

# Crossing Two Thresholds with one Stepping Stone – Scenario for a More Comfortable Design Environment

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## **Abstract**

In architecture, design ideas are developed as much through interaction as by individuals in isolation. This awareness inspired the development of a dynamic architectural memory online, an interactive platform to share ideas, knowledge and insights among architects/designers in different contexts and at different levels of expertise. User interaction revealed this platform to suffer from at least two thresholds: First of all, consultation during design is impeded by a physical threshold that separates the platform from the designer's working environment. Secondly, designers tend to sense a psychological threshold to share their ideas and insights with others. This paper proposes to cross both thresholds by connecting the collective platform to a private design space, where designers can feel free to jot down and reflect on their ideas without fear for criticism, compromise or copying. This connection should allow them to access the platform during the very act of designing, and to regulate to what extent they 'give away' their own ideas. The latter regulation is literally meant as a stepping stone that if not primes, then at least paves the way for a sincere shift in mentality.

## **1 Introduction**

Once upon a time design was considered predominantly a sequence of cognitive operations entirely conducted within one brain. More recently the awareness that design ideas are developed as much through interaction as by individuals in isolation fostered a whole variety of collective/collaborative design tools. Hermes, for instance, keeps track of the discussions, decisions and comments of all design team members, while the Augmented Informative Discussion Environment (AIDE) was developed to support collaborative concept formation (Stahl 1992; Mase et al. 1998).

In the field of architecture, this awareness inspired the development of a dynamic architectural memory online, an interactive platform to share ideas, knowledge and insights in the form of cases among architects/designers in different contexts and at different levels of expertise. Platform users cannot only consult cases in memory; they can develop and improve memory by submitting self-designed cases, and by commenting on or making links between cases already available.

Confrontations with professional architects, however, revealed this platform to suffer from at least two thresholds. First of all, consulting cases during design is impeded by a physical threshold that separates the platform from the designer's working environment. Having to leave this environment to explicitly look up cases inconveniently interrupts the design process. Secondly, when it comes to case submission, designers tend to sense a psychological threshold to share their ideas and insights with others. Part of this threshold may be due to the fact that collaboration makes them more critical about their ideas and forces them to make compromises. Perhaps more importantly, designers seem to fear that, along with their cases, they will give away 'the secret of their success'.

This paper proposes to cross both thresholds with one stepping stone. The idea is to connect the



collective platform to a private design space, where designers can feel free to jot down and reflect on their ideas without fear for criticism, compromise or copying. This connection should allow accessing the platform ‘en passant’, that is during the very act of designing. Just like the Shift+F7 shortcut in Ms<sup>®</sup> Word enables authors to look up synonyms in a thesaurus without leaving their text, designers could trigger case retrieval from within their personal design space. In addition, the connection should allow designers to regulate to what extent they ‘give away’ their ideas. By submitting to the platform only a selection of material about a case and mentioning the possibility to inquire further particulars, designers can tune what they release to the user in question.

By way of background, Section 2 starts by justifying our focus on design ideas in architecture. Subsequently, we sketch the collective platform developed to exchange design ideas (Section 3), the personal design space (Section 4), and the connection between both (Section 5). We conclude with a summary and some topics for future research.

## **2 Design ideas in architecture**

Implicitly or otherwise, every tool that aims at supporting architects’ design process implies a value judgement of architecture. There are different viewpoints to assess the value of architecture, and along with the viewpoint the judgement may vary. At one time in history considerations of form determined architectural quality, later functional ones. Today we assume that what makes an architectural design valuable is its underlying idea. As Bryan Lawson contends, “Good designs often seem to have only a very few major dominating ideas which structure the scheme and around which other relatively minor considerations are organized” (Lawson 1994). There is nothing wrong with taking this view, provided we are clear about it being *our view at this moment*.

