Dynamic Data Sets as Collaboration in Urban Design

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Summary:

Computer applications to urban design involve a disctinctly rich hybrid of geometric, geographic, and annotative information. This condition raises opportunities for collaboration, needs for data integration, and examples of the increasing importance of rich datasets as a basis for design work. This paper describes these general issues, provides substantive examples from recent studio work, and demonstrates a specific implementation of software integration. The latter includes a prototypical data interface, translation tables for multimedia linkage, and capacity to work together with a web browser.

Keywords:

Datasets, Software Integration, Urban Design, Collaborative Work

1. INTRODUCTION

People work together on shared objects of design, and these objects define the nature of interactions to occur. Thus collaborative design includes more than simple document exchange. It compiles, adds value to, and conducts dialogues over sophisticated artifacts. Increasingly, then, complex datasets may become the focus of research in computer-aided design.

Urban design produces especially pertinent examples of this condition. Due to its position at the crossover of architecture, landscape architecture, and planning, urban design attempts both to measue the consequences of visual moves, such as design improvisations, and to visualize the consequences of measured moves, such as socio-economic policies. It tends to work both with more extensive documents, and with a wider variety of documents. It tend to involve many participants.

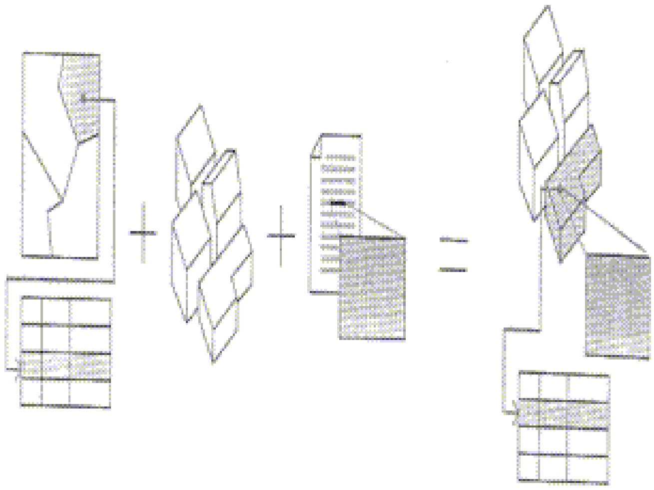


Figure 1. Integrating geometric modeling, spatial information systems, and hypermedia

Computer applications to urban design have recently developed a distinct identity, based on a blend of computer-aided design (CAD), spatial information systems (SIS), and interactive multimedia [Figure 1].[1] As such it is distinguised from the more purely formal improvisations conducted conducted by architects, and the older demographic-statistical analyses conducted by planners. Research in these topics, upon which theory and precedent much of this present work is based, has been presented at CAAD Futures and related conferences.[2]

