The *Manufaktur*:
Supporting Work Practice in (Landscape) Architecture

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Abstract. We describe fieldwork with (landscape) architects in which we identify key features of their work settings. We analyse the ways in which materials, many of them graphic and visual, are assembled, arranged and manipulated as an integral aspect of their work. We describe an early prototype of a 3D environment to provide a digitally-enhanced work setting, the organisation of which will emerge from use by practitioners.

Picture a practice of architects in their design studio. There are several interconnected largish rooms, each with two or three desks, each of these with a workstation. Some desks are sparse and tidy, perhaps with a single printed plan. Others are a seeming jumble of disparate materials – plans, sketches, notes, photographs, documents, books, samples, etc. On a large display table there is a more ‘staged’ setting of material on show – inspirational objects, art and design books and magazines open at particular pages, drawings of a recent project. On another table is a large physical model of a current project – a cinema complex – and lying next to it an endoscope with which internal views can be obtained. On shelves are models from other projects and on one wall a library of reference materials. The walls too are used as an exhibition space and decorated with plans and photographs of previous work.

Most of the desks are occupied and often work proceeds quietly with little movement, to be interrupted by bursts of activity. This reflects the character of the architects’ work. On the one hand it involves a smaller number of quite large projects, each of which lasts for months if not years. On the other hand the office
puts in many tenders for competitions for which a design proposal has to be prepared quickly under high pressure. Communication with external consultants is interwoven with planning in an ongoing process. These interactions take place in different forms: asking for ad-hoc advice on the phone, exchanging faxes and files, or meetings.

Our other user partners are a practice of landscape architects. Their offices are very similar in their mix of tools, materials and activities, though the practice has fewer people and the space is more compressed. There is a more continuous movement of people around the space, combining and recombinining in different patterns and with a steady flow of conversation. This also reflects the character of the work. In comparison with the architects, the landscape architects typically work on a larger number of simultaneous projects which are smaller in scale and shorter in duration (though sometimes with a long hiatus during which work is suspended). There is correspondingly a less stable division of labour and more frenetic switching between jobs.

How – if at all – should this work be provided with better computer support? In part, of course, that is a matter of providing better versions of the computer-based tools which are already in daily use: specific tools such as CAD packages and graphics tablets, and general tools such as spreadsheets, email, browsers, printers. But it is also a matter of trying through computer support to enhance the environment within which work can take place, and which is different than just the sum of these tools.

Fuzzy concepts and rich visions: the Gasometer Study

We have therefore been studying the character of this work environment, and we have given particular attention to how it is constituted by the deployment of the materials that are in use. One example undertaken by the one of our user partners is the Gasometer Study, which is an urban planning study that covers a large, partly derelict area bordering the highway to Vienna Airport, including four huge and striking brick-built gasometers dating from the end of the last century. It is connected to a series of architecturally prestigious revitalisation projects, among them the conversion into apartments of the gasometers themselves, an entertainment centre (Pleasure Dome, another of the office’s projects), and the extension of a metro line into the area. Two people from the architectural practice are collaborating on this project with an external consultant, under the direction of the principal architect. Their approach to urban planning is to create a relational field with places of different qualities, and to define a set of principles on which further building projects will be based, rather than planning the area in detail. While the relational field is created by combining different methods (grid, vistas, zoning), the spatial qualities are largely described through metaphors and images.
The planning process is guided by a series of ‘concept sheets’ produced by the principal architect, usually in intense conversations with other members of the team. These sheets are not just lists of what to do and what to clarify, but complex visualisations of methods and open questions. They often include small sketches, arrows, references to material to look for, or people to contact. Sometimes they appear on photocopies of a plan or a sketch. This concept sheet (left; one of almost 20) specifies some of the main elements of the planning process – methods, spatial categories, and representational techniques. It was produced in the very first planning session and has since been annotated from time to time.

The team’s task is to translate these concept sheets into a design which will be described through a variety of representations – different types of plans, a model, text, photographs, association images. A crucial aspect of this work is to be able to work with ‘fuzzy concepts’ and to maintain things at different stages of incompleteness. In the following transcript the principal architect is discussing how to represent the separation of and fluent transitions between residential and industrial/trade areas:

"... there are a number of things we can indicate in this area, there is this wall which can be animated, developed, similar to the wall in Austria Email (a previous project), where we also have such an in-between zone, where these areas for trades, meeting places, greenhouses, ... here one should draft a structure, as a placeholder for what might be there, a phase-plan, this is also something which we still need to, this story with this in-between space, we could mark this symbolically in the plan ..." (13/1/99).

