solutions devised to make the technology work *in situ*.

This relationship between actual use of technology by real world communities and the development of technologies is central to most user (or citizen) centred approaches to development and is core to the work of the I^3 programme under which the work of the eSCAPE project is supported. However, a reasonable charge to be levelled against the development of interactive 3D

environments is that there has been little or no user involvement in the development of these environments. While features of environments have been informed from studies of settings (Benford, 1997), and these environments themselves have been exposed to use studies (Bowers, 1996), there have been few systematic attempts to develop and put in place an electronic environment that seeks to meet the needs of an actual community of users. In fact, just this shortcoming motivated the studying of users of electronic environments at the ZKM and the subsequent development of supporting facilities (Trevor, 1998).

The studies of the artworks allowed the project access to users who could be considered representative of general citizens. The interaction of these general citizens with the various art pieces developed in the project allowed us to undertaken some initial studies of the utility and potential of often radically new interface techniques and devices. However what is clear is that these were particular users who had come to visit a multimedia museum and for whom the experience of using these environments was sufficient. To make more progress in our understanding of the design and development of these environments it is imperative that we consider how these environments may be developed and used to meet the everyday needs of users with a real world application purpose to be met. At this point it is worth making a clear separation between the studies of the art pieces and the studies of the application domains used to drive the construction and further study of the demonstrators reported in Deliverables D4.1 and D4.2. In this deliverable we essentially consider the study of the artworks. The studies of the application environments are reported alongside the demonstrator landscapes they inform.

Understanding the use of the Artworks.

While the various multimedia art installations developed during the project represent significant endeavours in their own right and allowed the exploration of potentially radical new interfaces their principle role in terms of understanding users was to provide a point of exploration for future arrangements and technologies. As far as the eSCAPE project is concerned, the design of the artworks preceded the studies as did the design of many of the technologies used in the construction of the systems reported in Deliverables 4.1 and 4.2. With one exception, neither the design work nor the studies of the artworks-in-use done under eSCAPE directly influenced the further development of the artworks.[1] However, and from the beginning, it was felt important that the project should obtain an informed sense of how users of the artworks engaged with and used them. This provides for the possibility of bringing knowledge of end-users and practical circumstances of use to bear on the design electronic landscapes in and as of the process of design itself. Unlike the kind of design circumstances

[1] The exception is the study reported in Crabtree *et al.* (1999) and attached as Appendix 1 to this Deliverable.

outlined earlier, this was not so much a case of trials for usability after much of the design work had been done, but rather, using the studies to think about possible and interesting uses for VR technologies. The studies thereby act, one might say, as an aid to a 'sluggish imagination' in coming to evaluate the relationship between art and technology design.

Accordingly, the studies of the artworks were fed into a continuing process of discussion and design debate (see for example the discussions surrounding the development of the design of the tourist information centre in Deliverable D4.2). These design workshops and the process of continual debate were intended to focus the design effort toward realisable but imaginative possibilities within the constraints of the 'economics of information'. Many of these constraints were, as pointed out earlier, technical in character. In common with much engineering, design choices have to be made between inventing new technologies and using older but workable technologies: a choice which can be as much influenced by the costs of time and money as it is by some notion of optimum efficiency. Design is, inevitably, a 'satisificing' activity and so it is with eSCAPE.[1]

Although the major focus of this Deliverable is the study of the artworks and the various lessons for the developers of future environments, it is important to position these studies in terms of the studies of the application domains. While we can consider the studies of the art pieces (reported in summary in the next chapter) as the inspiration for design, the ethnographic studies of the Tourist Information Centre and the library can be seen as driving the development and application of the two demonstrator environments reported in Deliverables 4.1 and 4.2 respectively.

Understanding the Tourist Information Centre

This set of studies emerged out of thinking about the possibilities of using what we had learned from the study of the artworks in a real world setting. The challenge presented was to allow a situation where the exploration of constructed cityscape like structure could be put to use to meet a real world application. One possibility explored during the year was to place the Legible City installation within a fitness centre since not only were aspects of the technology, notably the bicycle, familiar but it might well provide an additional experience to the activity of exercise. However, when we undertook studies of the fitness centre, serious problems and significant issues became manifest (Murray, 1999). In particular, it became clear that the use of the Legible City in this way was not as good an idea as originally thought due to the clear observation that users of fitness centres are highly motivated and concentrate fixedly on their fitness activities and do not relish any diversion. Accordingly, the project turned to other venues and focused the efforts of those involved on these activities. A clear candidate for exploiting the concept and principles of the cityscape based electronic landscapes was to

[1] See Shapiro (1994) and Pycock (1999) for a discussion of this notion.

support those working in a Tourist Information Centre as a place where shared social reference to a city like structure was central. As a result a Tourist information centre local to one of the sites was selected for further investigation with a view to developing an electronic landscape for usability trials in such a context.

A 'quick and dirty' ethnography was undertaken in a local Tourist Information Centre (TIC) which supported the idea of developing a first prototype to explore some of the ideas further (see Deliverable 4.2 for a description of the study and subsequent development). There seemed to be a number of benefits to the Tourist Centre:

1. Such places are required to be 'information rich' in terms of the need for the staff to respond effectively to whatever queries might arise from people 'dropping in'.
2. At the point of the initial contact of a user of the service, the staff do not know what information is required. While the experienced staff of the TIC may have a good idea of 'the kind of things' people need from such a Centre – railway timetables, list of hotels or boarding houses, entertainment sites, etc. – they do not know precisely what this person wants until the query is articulated and a search for the relevant information can begin. This posed interesting issues for the design of innovative information browsing services to support TICs.
3. There was the opportunity to exploit ideas culled from the artworks; ideas which might offer stimulating possibilities for the presentation and representation of information in such a setting.

It is important to note that the connection between the study of the Tourist Information Centre and system design was not that of requirements capture so much as using the former as an inspiration and point of real world contact for the latter – as an aid to design in the face of radical uncertainty. The ethnographic study furnished a detailed sense of the day-to-day work of the personnel of the Tourist Information Centre along with an informed idea of what the possibilities might be for a system to support that work. Again, it is important to stress that the research is more to do with exploring ideas – particularly ideas concerning interaction with a potential multiplicity of different virtual environments - than it is with designing systems which could have a more directed relevance to the current work of the Centre. But, having said this, it was important to gain a sense of the work of the TIC (which inevitably focussed on users both as users of its services and providers of its resources) in order to design the prototype.

The process was very much one of 'design by brainstorming', looking at what we had, what we had learned from the studies, what was doable within the time-frame and, as important, what the potentially interesting next steps might be. As indicated, this last point is an important one knowing that the future work of the project might well depend crucially upon technical decisions made at this stage. Accordingly, and for example, although the TIC demonstrator/prototype elaborated in Deliverable 4.1 is currently not used in a fully distributed manner it

was felt important that the architecture of the system should support this for the coming year's work. This meant that the demonstrator/prototype could be used in initial usability trials – in the sense discussed earlier – and from which we could learn in order to feed into an incremental design which did offer the possibility of supporting distributed use.

Understanding the use of the Library

In a manner akin to the studies of the Cityscape to support the development of the physical (or cityscape) based electronic landscape demonstrator, the need for a real world application and site of study emerged for the abstract electronic landscape demonstrator. The library studies emerged out of a concern to further develop existing abstract eSCAPE technologies within a concrete community of end-users and for the express purpose of public (citizen based) utility. Libraries are, amongst many other things, very public spaces concerned with the provision of public services and, as such, seemed to provide the opportunity to explore some of the key objectives of the eSCAPE project, namely, developing electronic landscapes for public use in cooperation with distinct communities of end-users. This becomes even more crucial given the on-going shift to digital libraries and the emergence of on-line public access facilities to allow users to search for and use a growing range of digital material.

For the eSCAPE project the concern lies with developing electronic landscapes that bear no resemblance to physical spaces. Rather we are concerned with how users of an on-line library system interrogate and make sense of an abstract information space. We are interested in how the presentation of an abstract space whose appearance is based on the semantic content of the information within the space can be used by on-line citizens. This requires us to consider different techniques for presenting information and user searches for information across a community of users and exploiting this landscape as a means of making sense of the large on-line corpus of material stored within the library. In contrast to the physical electronic landscapes where we are exploiting the static and slowly evolving structure of the environment the abstract information space builds upon the dynamic nature of these virtual environments and the ability to rapidly reconstruct these environments based on abstract criteria.

This presentation of a digital library as a virtual environment represents a fairly radical move away from the current predominantly web based 2D interfaces and environments. Although a number of existing demonstrators have considered the use of 3D interfaces to present a range of different collections of information a distinctive feature of the work of the library is that the presentation has a strong real world setting. A real world on-line public access catalogue is used to access an existing library collection and this is presented to actual users of the library in order to assess and understand its utility.

Involving end-users in what is effectively a ‘blue-sky’ research project (Rogers & Belloti, 1997) is no easy task however, not least because at the outset we have little tangible sense of what it is we are to involve end-users in. To say “the informed design of e-scapes” is, quite obviously, not enough. Like general formulations as to the relationship between art and technology, such a position statement says little, if anything, of practical use in local circumstances where cooperative design has to be achieved. In order to involve end-users in a ‘blue-sky’ context, we thought it would be of most benefit to establish some ‘realistic possibilities’ for design (Randall *et al.*, 1995; Crabtree, 1998) with which end-users could sensibly engage with, elaborate, change and / or refine. Accordingly, studies of library usage served to ‘sensitise’ the members of the project to the everyday activities of library users, and naturally led to a particular focus on ‘search’ activities. In developing an appreciation of the real-world, real-time ways in which library users undertake and accomplish searches for information, the studies served both as foci and input to the design of the ‘abstract’ e-scape demonstrator.

In terms of the library demonstrator consideration of the real-world character of search activities, and available technological possibilities, led to the formulation of some rather specific requirements to be implemented in the demonstrator or prototype (see Deliverable 4.2, Chapter 2). In concrete form, the first version of the prototype presents to end-users some basic but nevertheless realistic possibilities for the support of search activities. These possibilities are not in any sense intended to be ‘complete’ but elaborated, built upon and transformed through ‘hands on’ experimentation by end-users. Thus, it is in and through bringing end-user competences to bear on, and producing iterative versions of prototypes, that end-users inform design in confronting the demonstrator with practical situations and requirements of use from the perspective(s) of end-users.

End-user involvement in design is reported through ‘situated evaluation’ of ‘hands on’ experimentation. The focus here is an ethnographic one directed towards the technology-in-use and the embodied work that makes the technology work. Attention to the lived or embodied work of technology usage enables the design team to develop an appreciation of the practical problems, confusions and solutions end-users encounter in confronting the demonstrator with practical situations and requirements of use. In addition to documenting end-user feedback, it also provides further input into design in explicating the sociality of ‘hands on’ experimentation. Such 'situated evaluations' of the TIC demonstrator and the artworks were conducted and it is towards a deeper consideration of the artworks and their input into design that we now turn.

Connecting with the artworks

Returning to the art works which is the main focus of this Deliverable, we want to present in this final section the main elements of the strategy followed for bringing the interactive artworks to bear on the design of electronic landscapes.

As we pointed out at the beginning of this Deliverable, the strategy was worked out in the course of the project, through discussions and studies, and trying to think through a basis on which the artworks could inform the design of systems. Inevitably, practical considerations have played a large part in determining what was feasible and doable with the time and resources available both from the point of view of carrying out the fieldwork and, importantly, what ideas it was realistic to develop.

The method used for the evaluation was ethnography, which is a method intended to gather material on the real-world, real-time activities of persons. In the context of Computer Supported Cooperative Work (CSCW) this has proved to be an important addition to informing the design of systems to support work activities.[1] Its value lies in observing first hand how work is actually done rather than relying upon reports or, worse, idealised versions as these appear in job descriptions, work process models and the like. In practise, the method involves a fieldworker spending some time in a work setting observing what people do, talking to them and gathering whatever material comes to hand. The aim is to understand the social organisation of the work setting from the point of view of the participants to that setting and, importantly, bringing this to bear upon the design of systems which better resonate with the ways in which the work is actually done.

However, it became clear from the outset, as we have already pointed out, that studying artworks was not quite as straightforward as studying work. For one thing the fieldwork would not be studying the production of the artefacts – these had already been designed and built – but rather the realised artefacts on display and, accordingly, beyond our control to affect further. Moreover, examining artefacts on display is not, on the face of it, equivalent to studying the users of computer systems as this is traditionally understood.

The issue of evaluation

Quite early on the issue of standards surfaced as a problem relevant to the evaluation of the artworks. In summary form this was an issue to do with aesthetic criteria. In some significant respects this had to do with a lack of confidence on the part of the computer scientists and sociologists on the team to be seen as passing judgement on the work of artists. However, it did point to some very real puzzlement as to how aesthetic evaluations could inspire system design? System designers, and this has also been the experience of the design-

[1] See COMIC Deliverable 2.1, 2.3 for extended discussion of ethnography in CSCW.

oriented sociologists on the team, tend to conduct evaluations against a backdrop of design lore about users and what it takes to make a system accommodate to some notion of the domain in which it will be used.[1] Such design lore, although not ignoring the decorative, tends to focus on more utilitarian matters rather than aesthetic and the experientially challenging.

In contrast to this, as commissioners of art, ZKM has focussed on the 'aesthetically informed' rather than the 'aesthetically decorative'. The rationale for this is a view that

> ' .. the engagement arising from committed conceptual exchange between artists and developers is more likely to engender profoundly new approaches to eSCAPES than engagement at a superficial level.' (Norman, 1998: 235)[2]

However erudite, this reasoning did not provide us with clear guidelines as to how the evaluations and studies might proceed. Moreover, and another contrast with the previous experience of the researchers, the typical environment of an artistic production is an exhibition or gallery into which an audience is invited. As we shall discuss below, unlike work settings, in galleries or exhibitions the opportunities for observing the interaction of a putative user with an artefact are much less available and, when they are, much less straightforward to understand. This was compounded by the fact that it was an important element of the audience's experience of the artwork that they should receive little or no direction and guidance but, instead, be open to whatever experience the artefact might provoke in them. As we have already indicated, some of these issues are discussed below.

Moving from evaluation to experiment

Given the uncertainty of what was being assessed it became clear that the evaluations we were to undertake would be very much by way of explorations of what is a little understood evaluative context. As should be clear, evaluations of artworks even from within the art domains themselves are variable and likely to occasion no little debate and controversy as to their artistic merit let alone how they might relate to technology design. Nonetheless, in significant ways, we took it that the artworks could usefully be viewed as 'breaching experiments' - that is, as temporal infractions of taken-for-granted organisations of space[3] - and as such, provide an initial purchase towards developing an appreciation of the prospective relationship between interactive artworks *and* the design of electronic landscapes of (potential) widespread public utility. Accordingly,

[1] We are not saying that following this lore always gets it right.

[2] It is important to note that the term 'superficial' here is not intended as a pejorative judgement. The point is to argue that for artists to be effective partners in technological development they need to be involved as early as possible not only to have an influence on shaping technology but also themselves to benefit more from the exchange.

[3] The term 'breaching experiments' is taken from Garfinkel (1967)*. We use the notion in the spirit, if not the same (sociological) sense, of Garfinkel's notion.

observing and reporting on the ways in which such infractions were produced, managed, repaired, etc. would serve to make visible, and available to design, the "just what's" of occasioned use.

The spirit in which Garfinkel uses the idea of 'breaching experiments' is as 'aids to a sluggish imagination'. As such, the artworks, in breaching members' taken-for-granted organisation of space, serve to elucidate some of the practices and practical troubles arising in encounters with electronic spaces which may well require support in design. It cannot be stressed enough that the studies of artworks are aids to design and important ones at that. They are a starting point towards understanding the very practical relationship between interactive *artworks* and the *design of* shared virtual environments in the eSCAPE project and it is to a consideration of such matters that we now turn our attention.

In the following chapter we present in a summarised form the studies undertaken of a collection of rather radical artistic investigations. These studies provided a significant background to the motivations for the different technical decisions and approaches undertaken in the design of the demonstrators reported in Deliverables 4.1 and 4.2 and these studies were reported alongside the detailed studies of the settings within which the demonstrators were to be placed. It is worth noting that many of these art pieces are also documented in the accompanying CD ROM containing video clips and images of many of the different interfaces explored during the second year of the project.

Chapter 3
Thinking with the Studies

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In this chapter we present worked through reports of the studies conducted this past year of some of the installations shown at ZKM and elsewhere. What we have tried to do is retain some of the flavour of the original reports presented at various times to the project team. However, there has also been some selection intended to bring out what we see as the more salient lessons for the eSCAPE project, many of which are incorporated in the systems reported on in the other Deliverables. The reports are not in any particular order, certainly not in an order which reflects when the studies were originally done.

What emerges from the studies is the importance of the notion of citizen and the distinction between a member of the general public and a user of these environments. This distinction was to us at least, somewhat surprising, and the main reason why much of the reportage focuses on *how* people learned to use the artefacts. While this process is of interest to the design of electronic landscapes in its own right – as we shall discuss – we take the view that the setting in which they were displayed, namely, in exhibitions, also has much to do with shaping the character of the interaction with the artefacts. From the point of view of users, engagement with any particular artwork took time to learn and 'getting the idea' of how it worked seemed to be sufficient for them. Few, in other words, seemed inclined to use the artefact further. 'Getting to see how it worked' was like a puzzle and, once solved, any further interaction typically ceased. There are, we suggest, a number of reasons for this. One is the non-intuitive nature of the artworks themselves which, in the case of Legible City, was more marked than we suspected. An equally important effect was the nature of the setting in which the general public encountered these artworks.

Visitors to exhibitions and museums tend to wander through seeing what is 'on show', trying out as many installations as possible in the time that they have available. The fact, too, that if the exhibition is crowded there is a pressure from other spectators who may wish to 'have a go' is an inhibiting factor in the amount of time any one user may feel inclined to use the artefact. Clearly, and if these surmises are on the right lines, then the nature of the setting has an important bearing on the design of electronic landscapes. We would argue that these studies

need to be seen in contrast to the development of other electronic environments such as those reported in Deliverables D4.1 and D4.2 that have been developed to meet a broader purpose than conveying an interactive experience.

In the rest of this chapter we briefly report on some of the studies of the developed artworks being used in a range of settings. These different settings vary from exhibitions within the ZKM multimedia museum to a range of demonstrations in more industrially oriented trade environments. In each of these studies a general issue to emerge was the means by which users engaged with each of the different art pieces and the public nature of this engagement.

Engagement with the Mimetic Blob

The Setting

The Mimetic Blob was exhibited at the *Information Society Technologies conference 1998 (IST 98)* in a large public auditorium at the Austria Centre, Vienna, between the 30th of November and 2nd of December. Over 130 stands displayed 'leading-edge technologies and products'. Stands were grouped in discrete sections, the Mimetic Blob being exhibited in the 'Future Technologies and Interfaces' section.

The Blob was displayed within a closed space (due to the 'noise' it made and possible interference with other displays) measuring some three metres square. The outer 'shell' of its display space was unadorned, although posters announcing the site as a 'virtual opera', and showing a person interacting with the installation, were displayed on the inside of the display space. The installation was physically positioned adjacent to the Legible City and co-located with a 'virtual piano', thus affording visitors the opportunity to 'make a concert together' with virtual instruments should they desire to do so. Few visitors took up the opportunity, although many 'experimented' with both installations – moving from the Blob to the virtual piano or vice versa, as the flow of persons into the display space and engagement with the installations allowed.[1] The Blob essentially relied on people manipulating it through touching a large touch sensitive display (see figure 1 and the corresponding section of the CD ROM enclosed with these deliverables).

[1] See Trevor *et al.* (1998) for issues concerning the 'flow' of persons through space as a feature of engagement with electronic landscapes and interactive installations

Figure 1: Engaging with the Mimetic Blob by dragging it around

To persons attending the conference, the Mimetic Blob was described by conference organisers in the official guide as:

> ' .. a virtual sculpture that is both a reflective and interactive "substance". The blob tracks the finger placed on it in an organic and squid-like way. But the place and way it is touched affect it differently and can trigger a change in shape, visual appearance, colour and transparency. The blob is constructed from triangular shapes with 40 different textures inspired by the ocean and its life forms. The substance generates sounds and can project memory fragments that come from images of real world objects contained in the surface textures.' (IST 98, *The Guide:* 129)

The Blob was described by the demonstrators, in the course of interaction with visitors, interchangeably as virtual art, a virtual sculpture, virtual opera, and a virtual instrument.

Three demonstrators – two male, one female - populated the site, moving between the two adjacent installations as contingencies required (lunch breaks, an influx of visitors, etc.). The primary demonstrator was female. She was a part of the development team and responsible for the artistic aspects of the Blob. Of the two male demonstrators, one was a member of the development team responsible for technical aspects (including doing 'running repairs' occasioned by the Blob being 'dragged around too much'), and the other, a professional composer responsible for the virtual piano. All three demonstrators encouraged visitors to become users of the Blob.

At this point we come across one of the more important of the emergent findings from the studies, one connected to the usability guideline, but having poignancy in that though seemingly trivial has immense relevance for the design of electronic landscapes, namely, 'getting to use the installation'.

Compared with a number of the other installations most people grasped intuitively that it has to be touched. As one demonstrator described the Mimetic Blob:

> "People seem to immediately understand what's going on with it .. at least in a sort of intuitive way . when you touch it reacts .. and er . some seem to understand also . sort of seen by the movement . seem to understand that it moves around by dragging it … I tend to explain it anyway"

Attention to the demonstrators' work of 'explaining' to visitors 'what's going on' illuminates the natural practices whereby visitors came to engage with the Blob and with the other installations reported on here.

The purpose of attending to natural practices of engagement is not to assess the efficacy of the Blob in a real-world, real-time context as one might choose to evaluate a more orthodox system.[1] The intention is to explicate some of the social mechanisms, in detail, by which engagement with the Blob is facilitated as a social encounter. As we indicated, this is relevant to the kind of considerations relevant to someone becoming a user and, as such, of wider relevance than this particular artefact. The account that follows provides considerable detail.

Public Use

As we pointed out previously, this installation was situated in an exhibition in which visitors would wander round the exhibits as they chose. There was no compulsion to try any particular artwork; this was a matter for the particular visitor. This meant that the demonstrators, should they be inclined, would normally have to extend an invitation for a potential user, that is, a person displaying a curiosity or interest in the installation, to 'try the Blob'. If the invitation was accepted the visitor (or visitors since they often numbered two or three) was handed a pair of 3D glasses and taken to the installation. Orienting users to the Blob involved turning them to face to 'the table' on which it was displayed. The table measured approximately a metre square. Achieving an orientation to the table consisted of making hand gestures towards the object on the table and describing something about what the object (the Blob) was / is, such as 'it's a virtual artwork', 'a sculpture', 'it's a virtual opera…an instrument'. But whatever the description this was always accompanied by some statement of the order – 'you can interact with it'.