The ideas underlying an architectural design are known to architects by many names, ranging from ‘image’ (Alexander 1979) over ‘primary generator’ (Darke 1978) to ‘organising principle’ (Rowe 1987), but most often are called the ‘parti’ (Leupen et al. 1997) or ‘concept’ (Lawson 1994). They do not necessarily require the addition of an extra ingredient. In fact, every aspect already present in the design situation, e.g. a special feature of the site or programme, or a curious trait of the client, may qualify for this role. Moreover, underlying ideas are rarely found in the singular. In the Institut du Monde Arabe in Paris, for instance, Jean Nouvel combined the need for sun shading with a ‘Moucharabieh’ pattern and the idea of a light-controlling diaphragm in a camera lens (Sharp 1990).

Coming up with design ideas is one thing, translating them consequentially into a built artefact is yet something different. Indeed, what makes designing good architecture extremely difficult – and at the same time extremely fascinating – is that this translation is far from straightforward a procedure. The use of design ideas is constructive in nature and similar to a dialogue (Schön 1983). Tom Witt compares this process with telling oneself stories (Witt 2000). In order to tell a story, that is to explore and communicate their ideas, architects/designers combine different kinds of information and representation. Yet, unless the story is consistent and continuous from the earliest conceptual phases right through design development to detailed design, those important underlying ideas will get lost. Apparently, this ‘hanging onto the big idea like grim death’ is something architects/designers tend to struggle with (Lawson 1994). Speculating about the role of digital media in architectural design, the question rises: Can computer technology improve the consistent development of design ideas?

## **3 DYNAMO – A Dynamic Architectural Memory On-line**

Convinced of the important role of interaction in developing design ideas, we decided to build a collective platform to accommodate and stimulate this interaction. DYNAMO, which stands for Dynamic Architectural Memory Online, is a Web-based design platform that tries to kill two birds with one stone.

At short notice, it provides architects with a rich source of inspiration, ideas and design knowledge, as it

is filled with a permanently growing collection of design cases by and from different architects. Especially in the early, conceptual stage of the design process, previous design cases provide grist for a number of decisions to be made (Domeshek and Kolodner 1992). Being themselves end results of initial concepts, cases are cut out to illustrate how a particular idea can be pursued through all aspects of an architectural design.

DYNAMO's long-term objective is to initiate and nurture the life-long process of learning from (design) experience as suggested by the cognitive model underlying Case-Based Design (CBD). Being rooted in the Theory of Dynamic Memory, this model claims that human memory is dynamically changing with every new experience (Schank 1982): it acquires new cases by storing fresh experiences in memory; re-indexes cases that are not immediately stored in the right place; and generalises individual cases that belong under the same heading. Inspired by this model DYNAMO is conceived as an (inter-)active workhouse rather than a passive warehouse: it is interactively developed by and actively develops its users' design knowledge. Its most important feature is not merely that it presents cases, but that those cases trigger in-depth explorations, stimulate reflection and prime discussions between architects/designers in different contexts and at different levels of expertise.

Physically, DYNAMO consists of:

- 1) a growing collection of cases – the actual memory content: Cases are entire building designs, both built and unrealised projects, and are represented by a mix of text, photos, graphics, 3D models, facts and figures, video and sound.
- 2) a database that structures this memory: In this database, each case is characterised by various features, so-called indices, which serve as filter criteria during retrieval and as links to other cases having common characteristics. These features include the underlying idea(s) of the design as well as aspects of form and space, function, construction and context. If we consider cases encapsulations of design knowledge, this web of indices further enhances each case's value. It allows users to approach a project from different perspectives and to situate it in relation to other projects.
- 3) a user interface to consult and modify memory: The interface allows users not only to consult and navigate between cases in memory, they can also change and improve memory as suggested by CBD's cognitive model, i.e. by adding new projects (possibly self-designed), making links between them or creating extra indices.

The case collection and database are stored at the server side; the interface can be viewed with a standard Web browser at the client side (Figure 1).