This passage shows how topics are addressed and ‘encircled’, often taking the team through the entire area or object being planned, since each topic has ramifications for others. While some aspects are discussed in detail and fixed, others are left entirely open. The conversations unfold through addressing particular issues, trying to clarify the facts, generating and testing preliminary ideas or solutions, and deciding how to proceed further. The openness of this process is captured by the notion of ‘a placeholder for what might be there’ (Tellioğlu et al., 1998). It stands for something that is in formation and may only be defined on a conceptual and metaphorical level. Placeholders may range from
very small things (e.g. a missing parameter in a product specification) to large ones (the detailed design of the in-between space mentioned in the excerpt).

Talking through a topic is intermingled with the handling of a variety of materials – plans, drawings, sketches, faxes, letters, images, photographs. Their assemblage is expressive of the way the design problem is addressed and solved. One of the first steps taken in the Gasometer Study was to structure the whole area by constructing a series of visual lines representing vistas and openings from different places to particular points or places beyond. This also creates a particular silhouette as seen from a distance. From these visual relations a ‘grid’ or ‘relational field’ is constructed which can be filled with places of different qualities (Lainer & Wagner, 1998). For developing this structure a series of photographs was taken from different viewpoints (above). While working on the area plan, the architects use them as visual instantiations of the lines to be constructed:

"... on the first day, when you look from Baumgasse, you see how the gasometers disappear under the Tangente (a main highway), and then appear again, the whole air space, and then there near the Arena, this box covers them again. You can see this in the section plan, how dominant this is, ... , these are the ‘visual relations’" (15/12/98).

Fitting this structure onto the existing one of buildings and roads requires a high level of fuzziness. Details have to be ignored in order to highlight the main structural qualities of the design, as in this excerpt where the two junior architects are discussing how to visualise structure:

"... maybe in this case it is better to leave out these differences of structure, and just to highlight the paths, to do this a bit differently, in a much more abstract way, not like the one I just started to draft, these zones, this doesn’t tell us much" (24/11/98).

A central task in this project is to define places within this structured urban space with specific spatial categories and qualities – among others ‘activity space’, ‘art space’, ‘row’, ‘display case’, ‘bridge as skywalk’. Much time is spent within the team clarifying these concepts which are encircled by using metaphors, producing sketches, and searching for association images. Going back to the conversation about in-between spaces, this time between Pleasure Dome and Gasometer:

"... this cross-section through the ‘art space’ on the one hand means that there is this wall of the Pleasure Dome which is defined as a wall which is drenched with colour and light and has a certain visual transparency, and on the other hand the base of the gasometers, which are covered with green plants and represent a harsh image of nature. Then the question is, what do we do with this in-between space ... we might emphasise this transition zone of the base, that we say, there is this dip where nature transgresses into the space of the road, there are stones and light, that we point to this base... and then these entrances and drives, ... this dreary sequence, that we amplify this." (13/1/99)
The language here differs from that required for technical detail. Qualities such as ‘art space’ with its transparent walls filled with light and colour, the ‘harsh nature’ of the Gasometer base, and the ‘dreary sequence’ of driveways require the construction of rich narratives which others can grasp. Some of these images and metaphors were taken from previous work, others from memories of sites and paintings, such as a ‘hill’ painting by Mario Merz or an installation by Lois Weinberger “who works with the principle of denaturation, ... he just left strips within the asphalt for wedges and plants, which create an interesting structure” (13/1/99). These images are merged with a sketch for communicating the idea of ‘Verbindungsraum’.

Another example of spatial qualities is ‘the Display Case’, with a variety of meanings which are expressed in images (such as this sketch from a previous project and a screen façade by Oskar Nitzchke from the 1930s). As an ‘osmotic wall’ it may mediate between inside and outside, between public space and entertainment and consumption space. It may be walked through as a ‘space for movement’, or be used as an ‘exhibition space’ (Lainer & Wagner, 1998). Sketches and stories are created around each of these themes or qualities, and the growing, metamorphosing idea of each is represented in the material that is collected and produced, including the talk around it. This is a good example of Mitchell’s (1994) observation that although an image (or idea) may be ‘abstract’, “language, narrative, and discourse can never – should never – be excluded from it” (p. 226). In this sense, visualisations are used for bringing the narrative element in a concept to the fore (Bücher et al., 1999).

A recurrent theme of the design sessions is what to make visible and how. Plans of different types are defined, some of them part of the standard repertoire of architects, others innovative and, again, difficult to envision and implement. Examples are ‘image plans’ (a collage of photographs, sketches, and association images on a plan), schematic plans (sketches which explain a theme or principle), or abstract 3D visualizations of layers, cuttings, and openings. ‘Shadow plans’ are another example, a series of pictures of the
physical model with the light coming from different angles. These attractive images of volumes, light and shaded areas serve multiple functions. As a basis for defining heights, cuttings, edges (open/closed, soft/hard), transparency, width of roads, open spaces, etc., they are essential for formulating the 'rules' to be observed by building projects in this area. On the other hand they enrich the imagination space both of the design team itself and of the audiences to which the project will be presented. Although not all the material created in the design process will be published, it is hard to distinguish at this point between different uses and audiences. All of the representational material will be used by the team itself - creating a representation always means taking a step forward in the common understanding of the design.