The user was then instructed to put the glasses on in order to interact with the Blob and told that 'you need to touch it to make it interact'. At this point, and although some users touched the Blob immediately, the demonstrator would elaborate what was meant by 'touch it'. The demonstrator started to drag the Blob around the table using the index finger and then proceeded to drag his or her finger across, up, down, backwards, and so on, over the surface of the table. In reaction to this the Blob would emit various sounds and follow the route traced

[1] What measures for efficacy? That is, in what ways could the blob be considered efficacious? For what purposes? By whom? To what ends? Why? Could it not be considered otherwise?

by the finger. As the finger moved, the Blob morphed, changing shape and colour and texture. The harder and faster it was touched and dragged around, the louder it emitted the sounds and the more it morphed. As the demonstrator often described it: 'you see…you have a direct reaction'. Invariably, the user did see and started to emulate the demonstrator's actions.[1]

Electing to engage and emulate the demonstrator's actions while not requiring any great degree of skill, was not always an untroubled affair. On a number of occasions the demonstrator needed to go over the actions required to interact with the Blob: 'you need to press harder' being a common instruction, for example. Such instructions were often accompanied by further demonstrations, this time in concert with the user demonstrating-by-showing-and-doing just what degree of pressure to apply. The user would then try to reproduce the demonstrated actions until he or she 'got the knack' of it, often taking two or three attempts at it.

As the user proceeded with the engagement, the demonstrator would often provide further instructions or advice. For example, on occasion users would recognise that the Blob was not behaving like it did when the demonstrator used it. In which case the demonstrator would provide further guidance: 'it depends on where you touch it as well…it plays different music', or 'depending on how you touch it…it has different textures and colours'. Finding out just where touch and (thus) just how to use the artefact was a collaborative action accomplished through concerted demonstration which instructed users in the just where's and how's.

Public use: learning use by watching

Some substantial numbers of users of the Blob became users not only through the demonstrators' personal instructions but by watching other users interact with the installation.

However, this was not always a simple matter of 'looking on' but often involved moving to a position to watch and making this known to other onlookers by gestures and other physical movement such as skirting round the crowd of other onlookers and looking over people's shoulders. The success of this kind of activity, if not exactly hit and miss, depended upon the responsiveness of other persons to accommodate to efforts to gain a better vantage point. On some occasions the efforts were not successful and the person 'tired' of the attempts and left the scene. On others, gaps were made by other onlookers and the person invited to take the place offered. In other words, the setting of the artefact, in particular what it allowed and what was expected of the viewers, played a part in shaping the opportunities to look, learn and be instructed in how to use the installation

[1] Not all visitors were so include but preferred to watch others use the installation instead.

Trivial though these observations may seem, they are vital to understanding the various social dynamics which can be involved in 'getting to learn' about how to use an interactive installation in the setting of an exhibition. To engage with the artefact, a user is required to proceed from being in a position to observe interaction with the artefact, to engaging with the artefact on the basis of what is observed. What is learnt 'in the watching' - for example, that you wear glasses; that you touch the table; that you drag the object on the table around; that when you do so it makes sounds and changes colour and texture; that the faster and harder you touch it and drag it around the more sound it emits and the more it morphs; that the demonstrator will instruct you in use should troubles arise and so on - are like learning the 'moves of the game', so to speak. That is, the natural practices and competencies whereby interaction with the artefact is achieved and the technology made to work. Visibly for members at the fieldsite, the interaction is 'read' or, better, naturally understood, as practices instructing interaction. Seen and understood as such, potential users undertake engagement with the installation on the basis of, and in the same ways as, they have witnessed others engage with the installation.

However, to say that onlookers, as potential users, learn how to engage with the artefact by observing the activities of others and treating these as instructions, is not to say that these are simply 'read off' as instructions and the person proceeds from there. Much can be learned from watching others – how to engage with the artefact, what engagement looks like, what kind of actions to perform, and so on. However, insofar as the potential user is *observing* then there are 'gaps' – the "just hows" and the "just what's" of actual engagement – which need to be filled in, and this can only be done through actual use. In other words, although users can learn a great deal from 'watching others', when engaging with the installation itself, practical 'troubles' are regularly occasioned, often requiring the assistance of the demonstrator.

Some features of engagement

Observation of the public arrangement of the Mimetic Blob enable us to consider how users, first encountering the artefact, make the transition from trade show attendees to users of a novel future interface. This is important since such users are 'general citizens', so to speak: a vital consideration in the design of future interfaces intended to support the activities of the general, and non-expert, public. In what follows we set out more formally the 'phases of activities' which are likely to be involved in the transition referred to above

Engagement with the artefact typically begins with an '*invitation'* to try. This is followed by a general description of the installation and what it does. The potential user treats such descriptions 'instructively'; that is, as 'for now' elaborating the character of the artefact and the kind of operations that may be performed. This general description is often accompanied, or followed in close order, by '*showing*' the use of the operational features. In the case of the Mimetic

Blob, the demonstrator instructs the user to 'put the glasses on' and then shows the physical actions that can be performed to make the artefact 'do things'. Thus, the demonstrator instructs through the description and physical demonstration of engagement properties '*how to begin'* engagement with the artefact.

Becoming a user witnessably relies upon the common-sense, natural and reflexive methods, or practices, of '*demonstration-by-showing-and-doing*'. This displays for neophyte users 'how to go about' using the 'pointed out' properties of the artefact. This is, in effect, a baseline of understanding, a resource that enables the neophyte user to begin using the artefact. By applying this understanding the user is then able to 'fill in' the irremediable and practical 'gaps' between instruction and action.[1] Instructions are always incomplete; an incompleteness which is experienced and manifested as 'practical troubles' – the 'just how this or that is done?' – and which is practically remedied by practise. It is this latter which marks the movement from the status of neophyte to 'practised', even 'competent user'.

'Demonstration-by-showing-and-doing' is intendedly accompanied by the user as an emulating and embodied witnessable performer of 'following the instructions' and, as such, the bridge between a neophyte and practised user. This is a process which can and often does involve repeating the instructed actions to overcome the 'normal, natural troubles' experienced until the 'knack' is acquired and the user can become a more competent user of the artefact.

The "process" of becoming a user

Widening the perspective a little, learning from what others do depends upon taking, or making, the opportunity to put oneself in a position to learn. In the settings in which the artefact studied was placed, physical access could, on occasions, be restricted by the number of onlookers. Typically, this involves the common-sense knowledge of how to conduct and position oneself in a crowd – in effect an audience – with a single focus in order to gain a suitable vantage point. If the possibility of engagement is of sufficient interest, then steps need to be taken to place oneself in a position to be selected as a 'user'.

This point underscores the fact that becoming a user can be sequenced event which occurs over time and through familiar, routinely produced and reproduced practices of social encounters in public places. These can include the following:

- doing invitations.
- introducing the user to the installation and its features, and thereby beginning engagement, through the provision of general descriptions 'pointing out' engagement properties and operational features.
- verbally / descriptively instructing users in the use of engagement properties and engagement features.

[1] See Garfinkel (1967; 1996) for a discussion and treatment of the irremediable incompleteness of instructions in practical circumstances of everyday life.

- showing users just how to engage through the method of demonstration-by-showing-and-doing (instructed action).
- engaging by emulating-demonstrated-showings-and-doings (following instructed actions)
- achieving position to observe practice
- observing practice and learning (some of) the moves of the game by watching on
- bridging practical gaps not filled through observation through the methods of demonstration-by-showing-and-doing and emulating-demonstrated-doings.

These practices constitute the interactional work of the site: work that is sequentially organised. It occurs for specific purposes and in the face of specific practical troubles at specific points in time, and it occurs *recurrently* in just these specific ways regardless of particular demonstrator or user. Such is the *social* organisation of this setting.[1]

Public utility

The studies of the Mimetic Blob in use, suggest that the sequences of the social organisation of engagement and learning needs support; support which is sensitive to the 'worksite specific practices' as described above. In the case studied, among the specificities of the site was the presence of an expert demonstrator, which may not always be the case in other situations or settings. While almost trivial in its simplicity in the case of the Mimetic Blob, the 'pointing out' of engagement properties in, and as, the course of beginning engagement is, nevertheless, crucial to interaction with novel future interfaces.[2] This is to say that real-world, real-time studies of public use suggest that novel future interfaces fronting eSCAPEs should 'point out' (or ostensively define) quite clearly the engagement properties of the space as a feature of beginning or undertaking engagement with the space. (See Trevor et al. 1998 for a discussion of some of the issues here, particularly the notion of an 'annotated gateway'). As such, 'pointing out' of engagement properties – of technical requirements for, and features of, engagement – will be embedded in descriptions introducing the

[1] Note that this is not to say that persons' conduct is determined by the sequence but that the sequence is produced and reproduced through persons conduct which is the conduct *of the site:* of using, and thus becoming a user of, a novel future interface at an exhibition (in contrast to a usability lab) in this case. The conduct of the site consists in the resolution of endemic practical troubles - normal, natural troubles that are tied to the accomplishment of technological usage. If users are to become users then they can do no other than produce and reproduce the work of the site as it is through that work that they *become* users without exception. In more organised settings the conduct of the site would quite naturally be said to consist in differentiated 'jobs' of work. As any 'job' the practices of its performance, while subject to contingency, are routinely invoked, enacted and accounted for in and as the doing of the site's work. The work of working the Blob is no different in this and becoming a user may rightfully be thought of, and treated, as a job of work to the extent that it involves a division of labour and achievement and coordination of routine activities manifest as sequential orders of work.

[2] Though we would not necessarily want to restrict the lesson here to future interfaces. Any interface which is novel to a user may well be in need of support.

user to the interface and eSCAPE alike, so instructing users in engagement and starting the process of moving from neophyte to practised user.[1]

The design of technical support for engagement would consist in the construction of 'instructed actions' (Lynch, 1993). That is, courses of technically embodied actions showing users, where and when necessary, 'just how' to accomplish engagement by pointing out engagement properties and operational features in a sequentially organised, unfolding order of actions that need to be done in order to engage with this artefact / environment. In a word, demonstration-by-showing-and-doing (providing for emulation by the user). Instructed actions make observable to the neophyte user 'just what' he or she has to do now in order to progress. It is, foreseeably, in supporting the ordinary practices of learning how to use an artefact, that users may be encouraged to become *users* and learn the interface and the environment alike.

Users quite clearly learn a great deal about engagement from observing practice. Observing practice requires that the user be in a position to observe. This seemingly trivial point has important implications for the design of eSCAPEs however. Insofar as eSCAPEs are 'immersive' distributed and populated environments, then learning how to 'use' them very much depends on being able to establish one's presence 'within' that shared space. Establishing presence enables users to make their intentions to observe, for example, noticeable and, accordingly, allows for some response (such as recognition and reaction) from others in some ways engaged within the space. How presence is 'registered' so to speak is very much an open question. In 'real world, real time' spaces it is a question of 'signalling', through body language and gestures and of making physical reactions to those gestures, some further details of which will be explicated and addressed in the following studies of artworks in situated public use.

[1] This is not to negate the notion of an annotated gateway, clearly such a notion is indispensable in connecting various and different eSCAPEs. Rather, it is to provide further support to the public user who has elected to 'check out' any particular space. Thus, the embedding of engagement properties in courses of instruction for beginning engagement would be an encountered feature *on entry* to any particular domain on having passed through the annotated gateway. The difference between the two is that annotated gateways 'tell' users *what* the technical requirements or features of any particular space are whereas engagement properties embedded in courses of initial instruction 'tell' users *how to* 'go about' employing said features. Such courses of instruction should, naturally, not be imposed but available on clearly marked, readily available command. (The implication here is that insofar as eSCAPEs and future interfaces are being designed for *public* use, then they should be designed in light of an ever-changing staff of 'perpetual novices' - Crabtree *et al.* [to appear]. A significant part of the job of design might be seen, then, as supporting the shift from novice to competent user. That is, in supporting the learnability of the interface and (thereby) the domain - see Hughes & O'Brien, 1998 for a discussion of learnability. The suggestion here is that insofar as the work of the site is, quite clearly, sequentially organised, then learnability may be supported through the 'teaching' of the sequence in details of its work. Of course, that means that engagement sequences have to be designed).

Practically accomplishing engagement with the Legible City at IST '98

The Setting

The Legible City was exhibited at the *Information Society Technologies conference 1998 (IST '98)* in a large public auditorium at the Austria Centre, Vienna, between the 30th of November and 2nd of December. The installation was displayed in an open space surrounded by posters announcing the installation as a member of the eSCAPE project. The installation was located adjacent to the Mimetic Blob also advertised on the posters. The Legible City was described by conference organisers in the official guide as follows:

> 'Created in 1989, the Legible City is generally considered to be the first computer-based interactive art installation ... The Esprit eSCAPE project has developed the installation from a single to a multi-user version that can show new possibilities of visual and vocal shared experiences in an artistic virtual environment … At IST '98 a 21" monitor is mounted on a modified exercise bicycle … The cyclist wears headphones and a microphone … the installation is connected .. to two other remote locations (the 'surroGate' exhibition at the ZKM Media Museum, and the V2 gallery in Rotterdam). The cyclist can explore the Legible City's virtual text formed cities, meet cyclists from the other two installations and talk to them to imprint their own text architectures on the virtual environment.' (IST 98, *The Guide:* 130)

The Legible City was invariably described by the installation's sole demonstrator in the course of interaction with visitors as an 'artwork' which 'you can ride through', 'meet people' and 'to talk to'. The legible city consisted of an electronic environment that allowed users to cycle through a landscape consisting of letters laid out using the street plans of one of three real world cities. (See figure 2 and the corresponding video in the escape CD-Rom)

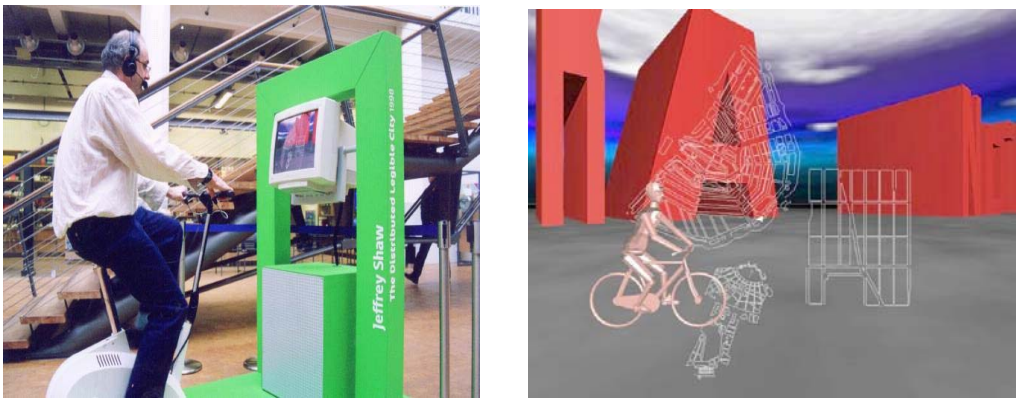

Figure 2: The legible city and the corresponding cyclist in the virtual environment.

The demonstrator was not always present and visitors were, at times, left to their own devices (see Murray (1998) for details). Insofar as the demonstrator

was present, then all visitors were encouraged to *become users* of the Legible City in the same *practised* manner. That is, through the same practical techniques of engagement we have discussed in connection with the Mimetic Blob. The ethnographic study below explicates the work – specifically, the natural practices - whereby visitors became users of the Legible City. Formal features of engagement are explicated in conclusion.

Public Use

Potential users, that is, persons displaying a curiosity and interest in the installation, were typically invited to ‘try the bike’. On the visitor doing so, the demonstrator would provide a general description of the installation and its features. These were typically comments such as; ‘this is an artwork’ which ‘you can ride through’, 'it’s connected to three installations’; ‘there’s a map which shows where you are and where other bikes are’; that the ‘little dot on the map is you’ and the others ‘are people riding the bikes’ at other installations. These were very often accompanied by specific instructions on how to operate the artefact: ‘you pull the map up by pressing this button’ on the handlebars, that ‘you can talk to others when you get near them’, and ‘explore the world together’, and so on.

The user would then be instructed to ‘experiment’ and ‘explore’ the virtual environment. Following this instruction, the demonstrator observed the user’s activities and furnished further, more specific, descriptions about the installation, its features and how to use them as events unfolded either in response to observed activities, or queries from the user. In this way, users found out that 'you can only talk to each other if you’re close together’; that 'you can always pull up the map to see where you are at any time’; that 'you are in Manhattan’ (or Amsterdam or Karlsruhe) ‘right now’; that the others are in ‘Amsterdam’ (or Karlsruhe or Manhattan); that 'you can see where you’re going’ by looking at the ‘little triangle’ on the map; that 'you push either of the two buttons’ on the handlebars to ‘pull up’ the map; that ‘this’ is your location now and 'you go in that direction’; that 'you want to turn round to meet the other person’; that 'you just go up that street’; that the other is ‘straight ahead’ and ‘just round the corner’; that 'you don’t have to keep the map up all the time’; that 'you can pull the map up to check where you are’; that 'you can see if there’s somebody on the bike’ by ‘talking to them’.

Indexing troubles

The furnishing of the ‘further instructions’ described above are examples of the way in which instructions can index the practical problems encountered by neophyte users of, in this case, Legible City. This indexing had an ‘unfolding’ quality to it in that finding a solution to one problem usually meant that the user, although making progress, went on to find other ‘troubles’. An example of this is connecting with other users of the installation, itself a task that involved not a

few problems. Having made contact with other connected users, a period of 'playing around' would typically ensue as they would first follow one and then another, taking turns, and generally exploring the possibilities. A further typical trouble occurred in the attempt to co-ordinate a face-to-face (avatar-to-avatar) encounter. This was no easy task. Users would cycle towards each other, decreasing their speed but, with few exceptions, this would result in over-shooting one another. This meant a period of reorientation and circling around in order to resume a semblance of a face-to-face approach. Circling around was not easy due to the very wide 'turning circle' of the bikes which required not only physical effort but considerable perceptual adjustment. Many users gave up at this point. Those who persevered and achieved realignment – often after much assistance from the demonstrator – would engage in small talk for a moment or two and then dismount, and so on to the next user…

Some features of engagement

Much of the pattern of instruction discussed in connection with the Mimetic Blob was witnessed in the case of Legible City. Here we will concentrate on other formal features that emerged. One of the major differences between the two artefacts is that Legible City is intended as a cooperative virtual environment (CVE) rather than a single user installation. Again, we are interested in how non-experts move from being neophyte users to practised users insofar as this is relevant to the design of virtual environments for the general public.

As described previously, engagement with the installation follows the pattern of the demonstrator providing general instructing descriptions of the artefact and what it does. From this very brief and general description, the user is then shown operational features and their use described. In the case of the Legible City, for example, the demonstrator 'pulls up', and at the same time points out the operation for 'pulling up', the installation map. Having 'pulled up' the map, the demonstrator describes the map's features: where the connected others on the map, where the rider is on the map, and which others the rider may interact with. Again, the user treats such descriptions instructively. That is, as a set of instructions providing for engagement with the CVE and its contents. Thus, and again for example, the user learns that the map may be pulled up by pressing *this* button, and that it displays the position 'within' the CVE of him or herself and connected others with whom he or she may interact.

Such introductory descriptions serve to prepare users for engagement with the CVE through familiarising them with the CVE and its basic operations. Introductory descriptions provide users with just enough practical instruction to begin engagement. 'Just enough' is the operative characterisation here since, typically, users seek to know 'just enough' to 'get on with it'. They do not seek to find anything like a complete set of instructions for use because, in a strong sense, they do not know what else by way of instructions they will require. It is likely that they will realise that more will be needed, but at this stage they have

no experience to determine what this might be. They need to know sufficient to start the engagement with the artefact and leave the rest dependent on how 'things unfold'.

The course of 'becoming a user' consists in the use of sufficient instruction to move to the next point, a process of dealing with troubles 'here and now', as they are encountered. Thus, and for example, following introductory descriptions and instruction to initiate engagement, the user of the Legible City starts pedalling the bike and shortly encounters a practical problem: the user can not see where s/he's going. That is, s/he can not see the way to the connected other(s). The demonstrator instructs the user to pull up the map and describes both the user's and connected other's location. This description 'pin-points' the two positions 'precisely' and traces the route from the rider to the connected other. At a formal level, the description is a *specific in-action instruction* (in this case, as to the map's features and their uses). The description, treated instructively by the user, provides for the next action necessary to successful engagement from *this* point. Thus, in the above case, the description reads as an instruction to pull up the map to see where you are going, that you are just here and the connected other just there, and the that the way to go in order to meet the connected other is along this route from here to there (which means, in this case, that the rider must 'turn around').

In and as of the natural course of engagement, the user proceeds to follow the specific in-action instructions provided. Should the user currently – at any point in time – be engaging with the CVE 'incorrectly' (misusing operational features), further descriptions instructing the user in alternate modes of engagement are furnished. Similarly, should the user currently be experiencing problems then descriptions furnishing instructions to achieve a solution are provided.

The furnishing of further instructions is tied to the temporally unfolding, situationally relevant, courses of action and the 'troubles' encountered. In the case studied, this unfolding very often was directed at achieving connection with other users in the virtual space. As we have seen, instructions tend to become specifically and relevantly directed to achieving this particular task as it emerged.

The "process" of building a user

Analysis of the situated action and talk produced by parties (demonstrator and rider) in, and indeed *as*, the course of practically accomplishing engagement with the Legible City, displays members' worksite-specific practices providing for that achievement. Of central importance is the temporally sequenced production of descriptions, which are treated by production cohorts *as instructions for engagement and interaction* with the virtual environment and its content (and, thus, of achieving the site's work). In the sequenced production of descriptions, users transform them into instructions providing, over an unfolding course of time, for:

- an introduction to the CVE which renders the space intelligible in terms of its general engagement properties: what kind of ‘place’ the CVE is, and what can be done ‘here’.
- the practical orientation of users to engagement with the CVE: what the user needs to know now in order to engage with the CVE.
- preparatory engagement: in light of the previous action, what specific activities can be engaged in here
- beginning engagement: pointing out what actions need to be taken to commence engagement
- specific in-action instructions providing for the next action necessary to the accomplishment of successful engagement from this point, wherever that may be.
- different modes of engagement in the course of engagement itself
- using the installation’s features effectively in the course of engagement
- situationally relevant assistance in the accomplishment of the site’s work.