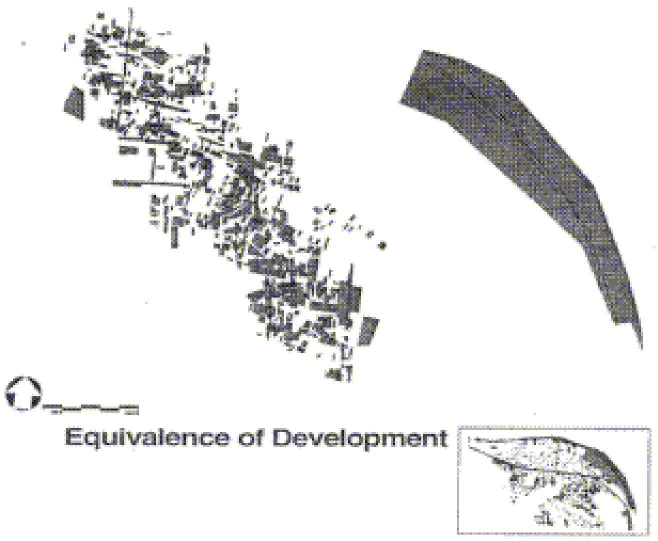
Consider a typical process within this repertoire. One might begin with an area analysis, perhaps for the purpose of site selection, by means of a geographic information system. Here, a system of queries might gradually isolate a concise set of possibilities. Next, (or as an equally valid point of departure) one could conduct numerical simulations, e.g. density calculations or traffic flows, by means of a spreadsheet or a specialized analysis program. Visualizations of these models have normally been confined to charts and graphs. For a more pictorial visualization, one would then have to build a three-dimensional model in a CAD system, using plan data from the GIS, and vertical data from a variety of sources, possibly including field survey. Any relations inherent in the existing databases or simulations would normally be reduced to a simple layer classification and/or block hierarchy. At this point, hovwever, better visualization of other sorts would become possible, as one could now prepare images of the three-dimensional model by means of a rendering program. These images could use color, texture, lighting, etc. to express schematic differentiation in a manner intelligible to a design-oriented audience. Finally, content from any of these many representations could be assembled in narrative structures, such as animated presentations, intelligible to a truly general audience. Some of these collections could be arranged to be navigable by browsing and made available for asynchronous review, either by delivering a multimedia stack on disk to a client, or by posting on the World-Wide Web.

While all of this situation represents a considerable advance over attempting such work in a purely CAD-based environment, it leaves many needs unanswered. Since so many tasks are separated by so many pieces of software, the design process becomes compartmentalized, overly serial, and inadequately able to evolve a design on the basis of complex relationships. The situation is limited by the static nature of the data. Moreover, since most actions are structured by intrinsic properties of the tools, rather than the data, many relationships directly evident in the data remain difficult to explore.

2. BUILDING RICH DATASETS

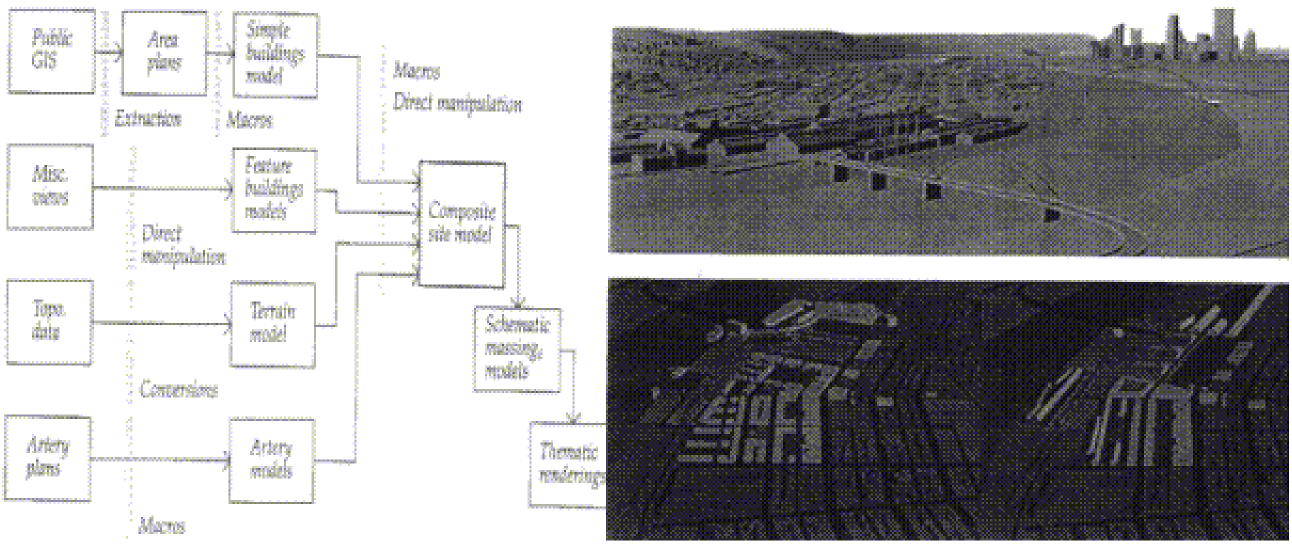
How does one begin to establish a dataset? Obviously it is impossible to represent every formal and conceptual relationship that may influence a design project. The very idea is absurd. Under present conditions, the work of establishing very many relations between any but a trivial number of data entities has been prohibitive. Indeed this has been a perennial problem in CAD research: despite what is often inferred to the contrary, deterministic methods having demonstrated success on trivial problems seldom generalize well to complex, useful problems. We need a more open-ended approach. We must also attain a better balance between structure and improvisation. We need both descriptive and predictive models. Above all, somehow we must wed formal symbolic processing to the inarticulate mental agility, e.g. quick visual insight, of talented designers.