In a highly conceptual project as the Gasometer Study a problem is how to maintain a connection between the rich context of a given urban area, and the host of structuring principles and spatial categories that form the core of the design. The physical layout of the office and its use as an exhibition space help in this. Although projects are allocated to specific rooms, the space is open and only lightly and flexibly regionalized. The office provides practitioners both with specific affordances for carrying out their activities, and with a particular perspective on their work. It is an ideal place for co-located work and dense interactions. However, this way of preserving context has its limitations. Project material, unless visibly placed on the desk, tends to get 'lost' in the maze of tasks and parameters to consider simultaneously. Just moving a concept sheet, a sketch, an association image, or text into a pile of documents makes it invisible, filing it may mean never retrieving it again.

This lack of presence of context creates real problems in the actual process of producing plans. Drafting is an absorbing activity, with its own logic, involving trained visual conventions to be observed, as well as a certain level of detail and precision. Also, some plans may be huge, difficult to handle on a computer screen, impossible to compress into an A3 format, full of inaccuracies, difficult and time consuming to correct, etc. All this is not conducive to a conceptual, metaphorical approach to designing, for which one needs to emphasise principles and qualities in an open way. Much of the time of the junior architects is spent on drafting plans. This creates a mental and practical distance from the context, which comes alive through telling stories, looking at images, encircling with metaphors. This is why time has to be spent on comparing and modifying the plans that are produced for a first project presentation, to reconstruct their context and reconnect each of them to it.

Different participants need different kinds of context. From the point of view
of the principal architect (who manages at least 6-10 projects of various kinds in parallel), the context of the Gasometer Project is represented by a limited set of visual reminders. On his desk he has artfully arranged these reminders, most of them his own concept sheets, together with sketches, post-its of different colours, images. The pictorial character of these reminders is crucial. They are of a type that one can 'fly through', take in 'at a glance', and 'recognise immediately'. These selected reminders of the context of a project which is one of many (see left) are different in kind from the detailed view needed for completing particular design tasks.

Many matters which are consequential for understanding work practices and the working environment can be drawn from this extended example. A key perception, for our purposes, is to do with the ways in which materials are selected, assembled, arranged and handled. What emerges is that manipulating the presence and absence of materials and bringing them into dynamic spatial relations in which they can confront each other are not just a context or prerequisite for doing the work; rather, they are an integral part of accomplishing the work itself. To manipulate the context is to do the work. Typically, what is important is not just to create or change a document or other materials, but to do so in the presence of and in relation to others.

That is the case for most forms of work and certainly, we would suggest, for all forms of office work. But it is intensified and given a particular character by the graphical and visual features of many of the materials used by architects and landscape architects: plans, sketches, diagrams, photographs, scale models, samples of materials, catalogues, etc. etc. The presence, placing and inter-relationship of these materials – sometimes precise and detailed, sometimes placeholders and metaphors – underpin the passage from possibility to actuality which is the work of design.

These are processes that repeat themselves at different levels of detail and over different temporal scales. In the Gasometer example, much of the purpose was to create, develop and maintain a high-level urban planning concept that will itself inform a range of other detailed projects. The arrangement of materials therefore inhabits the temporal 'longue durée', as a means through which the underlying concepts can be kept present and active over the lifetime and the diversity of the urban plan. As we shall see later, other contexts are far more immediate and short term.

Collections and handovers: Central Square

From time to time in the design process documentation is produced which has a different status in that it is explicitly intended to capture or summarise the point that a project or part of a project has reached. This often happens when
negotiation needs to take place or agreement needs to be obtained from outside parties. Such materials have been referred to in studies of science as 'punctualisations' (Law, 1992). One role of such documentation 'packages' is to serve as a resource around which different perspectives can be explored (as 'boundary objects', Star & Griesemer 1989) in discussions with clients or partners in the design process. Another is to act as a 'recruitment device' (Latour 1990) which will carry persuasive force. Often, agreement relies on the support of other parties (e.g. planning authorities, public consultations, or council decisions) which are themselves complex organisations or institutions. If so, such packages can be handed over and used by partners to gather support within their own ranks and to return to the (landscape) architects at a later stage to commission the continuation of work. Projects can stretch over long periods of time, sometimes years, and some of the 'punctualisation packages' return after many months of internal negotiations elsewhere.

The landscape architects have a three-year contract with the Metropolitan Borough Council of 'AMBC' to undertake all landscape architecture projects as they arise. There are altogether 20 different projects associated with this contract and, at present, the landscape architects spend the majority of their time working on various stages of these. 'Central Square' – the main square in front of the town hall in AMBC – is one of the most important.