Insofar as users – without exception - treat descriptions as instructions for engagement, then the granularity and situational relevance of descriptions is of paramount importance. Detailed instruction in operational features and use only become relevant at certain temporal points, notably later and discretely, in the sequence where the next action, whatever it is, requires such instruction now for its achievement. The challenge to developing CVEs for use by the general public is, then, to provide naturally intelligible, temporally organised engagement sequences for cooperative CVEs. Engagement sequences that describe, in lay terms (ordinary, not professional, talk), the particular environment and which, in doing so, furnish situationally relevant instructions for action and the achievement of the site’s work.

Engagement with the Web Planetarium in EVE

The Setting.

The Centre for Art and Media Technology (ZKM) in Karlsruhe, Germany, has developed an assemblage of apparatus known as the Extended Virtual Environment (EVE). This apparatus was conceived as ‘a new form of interactive immersive visualisation environment and virtual-reality apparatus’ (Duguet *et al.*, 1997). As part of the collaboration between the Swedish Institute for Computer Science (SICS) and ZKM in the eSCAPE Project, the demonstration and exhibition of the Web Planetarium device in the EVE apparatus was considered an appropriate and effective combination for experimentation and display. The

Surrogate exhibition (1st November to the 6th of December 1998) provided the opportunity to make the installation available to public use

The exhibit was housed in an annex at ZKM within an inflatable dome (the shell of the Extended Virtual Environment) measuring approximately some ten metres across and 5 metres high, inside of which a projector mounted on a tripod in the centre of the dome projected the dynamic image of the Web Planetarium. (See figure 3 and the corresponding clip in the eSCAPE year two CD-ROM)

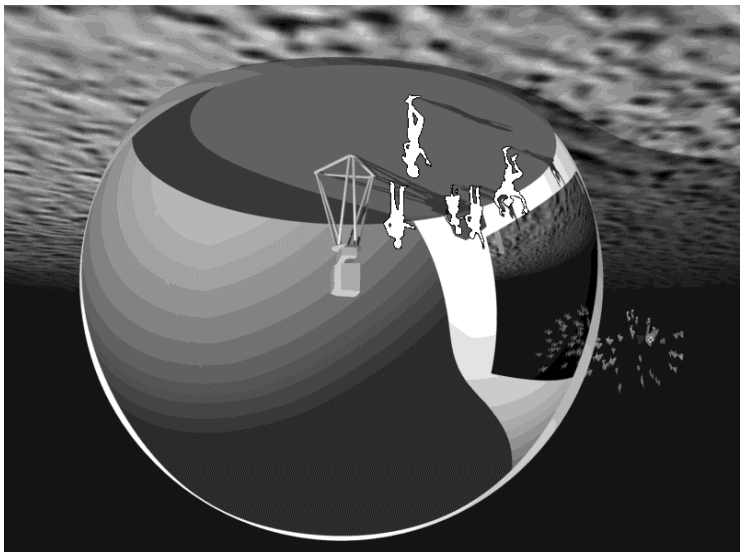

Figure 3: The EVE dome showing it immersed inside a virtual world

Members of the public-cum-audience members were to view the scene using polarised spectacles, which would allow them to see the scene in 3D. Users were to view the scene through similar glasses, although these were fitted with an infrared light pointer that controlled the movement of the scene projected onto the interior of the dome. A joystick allowed the user to control forward and backward movement within the virtual scene. An initial period of study took place during the Surrogate exhibition (2nd to the 5th of December) and again shortly afterwards (20th to the 25th of January 1999). The study took place during hourly guided tours of the exhibit. These tours made it possible to conduct an empirical investigation of the exhibit in details of public use.

Public Use

Members of the public entered the EVE environment through a small revolving door in single file and in doing so invariably found themselves plunged into darkness. It took several moments for their vision to adjust, to organise their positions within the dark space, and to notice that displayed on a portion of the dome was a blurred ‘constellation’ of images that resembled ‘planets’. The tour guide explained what the constellation of images represented - links on the Internet. He would then turn the lights on in the dome and instruct the present assembly to retrieve, and wear, a pair of 3D glasses from the container next to the

revolving door. Glasses retrieved, the lights were switched off and one of the assembly was invited to assume control of the user glasses and joystick. Not every member asked accepted the invitation and so it was remade, often with the invocation of the device being 'fun', until one of the assembly accepted. On occasions, no-one accepted the invitation and the tour guide would assume the position of user, which after demonstration often prompted subsequent use by members of the current assembly.

In demonstrating the device, or once having enlisted a user, the tour guide issues a description of the device, explaining to the user and / or assembled 'audience' what the exhibit consists of and how it may be engaged with. For example, that you may navigate the 'planets' by moving 'towards' and going 'through' them. Notably, the sense of movement this course of instruction engendered was initially conveyed through moving the control glasses around by hand to demonstrate simultaneous movement of the screen and, similarly, by manipulation of the joystick. Thus an initial sense of use and engagement was conveyed by instruction and demonstration of device features.

The sense of use and engagement is further elaborated in the course of use as the tour guide 'tells' the user to 'move' to various arbitrary locations and at the same time physically guides the user, directing his or her hand and visual attention to the arbitrary places specified. In going through this exercise, the assembly or user learns to move not simply the head in moving the image but to align the body with the head in moving around the Web Planetarium.

On occasions and for various reasons, be they technical (breakdowns or moving too fast for the equipment) or distractions (noticeable 'noises' oriented to outside or among the audience), the projected image does not follow the user's head movements. The movement and image are 'uncoupled' and use breaks-down. Such contingencies require 'repair'. Users adopt two visible strategies for repair: moving back to the point where they last saw the image, thus seeking to re-establish the connection, or by asking the guide for assistance. In response, the guide directs the user in 'picking up' the image again. Insofar as the uncoupling is not due to moving too fast, then the guide must 'fix' the equipment (not uncommonly, and often successfully insofar as the projector unit's movement has 'frozen' yet again, by 'whacking' the projector unit with a wrench).

In the course of engagement, members of the audience begin to ask the guide questions about the exhibit, clarifying the things she has said and seeking explanations for what they see. As the user manipulates the joystick, the projected constellation of images moves around the dome and 'towards' and / or 'away' from the assembly as directed by the use of the joystick. Initially, members of the audience remain rooted to the spot, twisting torso and turning head to maintain visual contact with the Web Planetarium. The user, however, begins to turn and walk around, particularly when his or her view is blocked by audience members or the projector tripod. Members of the audience subsequently orient to the user's movement and begin, themselves, to move around the space in sequence with the movement of the images as directed by the user.

As the workings of the device start to become apparent to the assembly, members of audience try to guide the user in his or her activity, pointing to ‘planets’ and issuing directions and instructions for movement. At this stage, the user often undertakes to ‘pass on’ the control glasses and joystick. The transference of the peripheral devices (control glasses and joystick) played a key role in the nomination of new users. Taking off the glasses, the user would offer them to the some member of the audience. As when the tour guide invited use on entering EVE, the user’s offer was not always accepted. On such occasions, the guide would often intervene, again prompting use through the invocation of ‘fun’. Alternately, on seeing the users offer, audience members would nominate themselves by reaching out for the peripherals. Notably, very few audience members made direct requests of the user for control.

Instances of peripheral exchange were also occasioned by success, failure or difficulty. For instance: having reached a planet; having difficulty in finding the constellation; the screen going blank; the occurrence of uncoupling between the viewer’s head movements and the projection camera. All these instances, and more, occasioned users to ‘give up’ the peripherals. Now ‘previous’ users would often become members of the audience and, standing close to the new user, would often begin to ‘point out’ details of use, thereby instructing the new user in and as the course of use. Thus, as a new user assumes control, the work of the site continues. That is, the work of making sense of the device, becoming a user, learning the controls, repairing breakdowns and / or passing on control is produced and reproduced yet again and by every new assembly entering EVE.

Some features of engagement

Observation of the public arrangement and use of the Web Planetarium in EVE allows us to consider how users first encountering the installation make the transition from ‘visitors to a museum’ to ‘users of an eSCAPE’, so to speak. Again, our focus here is on non-expert users in order to better understand some of the practicalities of public use and their design implications

As with the previous studies, engagement of the neophyte user is one which requires instruction in the properties of the artefact and how it can be operated. This stage is followed by an invitation to some member of the audience to ‘try it out’. Very often the attempt was made to encourage participation by saying that it ‘is fun’. However, on numerous occasions this failed to convince or overcome the ‘natural reticence’ of strangers suddenly invited to enter the limelight using a technology of which they have only just become aware. In which case, it was not uncommon for the demonstrator to do a ‘walk through’ which was often sufficient to encourage a member of the audience to come forward and ‘try it out’.

There were occasions, however, when a member of the audience volunteered to accept the invitation. Following this the demonstrator gave a general description of the controls, and demonstrating operational features. This was

often supplemented by guiding the body movements of the user and showing how this produced the results on the projected image. In the course of being guided in use, it begins to become apparent to individual users and the audience alike that head movement is coupled directly to the projection camera 'point-of-view'. That is, that the control glasses are connected in some way to the projected image. Thus, when the head moves, the image moves. When the user turns his or her head around, the image moves around the dome. As such, it emerges that use of the device, and 'exploration' of the Web Planetarium, relies on the coordination of hand, head and body movement. The coordination of hand, head and body is, in the first instance, an instructed coordination of actions. The tour guide 'tells' the user to 'move' to various arbitrary locations and at the same time physically guides the user, directing his or her hand and visual attention to the arbitrary places specified. In going through this exercise, the user learns to move not simply the head but to align the body with the head in moving around, thus accomplishing proficient use.

A notable re-occurrence in the course of use was that of dealing with contingencies – specifically, breakdowns. Although the installation is but an experimental one, bugs, glitches, and all sorts of unanticipated anomalies are to be expected in the course of use of developed eSCAPEs. How such things are to be 'dealt with' is an open issue, which at some point must inevitably be addressed. The present studies offer no solutions: users re-trace their steps and, failing success in that, seek assistance. Thus, the current studies simply draw attention to the contingent breakdown issue.

In the course of use, audience members come to learn practices of use from observing interaction between the tour guide and user, and from the user's subsequent interaction with environment and its features. There is, in many respects, a concerted character to the course of becoming a user and, to use a phrase, the 'transmission' of competence adequate for engagement. Not only do the user and the audience alike learn the 'just what' and 'just how' of engagement from observing interaction between the tour guide and the user. Eventually, in the course of the user's 'solo' activities, the audience themselves become active participants in developing, first a sense of movement through manipulation of control devices as produced by the user, and then, through attempts to direct the user's activities. As the user's sense of, and ability to, manipulate the controls grows, so does that of the audience members. Thus, audience members instruct the user to go to places, to move around, and the rest.

The attunement of audience members to the workings of the environment and its features, as manifest in the issuing of directions and instructions, prompts, as a matter of routine, the 'passing on' of the controls to some unspecified member of the audience.[1] In assuming control, the work of the site is contingently

[1] Conduct in some sense unique to the categorically 'fun' nature of the device – that is, to activities in which the 'seriousness' of social life and commensurate 'respectful' demeanor is temporarily suspended and the *occasioned* participation of present members is, not without the prospective possibility of mis-reading, correction or sanction, tacitly invited.

reproduced. Thus, the new user may find him or herself engaging in a course of ostensive definition, guidance and / or the instructed coordination of actions. This time however, there is every possibility of that work being undertaken and accomplished in concert with a previous user.

The "process" of becoming a user

Once again, analysis of the situated action and talk produced by the demonstrator, users, and members of the audience, in accomplishing engagement with the Web demonstrates the worksite specific practices which accomplish that achievement. By worksite specific we mean essentially the practices necessary to work with *this* technology in *these* circumstances in the company of *these* persons. The explication of the worksite specific practices makes visible a number of endogenous activities which constitute the “just what’s” of becoming engaged with the Web Planetarium. These consist of:

- Instruction in engagement properties: ‘pointing out’ technical requirements of use.
- Walk-throughs: encouraging use through demonstration.
- Ostensive definition of operational features (controls): ‘pointing out’ controls and their use through manipulation of them.
- Guidance in use of ostensively defined features: instructing users in the ‘hands-on’ manipulation of controls
- Instructed coordination of actions: practical exercises in coordination of controls and achievement of activities.

These findings suggest that attention to and support of such practices provides for the possibility of encouraging the adoption and use of future eSCAPE technologies by members of the public as it is in and through these practices that users visibly become users.

Engagement with Nuzzle Afar

The Setting.

The Nuzzle Afar installation was available to public use during the Surrogate exhibition (November 1st - December 6th, 1998) at ZKM, Karlsruhe. The installation was located within the exhibition area, on the 2nd floor of the museum.

Nuzzle Afar consists of an enclosed room, with left and right side entrances. Within the room are two podiums, in front of which are two projection screens. Trackballs embedded on top of the podiums allow users to control movement through the computer-generated environment displayed on the projection screens, and microphones similarly located allow distributed users to communicate. As

users move through the electronic environment, a string-like trace is left upon the virtual landscape, which may be locked onto and followed by another user. The enclosed space of the virtual world consists of four walls, ground and sky plane. Upon the walls are images of a ‘sense’ organs (e.g. a hand, an eye, an ear, etc.). In addition to spherical ‘avatars’ of unique colour, a sphere and a cylinder are placed within the virtual room. These latter objects are the means by which users can enter or depart a series of three rooms.

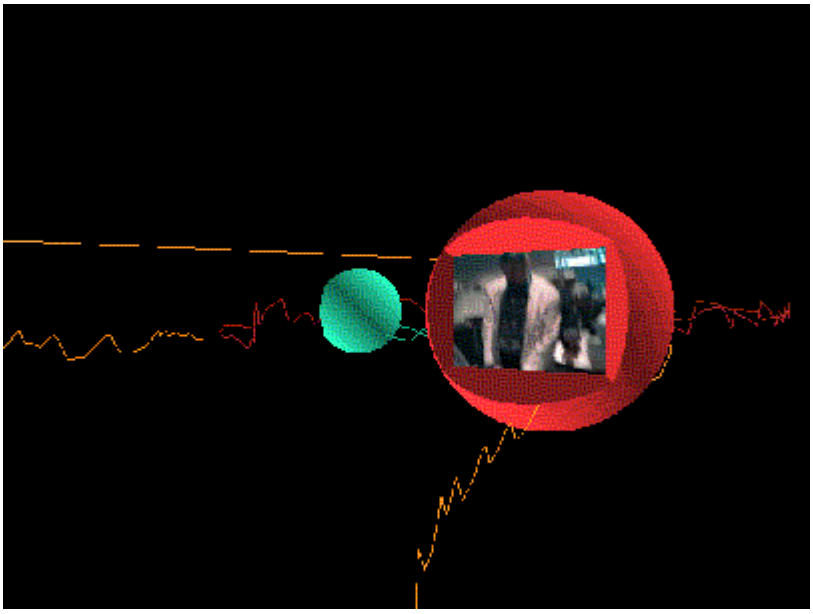

Figure 4: A user avatar in Nuzzle Afar with a video image of their use at ZKM

Within each of the spaces in Nuzzle Afar navigation needs to be learnt anew: effort, space and travel have different relationships within each. When two or more users are in close approximation ‘within’ any of the spaces, they are able to see a video image of one another mapped and wrapped, visor-like, around the middle of the sphere. This allows for recognition of the others’ identity. In meeting each other, any two users are able to enter a new virtual space which encompasses them, while locking out the previous environment and any other inhabitants. This new space is, however, visible to other users as a spherical object inside of which the colours of the two users ‘inside’ merge. Once inside this new space, users are represented via their video images on a 2D square. When one or both of the users leave this space, a video still of the two users remains, along with details of the time and physical locations of the encounter (Blunck & Fujihata 1999).

Public Use

On entering the display space potential users have to determine how the artefact is to be controlled. To be successful, even at a minimum level, this has to be done collaboratively. Typical comments heard during the fieldwork were: ‘we move around with the track balls?’; ‘we’re in the same environment aren’t we?’; ‘can

you hear me [through the mic.]?' It is in and through 'experimenting' collaboratively with the artefact that users find out how to use it and what it does. Thus, users move the track ball around and observe movements on the screens, interpret, in moving around and seeing 'the same things', that they are 'within' the same environment and, even though they are co-located, learn that they can communicate by talking into the microphone.

This initial process of trial and error gradually eases into more serious attempts to use the installation. However, very often this is still a matter of exploring the artefact and, principally, trying to establish a 'convergence of views'. That is, establishing a basis for collaboration by establishing a common viewpoint. For example, one of the first things users typically try to establish is their current position 'within' the space. This consists of assessing the objects displayed on their respective screens and cross-checking them against the other's.

Nuzzle Afar: transcript extract #1.
[7] A: So looking at this [the screen in front], I can see those hands [on partners screen] to my left. Oh, no yours has changed, oh mine's changed now. There's a delay in the visuals as well isn't there? That's obviously, the hands up here now...
[8] B: Yes
[9] A: You're looking directly at that wall, it's slightly to one side, and I was wondering if we could get the same point of view of things, if I'd get to see that round thing in a second. It is...
[10] B: It is the same scene from different perspectives.
[11] A: Well that's what I was wondering, but I can't see your circle that's over there.
[12] B: No. [walks over towards partner] It's the same roof, that's a view of a roof. The browny bit is the top of a house.
[13] A: Ah. There's the circle, so we are in the same...

In seeking to establish current location, the different perspectives offered by each screen are compared by users to orient each of them to securing a similar point-of-view. That is, establish a mutual sense of coordinate position in the space. In and through accomplishing this, users compare the general topography of each screen, then identify finer detail (such as the blue circle) to further confirm common virtual positions in a shared environment.

Once coordinate position has been established, the participants begin to look for an object which might in some sense 'represent' them as virtual embodiments. There is, then, a natural presupposition as to representation: something must be here that's 'us', and more precisely, that's 'yours' and that's 'mine'. What though? Finding out 'just what' is the practical problem to hand:

Nuzzle Afar: transcript extract #2.
[25] A: I can't see that yellow thing on yours [B's screen]. I wonder if they're us? Do you see that blue ball there?
[26] B: Yes.
[27] A: You've got a red ball there. I wonder if they represent us?
[28] B: Well I've got a blue ball as well behind the red one.
[29] A: Right, there that green one. Do you see the green one you've got there?
[30] B: Yes.
[31] A: Do you see the red thing coming out of it? That's there isn't it?
[32] B: Well, that's like a golf ball thing isn't it.
[33] A: Well I can see that, but I can't see you're yellow stream.
[34] B: No, well I can't see your red stream.
[35] A: But there's red there.
[36] B: I can see the red. There's the yellow.

[37] A: Oh, there's the yellow, yeah. So that must be you.
[38] B: So I must be yellow.
[39] A: So can you look for the red one, because I must be red.
[40] B: There's the red [stream]
[41] A: Can you find the red ball though, because then you'd be looking at me. You look like you're coming towards me, if that's you.
[42] B: There's the red ball.
[43] A: Right. I think that red's me looking at you, and there's you looking at me, the yellow one.
[44] B: Right [laughs]
[45] A: I'll try and come towards you and see whether... Yeah, the red one looks like it's coming towards...
[46] B: It's coming towards me.
[47] A: So that's me, and this one's you.
[48] B: I'm yellow, you're red.

The above dialogue again makes visible the effort to achieve a mutual, situated understanding of virtual arrangements through an attention to, and coordinate manipulation of, visible object(s). Notably, coordinate manipulation consists not only of seeing the same things but on the categorisation and re-categorisation of shared objects. Thus, users identify representations that are 'us', and 'yours' and 'mine' in particular, through orienting in the first instance to the same objects – the 'yellow thing', the 'blue ball', the 'red ball there', the 'green one you've got', etc. Orienting to the same objects is achieved in and through categorising what is seen, thereby instructing one another in what is seen. Instructed objects become candidate categories of solution – 'I wonder if they represent us?'; 'that must be you'; 'if that's you'; etc. Thus, the 'blue' and the 'red' balls become candidate representations of 'us', and 'you' and 'me' in particular. Mutual consideration of the objects and their features, however, prompts re-categorisation whereby new candidates of solution are formulated. Thus, in mutually orienting to 'the green one you've got there', the 'red thing coming out of it', and in not seeing 'you're yellow stream' but seeing 'the red' one, the 'yellow' ball becomes 'you' and the 'I' must be 'the red'. The status of these reformulated categories of candidate solution is established by coordinating the manipulation of the candidate objects: 'I'll try and come towards you and see whether ... Yeah, the red one looks like it's coming towards …', 'It's coming towards me.' 'So that's me, and this one's you.' 'I'm yellow, you're red.' Thus it is established that participant A is 'represented' by the 'red' ball and participant B by the 'yellow' ball, and thus 'these' objects (the yellow and red balls) are 'us' and (the red) 'yours' and (the yellow) 'mine' in particular.

Having established the meaning of artefacts (what they are and what they do), coordinate position (where 'we' are), and the presupposed virtual proxies (*that* is 'you' and *this* 'me'), users proceed – insofar as they do proceed; many give up the effort of engagement at or before this point – to 'experiment' with their virtual proxies and to 'explore' the space:

Nuzzle Afar: transcript extract #3.
[60] B: We flipped into another little world.
[61] A: Well, we flipped out again, haven't we? So maybe, we've got to find each other again. Have we changed, because that looks like you there doesn't it? Weren't you yellow, wasn't you?

[62] B: Yes. [scene changes back into sphere environment] When we get to a critical size we flip into this jigsaw puzzle.
[63] A: If I hit you again I think we go out into the world [moves towards partner, the scene changes back to outside, accompanied by a 'Zing' sound]
[64] B: Oh I see. You zapped me.
[65] A: Those are outside now. So we've got four of them outside.
[66] B: Right.
[67] A: So we started of as being a yellow and red ball, and we've gone into each other twice, and there are now two sets of things there aren't there?
[68] B: Erm.
[69] A: We've been in twice, we've got two sets now.
[70] B: We've now got one out in the other world?
[71] A: Well each time we've gone in another two have come out. If we go in again another two will probably come out. You come towards me now. [B moves his virtual position towards A. The scene changes back into the sphere, accompanied by an electronic sound]. Right.
[72] B: Right.

In the course of experimenting with, and exploring the space, users chanced upon 'terrain' facilities. Users came to learn the installation and its features serendipitously. Thus, some users discovered that achieving the 'face-to-face' positioning of avatars allowed communication by microphones and that avatars in the immediate virtual area could also witness their dialogue. Others discovered that when two avatars come closer together, an alternative virtual space is created around them, visible within the departed 'world' as a spherical object made up of the colours of the conversing avatars, and that when one or both of the avatars leave this newly created space, it vanishes, leaving behind a two-dimensional video still composed of the two actual users.