Yet already it is possible to assemble enough information in a sufficiently versatile manner so as to be of considerable worth not only for standard references but also for individual projects. In comparison to, say, raw data such as census findings or terrain elevation, a project-centered dataset adds value through collection, cross-referencing, interpretations, and presentation. In essence, a project aims to turn data into information, and information into knowledge. To do this is not so much a matter of how much information one can amass as what kinds of relations one can represent. For example, figure 2 shows an area-equivalence relation.



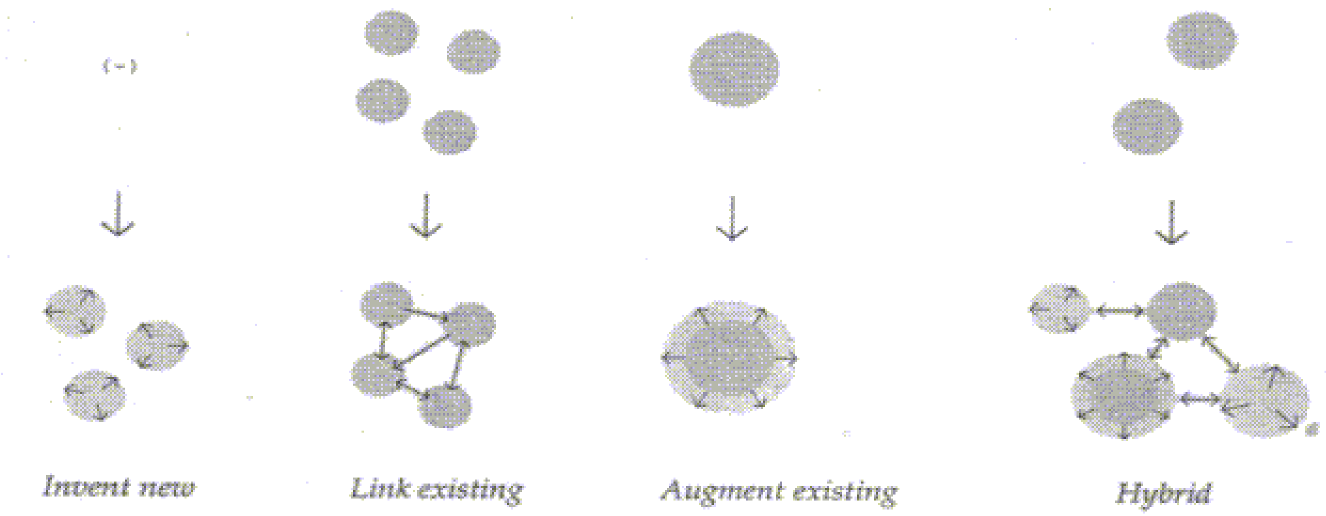
2. An example of an area equivalence relation

Substantive datasets rarely materialize out of thin air. Rather, different stages of work cumulatively modify and append existing datasets. Ideally, each stage of the work adds value. One project's completed assemblage may become another's raw data. Often this takes the form of model building: for example, figure 3 shows a typical condition: a studio project rendering, placed in a shared site model, build from public agency GIS data. However conditions are selcom confined to so direct a data flow, nor do all data sources get pulled together or have the potential for total integration. Instead, the usual result is collective, heterogeneous bodies of partially connected data. It follows that several theoretical and practical issues emerge: strategies for the tracking of inputs, freedoms to change what is given, inter-medium connections, pedigrees of the data.