After some negotiation, a layout plan for the design of Central Square was agreed with the client. The start date for the implementation of this scheme is only a few months away and the next item on the overall schedule for the project is the specification of paving, planting, lighting, and seating. These details have been under consideration since the beginning of the project. Central Square is one amongst many projects in the overall scheme of regeneration in AMBC, and continuity of materials is one aspect of the overall design. Moreover, the actual look and feel of such materials is entwined with the conceptual design. This 'stage' in the design process thus does not constitute a discrete 'step' within the flow of a sequential 'design process'. Rather, it can be described as a shift of focus in the development of the field of artefacts, interaction and communication in and through which the work of designing is achieved – and which is now being brought to a particular 'punctualisation'.

Specifying materials for Central Square

The landscape architects have arranged a meeting with the client where preferred options for materials can be discussed and decided on. Samples of candidate materials have been ordered over the past few months. Now it is a question of considering the options in earnest and putting together a 'package' to take to the meeting. Steve, one of the junior landscape architects involved in the design for Central Square, has annotated a copy of a part of the current layout plan with
ideas and open questions (below). Lynn, a senior landscape architect who spends 3 days a week working from home and two days in the office, is in today. Steve and Lynn take some paving samples and lay them out on the floor. The design of the square is divided into two main areas – a large semi-circle in front of the town hall, and a smaller circle to the side of the town hall with a statue of Queen Victoria. In both areas light coloured paving fills the circles while darker and smaller paving blocks define lines fanning out from the town hall steps and at various radii of the circles.

Two fairly firm decisions about materials have already been made: the lines will be defined by small blueish blocks (Brindle®), and larger, sandy coloured Yorkstone blocks will be laid in the semi-circle in front of the town hall. These Yorkstone blocks cannot be used in the smaller semi-circle around the statue of Queen Victoria because they are too big for the radii. A smaller stone which is similar in texture and appearance has to be found. There is a paving stone that would meet these requirements (Tegula®), but it has been used widely within AMBC and so would not convey the sense that this space is something ‘special’. Both Steve and Lynn remember having seen stones that might have all the desired qualities. They turn to the manufacturer’s brochures on the shelves. Steve finds a suitable example first:

S: Here we go Lynn (Perfecta), three hundred by two hundred ((handing her product information brochure)), look at that photograph.
L: Yeah
S: They’re a bit dead on texture, …
L: Mhm.
S: … aren’t they.
L: mhm. And they don’t have – what I like about this ((pointing to paving stones laid out on the floor)) kind of system is that you get that randomness. ((gesture))
S: Mhm.
L: You get the courses ((gesture depicted on the right)), constant courses, but within that course …
S: Different sizes, yeah
L: … you get different sizes, and that just makes it that bit

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1 Transcripts are given in simplified and non-technical form
more lively ((leafs through brochure)) You see they've got their own version of ...
S: Tegula.
L. Yeah.

Gestures and talk translate or formulate (Lynch 1990) the main design concept of 'fluidity' as 'courses' that structure the design of the whole of the square and associate it with 'randomness' and 'liveliness'. Here, the arrangement of resources 'tells the story' of the process of making decisions, about the options considered, final choices, and discarded alternatives. A similar procedure is repeated for many of the elements that need to be specified (other surfaces, seating, planting, lighting). Steve produces the materials sheets over the next few days, and Lynn updates the layout plan in the light of their discussions. Steve and Lynn then take these documents and an assortment of samples to the meeting with the client.

In generating a package to present to the client, the architects also configure a context for the design task. After completing the package, a copy is filed away together with some of the resources used in its production in the 'job file(s)'. Other elements of the context are returned to their original locations (e.g. books to the library, brochures to the shelves), some are collected in personal spaces (personal files, boxes, or just in a pile on one's desk), yet others are discarded (e.g. quick 'doodles' or sketches, hand-written notes). However, the relations between different elements of the context established during the course of unfolding work are dissolved. On returning to a project after a potentially very long period of dormancy, there is a lack of information about how this particular package is tied into the context of the work as a whole. Even though the punctualisation was itself designed to produce and to convey a context, its own working context would be quite difficult for the landscape architects to recover.

Choreographies of design

In our previous examples we have discussed the use of materials for individual projects, and to do that we had to abstract work on each project out of the general flow. But in everyday work projects are intermingled, not neatly separated, and to understand and support this it is necessary to follow the complex mappings and interweavings of materials, projects and people over time. We will illustrate this by following in bare outline a sequence of activities which unfolds over about 40 minutes. On this particular typical working day, 4 landscape architects are present in the office and they do significant work on 7 different projects, while several more are touched on. These include the redesign of two industrial sites, one local and one in London; three parks, all in the local region; and several invitations to tender for new jobs.
An ex-industrial and now heavily overgrown site in London, ‘Southsite’, is to be regenerated and converted into a park. Based on an ordinary map, a sketch layout, some sections, and an analysis drawing had been produced some time ago, and Will, the senior landscape architect, has these on his desk in front of him. The project is on the verge of being given the go-ahead, for which more precise drawings will be required, and Will therefore commissioned a survey of the site, which he has just received. It is on his desk on top of the other material. There are deficiencies in the survey and Will speaks to the surveyor on the phone to explain these and ask for a corrected version – Will promises to obtain and send him a benchmark height so that he can do so, even though that should really be the surveyor’s job. Will finishes the telephone call and turns his attention to an invitation for a bid for a project in Wales, which he places on top of all the Southsite materials.