Some features of use

Observations of Nuzzle Afar in public use reiterate endemic practical problems or troubles encountered and addressed by users of artworks at ZKM.[1] Given that these aspects of use have already been treated, they are but summarily restated here. When encountering electronic environments, users must establish what the artefacts they are confronted on entering the space are and how they may used. This occasions collaboration between users - or in other cases demonstrators - in interpreting and making sense of the artefacts. Insofar as artefacts are natural objects in common use, such as microphones, they 'speak for themselves' to some large extent. Insofar as they are not common objects, experimentation more often than not serves to elucidate their meaning and use. Thus, and for example, rolling the track ball and watching the screen serves to establish that track ball is an artefact affording navigation 'within' the space. As noted, the achievement of sense is a *collaborative achievement* and, as such, users constantly ask and inform one another as to the sense of the artefacts 'around' them.

Learning how to use the artefact is a graded process involving much trial and error as well as using what one has already 'found out' thus far. This is perhaps

[1] See Büscher, *et al.* (1998).

not surprising given the less intuitive appearance of the artefact compared, for example, with The Legible City.

Finally, with little exception (except instructed use) users 'learn' the environment serendipitously. Thus, users 'stumble' upon features of the environment by chance. Insofar as public use *of artworks* is concerned, this not is not seen to be a problem (Blunk - eSCAPE Plenary Session, ZKM, Germany, December 1998). Insofar as public installations for public use are concerned, then this approach to design is, as the studies reported here serve to illuminate, more problematic. Simply put, and as the study of Nuzzle Afar points out, in such circumstance users frequently abandon their efforts *to become* users. Serendipity, while fine for the curious, does little to encourage public use.

The construction of public setting

In exploring and reviewed the studies of the four different artworks in these previous sections we have focused on the relationship between the virtual environment and the general public. A particular issue of focus has been the notion of engagement. We have seen how across all of these different environments the process of engaging with the environment has been central to allowing the everyday citizen to migrate from being a member of the general public to a user of the virtual environment and objects making up these artworks.

However, this is far from the only issue to be drawn from these studies of the use of the artworks. In this section of the Deliverable we consider the social organisational aspects of real-world and virtual public space. Here we explore the extent to which a natural sense of space and spatial arrangements underpins interaction 'within' real and virtual environments in considering background expectancies involved in 'setting up' the Legible City for public display and embodied orientations to Legible City's physical structure. This exploration allows us to consider the way in which these environments draw upon the nature of the place within which they are situated and the extend to which these places can themselves be constructed.[1]

One of the first requirements of an ethnographic study is to describe the setting or, to put it loosely, the context in which the activities take place in order to give, we might say, a sense of place. It is not to treat the setting as if it were a container, an arena or a stage, (though some settings might have just this quality), but to acknowledge that real-time, real-world activities occur in a particular place, and that this might influence the character of the interaction which takes place. There are conceptual subtleties to this notion of setting (many of which are discussed by Hughes & O'Brien, 1998; Crabtree *et al.*, 1999). This need not detain us for immediate purposes except to say that as we use the idea it is intended to convey that the character of the setting and the activities which take

[1] Interested readers are referred to Harrison, S. and Dourish, P. (1996) for a more extensive discussion of the nature of space and place within the CSCW community.

place within it are reciprocally connected. In other words, we want to bring out the idea of setting as involving much more than the materialities of rooms, buildings, artefacts, props, and so on, though these are by no means irrelevant. What we seek to capture are the ways in which a setting has a meaning for the people who live and work within it and this encompasses more than a setting's materiality.

The issue of the real-world setting of the artwork, and the virtual settings the artwork situates members actions 'within', is relevant to eSCAPES insofar as one of its longer term objectives is to explore IT spaces which are not rooted to the desktop. IT spaces may be located almost anywhere including various kinds of public spaces, which may be important given how it is envisaged that the virtual space is used. This clearly, but in complex ways, impinges on the issues of private versus public worlds.

Real-world settings

The real-world setting for most works of art is a gallery, museum or exhibition although this is not their sole method of display. Others include carnivals and festivals as well as works of art which are intended to be displayed in public places such as streets or adjacent to buildings, for example. However, here we concentrate on museums and exhibitions since all the works of art studied were placed in such places. Such settings have key features that are important to note.

Firstly, although there are often attempts made by the organisers of the museum or the exhibition to direct an audience through the exhibits, on the whole members of the audience can more or less please themselves when and how they view what is on show. Secondly, and closely related to the first point, members of the audience can choose with whom they view the exhibits. They can view them as a solitary activity or as part of a group, both of these being situations which could well have a bearing upon how the exhibit is experienced. Thirdly, museums and exhibitions have what we can describe as their own 'aura'. By this we mean that as settings in our culture a 'respectful demeanour' is expected on the part of the audience. What they convey is a certain authority, more than a hint that what will be found there is worth taking seriously, worth looking at, worth spending time here. At the risk of exaggerating the point, what we are trying to point to is the ways in which different demeanours are appropriate to various settings. Museums and exhibitions are not market places, they are not bars, nor carnivals, nor airport lounges, etc. They are places where a certain respect is due to the exhibits and where exuberant behaviour is to be avoided.

There is, perhaps, a danger of making too much of the last point, not least because there is nothing sacrosanct about artistic productions being displayed in this way. Indeed, as many artists themselves point out, art should not be confined, or consigned, to museums and galleries. And as we have already pointed out, there are very many instances of art pieces being sited in churches and other buildings, in market squares, by road sides, on hills, in forests, in dining halls,

and more.[1] However, the fact remains that the art installations reported on here were situated in exhibitions and museums (which will be described shortly).

There is one issue, however, which may arise, one that is relevant to system design, namely, the seeming asymmetry between the location of the artefacts studied and the potential location of the systems developed. In studies of work settings there is already a strong connection between the setting-of-inquiry and the setting-of-use. In this case, however, and even though the settings-of-use for the systems being developed are only vaguely envisaged, we cannot, with very much confidence, assume there is a similar parallel between the respective settings. There is little we can do about this except to note it as a possible limitation bearing in mind, too, nor should we necessarily see the discrepancy as a serious obstacle. These are matters that need to be weighed. However, and as we shall see, important lessons were learned for the design of electronic landscapes from the observation of people using, and trying to use, the artworks.

ZKM can by no stretch of the imagination be described as a sombre museum. It was designed as a very different kind of institution bringing art and technology together in new ways; ways which encouraged exploration within an environment which was supportive rather than overly serious. As an ex-armament factory it has available very large spaces some reaching up to three stories high and extending to the full width of the building itself. The Media Museum – there are three museums in the institution itself – houses exhibits of interactive media art by national and international artists. The entrance hall is large and spacious and, shorn of exhibits and posters, would look like what it is, an empty factory space, utilitarian and unadorned. To one side is a shop and, on the other, a café bar. Metal stairways provide access to three floors that provide extensive space for exhibits.

At the time of when much of the fieldwork was done, the main exhibition, Surrogate, consisted of a series of works exploring, conceptually and experientially, the properties of multimedia environments. The majority of the works were interactive installations projecting images onto screens of various kinds. This meant that in order to ensure the quality of the projections many of the installations were housed in and surrounded by purpose built rooms. Thus, while being located in the public space of the museum, the visitor is required to enter a succession of darkened enclosures to view the artworks. As one of the designers pointed out in respect of a previous exhibition held at the museum, the exteriors of the small rooms housing the exhibits were given a ‘mediamatic’ quality to convey the idea that the visitor is passing through a ‘string of events within the architectonic space of the existing building’ (quoted in Trevor *et al.*, 1998). Importantly, through the design of the ‘outer shells’ of the rooms, some first clues about what was ‘inside’ were conveyed. Visitors used these clues as a

[1] The practicalities of types of artistic production is clearly relevant here. Compared to sculpture, which tends to use resilient materials, paintings are much more vulnerable. The relatively delicate nature of many of the electronic components used in the installations studied here places a constraint on where they may be exhibited.

resource in their movement through the exhibition. That is, the use of ‘shell’ designs as a resource in moving around the general space of the museum was / is a practiced use. Most effective were designs that allowed people to get a ‘glimpse’ of the installation from the outside.

In the above respects, practices for the use of the outer shells are understood by visitors against a ‘seen but unnoticed’ background of expectancies providing a distinct ‘scheme of interpretation’ (Garfinkel, 1967)* which enables visitors to *formulate* some initial impression about what is inside. It is against the background expectancies tied to the setting that visitors conduct their affairs (hang around for a while, engage with the installation, move onto another, etc.). In practical detail, formulating an impression ‘about what is inside a room’ consists of: 1) ‘noticing’ (and being able to notice) that someone else’s

1) ‘noticing’ (and being able to notice) that someone else’s curiosity has been sufficiently piqued to motivate them to stay and watch for a while; that there is

something ‘within’ that might be interesting as indicated by other peoples

2) A window, a gap in the wall, or other structural arrangements, allows people not only to ‘glimpse’ the content of an installation, but also establish a sense of its popularity, and the general character of the experience it provides;

3) Moreover, such permeable structures afford the visitor an at-a-glance

3) Moreover, such permeable structures afford the visitor an at-a-glance availability of the ‘queue’ inside the installation. The queuing system that regulates access to the installation is displayed to the passer-by through the position and orientation of people in and around the installation. Visitors can watch events in the installation as the ‘next in line’, they can be ‘spectators’, or

they can be ‘floaters’ – ‘peeping in’, in order to decide whether they want to stay,

This queuing system, displaying to visitors the 'flow' of people through the exhibition space, furnishes part of the information visitors rely on, and look out for, in making decisions over where to go and what to do and in conjunction with points 1) and 2). The queu is an endogenous background expectancy at work in the self-organising 'movement of human traffic' through exhibition space; 'movement' which is irredeemably tied *in and through practice* to the very spatial arrangements constituting the space itself.

Developing an appreciation of the background expectancies underpinning inter-action 'within' public spaces (such as the exhibition space) has been of some not insignificant use in the design process to date; informing, specifically, the development of annotated gateways (Trevor *et al.*, 1998). While it is not always immediately obvious or apparent in 'just what' ways such understandings may be brought to bear on design, it is, nevertheless, towards some significant background features at work in the organisation of public spaces that we now turn our attention in considering the 'setting up' of an artwork at a public exhibition.

Setting up the Legible City (a 'happening' account)

The study reported here was conducted in Essen, Germany at the launch of the Fifth Framework Programme in February, 1999. An evolved version of the installation was displayed on the 25th and 26th of February 1999. This part of the report describes the set up of the installation on the 24th of February. Essentially our interest here is the means by which the virtual environment and the physical interface to it are made to fit into the new place within which they are placed. Given the importance of the physical setting discussed in the previous section developing an understanding of how these environments are configured and set up allows us to develop some understanding of the importance of the fit between the real and the virtual environments. It also offers the potential to allow us to reflect on the issues of configuration involved in using these environments in real world settings.

The following description is called a 'happening' account for the simple reason that the people who set the installation up conducted their activities in the German language – a language the ethnographer who conducted the study did not speak. That he did not understand German does not mean that he did not understand what it was that the people who were assembling the installation were doing. Nor that, insofar as those people were proficient in English, he could not ask them to clarify what they were doing. This is a 'happening' account, then, in that (through points #1-15 below) it 'tells' what happened in setting the installation up. Given the circumstances of its production no claims to rigour are made - many practices whereby the assembling of the installation was achieved are missing from the account. It nevertheless serves to illuminate the rich texture of the work – specifically, the parties, practical details, problems, and solutions - involved in setting up an eSCAPE. Importantly, in this respect the study brings to

light a number of background expectancies essential to the organisation of public spaces; background expectancies that impinge upon design in subtle ways.

One issue is of particular relevance here, namely, maintaining the artefacts. One of the main ways in which artists display their works is by showing them in a number of museums or galleries. Although it is common for major galleries to have their own permanent exhibitions, usually of artists of the past, it is becoming increasingly common for artworks to be transported around various exhibitions. This places a special premium on many interactive artworks that the technological infrastructure be available to support the display and the operation of the artwork itself. We include a report of some of the problems involved here in the next chapter. There is, however, a more general issue arising from this to do with the fact that although electronic landscapes are virtual spaces, the interfaces to such technologies will be located in real-world, real-time space which will need to provide the affordances and the support for the effective use of escapes.

#1. A party of three from ZKM arrive at the exhibition hall and go to find their display spot. On locating the spot, they discover that the allocated space is too small for the installation, measuring some three metres square. They need twice that amount of space to demonstrate this version of the Legible City. 'This' version consists of two bikes co-located 'within' the same space and separated by a 'wall'. The set up team go to find someone who can help them resolve the problem, returning with the exhibition's chief organiser and a fitter shortly afterwards.[1] The organiser, fitter and team members talk over how best to extend the display space. Extending it backwards should double the space and cause the least problems. The fitter leaves the scene and the team decide to start unloading the installation's parts from the van and bring them into the exhibition hall. While the team is unloading the parts, the fitter returns with a 'mate' and instructs him in the changes to be made. The two then leave the scene.

#2. Two different fitters arrive on the scene and, following one the team's instruction, remove a computer provided by the exhibition, 'noting' the move on the list. It takes about twenty minutes to unload the van. Now they need to assemble the installation. No changes have been made to the space as yet however. They decide to erect the 'wall' that goes between the two bikes while waiting for the fitter. The 'wall' is a hollow metal frame about two feet thick to which covering boards will be attached. It is intended to put a concrete 'boundary' between the two bikes and their riders.

#3. The changes to the space have not been made by the time the wall frame has been erected. The team decide to go and sort out registration for the conference. On returning some twenty minutes or so later, two fitters are extending the display space. An exhibitor from the stand next to this one approaches the team. She is not happy about the changes, which reduce her wall space. She tells the team that she was 'promised' that wall space for displaying her posters on. As this is happening, another exhibition organiser arrives on the scene. He asks the team if it is possible to put the bikes side-by-side. The team says no – the technology requires this layout as pointed to the exhibition's chief organiser. This organiser accepts their account. The new layout stays.

[1] They chief organiser was contacted through making enquiries at on on-site booth signed 'Exhibition Organisers' and a large team of fitters are present in the exhibition hall assembling display booths, putting in electric's, lights, computers, and the rest of the things that go to 'make up' the physical structure of the exhibition space within which particular items are displayed.

#4. The fitters finish changing the space and the team start unpacking the installation parts. Many of the parts are in boxes or wrappings which are labelled to show their particular contents. The team start unpacking the bike stands and organising the assembly space. The rear stand and the wall frame are placed in the display area and the team start to position them. They are discussing where to locate things. The discussion involves positioning and repositioning the stand and the wall, and their relation to one another. First they place the stand and wall at varying angles from left to right within the space. They stand back and appraise the potential layout. Then they rearrange the stand and wall frame, placing them in straight line. Again the layout is appraised. The stand is removed from its position and one of the team gets a spirit level from the toolbox. The layout is settled and the team make adjustments to the wall frame until it stands level in its position.

#5. The team now start to assemble the wall casing, at which point a light fitter arrives on the scene: where do the team want lights placing? The team consider and point out where it would be best to position lights. The fitter then leaves the scene. The team carry on attaching the casings to the wall frame, working in concert to place the casings correctly, lining them up with screw holes, and screwing the casings into place. The two front casings are attached and one of the team members unpacks and places a computer inside the wall cavity. He then starts placing and assembling the rest of the technical bits within the wall. Meanwhile, the light fitter returns and starts putting the lights in the requested positions. One of the other team members assembles a strut. The 'strut' contains the 'polyhemus' – the *VR* headset's receiver and tracker. Once assembled, the strut is attached to the wall. (One will be attached to the other side of the wall, hence not being able to locate the bikes side-by-side).

#6. The team member who assembled the 'bits' inside the wall now gets one of the *VR* headsets and attaches it to the computer and bike which has been placed adjacent to the attached strut. The other member, who assembled the strut, now assembles the bike stand, and the bike is then placed on the stand. The third member of the team is attending to aesthetic details, taping up the joints between the wall casings and screw holes to give the wall a 'solid', one-piece, look. (From here-on in he almost exclusively attends to aesthetic details – the other two members deal with the 'technical' assemblies).

#7. At this point in time no technology is 'running'. One of the two boots the computer and then they start unpacking the external computers. There is one computer for each bike, each of which are 'housed' in coloured shells to be located between the bike and the wall. Before the external computers are put in place, the back wall casings, and one of the side wall casings, are unpacked and attached. Again, the three members work in concert positioning and attaching the casings. The back strut and the top part of the remaining casing are put in place – the lower part of the side casing slots into place allowing easy access to the 'workings' inside the wall at anytime - and the third member of the team starts taping up the casing joints and corners.

#8. The other two members start connecting the bike up to 'run'. They put one of the external computers in position and connect the polyhemus, headset, and audio mixer on the bike at the front of the display. They 'power up' the computer – all lights are on although nothing is 'configured' yet. One of the two puts the headset on to see if it's powered up. It looks 'OK'. The back cover is placed on the external computer shell, then the second bike is connected up in the same way. The third member of the team is now painting the taped joints white to blend with the wall.

#9. Having installed the computers, the external monitors are then unpacked by one of the two members dealing with technical assemblies. The two then configure the external computers – the audio mixer is set to zero, they check that the headset is powered up and that cable is the right length (the cable is extended). The headset on the front bike hasn't 'booted'.

One of the two gets the keyboard inside the wall and ‘reboots’ it – ‘sometimes you have to boot it twice’ he explains. This time it boots – the other member checks that the map ‘pulls up’ and that the pedals work. The front cover is then placed on the computer shell.

#10. At this point there is a phone call on the third member’s mobile – it’s the team’s ‘boss’. The team member explains the contingencies encountered and the layout of the installation – its OK, you can see the green bike and when you walk round, you can see the red. They talk about the size of the space and the positioning of posters.

#11. The other two members carry on configuring the bikes – each assumes position at a bike and puts a headset on. They are talking into the microphone on the headsets. The sound is not working. They don’t know where the problem is and are going to ‘shut down’ the audio mixers on the external computers and configure the sound manually. One of the two starts working on the computer inside the wall and then starts running diagnostic ‘checks’ on the audio controller. The other has a headset on – ‘no .. no .. no .. no’. The diagnosis is not going well – ‘I don’t think it’s the electronics because it worked yesterday; I think it’s a plug or cable’ explains the member running the checks. The same member a few moments later: ‘Oh f**k! There are two parallel ports. I think I’ve plugged it into the wrong one!’ The other member changes the connections round and both put headsets back on. Both start talking through the mics. They take the headsets off – the sound is working now.

#12. Everything is working now: the headsets are working, the audio is working, the bikes are working. Now the rest of the installation can be assembled. The ‘frames’ that hold the external monitors are put in place; strut ends are taped up and painted, posters are unpacked, external monitors are installed in their mounts, connected and powered up, on-screen functions are checked, bike functions are checked – everything is up and running. The external monitors are then shut down, everything is okay technically but the installation is not finished yet. Posters, like the wall casings, are put up in concert: one member positions the posters, the other checks positioning and instructs on repositioning, the third attaches the posters to the wall. Attention to detail runs to picking the ‘right’ screws for hanging the posters – brass ones rather than chrome, of a certain size, shape and length. The bikes are secured to their stands (wooden blocks are screwed to the stands to stop the bikes moving around). ‘That’s it’, the last screw is in; all that remains is to tidy up.

#13. Having tidied up, one of the technicians gets on a bike and tries it out while the other watches on. There’s a problem. The ‘birds’ aren’t working properly, one of them is out of position. The other technician checks the other bike out – there’s ‘a polygon mistake’ too (an aesthetic blip for want of a better description). The side wall cover is removed and the keyboard retrieved. There is a ‘known bug’. It was fixed but some of the line code was left in. This code is assumed to be causing the bird problem. The member now acting as ‘programmer’ explains that the code was deleted from the other bike but not this one. He now deletes the code and the bike is rebooted. The rider tests it again and the programmer goes to check the other bike.

#14. As he is about to mount the other bike, the other team member passes him the mobile phone on which he has been talking for the last couple of minutes. Again, it is the ‘boss’. The programmer appraises him of the problems encountered. Meanwhile, the other member starts checking the bike. The two riders check the bikes together. Everything is OK now (which is relayed directly to the boss), except for known problems: the map only shows one arrow (indicating only the rider’s position) and it is not coloured according to the bikes placement on the installation (red or green); and there is the polygon mistake (all details which are relayed to the boss). Following the phone call, the programmer tells the others that the boss wants the team to sort out the map problem (the polygon mistake can’t be fixed now). This version of the map was only installed five days before – the weekend, packing and transport

mean that time has not lent itself to resolving the problem. The team feel that it is risky to start making changes now. The installation is up and running – it may well not be so if they undertake changes. Although they have a *CD-ROM* with another version of the map from an earlier incarnation of the Legible City to-hand, they decide to leave the installation as it is: making changes is too much potential trouble. They might do it tomorrow night – right now they have a running installation and they would like to keep it that way given that 'showtime' is but a few hours away. The seat heights on the bikes are set, floors cleaned, cables placed in their proper positions, tools placed in their boxes, boxes carried out in concert and placed on a pallet. Coats are gathered, bags are packed. The installation is 'set up' and, some five and a half hours after arriving, the job is done.

#15. The following morning: the programmer assesses the possibility of sorting out the map problem. He has discovers that he can't change the code and (thus) can't run the other version of the map. The code is not his (but Manchester's) and incompatible with the old map code. The current set up stays for the exhibition (see Appendix for details of the use).

Background expectancies in setting up the city

Observing how the installation was 'set up' serves, on the one hand, to sensitise developers to some generic socially organised features of public space, and on the other, to identify some generic technical issues involved in making electronic spaces available to public use.

In previous Deliverables we have discussed some of the generic features of the social organisation of public places. In simple terms, the social organisation of public spaces is about the management of access and territoriality within a populated environment. In the case of an exhibition while there is typically some central direction the organisation of the space, it is rarely the case that this works 'first time round' for all the parties who have to use the space for the duration of the event. For example, on arriving at the venue, the installation team finds that changes need to be made to the display space. They cannot just do this themselves, but must obtain permission. Obtaining permission requires some 'negotiation' with the relevant authority (the chief organiser in this case). Authorisation to change the space involves further collaboration on the part of the relevant authority with parties who are to make the changes. Changes are instructable changes, 'pointed out' by production cohorts in specific detail within a context of situational potentials and constraints. In the first instance, then, the social organisation of space consists in a taken for granted orientation to public space by members, and number of pervasive common sense procedures for producing and managing alterations in the fabric of this type of public space. More formally:

- Members orient to public spaces as places subject to access and control – members cannot do, and do not expect to do, just what they want to the organisational fabric of public spaces *ad libitum*.
- A category of activities that might be described as 'ordinary exceptions' (such as alterations to the fabric of space) within public spaces require

warrants for their passing – members expect, as a matter of course, to have to obtain permission to alter the organisational fabric of public spaces.