3. Static geometric models. Data flow, composite site model, and inserted schemes.

Continual striving for a good dataset therefore becomes something of a collaborative focus. Design, maintenance, and adaption must be accomplished by a variety of parties and in a quasi-continuous manner. Some component elements, created by individual participants, may be exchanged like messages. However the primary collaboration ceases to consist solely of document exchanges and becomes more of a communal construction. Thus besides creating their own documents, project participants link up data, expand existing datasets, and mix all of these approaches [figure 4]. The result may not be such that everybody can see all data, but there at least emerges a collective body. This is somewhat a matter of convention: collective datasets only become useful when their language is clearly defined and agreed upon, allowing translation between the participants disciplinary languages and personal experiences.



4. Components of expanding project data

This is quite a change, particularly for students, for it converts design into the navigation and interpretation of an information-rich space. Too often, especially in the schools, design is cast as improvisation from *tabula rasa*, with a premium placed on originality of the objects. Under this newer framework, however, the emphasis shifts to the originality of the insights. Lines of inquiry extracting pertinent elements from an excess of information become more important than purely formal invention.

And here is one key to developing more dynamic representations of problems. Inquiries determine elaborations. Rather than attempting to link up so much material in advance, designers can augment where necessary as they work. However the means of augmentation is not necessarily a conventional hypertext system, but can consist of work directly in a three-dimensional relational model. The problem of integration is handles by providing adequate translations between normal, more static standards and the more inclusive argumentation medium. Consider how this might occur.

3. TOWARDS A DYNAMIC OF COLLABORATION

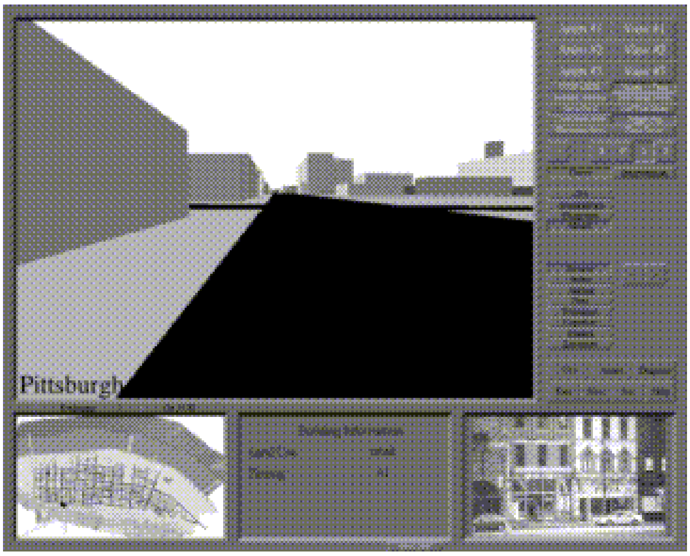
3.1 A Scenario

How might we begin to encode and employ more dynamic, multivalent datasets for collaborative processes, as in urban design? How might a dataset begin to become an interface? What kinds of activities are useful for researching these questions? Imagine a scenario where the design process is driven bya series of queries and modifications to objects, in which discovery plays an important role. The three-dimensional model becomes more than a picture or a report, and three-dimensional form emerges as the principal access structure to a variety of information. Interactive urban models enable questions expressed as model views, attribute queries, reference images, text annotations, dimensional parameterizations, extent calculations, and so on.