Diane stops on the way past his desk, hands him a letter and a brochure sent by civil engineers introducing their services: “These were in Lynn’s tray” [downstairs]. Will looks at them briefly, then places them in Lynn’s in-tray next to his desk. He turns around further and asks if Diane is on track with getting together the drawings for another project – ‘Northsite’. She hesitates. Will stresses that the deadline is fixed and suggests that perhaps Victor could produce the site location plan, while Lynn works up and amends the already existing detail drawings, so that Diane could focus on the layout. In order for this division of labour to work, Diane needs to compress and then email the detail drawings by modem to Lynn at home. Diane gets onto this task, while Will walks across to Victor and Steve. Victor agrees to take care of the site location for Diane. Diane stopping past has provided Will the occasion to monitor progress and priorities, without being excessively intrusive or ‘managerial’. A negotiated reordering of the local and remote sharing of work activities results.

Victor and Steve have meanwhile been working on another project, ‘NewPark’, that concerns the design of secure sports facilities for different areas of a park. One aspect is the design and specification of fencing for an area with a high risk of vandalism. The client’s engineers had asked for repeated upgrading. Now, several months on, the clients realise that this has taken the costings far higher than the budget originally agreed, and there are some awkward discussions with the client about whose fault this is and how to resolve it.

Victor took over the job from Mark, who left SGS after completing his final exams several months ago. Six weeks ago, Victor was sent off at very short notice to participate in an 8-week ecology project in Nigeria, which has torn a hole in the division of labour in the office. Victor is now back for one week to prepare for and take his final professional qualification exams. Before Victor left for Nigeria he produced an overview plan and specification of all the fencing around the secure area and then handed this job over to Steve. He briefed Steve by ‘talking him through’ the file and the status of the project. In the course of this briefing
meeting he added post-it notes to all the documents that were particularly relevant to the fencing around the secure area.

Steve and Will had held a previous meeting with the client at which they agreed to produce alternative specifications to reduce the cost. They are due to discuss this at another meeting with the client tomorrow. After Victor agreed to Will's request to help Diane with the Northsite preparations, Victor and Will discuss when to meet to talk through Victor's pending exam. Will then says (à propos NewPark), "it'd be good if you could go to this meeting, if only for diplomacy." Will moves closer to Victor's drawing board, pulls a photograph of the secure pavilion area towards him. Victor slides another photograph next to it. They go on to discuss, with reference to the plans and pictures in front of them, ways of reusing some of the existing fencing materials, but repositioned and repainted in a much less insensitive and aggressive manner. Hence Victor, who is back for a week, is drawn into the preparation for this meeting, leaving a rather muddled allocation of responsibilities between Victor, Steve and Will - albeit a productive one, in that it draws in additional expertise. Victor goes off to a meeting about the Nigeria project, and Steve goes on to work through all the NewPark documents.

What emerges from this apparently mundane sequence is how matters which are highly consequential for the work - negotiating and modifying the contents of a project, reordering a division of labour, communicating and briefing, sharing and managing the work, deciding on priorities, maintaining an external focus on the client, coping with contingencies, making handovers, assembling activities into coherent collections, and much more - find reflection in the working materials, and are achieved through the intricate 'choreography', the rapidly-switching assembly, which is enacted among people, projects and materials as work unfolds. All of them are productively and purposively organised in space and time by the participants so as to facilitate the flow of work. This involves multiple overlaps; serendipitous connections, overhearings and overseeings; and the exercise of various sensitivities by the participants to each other's situations and activities.

Taken together, the fieldwork examples have, among other things, illustrated three different perspectives on the ways in which materials are assembled and deployed to constitute work settings. First, to provide long-term, deeply-informing contexts of an underlying conceptual character, as in the Gasometer Study. Second, the working up of punctualisations - sets of documentation for particular handovers at particular points in time - and their background, as in the materials for 'Central Square'. And third, the rapid-fire choreography of ongoing work, with its continuous flow of people, materials and projects. Of course, these are ideal-typical distinctions, and most examples in the real world will have a mixed character. We can also see that the use of materials has both a 'synchronic'
or static aspect, arising from a particular arrangement, and a ‘diachronic’ or animated aspect, arising from their movement and sequential display. The latter comes closer to a narrative of the work, in which stories can be woven and demonstrated about a project, its possibilities and its progress – for the benefit of the members of the practice themselves, and also for other audiences.