- Members wishing to make alterations to the organisational fabric of public spaces expect that warrants for ordinary exceptions will have to be 'negotiated' with parties controlling any particular space for their unhindered passing.[1]
- Negotiations are to be conducted with persons with the capacity to authorise ordinary exceptions.[2]
- The passing of ordinary exceptions – the actual instantiation of changes - requires collaboration with parties responsible for the 'ground level' management of the space.
- Collaborations with 'ground level' staff consist of the formulation of instructed actions to be taken in altering the space.

In the second instance, whether alterations in the fabric of public space are to occur or not, members doing displays of a public character show an abiding concern with organisational aspects of 'their' space. That is, with the part of space within which they are physically and interactionally situated. Of paramount importance is the 'layout' of the physical and interactional space. Insofar as planned arrangements are everywhere subject to situational contingencies (Suchman, 1987), then they are subject to a finite number of physical realisations of just what they will 'look like' and the affordances those 'looks' provide for.[3] Members must 'work out' which on-location 'looks' best to satisfy required affordances. Thus, the organisation of particular 'pieces' of public display spaces consists of the positioning *and* repositioning of display features to achieve a concrete sense of just what the display space will look like really, and just what looks best satisfy required affordances.

Decisions as to the layout of the display space are the concerted achievement of parties to the setting's organising work. Decision-making consists of such interwoven things as cooperating in placing and re-placing display features; in assessing different physical viewpoints; in appraising placements; in formulating concerns of affordance' in arriving at situationally reasoned judgements of 'what will do'. Cooperation between members continues in the assembly of display features and consists in the coordination of discrete tasks; of putting particular features in place; of putting together the parts of particular assemblages; of checking the working order of particular assemblages; of diagnosing faults in particular working assemblages; of correcting faults in particular working

[1] This is not to say that warranted ordinary exceptions will pass without trouble. But rather, that their passing is a sanctioned passing, with the circumstantial features warranting the sanction providing grounds for appeal in cases of trouble. Parties may object to the change (as in #3. above) but the 'reasonable grounds' warranting the change go towards (but with no guarantee of success) countering the objection and upholding the change.

[2] Which assumes that means to find them are available. In the exhibition hall at Essen, a booth signed as 'Exhibition Organisers' was clearly visible.

[3] A concern with affordances consist of a concern with such things as aesthetic presentation, viewing potential, access, flow of persons, safety, compliance with other regulations, and the rest.

assemblages; of addressing aesthetic details; of preparing the space for public viewing.

Making electronic spaces available to public use

One of the main design lessons to be taken from the study of the setting up of the legible city is the amount of work and design needed to allow this to take place. Often this is considered "invisible" work and is seldom see as a key aspect of the design and development of software systems. However, it appears to be crucial in determining how this public set up work and is central to setting the character of the electronic environment and the way in which it used by the general public. This raises a number of key questions in terms of the currently accepted boundaries of the development of virtual environments.

1. Where does the design of public virtual environment stop? In current considerations of the development of virtual environments and electronic landscapes this has tended to be a highly insular process with little concern to the world outside the virtual environment. However, the studies of the ZKM and the setting up within the Legible city highlight the amount of work involved in building the physical aspects of these settings.
2. When does the design of public virtual environments stop? A traditional view of software applications is that they are designed, developed and then delivered and subsequently maintained. This view has already being challenged by a number of considerations in CSCW and interactive systems that suggest an on-going process of customisation is critical. In the case of these public virtual environments we see a process of continual modification and a merging between design and maintenance as existing environments are made to fit the demands of the expected public users.
3. How do we support the process of putting public spaces in place? What is clear from the study is the highly contextualised and situated nature of the placement of public interactive devices and public electronic spaces. This suggests a need for us to consider how we provide support for the process of putting electronic landscapes in public spaces and the need to consider the development of guidelines and approaches to the placement of citizen based public access devices in public spaces.

These issues cannot be divorced from the social organisational issues with which they are interwoven. They cannot be divorced in that they are themselves social through and through and intimately tied to the social organisation of public space, specifically in terms of affordances. When assembling particular spaces, members have a concern with the aesthetic organisation of technical features: such things as lights, computers, posters, and other physical artefacts are arranged so as to add and / or blend in with the ‘overall’ organisation of the

space.[1] The ordering of technical things must not prevent the satisfaction of affordances.

The reverse also, and at the same time, holds however, affordances must provide for the ordering of technical things. The ordering of the space must provide for access not just to the space but to the technology of the space. Of particular concern here is the ability to configure the technology, to run checks, diagnostics, and repairs. All activities which require collaboration between parties for their accomplishment and which tend to be considered as development issues with little support provided for everyday users.

Making sense of 'space' in action

Background expectancies are not limited to the organisation of spatial arrangements in the real-world and we here consider one omni-prevalent social organisational feature of physical space integral to interaction 'within' the Legible City. That is, integral to interaction 'within' virtual environments drawing on real-world arrangements of space such as 'cityscape' or urban arrangements.

The Legible City, although consisting of urban arrangements of space represented in a textual form which may be cycled through, was nevertheless oriented to by persons in the course of use as real-world urban arrangements of space are naturally oriented to. That the Legible City consisted of buildings represented by textual forms that could be traversed in novel ways was of no relevance to persons undertaking action 'within' the virtual space. Instead, users acted as they would in real-time by cycling 'down' the Legible City's 'streets' and 'around' its 'buildings' regardless of the fact that the space was constituted by textual representations rather than facsimiles of real-world structures. This mode of conduct displays a natural attitude towards engagement with particular spaces. As such, the Legible City's textual forms were treated as if they were solid structures, and the spaces between them as highways and by-ways. Users cycled down and around the city streets, trying to avoid colliding with, what for them were ostensibly, text-form *buildings.* It was in the course of trying to avoid collisions (not always a straightforward matter due to the turning parameters of the exercise bikes) that users found out that the text-forms were not solid structures. This made little difference to their course of action however (beyond causing some surprise and even confusion) and users, more often than not (though not without the occasional exception) sought to resume a natural, real-world mode of navigating and traversing a cityscape.

Users embodied orientation to the Legible City makes it apparent that when undertaking inter-action 'within' electronic environments resembling real-world spaces, they employ a natural sense of the ordering of the virtual space they are engaging with. It is on the basis of an ordinary, everyday sensibility of particular

[1] Although it should be noted that 'overall' space is elaborated by nothing more than the arrangement of its constituent parts.

spaces and their physical arrangements that persons undertake inter-action 'within' virtual spaces of facsimile character. The point is a subtle one of immense complexity and (potential) import to the design physical e-scapes. It draws attention not only to gross observables (such as an orientation to streets and buildings when encountering cityscapes) but to much finer features such as the use of signs and signals, not to mention the internal arrangements of different kinds of building. By 'different kinds of building' we are drawing attention to the fact that buildings 'house' different activities. Hospitals, offices, libraries, schools, shops, and factories, to name but a few all 'house' different activities – activities which cannot be divorced from the particular spaces and spatial arrangements they might be said to be embedded 'within'. Just as the activities that occur in these, and all other, categorically distinct buildings are unique, then so too are the spatial arrangements at work. And, as noted above, just as spatial arrangements cannot be divorced from the activities that take place 'within' museums and exhibition halls, spatial arrangements at work in hospitals, offices, libraries, schools, shops, and factories, etc., cannot be divorced from the unique activities occurring 'within' them. Particular spaces, activities and spatial arrangements are tied together in and through particular practices and it is persons common-sense understandings of such matters that constitutes the background expectancies against which they make sense of activities and order their spatially situated affairs in conduct. As noted, this is a particularly complex issue and one to which we shall return in the following chapter.

Conclusions

In this chapter we have reviewed some of the studies of the art works undertaken during this year of the eSCAPE project. The review of these studies has considered the more generic lessons of the use of radical forms of interaction and the exposure of electronic environments to the general public. We have considered a number of distinct art pieces

The Blob: an interactive virtual object that allows users to manipulate it by touch causing a range of different reactions within the object.

The Legible City: a virtual cityscape environment that allows a number of users to cycle through it and meet other cyclists accessing the shared virtual environment from different physical locations.

The Web planetarium in EVE: a presentation of the world wide web inside a shared dome that allows a collection of co-located users to simultaneously experience access to a virtual environment made up of on-line web sites.

Nuzzle Afar: an abstract electronic landscape that allows a number of users to meet and record their meeting within a series of shared spaces.

In presenting these studies we highlighted, as a common interactive feature, the means by which users engage with these different environments and the commonality of the engagement process. A common aspect of this engagement

was the way in which scripted descriptions of the nature of these technologies and public demonstrations from guides were used as a set of instructions and familiarisations by use.

We complement our consideration of the use of these environments by the general citizen by considering how these environments were placed in front of these users and the work involved in developing the public settings in which these environments are installed. This configuration and maintenance work appears to be essential to the eventual success of these environments and is an important aspect of design and developing successful environments. In the following chapter we present some broader reflections on the lessons to be gained from these artistic experiences for future developers of virtual environments.

Chapter 4
Interactive Art & Technology Design? Some Concluding Remarks

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In this final chapter we want to step back from the studies and review some of the lessons that have emerged from the studies of the artworks. The aim here is to raise issues which not only have a bearing on this particular project but which also constitute some considerations for the design of virtual spaces more generally. Some of these have been raised in previous deliverables but here they are grounded more in the experience of studying the art installations discussed in Chapter 3 though the remarks are not confined to these. Moreover, they are more in the order of speculative remarks rather than dealing with the specifics of particular virtual spaces or installations.

One of the main purposes of electronic landscapes is to develop an interactive Internet medium. One of its key objectives is to enable geographically distributed persons to connect with each other in some way in the virtual space. This may be for the aim of gathering information of some kind, for the purpose of socialising with others, performing some activity or any combination of these. This, of course, simply states the objective; realising it is a matter of exploring possibilities and long-term research.

The notion of shared space raises a number of issues that will need to be addressed in such research. Many of these are, of course, technical but, equally important, are the problems of creating virtual environments that are, in a serious sense, social. Working out what this means is an issue to which this Deliverable is a contribution. As has already been pointed out many times, the challenge is one of working out how to incorporate elements of sociality, to call it that for the moment, while, at the same time, taking advantages of the affordances of the electronic medium.

In this respect the study of interactive artworks provides the opportunity to explore spaces which, deliberately or otherwise, changes the parameters, the

taken-for-granted organisation, of real-world spaces.[1] This is one of the ways in which the relationship between art and technology can be explored in practise, and for purposes of design. In addition, it enables us to accept the aesthetic dimensions of the artwork as more than just a surface feature. This is not to say that the 'aesthetically decorative' elements are unimportant. It is to accept that the ways in which the artworks breach the taken-for-granted organisation of spatiality can be treated as a 'test bed' for some of the practical design problems that can emerge in the design of electronic landscapes.

As such it also enables us to learn something about the 'human factors' involved. By the term 'human factors' we intend to refer to the gamut of issues bound up with the use of the artefact – in this case the artworks – rather than confine its sense to a particular approach to the study of the human use of technology. The issue of 'usability' is of concern to the design of the artworks just as much as it is a concern in the design of electronic landscapes. Some of the issues involved in usability are discussed in the following section.

Public and citizen based use

Public use has much to do with the 'usability' of the artefact; a not inconsiderable concern given the interactive nature of the installations. What we have in mind here are qualities familiar in the more pedestrian context of system design, namely, how easy is it for users to operate the artefact? As we say, this is a legitimate concern given that the artefacts are interactive artworks that a visitor to the gallery is intended to operate in some way in order to 'experience' what the installation has to offer. It is, accordingly, a minimal condition of the technology of the artwork that it should be usable without much ado. Usability also includes the infrastructure, where relevant, which sustains the operation of the artefact

Becoming a user

As we have pointed out, insofar as the artworks studied are interactive and insofar as future electronic landscapes are also interactive, then first and foremost they raise a major problem, namely, that of 'becoming a user'. As we saw in the studies, a person does not just become a user by simply 'getting hold' of the artefact. He or she has to learn how to use it. Discovering and learning how to use the artefact was an abiding practical concern in all of the artworks studied. What the studies made visible were the worksite specific practices of 'getting to know' how to use the artefact. Moreover, it is apparent that 'becoming a user' is a sequential achievement in not only taking place over a course of time, but in

[1] Bearing in mind our earlier caveat about this expression, we mean by this no more than what, in vernacular terms, we ordinarily understand. This does, of course, beg a huge number of questions to do with how we might analytically describe this. See Hughes *et al.* (1998).

building upon what was learnt earlier to learn how to do ‘new things’ next with the artefact.

Use is frequently initiated through courses of instruction, typically by a demonstrator or, in some cases, by watching as a member of the audience. Many of the instructions, especially early in the sequence, involve preparing the potential user – put 3D glasses on, pull up the 2D map, drag objects on the screen, etc. – so that he or she can operate the artefact. Some of the objects essential to the operation of the artefact ‘speak for themselves’ to some degree in trading on familiar everyday objects and their use. The bicycle of the Legible City is a case in point as are the glasses used in the Web Planetarium in Eve. However, in the absence of instruction, becoming a user is more of a serendipitous achievement but one which rarely produces users of much competence since, as the studies show, many simply ‘gave up’ after a short while. ‘Becoming a user’, then, relies to a large extent on a sequentially organised course of practical instruction.

Although in some ways this might seem a banal finding, it does, and importantly, draws attention to what needs to be a major design consideration of electronic landscapes, namely, support for their learnability and this, on the basis of these findings, turns out to be quite complex and delicate. Although, as we have pointed out, familiar artefacts were often used to facilitate engagement with the artefact, these very often did not obviate the need for instruction.

A ‘first stage’ course of instruction typically consisted of the ‘pointing out’ of features of the installation which would enable the user to begin engagement. This was often tied to descriptions of the general character of the installation – ‘it’s a virtual opera you can interact with’, ‘…a virtual city where you can meet people’, ‘they’re links to the internet’ – along with instructions as to how the engagement features can be used – ‘put the glasses on and drag it around’, ‘pull the map up to see where other people are’, ‘move toward the links by moving the joystick forward’. The important point to note is that these instructions are given in fine detail. Even when the installation is generally characterised this is regularly accompanied by detailed specification of what operating features can be used. In the case of the Legible City, for example, new users are told that they can talk to others via the headset when they are close, can find others in the first place by using the 2D map, and that others are represented by ‘these’ displays on the 2D map, and so on.

A ‘second stage’ course of instruction consists of demonstrating the use of the artefact by ‘walking through’ how it can be used. Thus, and for example, new users are shown how to drag the Mimetic Blob around, how to use features of the Web Planetarium, how to use the 2D map in the Legible City, and so on. Such ‘demonstrations-by-showing-and-doing’ are an important element in becoming a user of the artefacts and such ‘walkthroughs’, which are closely tied to instructions, bring out the operating features of the artefacts.

A ‘third stage’ course of instruction consists of instruction in which the user emulated the instructed action under the supervision of the demonstrator. This

typically occurs when the user has not quite acquired the skills of use but has to be instructed, for example, in 'just how' to drag the Blob around, 'just how' to coordinate hand and body in using the Web Planetarium, 'just how' to use the 2D map in the Legible City. This course of instruction is not so much a precursor to engagement with the artefact but occurs in the course of engagement itself. That is, demonstration-by-showing-and-doing is an unfolding course of action closely monitored by a demonstrator or a more competent user.

Characterising the process of 'becoming a user' as being sequentially organised does not mean that every potential user follows the process in just this order. What it points to are the corpus or family of practices whereby users can learn to use an unfamiliar artefact. Accordingly, in breaching the taken-for-granted orderings of space and spatial arrangements, the studies of artworks in public use point out a distinct area for design, namely, the design of engagement sequences which support the learnability of the electronic landscape.

The particular nature of the support will depend upon the particular environment in which the artefact is placed. As we earlier pointed out, the setting of the artworks was in museums or exhibitions which have their own ambient qualities. These considerations are important for, unlike in large organisations, training cannot always be assumed in the development of eSCAPE s.[1] What will be highly relevant are the availability of opportunities to learn from others. One can imagine that many electronic landscapes might well be accessed privately and the interaction with others supported by the shared electronic space; and this will require careful design thinking.

The organisation of space

One of the major tensions in the design of electronic spaces is that between incorporating the taken-for-granted organisation of space into the virtual space or making use of the affordances of an electronic medium and transforming the taken-for-granted organisation in some way.

The tensions involved are subtle and not easy to predict.[2] On the face of it there would seem to be considerable advantages in using at least some of the features of the 'taken-for-granted' organisation of space in the design of virtual spaces, not least those of familiarity. Take the case of the Legible City. In moving around the virtual space many users oriented to it in 'natural ways'. Although the city is composed of textual representations rather than architectural ones, typically the space was treated as if it were an ordering of physical space. The text was treated as if it was solid structures, or 'buildings', and the spaces between them as 'streets'. Users 'cycled' down and around the 'streets', tried to

[1] Regrettably, even large organisations are not as assiduous as they ought to be in providing training for system use.

[2] It is important to remind ourselves that what here we are referring to the 'taken-for-granted' organisation of spatiality is not some fixed, unalterable arrangement even though it is poorly understood. See, for example, Buscher *et al.* (1998) and Hall (1959), which is still a fresh look at the social organisation of spatiality.

avoid colliding with the text-buildings, and so on. Of course, at some point many also discovered that they could cycle straight through the text-buildings, though in many cases this also worsened the sense of where they were. However, the point is that they were using a 'natural' sense of the ordering of the virtual spaces insofar as these resembled the ordering of space in real cities. The 2D map, for additional example, depends upon natural competences in users coming to understand the map as a map of *this* environment and something that will assist in navigation.

The above features of the Legible City were, of course, provided in the design. But, of course, it would be hard to avoid users employing their 'taken-for-granted' orientation to space as an omni-prevalent sense of the ordering of things when first engaging with any virtual space. It is this backdrop, so to speak, which enables users to learn the ordering of the virtual space. In other words, the natural ordering of spatial arrangements are affordances for the learnability of electronic spaces. As a consequence any departure from these 'taken-for-granted' orderings of spatiality will need to be supported by means for instructing the user in characteristics of the virtual space itself. Experimenting with prototypes of virtual environments and arrangements of space will enable researchers to explore what we earlier called the 'natural sensibility' of spatiality and how, in being 'embedded within' specific orderings of space, such a sensibility might impinge upon, or be exploited in, the design of virtual spaces. Thus, just as the artworks have served to illuminate various taken-for-granted organisations of space, then so too should the development of more domain-specific installations enable research to bring natural orderings and understandings of space in juxtaposition with the development of learnable and usable eSCAPEs.

Navigation and sociality

Intimately connected to the organisation of space is the issue of navigation. As we saw in the case of the Legible City, users make use of their taken-for-granted sense of particular kinds of space, treating the text as if were buildings, moving around them in much the same way that one would cycle around the streets of a 'real' city. In other words, the taken-for-granted presuppositions about the ordering of spatial arrangements are integral to navigation and, hence, a basis for action and interaction.

Of course, the term 'navigation' can constitute a myriad of activities ranging from planning a route across Europe, sailing a yacht across the Atlantic, finding Lancaster University from the railway station, to using a search engine on a web server. It is the last of these examples which of is especial interest to the design of electronic spaces since web browsing in effect abolishes space from the point of view of the user. Navigation is by means of menus or icons and it is the system that, in a non-transparent way, accomplishes the navigation to the relevant server. From the point of view of the user, where the server is geographically is normally only known through the contextual details of such as the contents of the page.

This, of course, one of the major advantages of an electronic medium: its ability to minimise – from the point of view of the user, minimise this to almost nothing – the constraint that travelling through space requires time and effort.

However, and as we have been suggesting, the distributed arrangements of spatiality are themselves a resource for navigation and itself a complex matter. We might, as a very rough and ready distinction, speak of 'local navigation' around immediate surroundings and more 'global navigation' involved in finding routes over larger distances.[1] The distinction is clearly not a hard and fast one and nor is it tied especially to navigational aids though these are not irrelevant. For example, signs are used for 'local navigation' as well as for more 'global', in the latter case often, as in road signs, by breaking the route down into more local distances. Both kinds can, of course, depend upon familiarity even in cases in which a person is visiting a place never visited previously. Department stores are a classic example of such cases, where the direction one needs to go for certain goods is usually posted near escalators reinforcing, in many cases, the 'know how' that shoppers can acquire about department stores and how they are organised.

The general point we are making has to do with the intimate connection between navigational aids and the social organisation of the space itself. In significant respects the former is integral to the sociality of the space. If one considers, even cursorily, the distinction between public and private spaces, for example, then there must be means within the virtual space of signalling these in some way. Matters become even more challenging if one refines the distinction between public and private space to consider spaces that are temporarily occupied by someone, such as a seat at the theatre or a viewing place in an art gallery. The location is not owned by the person except for the short duration in which the space is occupied. In 'real' space we can readily see that the person is occupying that location and navigate accordingly so as not to intrude. How and in what ways such considerations might affect virtual spaces and their navigation is a matter for further research.

A further point which is immensely relevant to providing for the sociality of electronic environments, is that such distributed arrangements will need to be stable and known in common by other users. Providing for an electronic environment that enables users to interact in 'real time' even though geographically dispersed or, preserving the traces of other users, is a major challenge in the design of eSCAPEs. As we saw again in the case of the Legible City interacting, with other users in the way originally intended did not seem to engage smoothly. There are, no doubt, a number of reasons for this including the characteristics of the setting, the 'difficulty' of learning how to engage with the artefact, problems of navigation and the 'unreal' sense of 'being together' within the space itself.[2] Most users who got as far as meeting someone else within the

[1] We do stress that this is a rough and ready distinction.

[2] Some of these problems are currently being addressed in further versions of the Legible City.

virtual space treated the fact of meeting as an end in itself as if this was the point of some game. Few bothered to exploit the possibility of exploring the space together.

We raise these issues not by way of criticism but, rather, to point to some of the very real challenges in designing electronic environments that provide for the possibility of social interaction with others which goes beyond that already provided by such things as email, the telephone or on-line discussion groups.

The presence of others and audiences

We have discussed presence in previous Deliverables (see Büscher *et al.*, 1998) and here we want to focus on an issue provoked by the study of artworks and one which has not been raised sufficiently in the discussion of virtual spaces. One of the features that came out of the study of the artworks was that the settings in which they were located provided for the possibility of an audience observing how some current users operated the artefact. In this discussion we discussed this as one of the means by which users could learn about the artefact by watching others use it.