User interaction with DYNAMO has been surprisingly successful. Despite the tool's prototype nature, both student and professional architects have reacted favourably to using it during design and would like to use it again for future design tasks. A major drawback, however, seems to be the tool's separateness from the architect's actual design environment. As already mentioned, DYNAMO can be accessed through a standard Web browser. User friendly as such browsers may be, they are not particularly compatible with an architect's designerly way of working, especially not during concept development.

In a pilot study with professional architects, for example, videotapes clearly illustrated the gap between DYNAMO on the one hand and the designer's paper and pencil on the other hand. The architect must first realise that previous cases may provide useful information, try to find relevant cases in DYNAMO (which is the convenient shortcut for: switch to the browser, type in the URL, specify one or more selection criteria, screen the cases that meet these criteria and pick out the relevant information), and finally carry the information back to the paper and pencil environment. Each step of this process – realising that cases may be useful, finding relevant ones, and transferring the corresponding knowledge to the design – interrupts the design process considerably.

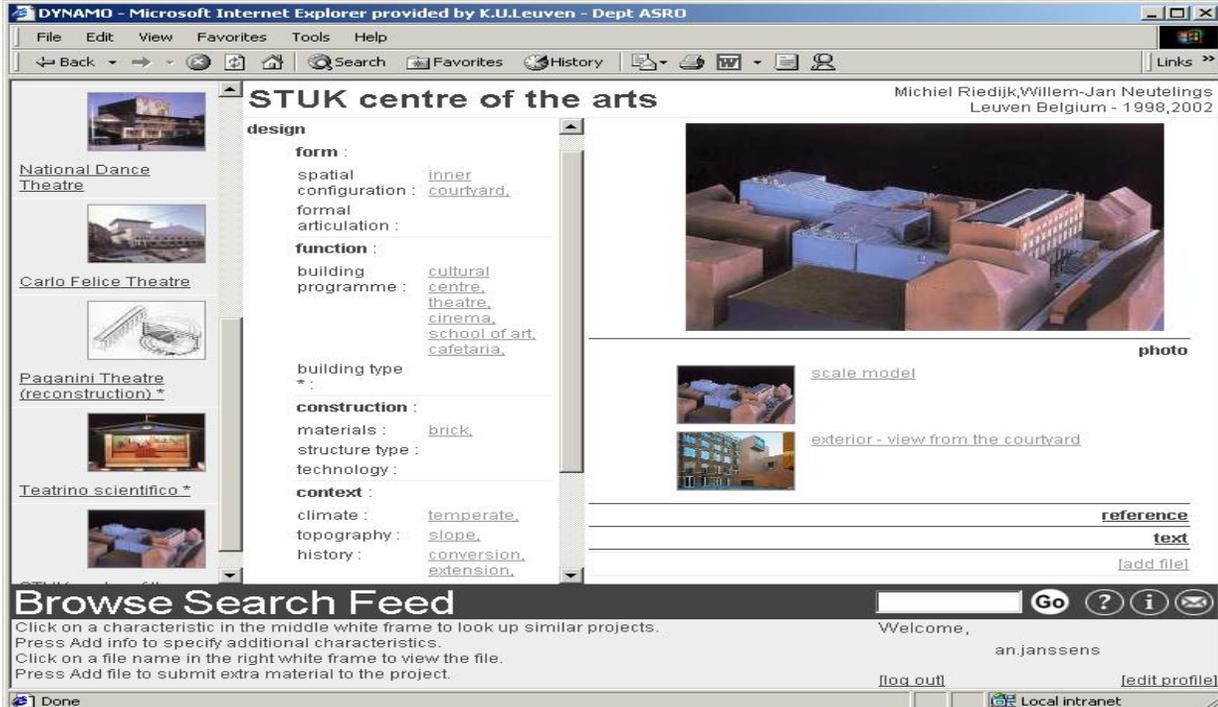


Figure 1. Screen shot of DYNAMO.