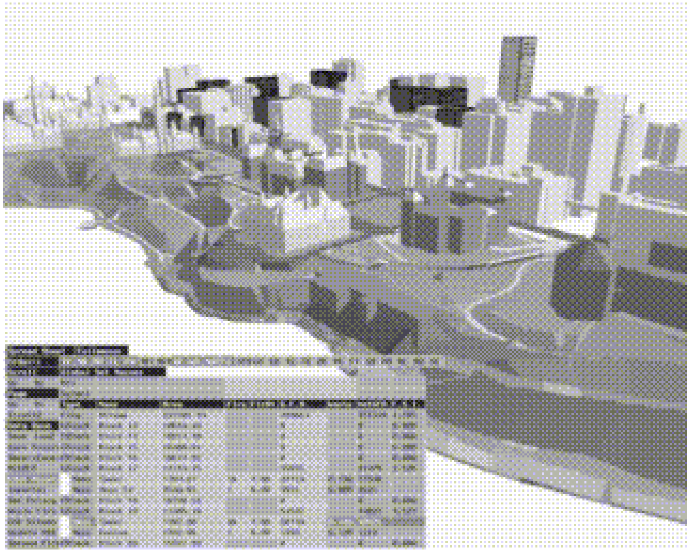
One of the more promising approaches to this condition is to overcome the seperation of tools and data and thereby to escape the notion of the interface as a "front end" to an autonomous data model. This is of course object-oriented design, which by its encapsulation of internal data representations with external interface operations inherently provides a better basis for an open-ended, multivalent, computer medium.

Consider that appropriately-encoded objects may be reported in a variety of formats. The same object may show up in a polygon map, a three-dimensional model, and a table of relations. Display in a model may depend on the results of recent queries or selections. Conversely, various reporting and manipulating functions can be overloaded to apply yo a variety of views of objects. Furthermore, objects may construct links to other objects sharing some property, whether a position, a dimension, or a keyword. Also, one can model more than actual geometry: zones, relations, and groupings can become data objects subject to a variety of actions and representations. Of course this has been true in conventional CAD, where one could draw circles and arrows on descriptive layers, but here the capacity for interrelation is improved.

For example, consider the design problem of strengthening the identity of a visual corridor. One could select neighboring objects as a buffer along a line feature, as in GIS, improvise additional form, as in geometric modeling, and call up photographs or processed views, as in hypermedia, to roughly and quickly evaluate fit. Figure 5 shows a multimedia interface implemented to explore such processes. Polytrim is an open-architecture geometric modeler and spatial information system developed at the Center for Landscape Research and running on the Silicon Graphics platform. Using polytrim, one could for example query all buildings in excess of a certain height, and then manipulate individual objects in a perspective view to improve the reading of the corridor. Or as was shown many years ago in the Canadian Capital Commission Study [3], one could conduct variations on a numerical model, and observe the formal impact in real time. Figure 6 shows a model-spreadsheet link.



5. In Polytrim, an interface to an integrated data model

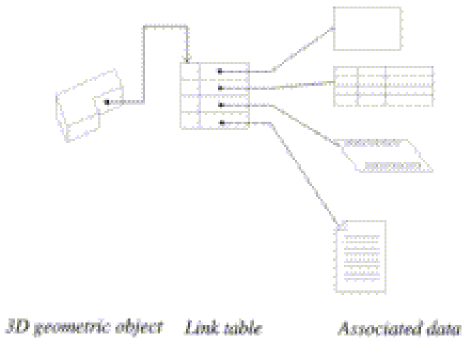


6. A model-spreadsheet link

Although many such processes are increasingly feasible using off-the-shelf software technologies, this work in Polytrim demonstrates a departure in the degree of dynamism. Because the data model is built on more than discrete, static geometries, many more operations of inquiry, relation, and display become feasible in interactive framework, even in real time. Many of what would be preventative delays due to loading different software and data, making translations, etc., are overcome. Increasingly, associations between different types of content yield insights when manipulated quickly. Navigating editable models, maps, tables, and photographs simultaneoudly is a qualitatively different experience from navigating even the best heterogeneous collections of such artifacts separately.