If we extend this notion to the design of populated virtual spaces, then some thought needs to be given to how the possibility may be incorporated into eSCAPEs. Not only might this facilitate learning by observing others but it also builds in the possibility of sociability.

As we earlier indicated, the notion of a virtual audience is an idea which has not been given much thought in system design. Yet, if in the future we are to have populated electronic spaces which are capable of containing more than one or two inhabitants, then attention needs to be given to the kind of activities that constitute an audience of 'co-present' users.[1] The audience provided by the exhibitions and museums in which the artworks were studied would be an example. In this case, the audiences coalesced out of the attendees as their interest was provoked in one or other of the artworks, and dissolved when the separate interests were satisfied. Another example could be the spectators are a soccer match or some other sporting event, or the audience for a play or a film.

However, as should be clear from the examples just given, the kind of interactions and conventions that typify audiences are variable. We have already mentioned the demeanour expected of attendees at an art gallery or an exhibition that contrasts sharply with that allowed, for example, at a soccer match.

The notion does, of course, raise in a very serious way the technical problems of representing the presence of large numbers of people simultaneously in the virtual space as well as giving consideration as to how such a collection can develop the foci and type of attention that is relevant to the various kinds of

[1] This term 'co-present' is used to demarcate the audience phenomena we are talking about here from such as the audience for a TV programme, say, who could be a distributed collection of individuals who happen to be watching the same programme but who do not otherwise interact.

audience. This clearly goes beyond registering the presence of others by means of trails, for example, or by changing a database to reflect other previous usages.

Sociality in (and as) practise

The above considerations are relevant to what is perhaps the main issue in the design of populated virtual spaces, namely, designing them to facilitate the opportunity for sociality within the space itself. Our view has been throughout to see this very much in practical terms recognising that it represents major challenges both, first, in terms of understanding what it involves and, second, implementing this understanding into viable systems.

There is, of course, an irreducible sense in which eSCAPEs are social by virtue of the fact that human beings use such systems as they do all technologies. This is not, however, a comment of much interest let alone guidance for design. Although banal as the comment might be, it serves as a reminder, and as we have already pointed out, that involvement in a virtual space at current levels of technology cannot entirely strip away the ordinary social conventions of spatiality. Indeed, and again as we have seen, the use of virtual spaces often relies upon such understandings. Of course, sociality is not any one thing, any one feature of our ordinary lives that could be incorporated into some virtual system. The challenge, and again a point mentioned previously, is to work out some appropriate intermeshing of sociality and technological affordances. To put it another way: the challenge is to work out just what elements of sociality, to call them that, will work in particular examples of virtual spaces.

One issue which did emerge in the studies has to do with the connection between what we can, not entirely happily, refer to as the ‘internal sociality’ of the virtual space and the ‘external sociality’ in which the user is normally embedded. An example of the kind of thing we have in mind here is provided by the relationship between the museum in which the artworks were situated and the spaces constructed in artefacts such as the Legible City. We suggest that, for example, the reluctance of many to continue interacting with others within the space was, in part at least, due to the fact that others were there waiting or watching. In other words, the sociality of the situation in which the interface for connection to the virtual space is placed is an important consideration.

The other side of the distinction, the ‘internal’ sociality so to speak, is, as we have already discussed a matter of trial and error not least to do with issues of members’ natural sense of particular spaces, the instructability of the virtual space, navigation, and the matter of audiences. However, one notion which is, we suggest, important is that of ‘worldliness’. By this we do not necessarily mean that a virtual space needs to emulate the real-time, real-world of taken-for granted space, as we have previously called it. The notion, rather, points to a space which is coherent, stable, and learnable. As we will suggest below, this does not imply that the world is beyond change, only that the changes need to be learnable easily, evolutionary rather than radical.

It is possibly only in the speculations of science fiction that we can envisage a virtual world which is entire unto itself and in which the user can shed any connection between the ‘internal’ and the ‘external’ socialities. Accordingly, it will remain a relationship which will need to be thought about in the design of virtual spaces not least in terms of the extent to which the ‘external’ can support the ‘internal’ seamlessly.

Making electronic places.

It is clear from the account of the set up of the legible city reported in the happening account in the previous chapter that the set up and maintenance of electronic environments is a very significant factor in making these spaces usable. Considerable effort is put into the establishment of the setting in which these spaces are placed and the aesthetics and layout provide a source of considerable debate. It seems clear from the happening account that for an effective environment to be usable by the general public that considerable effort is put into set up and maintenance and development of the environment.

When we talk of development we are not simply referring to the creation of a robust and reliable infrastructure, essential as this is to the development of an electronic landscape. We wish to also broaden our consideration to the development and maintenance of the virtual space as a space in which a distributed population can interact over a period of time. It may be that virtual spaces, unlike other software, will have to be much more enduring, evolutionary rather than the radical instantiation that is often presented in the collaborative virtual environment literature.

To a large degree this turn to evolution rather than revolution will depend upon the purpose of the virtual space. However, insofar as we are talking here of populated virtual spaces which must incorporate the features mentioned earlier – among others, of course – these are virtual spaces capable of becoming known in common to a large number of users whose purpose is to share that space with others. As others have said an essential feature of these spaces are that they can be made into places (Harrison, 1996). That is they can be amended and altered to match the demands of the social purpose for which they will be used and that they are ultimately evocative of that purpose.

One consequence of this set of observations is that electronic landscapes are not software that lots of individuals use as individuals and can, accordingly, upgrade as and when they choose without too much impact on others. The software for virtual spaces is likely to be more akin to a major international engineering infrastructure, such as satellite communications, the infrastructure of ship navigation in the pre-satellite era, air traffic control regulations, etc. in which technological change has to focus upon the systemic implications of change so that the whole evolves steadily rather than by radical shifts. This is

also likely to be the case with the organisation of the ‘internal space’, to use a term discussed earlier and discussed in more detail by Harrison et al(1996).

This bids to be another of the major challenges of the design of electronic environments in that there may well prove to be a tension between the speed of technological possibilities and the stability requirements of the virtual space. In other words, it does not follow than enhancements of the technology should alter the characteristics of the virtual space in fundamental ways. And, of course, any such changes would need to be indicated and learned from within the space itself. That is, the virtual world would need to be learnable from within and this would have to include any changes that have been made. This is, of course, the case with the real-time, taken-for-granted world.

Ironically, if this is the case then it is likely that legacy will be a necessary feature of virtual worlds rather than, as now, an impediment to organisational and technological change.

Conclusion

In this chapter we have briefly reviewed some of the general issues which have emerged from the studies reported in this set of Deliverables. There are, no doubt, more that could have been considered but what we have tried to do is move out, albeit more speculatively, from the studies to say something about the characteristics of eSCAPES. Among the features we have highlighted include the importance of learnability and considered some of the ways in which this may be organised. A major issue would be to move beyond the ‘demonstrator’ model in which a persons instructs a novice user to one in which learnability is provided in the virtual world itself. Of major concern here are the socially organised character of the space itself which, among other affordances, must furnish the user with the means of navigating and wayfinding. The point we made here is that the social organisation of the space is integral to the means of finding one’s way around the virtual space.

The general matter of the sociality of virtual spaces was discussed and much in this respect remains to be explored not least in terms of the mix of technical affordances and their connection to general and common understandings of sociality. This we see as a major challenge and field of future research in virtual spaces. In this connection we also raised the rarely addressed issue of audiences within populated virtual spaces and hinted at the serious technical problems involved in representing large numbers of people simultaneously. However, it does seem to us that one of the vital elements in ‘real world’ experiences is that the experiences are shared with others at the same time. To the extent to which virtual spaces might wish to capture such a feature then attention will have to be given to this problem.

Finally we drew attention to what seems to us would need to be a major characteristic of virtual spaces, namely, their stability and change through

evolution rather than fundamental rapid transformations. We suggested that, as in the ‘real world’ legacy might well be a virtue rather than a vice. In other words, virtual worlds might need to develop their own history.

References and Bibliography

Ayer, A.J. (1936) Language, Truth and Logic, London, Gollanz.

Beardsley, M.C. (1958) *Aesthetics: Problems in the Philosophy of Criticism,* New York: Harcourt, Brace & World.

Brewer, J. (1997) *The Pleasures of the Imagination: English Culture in the Eighteenth Century*, London: HarperCollins.

Büscher, M., O'Brien, J., Hughes, J.A. (1998) Interaction and Presence in Shared Electronic Environments: Fieldwork at ZKM, *Presence and Representation in Multi-Media Art and Electronic Landscapes*, eSCAPE Deliverable 1.1, 93-111, Esprit Long Term Research Project 25377, Computing Department: Lancaster University.

Button, G. (1991) Introduction: ethnomethodology and the foundational respecification of the human sciences, *Ethnomethodology and the Human Sciences* (ed. Button, G.), 1-9, Cambridge: Cambridge University Press.

Christensen, M., Crabtree, A., Damm, H.D., Hansen, K.M., Madsen, O.L., Marqvardsen, P., Mogensen, P., Sandvad, E., Sloth, L. & Thomsen, M. (1998). The M.A.D. Experience: Multiperspective Application Development in evolutionary prototyping, *Proceedings of the Twelfth European Conference on Object-Oriented Programming (ECOOP 98),* 14-41, Brussels, Belgium: Springer.

Crabtree, A. (1998) Ethnography in Participatory Design, *Proceedings of the 1998 Participatory Design Conference*, 93-105, Seattle, Washington: Computer Professionals for Social Responsibility.

Crabtree, A., Hughes, J.A., O'Brien, J., Rodden, T. (1999) On the social organisation of space and design of electronic landscapes, paper presented at *The 11th Biennial Conference of the Society for Philosophy and Technology*, Silicon Valley, California.

Crabtree, A., Nichols, D., O'Brien, J., Rouncefield, M., Twidale, M. (to appear) Ethnomethodologically Informed Ethnography in Information Systems Design, *Journal of the American Society for Information Science* (Special Issue on Qualitative Methodology), New York: John Wiley & Sons.

Crabtree, A., Pettifer, S., West, A. (1999) Inventing new technologies: the economics of information and situated evaluation, submitted to *ACM Transactions on Computer-Human Interaction* (Special Issue on Collaborative Virtual Environments), New York: ACM Press.

Duguet, A-M., Klotz, H., Weibel, P. (1997) *Jeffrey Shaw - A User's Manual*, ZKM, Karlsruhe, Germany.

Floyd, C. (1987) Outline of a paradigm change in software engineering, *Computers and Democracy: A Scandinavian Challenge* (eds. Bjerknes, G., Ehn, P., Kyng, M.), 191-209, Aldershot: Avebury.

Garfinkel, H. & Sacks, H. (1970) On formal structures of practical action, *Theoretical Sociology* (eds. McKinney, J.C. and Tiryakian, E.A.), New York: Appleton-Century-Crofts

Garfinkel, H. (1967) *Studies in Ethnomethodology*, Englewood Cliffs, New Jersey: Prentice-Hall.

Garfinkel, H. (1967)* Studies of the routine grounds of everyday activities, *Studies in Ethnomethodology*, 35-75, Englewood Cliffs, New Jersey: Prentice-Hall.

Garfinkel, H. (1996) Ethnomethodology's Programme, *Social Psychology Quarterly*, 59 (1), 5-21.

Goodman, N. (1968) *The Languages of Art*, Indianapolis: Bobbs-Merrill.

Grint, K. and Woolgar, S. (1997) Configuring the user: inventing new technologies, *The Machine at Work: Technology, Work and Organisation,* Cambridge: Polity Press.

Grønbæk, K., Grudin, J., Bødker, S., Bannon, L. (1993) Achieving cooperative system design: shifting from product to process focus, *Participatory Design: Perspectives of Systems Design* (eds. Namioka, A. & Schuler, D.), 79-98, Hillsdale, New Jersey: Lawrence Earlbaum Associates.

Grønbæk, K., Kyng, M., Mogensen, P. (1997) Towards a cooperative experimental system development approach, *Computers and Design in Context* (eds. Kyng, M. & Mathiassen, L.), 201-238, Cambridge, Massachusetts: MIT Press

Grudin, J. (1993) Obstacles to participatory design in large product development organisations, *Participatory Design: Principles and Practices* (Schuler, D. & Namioka, A.), 99-119, Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Hall, E.T. (1959) *The Hidden Dimension*, Garden City, New York: Doubleday and Company.

Hall, P. (1998) The Rediscovery of Life: Florence 1400-1500, *Cities and Civilisation: Culture, Innovation and Urban Order,* London: Weidenfeld & Nicolson.

Harrison, S., Dourish; P. (1996), Re-place-ing space: the roles of place and space in collaborative systems", Proceedings of the ACM 1996 conference on Computer Supported Cooperative Work, 1996, 67-76, ACM Press.

Heritage, J. and Watson, R. (1979) Formulations as Conversational Objects, *Everyday Language: Studies in Ethnomethodology* (ed. Psathas, G.), New York: Irvington Publishers

Hughes, J. & O'Brien, J. (1998) The Social Organisation of Space, *Presence and Representation in Multimedia Art and Electronic Landscapes*, eSCAPE, Esprit Long Term Research Project 25377, Deliverable 1.1, 5-24, Lancaster University: Computing Department.

Hughes, J., King, V., Rodden, T., Andersen, H. (1994) Moving out of the control room: ethnography in systems design, *Proceedings of the 1994 ACM Conference on*

Computer Supported Cooperative Work, 429-438, Chapel Hill, North Carolina: ACM Press

Hughes, J., Randall, D., Shapiro, D. (1992) Faltering from ethnography to systems design, *Proceedings of the 1992 ACM Conference on Computer Supported Cooperative Work*, 115-122, Toronto, Canada: ACM Press.

Hughes, J.A., Crabtree, A., Murray, C. (1999) *Notes Toward Evaluating Artistic Productions*, eSCAPE Working Paper, Computing Department, Lancaster University, UK.

Ihde, D. (1990) *Technology and the Lifeworld*, Bloomington: Indiana University Press

IST '98 (1998) *The Guide*, European Commission & Austrian Ministry of Science and Transport

Kensing, F. & Simonsen, J. (1997) Using ethnography in contextual design, *Communications of the ACM*, 40 (7), 82-88

Kuhn. T. (1970) *The Structure of Scientific Revolutions* (2nd edition), Chicago: University of Chicago Press.

Lynch, M. (1993) Instructed Action and Lebenswelt Pairs, *Scientific Practice and Ordinary Action: Ethnomethodological and Social Studies of Science*, 287-299, Cambridge: Cambridge University Press.

Mogensen, P. & Robinson, M. (1995) Triggering Artefacts, *AI & Society*, vol. 9, 373-388

Murray, C. (1998) *Preliminary analysis of the Legible City*, eSCAPE Working Paper, Psychology Department, The University of Manchester, UK.

Murray, C. (1999) Study of the Fitness Centre, eSCAPE Working Paper, Psychology Department, The University of Manchester, UK.

Norman, S.J. (1998) eSCAPE Art Works: The Commissioning Context, *Presence and Representation in Multimedia Art and Electronic Landscapes*, eSCAPE, Esprit Long Term Research Project 25377, Deliverable 1.1, 227-238, Lancaster University: Computing Department.

Randall, D., Rouncefield, M., Hughes, J.A. (1995) Chalk and Cheese: BPR and Ethnomethodologically Informed Ethnography in CSCW, *Proceedings of the Fourth European Conference on Computer Supported Cooperative Work*, 325-340, Stockholm: Kluwer Academic Publishers.

Rogers, Y. & Bellotti, V. (1997) Grounding blue-sky research: how can ethnography help? *Interactions*, 4 (3), 58-63.

Sacks, H. (1995) *Lectures on Conversation* (ed. Jefferson, G.), Oxford: Blackwells,

Schegloff, E.A. (1972) Notes on a Conversational Practice: Formulating Place, *Studies in Social Interaction* (ed. Sudnow, D.), New York: The Free Press.

Scruton, R. (1974) *Art and Imagination: A Study in the Philosophy of Mind*, London: Methuen.

Shapiro, D. (1994) The Limits of Ethnography: Combining Social Sciences for CSCW, *Proceedings of the 1994 ACM Conference on Computer Supported Cooperative Work*, 417-428, Chapel Hill, North Carolina: ACM Press.

Sharrock, W.W. & Anderson, R. (1994) The user as a scenic feature of the design space, *Design Studies,* 15 (1), 5-18.

Shaw, J. (1998) The Legible City, *Presence and Representation in Multimedia Art and Electronic Landscapes*, eSCAPE, Esprit Long Term Research Project 25377, Deliverable 1.1, 28-35, Lancaster University: Computing Department.

Snow, C.P. (1959) *The Two Cultures and the Scientific Revolution,* Cambridge: Cambridge University Press.

Suchman, L. (1987) *Plans and Situated Actions: The Problem of Human-Machine Communication,* Cambridge: Cambridge University Press.

Trevor, J., Büscher, M., O'Brien, J., Hughes, J.A., Rodden, T., Mariani, J. (1998) Developing a framework for e-scapes, *Presence and Representation in Multimedia Art and Electronic Landscapes*, eSCAPE, Esprit Long Term Research Project 25377, Deliverable 1.1, 113-136, Lancaster University: Computing Department.

Wittgenstein, L. (1958) *Philosophical Investigations,* Oxford: Blackwells.

Appendices

Appendix I
Inventing new technologies: the economics of information and situated evaluation

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Virtual Environments (VEs) are inextricably embedded in Human/Computer Interaction; key issues revolve around the psychology of interaction and perception, together with the socially oriented study of task, engagement and collaborative working. Because of this central role of the participant, the design of VEs that involve a significant degree of novel invention requires the open minded and explicit study of participants at very early stages of the project. This is in contrast to the traditional scheme of an initial "requirements capture" with real user engagement appearing late in the project evolution. We present one such study in detail. The VE application is that of a multi-user distributed art-work aiming to engage geographically dispersed users with each other and the environment. The open-ended nature of an interactive art-work almost demands this tight relationship between user evaluation and design engineering. In the paper, we evaluate the role of situated user evaluations in the evolution of the work and comment upon the wider ramifications of the approach to design.

Introduction

Many of the underlying technologies required to construct shared virtual environments have of late matured to the point where there is less need to demonstrate the basic viability of Virtual Reality (VR) as a form of HCI. Instead there is significantly more scope for examining higher-level issues such as usability or even aesthetics. In this paper we describe the design, construction and evaluation of a multi-media art installation in the form a shared virtual environment aimed at providing a context for social interaction.

The invention and development of these technologies occasion two interrelated problems of design. 1) Requirements capture: in situations *of invention* requirements are *radically* indeterminate. We are not designing for a specific and (relatively) easily specifiable ensemble of activities and information processes, such as in work-oriented design but rather, are faced by radical uncertainty as to just what potential activities and processes might be. A requirements capture phase is of limited viability in such circumstances then. 2) Nevertheless, consideration of the context of use is essential to invention. The

invention and development of new technologies relies in significant respects not simply on engineering issues – such as maintaining interactive frame rates or dealing with network latencies – but also on contextual specifications of what might constitute competent use (Grint & Woolgar, 1997). Such specifications are not machine specifications but human specifications and are primarily concerned with such issues as what user activities should the new technology support and in what ways? How, then, may the tension between the invention and development of new technology and the need to appreciate the context of use be remedied *in the course of* design? Or rather, how, given the limited viability of a requirements capture phase, are end-users and practical circumstances of use to be brought to bear in constructive ways upon the invention and development of new technologies?

Attention to the context of use is not a new concern in technology design. Recognising that activities of technology development depend as much on an adequate appreciation of contextual issues as technical ones – that technology and use context are *irredeemably tied* – has led to efforts to incorporate contextual perspectives oriented towards the practical circumstances of end-users into the design process (Floyd, 1987; Grudin, 1990; Hughes *et al.*, 1992; Grønbæk *et al.*, 1997; Kensing & Simonsen, 1997; Christensen *et al.*, 1998). Although 'quick and dirty', 'concurrent' and 'parallel' social studies (Hughes *et al.*, 1994; Crabtree, 1998), and 'experimental' approaches to user-involvement (Grønbæk *et al.*, 1993; Mogensen, 1995) have enjoyed some not insignificant success in work-oriented contexts of design, integrating ethnographic and cooperative techniques into activities of invention and technology development has proved to be no easy task (Rogers & Belloti, 1997; Grudin, 1993).

One of the primary reasons underlying current difficulties is not simply, and as Grudin (1993) points out, obstructive 'organisational structures' of product development but that rather, that design is not essentially an empirically driven but analytic activity. Empirical knowledge of 'the way the world is' – of end-users and practical circumstances of use – while entering the design process in many ways and at many crucial points, *does not drive design* as such information is neither 'a free good' nor easy to deal with, once gathered taking considerable time and effort to process into some usable form. Whatever the circumstances of design, constraints of cost and time renders the production of contextual knowledge subject to a particular 'economics of information' (Sharrock & Anderson, 1994).

This is not say that as a result of the economics of information that end-users and practical circumstances of use do not figure in current design practices of invention and technology development. On the contrary, as Grint & Woolgar's (1997) ethnographic study of a commercial design company elucidates, design practitioners employ a stock of 'company knowledge about users' in the invention and development of new technologies. Conducting a similar study in a large international development company, Sharrock & Anderson (1994) describe

more precisely and with greater clarity[1] just how end-users figure in design practice in characterising end-users as a "scenic feature" in design reasoning:

> 'Sometimes when the designers were trying to work out some particular detail, reference would be made to just who the potential user might be. Thus, for instance, it might be suggested that the user might be a secretary, or a manager, or a key operator. Having designated these kinds of users, it was possible to introduce sets of expectations about what they might be trying to do, what they might know about the machine or process in question and how likely they were to initiate one or other sets of routines. In the terminology of Schutz (1974), "secretary", "manager", "key operator" are *personal types* associated with which are constellations of roles and relationships. In addition to these types, our designers also employed what Schutz called *course of action types*. Here the defining characteristic is not social identity, gender, organisational position or role, but an envisageable course of action which is being undertaken. It was around what could reasonably be said about such courses of action that "the user" entered the design decision making process.'
>
> (Sharrock & Anderson, 1994: 12)

As 'scenic features' in design practice, end-users and practical circumstances of use figure as distinct types of persons and commensurate courses of action. This common sense, socially shared, culturally available knowledge of types and courses of action constitutes the 'stock of knowledge' designers routinely invoke and draw upon in *undertaking* activities of invention and technology development. Largely, it is only much later in design practice that 'the way the world is' enters the invention process and usually under the auspices of usability trials.