A 3D Manufaktur Space

A key aspect of the support that a work setting for architecture and landscape architecture must provide is support for the assembly, arrangement and manipulation of materials, as well as for acting on them with appropriate tools. But why should this be a digitally-enhanced work setting? If there is a justification for this, it is that it may permit some limitations of the physical work setting to be partially overcome. Specifically, a digitally-enhanced work setting:

- may overcome some of the boundedness of physical space. Materials and participants may be brought in from other places.
- may overcome some of the inflexibility of physical space and the ‘mass’ of objects in it. Physical spaces (desks, walls, rooms) are finite and costly; digital spaces are not, or not in the same ways. Physical objects can only be in one space and one arrangement at a time, digital objects can occupy many. In physical work settings, one arrangement in a space (a layer) obliterates others, creating an ‘archaeology’ of working materials; in an electronic space, arrangements need only be layered if that is specifically desired.
- can contain active objects as well as passive ones. A document may, for example, exhibit a behaviour as it approaches a deadline. A collection of materials can be animated in a presentation. Materials can be linked to each other, and one can update as another is changed. The relationships connecting a set of materials – their grouping or arrangement – can be stored. Materials can be selected or found by interrogating their properties and contents.

Of course these benefits do not come free, and any digitally-enhanced work setting will also have limitations and deficiencies compared to a physical one.

We have been experimenting with a computer-based work setting which supports and, in a cautious sense, replicates this environment. This has been conceived around the metaphor of ‘Manufaktur’ (‘craft workshop’). The Manufaktur is a 3D workspace which will support the configuring of multi-media documents to specific views of a project, including the possibility of ‘pre-fabricating’ such views for recurrent tasks. It will contain a series of desktop applications, some of which are underlying services (exploring & navigating technologies, linking facilities, support for sharing and awareness, document management, etc.). Specific applications will be developed in support of needs such as creating and displaying narratives, organising, and component design.
Up to now, the potential of electronic technologies to support the visualisation of information in three dimensions has been approached from three main perspectives (see Mariani 1998 Ch. 1). First, approaches that utilise the properties of ‘information objects’ and define rules for their distribution in space. These include ‘Benediktine’ Cyberspace (Benedikt 1991) and approaches that add to this statistical clustering and proximity measures – VIBE (Olsen 1993), BEAD (Chalmers 1992), and Q-PIT (Mariani 1998 Ch. 7), see also Benford et al. (1996). Second, visualisations of hypermedia-link based systems (Card 1991, Stenius et al. 1998). Third, human-centred approaches that explore the possibilities for the development of tools and techniques to allow people to structure and display information in electronic spaces flexibly. So far, the work undertaken in this area is mainly conceptual (Gray 1990, Benford & Snowdon 1997). Our work in some ways combines linking with a human-centred approach, but it is deeply grounded in the specifics of (landscape) architectural practice. Rather than attempting to structure the information field through the use of automated mechanisms, we are experimenting with the potential of providing an environment and some tools and techniques to organise and access different views onto the information. This approach takes into account the flexible and situated use of information resources.

We have seen the importance of selecting and relating materials. In a setting such as this, what kind of machine can there be for determining which materials are relevant and how they should be arranged? None, we propose. The members of the community of practice engaged in the work are the authority that decides how materials should be arranged. The purpose of the presence and arrangement of materials is to support context, awareness and action, but these are situated and relative. The same thing can be the work object for one activity, background material or context for another activity, and would be an irrelevant distraction for a third – all in ways which change on a moment-to-moment basis. The presence and arrangement of materials is therefore not something which can be automatically generated, but must emerge from the flow of the work itself, in the kinds of ways described in our fieldwork examples.

The Manufaktur is a workspace in several senses. First, it facilitates the (3D) spatial arrangement of objects, similar to the spatial arrangements of models, books, drawings, pictures, etc. in any (landscape) architectural office. In this sense, we envision the Manufaktur as a 3D environment, with an abstract and unbounded space, which can be furnished with various objects for particular projects and/or activities. Second, it provides space in the sense of supporting the context of the project or task specific assemblage of multi-media documents, their purposeful arrangements, and links between them. From this perspective, the Manufaktur is document-based. Third, it provides shared space between people. When we speak of the arrangement of objects etc. we really speak of references to objects which physically may be stored anywhere within a local area network (and potentially on a wide area network too). Somewhat similar to the sharing of
physical office space, the *Manufaktur* allows, for example, all the members of an office to work in the same unbounded space, in a distributed manner.

Below is a partly fabricated screen dump from a first and very crude prototype of the *Manufaktur*, which has only been in development for 6 months. The picture (minus the icons and the task bar) is a screen dump from the prototype running as an application. That screen dump has been used as wallpaper to show the vision of having *Manufaktur* running as a kind of ‘desktop’ (e.g. using Active Desktop).