3.2 Building in Complexity

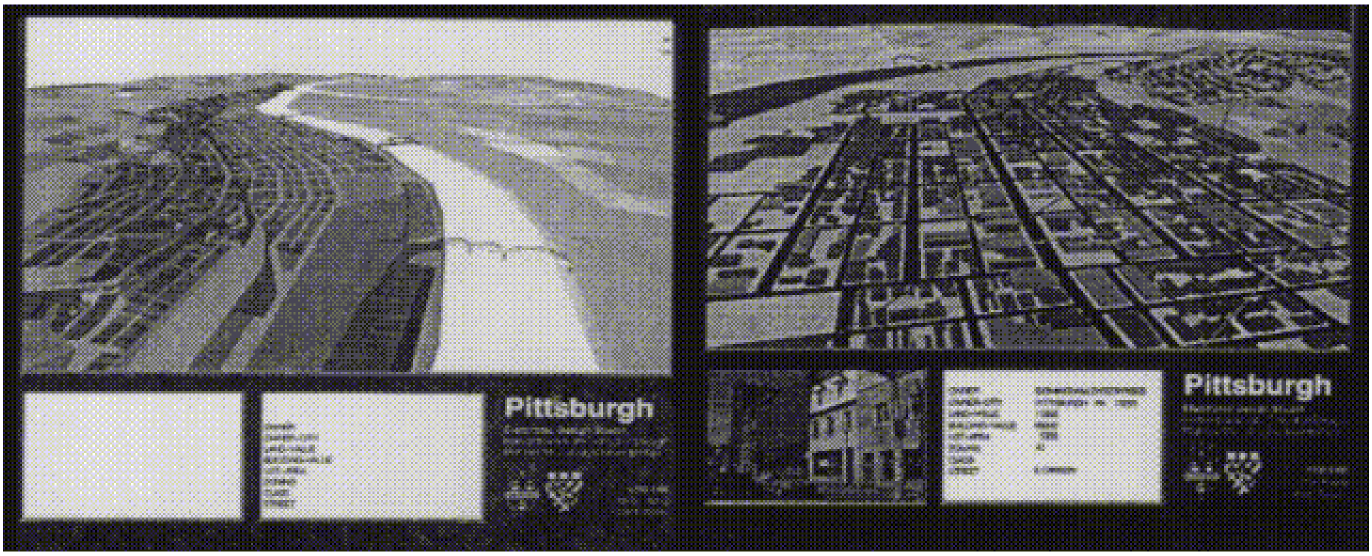
It is unreasonable to expect a degree of integration that would permit any dataset of such complexity to lie within the bounds of a single data format. As we know, software genres and datatypes continue to diversify, information becomes available from a huge range of sources, and all this must communicate through a growing constellation of standards. Yet immediate improvements are possible. In particular, whereas most CAD environments have only marginally supported relational databases, and SIS environments only two-dimensional geometries, a blending of the two can provide a rich spatially-queriable three- and four-dimensional environment.[4] When connected via hyperlinks, this type of environment can go beyond its pure database representation and associate with the rest of the necessary world of urban design information. Rather than attaching a single hyperlink to an object as a hypertext environment does, this type of environment uses the dataset language to form relationships with any variety of information. Arbitrary numbers of links are supported with a translation table, matching the database language to the necessary control programs for their representation [figure 7]. Any object may connect to imagery, text, video, spreadsheets, audio, either singularly or in conjunction with one-another. This provides a simple structure for multi-user datasets, facilitating interactions which are the interest of the designer rather than simply those of the presenter.