As Grint & Woolgar's study points out, the primary purpose of usability trials in situations of invention is to determine and thereby make explicit whether or not design conceptions of end-users and practical circumstances of use are correct. Notably, in the design practice described by Grint & Woolgar, 'the matter was made explicit … through an *assessment* of the courses of action which a user might engage in' (Grint & Woolgar, 1997: 79 emphasis added).

Results of the assessment are used to refine the technology and make it more accessible; to 'improve' the product. Central to the conducting of usability trials is the "enactment of the users' context" and "construction of natural users". That is, to the selection of appropriate locales and users for testing. Should beta-sites or real-world settings be used? Should users be specialists – expert computer users, psychologists, managers, etc. – or novices, 'coal-face' workers, dis-interested parties, and the rest? Or should users be combinations of various competences? Whatever the choice, 'the way the world is', and (thus) the context of use, invariably enters design through observation of the *performance* of usability trials in the invention and development of new technologies. Observation of the ways in which users accomplish the activities set for them; of the practical problems they encounter in doing them; of the confusions that arise in the doing; and the solutions devised to make the technology work *in situ*.

[1] The clarity or perspicacity of the matter arguably being a result of *attention to the work of designers* rather than *theoretical concerns and textual metaphors.*

It is at this point in proceedings that we feel this report has something to add to the development effort. Specifically, a rather more systematic treatment of the performance of usability trials that we characterise as ‘situated evaluation’. Our basic line of contention with current design practice, insofar as we have one, is that usability studies in the invention and development of new technologies pay a limited attention to performative details; to the heaccities or ‘lived work’ whereby the technology is made to work by the site’s local staff: ‘users’ and ‘testers’ *in medias res*.

The distributed legible city

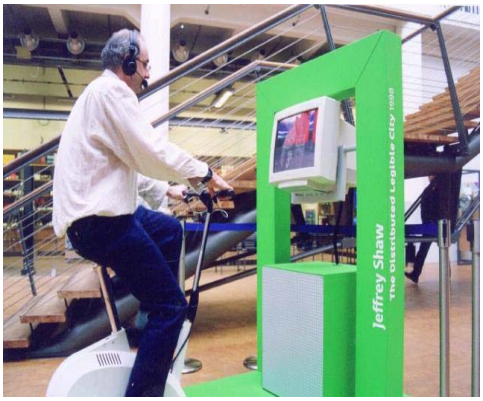
The Distributed Legible City (DLC) represents an evolution of Jeffrey Shaw’s 1990 multi-media installation ‘The Legible City’ (Shaw, 1998). In its original form the piece consists of a darkened cuboid room in the centre of which is mounted a modified ‘touring cycle’ facing a large back-projected screen. Seated on the bicycle, the visitor to the installation is presented with a three dimensional ‘street-level’ view of one of three cities: Manhattan, Karlsruhe or Amsterdam. A liquid-crystal display, mounted on the handlebars of the bicycle, shows an overview map, including the position of the cyclist in the virtual world, and a single large button transports the user between the three cities. Physically pedalling and steering the cycle causes the viewpoint in the virtual environment to move accordingly. Each city is represented in the virtual world not by buildings and traditional ‘street furniture’, but rather by solid letters forming sentences from texts appropriate to the location.

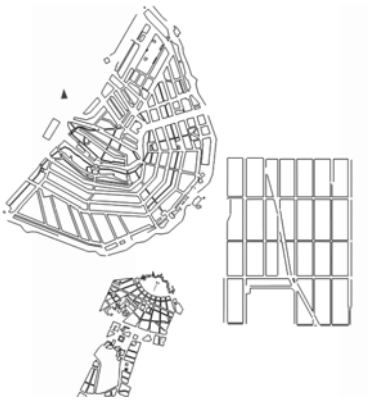
The original version of The Legible City was a single user virtual environment, installed within a purpose-built room, consisting of a custom built and instrumented tour bicycle, liquid crystal display and high-end graphics engine and projection system. The software responsible for rendering the letter-filled streets of the city was written in ‘raw’ OpenGL.

The DLC, the piece considered in this report, extends the original work to include multiple participants, and aims to provide an engaging shared virtual environment in which ‘cyclists’ situated at geographically distant sites can tour together around the three virtual cities.

The original legible city

The first incarnation of the DLC consists of a number of ‘stations’ (three were constructed for the exhibitions considered here) connected via networking technology. Each station has a 21-inch monitor that displays the user’s view into the city, and this is mounted in front of a modified exercise cycle. The cyclist is provided with an audio headset with headphones and a boom microphone, via which they may communicate with the other cyclists in the virtual environment. A button mounted on the handlebar of the exercise cycle activates an overview map that is superimposed upon the current view.





(a) A cyclist at one of the DLC’s stations, and (b) the overview map of (clockwise from top) Karlsruhe, Manhattan and Amsterdam

The issues involved in the design and construction of such a distributed virtual environment fall broadly into two categories: those engineering issues associated with ‘making it work’ in a most basic sense (rendering images onto the screen at an appropriately high frame rate, networking and synchronising the stations, instrumenting the cycle); and those associated with enabling the user to engage with the environment. In principle, the problems involved in constructing distributed virtual environments are well known and scoped, even if not yet fully solved. ‘Usability’ issues as may arise from the generation of virtual environments for supporting ubiquitous concepts such as ‘encouraging social engagement’ or ‘interaction with an art piece’ such as this are considerably less well understood. In practice however, the distinction between one category and the other is subtle. What are ostensibly usability issues such as the ‘aesthetics’, or ‘metaphor’ of the environment have significant implications that must be accounted for in the ‘lower level’ engineering decisions. Complementarily, designer preconceptions about potential usage, and limitations of existing technology percolate through to and shape higher level usability decisions.

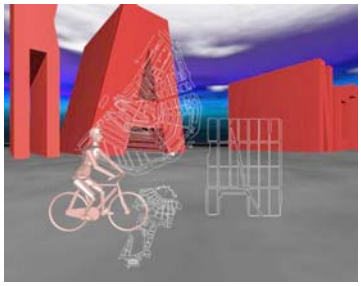
An example of the former relationship is the technical support required for the graphical complexity (‘aesthetics’ and ‘metaphor’) of the cities. Visually, the virtual environments of both the original and distributed versions of the Legible City are similar, with long streets consisting of solid coloured letters with a textured ground-plane representing stone, pavement, grass and, in the case of Amsterdam, canals. These are rendered against the backdrop of a blue cloudy

textured sky. The only significant difference between the original and distributed versions is that in the former the cyclist 'transports' between cities at the press of a button, whereas in the latter all three cities are presented together. Similar challenges are faced by both versions in terms of the graphical rendering of the scene, and simply rendering a view from within the cities is a sufficiently complex issue to warrant mention here. Each city consists of over 12000 solid letters, resulting in more than 170000 polygons per city. Treated as a single scene of such polygonal density, each city individually exceeds the capability of all but the top-end graphics engines to render interactive frame rates (and treated together, as they are in the DLC, the situation is clearly worse still with over half a million polygons to be drawn in all).[1] In both versions however, the fact that from a cyclist's point of view, only a small portion of any city can be seen at any one time may be capitalised upon to reduce the number of polygons rendered in any given frame. Exploiting opportunities for contextual optimisations like this, however, is generally difficult in 'traditional' (i.e. scene-graph [Wernecke, 1994] or VRML) based VR systems, which usually have to resort to more general (and less effective) view-frustum culling due to lack of access to application specific data structures. The original Legible City, which was 'hand-coded' entirely and specifically for the task in low level programming and rendering languages, avoids this issue since such culling routines form a fundamental part of the program's architecture. However, wishing to avoid re-inventing many of the basic requirements of generating a virtual environment without compromising on ability to optimise and cull the scene, in this later version the customisable spatial management structures of the MAVERIK Virtual Reality kernel (Cook, 1998) are used to selectively draw appropriate sections of the city (Gibson, 1998).

A second set of similar 'technical' issues with more subtle implications is associated with the distributed nature of the piece and the sharing of a virtual environment by multiple users. With its emphasis on social interaction in a shared virtual environment, the representation of other users in the Distributed Legible City is of central importance, though it is not clear from the outset *exactly* what form such representation should take. Given the context of the installation, the continuation of the metaphor of cycling through a city suggests that other users be represented as cyclists (rather than as, say, more traditional 'blockies' or walking human-like avatars). The graphical representation of such virtual cyclists is a relatively trivial affair, however, the distribution of their 'behaviour' (in this case the pedalling motion and movement) in the virtual environment presents more complex technological challenges. The main criterion in such a context is that the representations of other users appear to be behaving plausibly *and* intelligibly in the environment. Given that audio communication is possible between users, the behaviour of their representations in the virtual world must be consistent with the content of their verbal communication. The

[1] The distributed nature of the new version of the piece implies more than one 'station' that can participate in the environment, making the use of expensive high-end equipment unrealistic. Wherever possible, 'consumer' hardware was used, such as the standard PCs, 3D graphics accelerators and, in the case of the bicycle itself, a modified exercise cycle.

implementation in the DLC uses the Deva VR system (Pettifer, 1999) to distribute the positions, orientations and velocities of the virtual cyclists, whilst delegating the decision as to how to respond to such ‘high-level’ changes in terms of animation (pedalling, steering) to each individual station. The Deva approach makes a clear distinction between the participant’s perception of the VE, and the underlying "absolute" reality of that VE being managed by the system. The architecture is designed to make each participant’s individual perception of the environment as perceptually coherent as possible based upon the information and resources available. The intention is to arrive at a situation analogous to that of human perception wherein the world is seamlessly given a "best interpretation" as being smooth and coherent, even when evidence is too meagre to warrant that conclusion: optical illusions are one illustration of that process breaking down. Such an approach significantly reduces the load placed on the connecting network, whilst still providing smoothly animated cyclists that are correctly positioned and oriented. Extracts from fieldnotes presented later in this report support this approach inasmuch as a significant amount of communication takes place at the level of arranging for ‘face-to-face’ contact, with no attention paid to such detail as the exact positioning of one another’s pedals. Clearly, such optimisations are contextual and rely heavily on user’s expectations of behaviour in a particular environment. It can be expected that such ‘lazy’ animation of pedalling speed would be inappropriate in, say, a technical simulator designed to improve cycling technique, but where the emphasis is on social interaction, it affords significant savings on network



bandwidth.

The virtual cyclist

Although some basic ‘technical challenges’ must be overcome in order to provide for the fundamental functionality of such an installation as the DLC (for instance the frame rate *must* be high enough to give the illusion of smooth motion), others have less well defined parameters. (It surely must be possible to see the other inhabitants… but what should they look like? Need they be animated? Need their position or velocity be accurate?) Other requirements are even more indeterminate (what is an appropriate metaphor for locating another user in this esoteric environment … an overview map or something entirely different?). In the following sections we describe how situated evaluation informs the process of designing this novel technology.

The distributed legible city in use

The DLC was exhibited at the Information Society Technologies conference 1998 (IST '98) in a large public auditorium at the Austria Centre, Vienna, between the 30th of November and 2nd of December (Crabtree, 1998).* The DLC was invariably described by the installation's sole demonstrator in the course of interaction with visitors as an 'artwork' which 'you can ride through', 'meet people' and 'to talk to'.

The demonstrator was not present at all times during the exhibition and visitors were, as such, left to their own devices (see Murray, 1998). Insofar as the demonstrator was present, then all visitors were encouraged to *become users* of the DLC in the same *practiced* manner. That is, through the same practical techniques of engagement. The ethnographic account below explicates the work whereby visitors became users of the DLC at IST '98. Although simplified, the account is still somewhat lengthy but serves to convey in practical terms a strong sense of just what we mean by 'situated evaluation' and lends the paper its critical purchase in conclusion:

Fieldnote extract #1a.
Exhibitor: hi . would you like to try the bike ride
Potential rider: yeah (gets on bike, looks at earphones and mic., puts them on, starts to pedal)
E: so you're basically riding through an artwork call the Legible City
Rider: OK (slows down pedalling and looks at exhibitor)
E: its on exhibition in the media museum in Karlsruhe . we took the idea and created three installations like this
R: (stops pedalling, looking at exhibitor)
E: and they're all connected you know . so [inaudible] press a button and [inaudible] map (presses button and pulls up map)

Fieldnote extract #2a.
E: you see there are other little dots here and that's yourself (pointing to dots on map, showing which dot represents the rider and others in the environment) . there's people out there . in this case we have only this one [inaudible] in the museum (points to other bike's representation on map) and you can interact with them . you can meet them in the space you know . and talk to them

R: so it depends if there's another one on the bike or
E: yes yes . you can also talk to each other if you're close together . just like in the real world
R: OK . and is it possible to see all the time . where the other one is
E: yeah . you can always pull up the map
R: OK

#2a. Describing the map's features and use

Fieldnote extract #3a.
E: so just experiment a little bit riding around and
R: yeah . OK (rider starts pedalling)

#3a. Directing engagement: experiment a little

Fieldnote extract #4a.
R: but . you can't see where you're going or
E: yes you can . if you pull up the map you see the little triangle . you see
R: and the map . how do you pull on the map
E: push any of the two buttons (looks at buttons on handle bars
R: (presses a button on handle bars; map comes on screen)
E: yeah . see . you're this little triangle (pointing to triangle on map with a pen) and you go in that direction (ditto)
R: where am I (looking at map)
E: you want to turn around [inaudible] to meet the . person
R: I see . then I can meet the other . OK

#4a. Learning just how to use the map in the course of use

Fieldnote extract #5a.
Rider starts cycling through letters lining streets; following a straight line to the other rider using the map
E: you don't have to use the map all the time
R: I want . I want to meet this person so
E: just go up the street here (pointing out directions
R: up this (nodding at street on screen)
E: yeah . up that street here
R: OK

#5a. Coordinating use of engagement features: don't use the map all the time

Fieldnote extract #6a.
E: you can check . that's right
R: (presses map button; pulls map up)
E: yeah yeah . just straight ahead
R: OK
E: should be just around the corner there (points to place on screen)
R: OK

#6a. Achieving competent use of engagement features: using the map to check position and distance to the other bike

Fieldnote extract #7a.
E: it should just . be may be here (points to place on screen)
E: there (pointing out precise place)
R: oh . yeah
E: you should be able to talk to them . if there's someone on the bike
R: how can see if there's someone on
E: you should be able to talk to them if there's someone on . when you see the avatar you do that . talk to them

#7a. Describing next action: go there and talk to them

Fieldnote extract #8a.
R: hello . are you out on the right
R: so . yeah . yeah I'm trying to reach you
R: yeah . getting closer now . you . you shouldn't go that fast
R: no . this is terrible . you're too fast
R: [inaudible] out there having exercise
R: yeah . OK . thankyou . I'm coming
R: I'm too tired
R: OK . I'm following you
R: OK . where are you going . have you been drinking
R: yeah . just behind .. coming round . trying to drive *into* you now

#8a. Coordinating interaction: establishing mutual position

Fieldnote extract #9a.
Rider is riding straight towards others' avatar
R: what'll happen now
R: oooh . oh missed
Rider turns bars; trying to find other avatar
Rider is riding round in circles but can't see others' avatar
Rider pulls up and checks map
Exhibitor points other bike out to the right of the rider
Rider keeps map up and starts pedalling round to the right
Rider still can't see the others' avatar
R: OK (takes headphones and mic off; gets off bike) . so . it's very exhausting (talks briefly to exhibitor and leaves the site)

#9a. Coordinating interaction: attempting to accomplish 'face-to-face' meeting

Embodied use considered

The # numbered ordering of the fieldnote extracts is not an arbitrary ordering but emergent from, and describes in real-word, real-time details of embodied use, the

unfolding, sequential order of human-machine interaction. That accomplishment consists, in unfolding sequential order of the local staff's 'lived work', of

1. Making and accepting an invitation to try the technology and introducing the user to the technology in describing what it is: a city-scape artwork connected to other installations in other locations.
2. The ostensive definition of engagement features and their use; of technical features and what can be done with them: that a map is available, the dots on which show where you are and where others are that you can interact with and talk to when close to them, and which you 'pull up' by doing this: pressing this button here on the handlebars.
3. Engendering engagement in directing the user to begin use: experiment a little
4. Pointing out just how to use engagement features in the course of use: pull up the map; you are here, the other is there.
5. Coordinating the use of engagement features: use the map to check.
6. Achieving competent use of engagement features: using the map to check - that's right.
7. Describing the next action towards undertaking interaction: go there and talk to the other when you see the avatar.
8. Coordinating interaction through establishing a mutual and known position in virtual space: I'm trying to reach you, slow down, I'm following you, I'm just behind you, I'm trying to drive into you now.
9. The attempt to coordinate a 'face-to-face' meeting of avatars and disengagement with the technology.

This unfolding order of work is primarily an unfolding course of description *instructing* the user in the accomplishment of engagement. In other words, in describing the installation, its features, and their uses, *the demonstrator* provides a *course of training* which engenders engagement in its achievement. Thus, users *become* users of the technology. The formal features of that course of training are described from points one through to nine above. Consideration of those features serves to elucidate both generic and substantive features for design. That is, features which are generalisable to a great many 'virtual' technologies and features which apply to just this technology: the technology constituting the DLC.

At a generic level, the publicly available and distributed character of virtual technologies raises the question as to *just how* potential users are to *become* competent users of those technologies? Engendering public use is a significant problem to be reckoned with. Unlike in large organisations of work, training cannot be assumed in the development of virtual technologies for public use. Studies of a variety of virtual technologies in public use suggest that solutions to the problem consist in significant part in the design of 'engagement sequences'

- Instructing users in the concrete character of the environment.
- Ostensively defining engagement features and their use.
- Walking users through the use of engagement features.

The unfolding character of engagement work clearly suggests that courses of instruction should not be supplied 'up front' and prior to interaction but *in and as the course of* interaction thereby providing for competent use.[1]

Substantively, situated evaluation of the Legible City in use drew attention to the following interactional 'problems'.

1) As a *navigational* device, the 2D map was central to the accomplishment of engagement although learning how to use it in a competent manner was not a practically untroubled affair (as extracts #1a through to #7a make clear). In the first instance the map and operations for 'pulling it up' had to be 'pointed out' to users by the demonstrator (#1a-#2a). There was a similar *lack of computer-based instruction* with regards to the meaning of the map's features. Although users oriented to the map on the basis of a common 'background expectancy' (Garfinkel, 1967) that the map was a map of the DLC and its features situationally relevant ones intended to aid navigation of that place, nevertheless the demonstrator had to render those features intelligible. Thus, 'these are cities'; 'this dot is you'; 'that dot the other', etc.[2] Again, learning how to use the map in a competent fashion – to *check* position and relation to the other rather than traversing the cityscape with map permanently pulled up – required a distinct course of instruction that was not supported by the machine (#3a-#7a).

2) Insofar as competent use of the map provided for 'finding' the connected other in the virtual environment, then locating the other's avatar occasioned a recurrent practical problem for users (#8a). Namely, how do you know if there's someone else on the other bike? In the absence of any clear indication of 'inhabitance' or *presence*, users sought to resolve the dilemma through 'interrogation', cycling towards the avatar repeatedly saying 'hello?'. When no reply was forthcoming, the 'corpsed' (i.e. uninhabited) nature of the avatar was inferred and users cycled away, often quitting the installation shortly thereafter.

3) Insofar as the others' avatar wasn't corpsed then the ensuing course of interaction occasioned a marked difficulty: coordinating a 'face-to-face' meeting with the connected other (#9a). In real-world, real-time interaction speakers naturally and reflexively orient directly to one another in undertaking conversational exchanges. In attempting to achieve just such *a conversational orientation*, and with an invariable regularity, the cyclists 'overshot' one another's virtual positions; an event which occasioned 'corrective' cycling to

[1] While objections may be made that this is an enormous problem that human-factors researchers have been contending with for years and which will take years of further research by a myriad professionals to even begin to appreciate fully and remedy, we should be sceptical of such claims. They are far more indicative of the state of human-factors research than the nature of the problem to hand. Without trivialising the problem, or detracting from the work occasioned in designing 'engagement sequences', one need look no further than the booming games market, and the evolving *ways* in which use *is* engendered through courses of training, to get the gist of matters here.

[2] In the absence of the demonstrator, the meaning of the map was constructed over time through exploring and experimenting with the installation. On discovering the map, users might notice that one 'dot' moved when they moved the handlebars or that the position of the dots was changing over time thereby inferring that the dots represented others. Notably, in such situations, the map was not central to engagement. And just as notably in such situations, interaction would often be brought to a close before 'meeting' the connected other (Murray, 1998).

achieve ‘face-to-face’ contact. A great many users, as the one instanced above, found the work of corrective cycling frustrating and ceased interaction, dismounting the bike and leaving the installation. Those who did persevere, would briefly engage in conversation, exchanging little more than pleasantries (‘hello’, ‘nice to meet you’, ‘who are you?’, ‘where are you?’, ‘where are you from?’, etc.). The bulk of conversation-cum-interaction, occurred not in face-to-face meeting but in achieving face-to-face meeting. That is, in coordinating the effort of cycling so as to be able to locate one another and meet.

Awareness of these problems, derived from situated evaluation of the ‘lived work’ of technology usage, provided for iteration and refinement of the technologies at work, and it is to a consideration of those issues that we now turn our attention.

The distributed legible city revised

The situated evaluation of the DLC in use highlighted several significant human-machine and human-human interactional problems and occasioned the making of number of technical changes to the installation in order to address them.

1) Navigating the virtual space: In the light of the observable difficulties experienced by users in attempting to locate one another, the overview map was dropped in favour of a ‘tour guide’. This took the form of an animated, flying bird that positioned itself so as to appear to be flying in the direction of the closest other user whilst maintaining ‘line-of-sight’ contact with its ‘owner’. Technical issues / changes.

2) Achieving conversational orientation: The most significant of these in terms of its architecture involved the use of a Head Mounted Display (HMD) on each station. Though this changes the nature of the piece significantly from a ‘desktop’ (i.e. a world viewed ‘through a window’ and ‘from the outside’) to an ‘immersive’ (a world viewed from the inside) environment, in this report we are primarily concerned with the practical implications arising from the ability to simply ‘look around’ inside the environment, giving less consideration to the ancillary issues associated with the changes in ‘presence’ afforded by the use of immersive technology. In this revised immersive DLC, each station was fitted with a Virtual Research V8 headset (a high-end device capable of producing stereo images at VGA resolution) and Polhemus Fastrack position sensor, enabling the system to determine the position and orientation of the cyclist’s head and to render an appropriate viewpoint. Associating the viewpoint with the position of the cyclist’s head movement, rather than directly with the orientation of the virtual cycle gives the user the freedom to look in a direction other than that in which they are cycling, enabling them to easily look over their shoulder or to one side without the need to re-orient the cycle. The animation of the virtual cyclist was modified such that the head orientation reflected that of their user.