Double clicking any of the documents will launch the proper application with that document, on the active 3D ‘desktop’, and changes to it will be updated on the ‘desktop’ in near real time. The objects can be moved, rotated, etc. The prototype is developed in C++, using COM/ActiveX technology for integrating the documents, and DirectX v.6.0 for rendering them in the 3D environment.

**Objects in the Manufaktur**

Objects in this 3D space (as can be seen in this simple visualisation) can be moved around in different ways. They can be pulled to the front, where they are most clearly visible, or pushed further back. They can be turned so that one can see their spine (which can be given a semantic, e.g. with the thickness of an object indicating the number or size of documents in them, and the spine colour indicating an affiliation), or their back (which may be used e.g. for displaying a table of contents or relationships to other documents). Placing objects at an angle adds a perspectival dimension.
Several different types of objects can populate the space:

- ‘Live’ documents of various kinds (Word, Excel, CAD drawings etc.) residing in 3D rendered OLE/ActiveX containers. An example of such a 3D rendered OLE container could be a Microsoft Word document rendered on to one of the sides of a 3D box. The document is ‘live’ in the sense that what is rendered onto the 3D object is the current display from the document’s host applications, and updates are received as the document changes (OLE linking) – double clicking an object opens it within its host applications.

- (3D) models of parks, buildings, towns, etc. The (3D) models may, for example, be artefacts used in a project such as models of a building, urban area, landscape site, or entire counties. The models can be scaled, moved, turned, flipped, animated, etc. as any other object. They therefore lend themselves to several uses: as a reference point ‘up in the corner’ that one might take down and explore if appropriate; as models to ‘walk into’ or change, or as one big and ‘fixed’ object that is used for defining the topography of the space (e.g. a wire-line of a site gradually filled with documents as the project progresses).

- ‘Implantations’ – objects or devices that support the customising of a space to changing uses, for example, to create spatial partitions or for imprinting specifically expressive codes (Lainer & Wagner, 1998). An example may be the use of walls for providing a sense of size, location, or direction, or semi-transparent objects such as boxes, cylinders, spheres, etc. to define specific areas. Another example is applying ‘spotlighting’ of a specific colour to a certain area within the 3D space, to indicate some particular status of the documents placed in that area. Thus topographical features may (but do not have to) be added to decorate or aid the ‘intelligibility’ of the space – the system treats them just like any other object.

- Special applications such as ‘The Wunderkammer’, a collectively used multimedia archive for inspirational objects (images, sound, video), a collection support, and a view generator which is currently being developed in parallel with the Manufaktur (Büscher et al., 1999).

A 3D environment not only makes it possible to have many windows open at the same time, but it also, by spatial proximity, allows to indicate the (changing) relevance of a document for work-in-progress. This means that there are in effect different ‘levels of openness’ of a document, which can still be identified from far away. We see this as a possibility for supporting the kind of fluent relationships between fuzziness and precision described in our field work – “to zoom into a detail and out to see the whole” – and to simultaneously hold present a large number of parameters and their relationships.

At the beginning of an activity, this workspace is almost empty. People create their workspace as activities evolve. It could be handed over or inherited as others start working on the same or a similar project or activity. There might also be a case for having ‘pre-fabricated’ views for certain types of projects or activities.
Groupings

Even smaller projects rapidly involve hundreds of documents. One way of structuring these documents, besides visual appearance and spatial placement, is the notion of groupings. A grouping is comparable to a folder in a file system, except that here we only speak of references to objects. So any object may appear in as many groups as one wishes. One example of a grouping would be clustering together all material that describes and details a specific spatial quality, such as 'bridge as skywalk'. We are still in the early days of the prototype, and need to experiment with the exact appearance and functionality of groups. Obviously, we will have to support such features as naming, saving, re-finding, moving (both of objects in and out of groups, and of groups with or without 'content').

Views

Any given arrangement of objects, including position, lighting, shading, transparency, references etc. we call a 'view'. A view can be named and saved. One can, thus, shift between views (e.g. representing the context of different projects) or have several views open at the same time (in panes, in separate windows, or in principle on separate screens). Because, as mentioned before, we only store references and do so in a separate, shared database, one can open one's 'own' views or those of other colleagues. Naturally there are some privacy issues involved here, as there would be if parts of views were made publicly available to other contractors in the project or, potentially, to the public at large. At the moment, we focus on supporting cooperation between colleagues in an office.