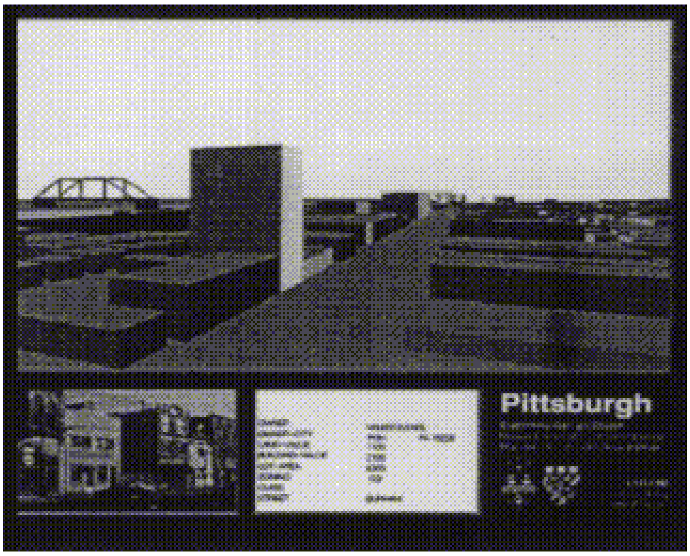


7. Use of a translation table to link multiple artifacts to a single form

3.3 Taking out Simplicity

Larger datasets require more capacity for queries and filters. These may be structured endeavours, targeting particular issues, or they may be more exploratory, unearthing new views and informing relationships being built by the designer. Both of these cases can be supported and readily processed through this type of object-oriented information structure.





8. Working within the interface

Polytrim provides much of such a capacity. Figure 8 shows several views of a three-dimensional intervention that employs relational data and hypermedia links. Queries can be in the form of traditional database queries, for exmplae: "highlight everything which is commercial, over two stories in height, and on a main street." A query may be an analytical exploration: "tell me about the building over there," (by graphically selecting it), and this might yield economic information in related spreadsheets. Perhaps we wish to be a feeling for the street by having site-photos or video play dynamically--based upon where we walk or what we have in our visual focus in the model. Providing both language-first and experience-first approaches allows the dataset to be useful at a variety of scales of design and with a variety of collaborators. Filters can focus out attention on pertinent information while query strategies allow that information to be exposed appropriately to the type of work being undertaken.

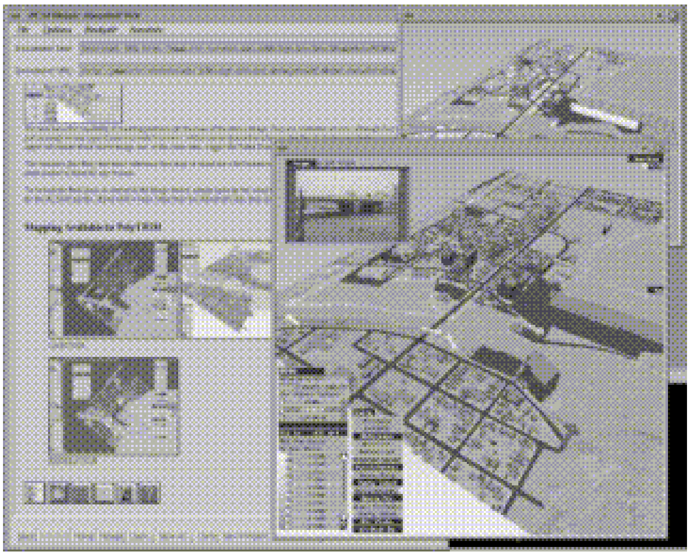
Using the dataset as primary interface may improve the dynamism of exploring relations and constraints. Why is a dataset necessarily static when we navigate it? If we choose to explore a design as an elderly user, the knowledge of our characteristics and those of the surfaces we are being animated over could alter our perspective, keeping us looking carefully where we are about to step rather than at the sculpture we are absolutely sure everyone will focus on in the space. As we plan an intervention, perhaps the planting of a tree, why in this day of material databases and soil/utility mapping can we not get feedback on potential difficulties with our choices? Knowledge of our actions as designers coupled with an active dataset provides a rich environment for collaborative discourse. As we add in the insights of other participants as notes in the dataset, we expand our perspective of the problem and its relationships. The building of those relationships is not only the responsibility of the designer, it is a collaborative effort between participants, including the computational environment and the dataset.