The revised version of the distributed legible city in use

The following account of the revised version of the DLC in use is a selective account, only documenting parts of the sequence relevant to the issues described above. In its revised incarnation, the DLC was exhibited, and made available to public use, at the Launch of the European Union's Fifth Framework Programme at the Messe Essen conference hall, Essen, Germany between the 25th and 26th of February, 1999. Unlike the previous exhibition, where the stations were situated at significant distance from one another (either in different cities or throughout the exhibition halls at the ZKM), restrictions placed on 'booth size' at the Launch required that the two stations be sited close together. They were installed facing one another but separated by a high wall to separate the users from one another (this difference in physical layout holds no particular implications for the system architecture of the installation). Although in this revised version, the user would wear a Head Mounted Display, a similar sequential order of work between the demonstrator and user was permitted in retaining the monitors mounted in front of the bike. Thus, the demonstrator had the same perspective on events as the user, seeing exactly what the user saw. Just as at IST '98, new users were 'introduced' to the installation and engagement features 'pointed out'. Users were then prompted to 'experiment' with the installation and instructed to 'follow the birds':

Fieldnote extract #4b.
User putting VR headset on
Demonstrator adjusting headset
U: it's good
D: it's good
U: yes
D: OK . so .. try to go
Demonstrator on other bike tells this demonstrator that the other bike is free
D: maybe you want to . to do . on the other one [to UC]
User's Companion: no
D: OK . just go along [to user]

#4b. Donning the headset

Fieldnote extract #6b.
Demonstrator: the birds are above you
User: I don't see them
U looking for birds
D: I think he's right . the bird is right
U: right
D: right
User's Companion: destra (right)
D: right side
UC: destra (right)

#6b. Following instruction: looking around for the birds

Fieldnote extract #7b.
U cycling, turning right
D: ah . this is you
UC: questo sei tu (this is you)
UC: devi [sterzare] contro fuxia (you have to turn against fucia)
Turn, that is, next to a particular piece of the cityscape text
D: [inaudible] try to reach him
UC: cerca di raggiungerlo (try to catch it)
D: and if you are very near you can [talk]
UC: quando sei molto vicino puoi anche parlargli
(when you're really close you can even talk to it)

#7b. Finding your bird: position circled on screen

D: thankyou
D & UC laugh

Fieldnote extract #8b.
U: what do you see
D: [inaudible]
UC: [laughs]
UC: vai vai vai . veloce . devi raggiungerlo
(go go go . fast . you have to catch up with it)
U: lo so faccio [troppo] (I know)
UC: eh
UC: dai dai dai dai . *corri* (go go go go . *run*)
U: [laughs]
UC: pero' scappa (but it's running away)
UC: vai vai (go go)
D: it's . the other one is there
UC: l'altro e' piu' veloce . oh (the other one is faster . oh)
U: che ci posso fare (what can I do about it)
UC: vai veloce . come fa ad essere cosi veloce (go fast . how can it be so fast)
U: e' un imbroglio (it's all a set up)
UC: no . sta andando piano (no . it's going slow)
U: e' un imbroglio (it's all a set up)

#8b. Finding the others' bird: position circled on screen

#8b. Confirming that the 2nd bird is others' bird

The user continues to follow the bird, notably trying to avoid the text lining the city streets. The demonstrator tells him that it doesn't matter, he can ride straight through the text, which the user does. On doing so he enters an open space:

Fieldnote extract #10b.
U: oooh
Other avatar comes into view
D: now . say something . say something
UC: digli qualcosa . di qualcosa (tell him something . say something)
U: hello
UC laughing
U laughing
U: where do you go
UC & D laughing
UC: vai vai vai vai . digli qualcosa . digli qualcosa
(go go go go . tell him something . tell him something)
U: hello
U: what's your name
U: my name is Salvatore
U: where do you want go
UC laughing
U cycling after avatar and laughing
U: go slowly . why you go so
UC laughing loudly
U: cos'e' che devo dire (what do I have to say)
U: eccoci qua (here we are)
U: okay . stop
UC: eccolo . eccolo li eccolo li (there . it's there it's there)
U: okay

#10b. Finding the connected others' avatar: position circled on screen

#10b. Approaching the connected other - position circled on screen

#11b.
U: we try to go together
U: where do you want go . right or left
U: right . *ai*
UC: ai . [inaudible] addosso (ouch . you hit it)
U: okay . okay
U: *my right* not your right
Everyone laughing loudly

#11b. Coordinating interaction: lets go right; my

#12b.
U: I go . my right
UC non va (that's no good) [laughing]
U: okay . you see me
U: you tell . okay
UC: no . no .dove vai (no . no . where are you going)
U: I go . on the map
U: on the map . to my right

#12b. Coordinating interaction: checking the map

U: okay
U: are you with me
U: I don't see you
U: do you see me
U: I go right
U: *I go home*
Everyone laughing
U: basta (enough)
U: where are you
Everyone laughing

#12b. Where are you? Loosing sight of the other

The other cyclist has ridden off and the user starts to look around for the birds. He sees the others' bird and follows it:

#14b.
U: eccolo li (there it is)
UC: ah
U: visto che l'ho trovato (see I found it)
U has reacquired others avatar
U: hello . I see you again
UC: magari e' un'altra persona (maybe it's a different person)
U: ah . e' un'altra persona . ecco (ah . it's a different person . there)
U: e' cambia (it's changed)
UC: e' un'altra persona (it's a different person)
U: okay
UC laughing
U: you are the same
UC: vai (go) [inaudible]
U: go on you
UC: e' giovane questo qui . corre (he's young this one . he's fast)
U: I go with you
U: you go home
U following other avatar

#14b. Reacquiring others' avatar

#14b. Coordinating interaction again: I follow you !

The user followed and then lost sight of the connected other. He then oriented to the birds again and reacquired the others' avatar. On reacquisition the user brought interaction to a close and left the installation.

Embodied use considered

Once again, the 'lived work' whereby the technology is made to work and visitors become users, is a unique sequentially ordered accomplishment. Is this to say that every user engaged with the technology in just the same way? Well no. Some users just watched, others found their curiosity piqued but did little more than put the headset on before quitting, or abandoned use when there was no-one else to interact with. Notably, the combination of riding a bicycle and wearing the VR headset induced nausea for a number of users, quickly drawing their activities to a close.[1] The work of the site is full of such contingencies but, insofar as visitors did become users of the technology, then it was in accomplishing as an observable matter of routine (i.e. recurrently) the distinct sequential order of work (partially) described above.

Design-solutions to the practical problems of use emergent from the IST '98 evaluation brought the following issues to light:

[1] We might speculate that a loss of peripheral vision occasioned by wearing the headset affected the users' sense of balance hence the feelings of nausea when cycling.

1) Navigation: Like the map, the use of the birds was an instructed use. Unlike the map, no background expectancy was at work here. The sense of the utility of the birds was not at all intuitive but had, as a matter of necessity, to be ostensively defined for users. Hardly surprising, afterall it is not at all natural to look up to the sky, seek out, and follow birds to your destination in navigating places and spaces in the real-world. Nonetheless, there was a marked economy of use to the birds. The meaning of the birds was conveyed, and learnt, with greater ease. As comparison of sequence segments (#1a-#7a) and (#6b-#8b) makes clear, there was a simplicity to the instructed use of the birds. Learning to use the birds consists of instruction that the birds are 'above you', that 'this is you', the 'other one is there' and 'you have to catch up with it'. If and when the user loses sight of the others' avatar, how to go about reacquiring it is simply instructed: 'look for the bird'. This contrasts with use of the map which requires instruction as how to 'pull it up', what the marks on it mean (this is Amsterdam, Karlsruhe, etc.), this dot is you, that dot the other, and the achievement of competent use (learning to use the map just for checking). In observable details of the 'lived work' of technology usage, although users encountered the birds as unfamiliar objects, they clearly found it easier to learn and achieve competent use of them *in situ*, in contrast to the map, as a result of a simplicity and economy of instruction. Less instruction was required to render the meaning of the birds intelligible and (thus) to make them work.[1]

2) Establishing presence. Efforts to make visible to users whether or not an avatar was inhabited or not were less effective than anticipated. Indeed, it is fair to say that the changes made no difference whatsoever to the sequence of human-computer interaction insofar as the 'corpsed' status of the others' avatar was indistinct. Whether or not the avatar was occupied was not *recognisable* by users or demonstrators. As sequence segment (#4b.) makes clear, the corpsed status of avatars was conveyed between demonstrators by word of mouth. Similarly, establishing the presence of a connected other in the course of 'finding' the other avatar was accomplished through compliance with the instruction to talk (#10b.).[2]

3) Achieving a conversational orientation. On this point a significant success can be claimed. The natural and reflexive orientation to the speaker was provided through the VR headsets, thus supporting interaction within the virtual space. Although the coordination of interaction occasioned practical difficulties, such as orchestrating directions to travel in (#11b.), the resolution of such problems was marked by a particular efficacy in movement. Just as the 'overshooting' problem was remedied by the turning of the head, then so too the coordination of

[1] Insofar as such objects are easily learnable given adequate instruction, problems of use are foreseeable in heavily populated environments. While the map allows a limited degree of individuation by distinctly coloured marks representing the position of other users, the birds did not do so. While individuation is not a problem where only two users are concerned, the same cannot be said where more than two users are concerned. Obviously, some means of individuation is required if persons are to find particular others in heavily populated electronic space and time.

[2] A future version of the DLC, to be exhibited in late 1999 includes explicit 'corpsing' of uninhabited cyclist avatars. Such avatars will be represented by a partially transparent rider-less cycle.

orchestrated movements were remedied by users – *and without need for instruction*. The VR headsets supported the natural propensity to orient to the conversational partner and significantly reduced the need for 'corrective' cycling. Furthermore, in reducing practical difficulties occasioned in achieving a conversational orientation, interaction was significantly increased. Users were no longer frustrated in their attempts to meet one another 'face-to-face' and thereby motivated to cease interaction and quit the installation but instead, ease of use promoted interaction. Although the nature of the talk between users was little different (none were 'fascinated' by the textual ordering of the urban space), users chased each other, followed each other back and forth, and generally attempted to coordinate their efforts at cycling around with a much greater frequency before quitting the installation. Were there some purpose to the interaction, some mutual activity to be achieved beyond the playing of tig-like games, interaction would, prospectively, have continued further.[1]

Particular successes and failures aside, the work documented here is not, of course, the end of the story. Much work is yet to be done in designing virtual technologies of purposeful utility and (thus) in constructing 'virtual reality'. To date, although inventing and developing new technologies, we have been doing little more than exploring potentials and constraints in the design of electronic landscapes through the modification of electronic artworks. Nonetheless, the practical purchase of situated evaluation in the on-going effort to invent and develop new technologies has hopefully been demonstrated to a sufficient degree. It is towards a more formal consideration of that particular purchase that we now turn our attention.

Inventing new technologies

The invention and development of new technologies such as distributed virtual environments presents design with two broad categories of 'technical challenge'. On one hand are the engineering issues involved in making design visions work. And on the other, usability issues concerned with the requirements that end-users and practical circumstances of use place on the technology. While analytically distinct, in practice the relationship between the two categories is much subtler. What are ostensibly usability issues, in practice, have significant implications that must be accounted for at both low and high levels in engineering the system.

As elaborated in our introduction, a requirements capture phase in activities of invention and technology development, is of limited viability due to the radically indeterminate character of requirements in this particular context of design. Envisioning the design of virtual environments that promote and support *social interaction*, for example, is simply too large a 'problem' to scope or formulate requirements for except in the most general of terms. Nevertheless, end-users and practical circumstances of use are not excluded from design,

[1] Naturally, providing technical infrastructures for the construction of purposeful environments, and mechanisms of interaction, is an abiding and on-going concern in our work.

entering the design process in many contingent ways as scenic features in design reasoning. Drawing on a common sense, socially shared, culturally available 'stock of knowledge', users and practical circumstances of use are routinely construed by designers as *types* of person and commensurate *courses of action* respectively (Porter, 1988; Schon, 1988).

Insofar as design is not primarily an empirically driven but analytic activity, and insofar as design, like a great many other activities, is subject to an economics of information, then empirical knowledge of end-users and practical circumstances of use largely enters late in the process under the auspices of usability trials. The purpose of the trials primarily being to *assess the efficacy* of technical arrangements designed to support construed courses of action and, thereby, to inform the design of technical 'improvements' of the product.

Assessment is an observational exercise oriented towards the performance of usability trials. Specifically, to the ways in which users accomplish the activities set for them; to the practical problems they encounter in doing them; to the confusions that arise in the doing; and the solutions devised to make the technology work *in situ*. Our basic line of contention with current design practice is that usability studies pay a limited attention to performative details. As Bannon (1991) describes matters here, usability studies focus on features that have 'been found in the use situation to be good or bad from the point of view of the user'. While positive, current practice has, we believe, too narrow a focus.

As the sequential orders of work documented here make perspicuous, the embodied achievement of use, whether successful or not and with all its contingencies, is the irredeemably cooperative, socially organised achievement of the site's local staff: users ***and*** demonstrators (or testers). It is an attention to the *concertedly produced* heaccities or 'lived work' whereby the technology is made to work by the site's local staff - users ***and*** demonstrators work – that is largely overlooked in usability trials.

It might otherwise be said that demonstrators or testers are crucial to the accomplishment of usability trials. The trials could not be conducted without them. Yet, curiously, the ways in which demonstrators/testers *engender use* in the course of conducting trials is invariably disattended. Focus is restricted to the 'problems' from the users' point of view. There is, then, something crucial missing from current studies-cum-assessments of use.

The 'missing what' of the matter might be said to consist of the locally produced 'engagement sequences' unreflectively, but nevertheless skilfully, constructed by demonstrators/testers *in situ* and *in the course of interacting with users* in engendering use.[1] Sequences of interaction engendering use are *unique*,

[1] This is not to say that persons who conduct usability trials do not pre-figure the activities they wish to engage users in, clearly they do, but to point out that pre-figuring the accomplishment of user activities *is not the same* as realising the accomplishment of user activities. The point, of course, is that it is in realising the accomplishment of user activities – i.e. in administering the test – that use is engendered. What does that situationally produced sequence of work consist of in embodied detail? Knowing *just what* would seem to be important insofar as it is through the 'lived work' of administering test schedules that use, and all the issues that brings to light, is engendered.

tied specifically to the technology under evaluation (note the *differences* between the two studies here). Furthermore, their construction consists of recurrent organisational phenomena which may be oriented to and documented in conducting 'situated evaluations'. Notably, *engagement sequences* consist of *distinct courses of instruction*, and each and every course of instruction consists of *distinct 'component events'* (Garfinkel, unpub. manu.); such as 'introducing' the user to the technology, 'pointing out' engagement features, training the user in competent use of particular engagement features, and so on. Attention to the 'lived work' of the component events comprising the sequence serves to elucidate the background expectancies, contingencies, circumstantial problems, confusions, and practical solutions devised by the technology's staff and in such detail thereby serves to inform design in constructive ways (as demonstrated in the evolution of the DLC, for example).

Such an approach to usability trials – i.e. situated evaluation – also serves to bring an ethnographic perspective to bear on activities of invention and technology development in a systematic way in explicating the sequentially ordered arrangements of cooperation whereby use is engendered. Furthermore, the approach incorporates a cooperative experimental perspective into such design processes in manageable and informative ways in that, and precisely because, the approach *relies on* end-users getting 'hands-on' the future. It is just that 'hands-on' experience that elaborates end-users' practical circumstances of use, such as the observable need to achieve a conversational orientation in undertaking co-located interaction in virtual space, for example. It is, we propose, in elaborating the *cooperative work* whereby demonstrators engender use of the technology and users get 'hands-on' the technology, that situated evaluation obtains its particular purchase in furnishing detailed insight into the context of use for design.

In conclusion, we might add that the approach to evaluation described here offers the prospect of 'value added' benefits to the development effort insofar as it lends itself both to evolutionary design processes such as our own and (conceivably) to more orthodox, commercial working orders subject to a stringent economics of information. Whatever approach to the invention and development of new technologies, situated evaluation provides for the systematic incorporation of a social and cooperative experimental perspective into design at little, if any, extra fiscal cost, as the primary factor at work here is but a shift in focus. A shift away from the user and machine *per se* to the *embodied work of the local interactional staff* whereby computer use, with all its occasioned problems and contingencies, is observably achieved in and as the very course of accomplishing the 'test'.

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References

Bannon, L. (1991) From human factors to human actors: the role of psychology and human-computer interaction studies in system design, *Design at Work: Cooperative Design of Computer Systems* (eds. Greenbaum, J. & Kyng, M.), 25-44, Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Benford, S. , Snowdon D., Colebourne A., O'Brien, J., Rodden T. (1997) Informing the design of collaborative virtual environments , Proceedings of the international ACM SIGGROUP conference on Supporting group work: the integration challenge , 1997, Page 71

Bowers, J., O'Brien, J., Pycock; J (1996) Practically accomplishing immersion cooperation in and for virtual environments, Proceedings of the ACM 1996 conference on on Computer supported cooperative work , 1996, Page 380, ACM Press.

Christensen, M., Crabtree, A., Damm, H.D., Hansen, K.M., Madsen, O.L., Marqvardsen, P., Mogensen, P., Sandvad, E., Sloth, L. & Thomsen, M. (1998). The M.A.D. Experience: Multiperspective Application Development in evolutionary prototyping, *Proceedings of the Twelfth European Conference on Object-Oriented Programming (ECOOP 98)*, 14-41, Brussels, Belgium: Springer.

Cook, J., Hubbold, R., Keates M. (1998) Virtual Reality for large scale industrial applications. *Future Generation Computer Systems.* 157-166. Elsevier Science.

Crabtree, A. (1998) Ethnography in Participatory Design, *Proceedings of the 1998 Participatory Design Conference (PDC '98)*, 93-105, Seattle, Washington: Computer Professionals for Social Responsibility.

Crabtree, A. (1998)* IST '98: Practically accomplishing engagement with the legible city, eSCAPE Working Paper, Esprit Long Term Research Project 25377, Lancaster University, UK: Computing Department.

eSCAPE Deliverable 4. (in preparation) Thinking with the studies, *The Common Methodology*, Esprit Long Term Research Project 25377 (eds. Crabtree, A. Hughes, J., Murray, C., Rodden, T.), Lancaster University, UK: Computing Department.

Floyd, C. (1987) Outline of a paradigm change in software engineering, *Computers and Democracy: A Scandinavian Challenge* (eds. Bjerknes, G., Ehn, P., Kyng, M.), 191-209, Aldershot: Avebury.

Garfinkel, H. (1967) Studies of the routine grounds of everyday activities, *Studies in Ethnomethodology*, 35-75, Englewood-Cliffs, New Jersey: Polity Press.

Garfinkel, H. (unpublished manuscript) *Concepts and methods for psychology lectures*, UCLA: Department of Sociology.

Gibson, S., Pettifer S., West A. (1998) Visualising the Virtual Cityscape. *eSCAPE Deliverable 3.1: Visualisation of structure and population within electronic landscapes.* 127-138. Lancaster University Press.

Grint, K. & Woolgar, S. (1997) Configuring the user: inventing new technologies, *The machine at work: technology, work, and organisation*, 65-94, Cambridge: Polity Press.

Grønbæk, K., Grudin, J., Bødker, S., Bannon, L. (1993) Achieving cooperative system design: shifting from product to process focus, *Participatory Design: Perspectives of Systems Design* (eds. Namioka, A. & Schuler, D.), 79-98, Hillsdale, New Jersey: Lawrence Earlbaum Associates.

Grønbæk, K., Kyng, M., Mogensen, P. (1997) Towards a cooperative experimental system development approach, *Computers and Design in Context* (eds. Kyng, M. & Mathiassen, L.), 201-238, Cambridge, Massachusetts: MIT Press.

Grudin, J. (1991) The computer reaches out: the historical continuity of interface design, *Proceedings of the 1991 Conference on Human Factors in Computing (CHI '91)*, 91-97, New Orleans, Louisiana: ACM Press.

Grudin, J. (1993) Obstacles to participatory design in large product development organisations, *Participatory Design: Principles and Practices* (Schuler, D. & Namioka, A.), 99-119, Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Hughes, J., King, V., Rodden, T., Andersen, H. (1994) Moving out of the control room: ethnography in systems design, *Proceedings of the 1994 ACM Conference on Computer Supported Cooperative Work (CSCW '94)*, 429-438, Chapel Hill, North Carolina: ACM Press.

Hughes, J., Randall, D., Shapiro, D. (1992) Faltering from ethnography to systems design, *Proceedings of the 1992 ACM Conference on Computer Supported Cooperative Work (CSCW '92)*, 115-122, Toronto, Canada: ACM Press.

Kensing, F. & Simonsen, J. (1997) Using ethnography in contextual design, *Communications of the ACM*, 40 (7), 82-88.

Mogensen, P. & Robinson, M. (1995) Triggering Artefacts, *AI & Society*, vol. 9, 373-388.

Murray, C. (1998) *A preliminary analysis of the legible city data*, eSCAPE Working Paper, Esprit Long Term Research Project 25377, Manchester University, UK: Psychology Department.

Pettifer, S. (1999). An operating environment for large scale virtual reality. PhD Thesis, The University of Manchester.

Porter, W. (1988) Notes on the inner logic of designing, *Design Studies*, 9 (3), 169-180.

Rogers, Y. & Bellotti, V. (1997) Grounding blue-sky research: how can ethnography help? *Interactions*, 4 (3), 58-63.

Schon, D. (1988) Designing: rules, types and worlds, *Design Studies*, 9 (3), 181-190.

Schutz, A. & Luckmann, T. (1974) *The Structures of the Lifeworld*, London: Heinemann.

Sharrock, W. & Anderson, B. (1994) The user as a scenic feature of the design space, Design Studies, 15 (1), 5-18.

Shaw, J. (1998) The Legible City, *Presence and Representation in Multimedia Art and Electronic Landscapes*, eSCAPE Deliverable 1.1, Esprit Long Term Research Project 25377, 28-35, Lancaster University: Computing Department.

Trevor, J., Rodden, T, Smith , G.B. (1998) Out of this world an extensible session architecture for heterogeneous electronic landscapes; Proceedings of the ACM 1998 conference on Computer supported cooperative work , 1998, Page 119, ACM Press

Werneke, J. (1994). The Inventor Mentor. Addison-Wesley publishing Company. 35-75.