Links

All the above are means to support the establishment and use of context when working on projects. They do so by providing means of arranging objects. But having them co-present is not the only form of supporting context and expressing relationships between parts of documents. Consider, for example, the work involved in producing a CAD drawing of a building. Here there are relationships between, say, the drawing and several initial sketches of the concept guiding it, between corridors and specifications for the widths, between doors and fire regulations, between a room and various suggestions for furnishing it, between a wall and potential materials for it, etc. All these relationships are hard to express by means of spatial arrangement alone, and if attempted would often produce unwanted clutter. Therefore we also operate with the notion of links. The support of linking is obtained through integration with the DEVISE, Hypervise hypermedia system (Grønbæk et al. 1993, Grønbæk & Mogensen 1997). The basic idea in Hypervise is to support a browsable network of references, stored in a separate hypermedia database, between various kinds of “documents”, called components. Components may be of all sorts, for example text documents, movies, WWW pages, spreadsheets, CAD drawings, etc. all being viewed and edited within their
respective host applications. Links are from parts of one document (selection of text, selection of cells, object in a CAD drawing, sequence of frames in a movie, etc.) to parts of another. A link can be followed both 'forward' and 'backward' (in contrast to e.g. HTML links) and can have as many endpoints as one wants. Following a link could, for example, result in a text file being opened in a word processor on, say, page 27, a spreadsheet being opened using its respective host application with certain cells selected, and a CAD drawing with a particular object highlighted. All the links are stored in a database separate from the documents being inter-linked allowing for sharing of various collections of links as well as various link browsers. These links are robust over, for example, the relocation of folders or files containing their targets.

The features and philosophy of Hypervise links are extensively described elsewhere, but for us an important aspect of its philosophy which Manufaktur shares is that its patterns emerge from work practices themselves as they unfold, not from any attempt to apply 'intelligence' to the automatic formation of the population of Manufaktur objects, or their configuration.

Using the Manufaktur

The current Manufaktur prototype is too early to be trialled in serious use in working architecture or landscape architecture settings – at the time of writing it has only been in development for 6 months. However, our user partners have been deeply involved in its development and an interim experiment which we have carried out is to prototype the Manufaktur in a manual version, creating a view of the Gasometer Study with paper documents on a large pinwall, and discussing with our user partners how they would envisage using the electronic environment. The documents related to a particular theme were clustered together into groups. It was a great advantage to be able to see (at least parts of) all these documents simultaneously, rather than having to leaf through piles to find them. The spatial arrangement was also very helpful in ‘framing’ documents with different kinds of relationship to each other, in ways that could be easily changed. It is possible to move them around, e.g. to highlight a central part, to move closer for accentuating a conceptual relationship. A stronger and more content oriented frame would be provided by a 3D model or map of the gasometer area itself within which documents could be arranged. The arrangement not only provided a good overview, but was also a good pointer to things that were missing, providing a strong ‘re-cognition’ effect for material that got lost. The spatial arrangement of fields and documents also has narrative properties and ‘tells the story’ (or history) of the project. Although it was rather close to the ways material is arranged for project presentations to outside audiences, it also proved highly useful for ongoing work.
Throughout the paper we described our fieldwork examples in ways which, we hope, make it easy to conceive scenarios in which equivalent work is done with the added resource of the *Manufaktur*. It is easy to picture the advantages, such as the capacity to save and retrieve views, to work with remote people and materials, to work with multiple arrangements of materials, to work with active materials. One of the main challenges which successful use would have to face, however, is the integration of electronic and physical work settings. This is partly a practical and technical matter, to do with such things as making it as convenient as possible to scan and to print material, to use graphics tablets, etc., to do with display technology, to do with the bandwidth available between offices and into the home. It is partly a 'historical' matter, to do with the developing availability of catalogues, regulations, standards, archives, images, etc. online. But it is more importantly a matter of what is a 'comfortable' medium for different kinds of work, and of the various trade-offs between 'physical' and 'digital' advantages. The time horizon for the development is around three years, so we anticipate that an environment which works adequately on, say, a 20'' monitor will work very well on a 30'' flat screen, and better still, eventually, in a true 3D environment.

**Summary and conclusions**

We have described some of the key features of the work settings of architects and landscape architects. We highlighted in particular the ways in which diverse materials are assembled, arranged, manipulated and displayed in their workspaces – around their desks, rooms, furniture and equipment. Much of this material, naturally, is graphical and visual in character. Some of it is precise and detailed but much of it is conceptual, metaphorical and in formation. It forms a context for their work but, more than this, we show that organising their materials importantly constitutes their work.

We have developed an early prototype of a 3D computer-based environment, the *Manufaktur*, to support these work settings. It enables practitioners to place, orient and move materials, and themselves, in three dimensions, analogously to their use of physical space. The aim is to take up the advantages of electronically-mediated spaces and materials while minimising their disadvantages. It enables them to work on materials in the space with their usual software tools, to 'furnish' it with a topography, and to share it with others. Another cornerstone of the environment is the provision of Hypervise hypermedia links, so that meaningful connections between materials can also be maintained without requiring their visible presence. In both *Manufaktur* and Hypervise, the organisation of materials, spaces and links emerges from the work of practitioners themselves. It is intended that the *Manufaktur* and the physical work space will be combined by practitioners in use to form a digitally-enhanced work setting.
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