To build such collaborative urban design datasets more actively, we need a number of capabilities: an interactive hypermodel and database syste,; robust query and filtering options to support a range of participants and types of inquiry; and a means of collaboratively utilizing/building such environments. Polytrim provides for the first of these in a robust manner, tested in a range of regional planning, urban design, architectural, and landscape architectural problems, both professionally, in research projects, and teaching environments. Of course, modes of inquiry is a larger problem with no clearly defined boundary, it is as diverse as the range of participants and types of issues under investigation. However, Polytrim has at least looked at areas of two- and three-dimensional constraints for plant and urban structure placement, environment and behaviour exploration, historical and environmental inquiry, and urban policy interactions from visual, economic, and microclimate positions to name a few.[5]

4. ISSUES FOR FURTHER STUDY

4.1 Distributed Collaboration

As the problems of urban design expand, so too usually so the numbers of specialists and participants involved in the work. At the same time, increasing economic pressure makes travel time and group meeting logistics significant problems. A forum for distributed collaboration can facilitate the collaboration of those groups who have stakes or special skills to constribute and would otherwise not be able. The wide acceptance of the Internet has been facilitating this for many groups [6], but with the current emergence of the World-Wide Web (WWW) and graphical hypermedia, this has taken on a new strength. A common format for communicating hypertext (Hyper-Text Markup Language, HTML) that works across platforms and can be added to in a truly distributed manner has started the formation of a community of urban design and related information on the Internet.[7]



9. Use of CLRmosaic on a similar project. (Courtesy John Danahy)

Specialists and the public are increasingly able to follow, comment and contribute their knowledge to design problems. What has been missing is a model of the design dataset that can be explored and manipulated by their groups remotely. CLRMosaic is a hyper-model environment developed by the Centre for Landscape Research to address these issues, taking the ideas embodied in Polytrim and making them more accessible as a facilitator of collaborative dialogue [figure 9]. Whereas the pre-defined images and text most commonly seen on the web provide some viewpoints of a dataset, they are not truly interactions with that dataset. CLRMosaic offers a flexible spatial data modeling language (SDML) integrating with other data formations through hyper-links. SDML itself supports the wide range of relational data and associated geometric descriptors while supporting any external resources through the WWW Universal Resource Locator (URL) structure. This provides a common base upon which net-based collaborations can occur and can be explored. Issues of data update, versions, protection, and permissions must still be resolved for this to adequately go beyond an exploratory mode (each participant only having asynchronous 'read' capability), but even this first level takes the capabilities some way beyond the current static approaches. These further issues of update and synchronous collaborative support are the next points in its development.

4.2 In the Studio

This research should have immediate applications to design education. The very reality of dealing with much more data could transform some studio experiences, which surrently overemphasize invention at the expense of observation. Collecting, integrating, and interpreting a much wider variety of descriptive material should become an important component of studio work-and especially of studio preparation. Learning to challenge information, for example to distinguish its accuracy from its precision, or to identify its sources and cumulative history, must be an increasingly important aspect of education in any discipline today. Finally, working within richer, wider media repertoires may serve to overcome obsessions with particular intermediate artifacts, whether those are basswood models or 3D Studio renderings, in favor of a growing respect for content. As hardware and software become cheap and plentiful, designers everywhere will rediscover the importance of data, which they will handle in a much more collaborative manner this time.

4.3 Emphasis on Datasets

Improving means for project data integration suggest opportunities to increase the power of substative datasets as a basis for design exploration. This is a fundamentally different emphasis than has been suggested by much research in formal, knowledge-based systems. In one sense it is less about the tools of software, and more about the medium of dataset. But in another sense, it discourages such distinctions, and invites a scenario in which the data themselves become the access structure, the objects of action, and the means of manipulation. This is a very general trend, which the specific technologies and projects shown here hope to illustrate.

ENDNOTES

[1] McCullough, 1993.
[2] grant, 1993. Van Bakergem and Obata, 1993.
[3] Danahy, 1988.
[4] Hoinkes and Mitchell, 1994.
[5] Wright and Hoinkes, 1993.
[6] Wojtowicz, et.al., 1993.
[7] Hoinkes, 1995.

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