In order to fully integrate the process of consulting cases with the very act of designing, users must be able to go swiftly back and forth between their design environment on the one hand and a case base on the other hand. In this respect, the ideal would be if DYNAMO could be accessed from within the architect's design environment itself instead of through a Web browser, as is currently the case. Therefore we propose to connect DYNAMO directly to a personal design environment called Idea Space.

#### 4 Idea Space

Architects, we have mentioned, do not only sketch during design. They combine different kinds of information and representations. We contend that all design information represented should be seen as small parts of ideas and contextual information, which are used to construct the design, to dialogue, or to tell stories. All these elements are captured and constitute a network, as if part of the frame of reference is being made explicit. This network of information is called the Idea Space, which is part of the E3dAD system. Whereas other research has concentrated on sketches and diagrams (Deering 1996; Gross et al. 1994, 1996; Igarashi 1999), the Idea Space focuses particularly on everything the architect writes down. We can think of descriptions of ideas, the annotations to writing, images and sketches, further more loose keywords and the writing in schemes or schemas (Figure 2).

The difficulty lies in linking up with the rich information structure that the architect constructs during the design process and the various cognitive processes s/he uses to handle this information structure. The combination of text, image, sketch and/or draft can provoke new associations, which keep the design process going. In making sketches and jotting things down, architects provide themselves with an external memory, visual cues for association and a physical setting in which thoughts are constructed. Suwa et al. have stated this for sketches, but in fact it holds for every representation architects use (Suwa et al. 1998). All design data, and all small parts of the construction that the architect makes contribute to the design. Moreover, the architect may even reuse parts that were crossed through initially. By consequence the system must be able to include all design content. Actually, what we are saying is that the information structure captured by the system is like a frame of reference. Without a frame of reference, one cannot tell stories, dialogue or build a construction, as in designing.

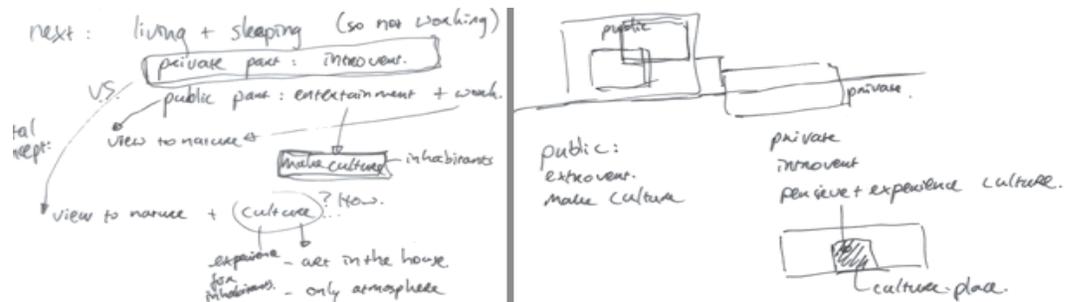


Figure 2. Architects do not only sketch during design.

In terms of a semantic network, the representations of the ideas are the nodes, and the relations between the representations of the ideas are the links. In the system, ideas can be represented in multiple ways: text, sketch, or image. Relations are divided into two groups: user- and system-defined relations. Together they form an information structure that resembles a frame of reference. We call it the Idea Space.

We distinguish between three types of user-defined relations. These are time-based relations, place-based relations, and gestures. Time indicates the time of action (project, date, time), whereas place indicates on which 'sheet' the action took place. A gesture is a mark put on paper by the architect, which connects ideas in an intentional manner, i.e. an arrow, an encircling, or a tree-like structure. The first two relations are important because they reveal the order in which ideas occur and the fact that ideas were placed near each other. This indicates that they were associated with each other, or will be. The third type of user-defined relations, gestures, can be used by the architect to directly influence or change relations between ideas in the Idea Space.

Besides the fact that words contribute to sustain multiple meanings in conceptualising the design (Lawson 1997), an extra advantage of words is that, compared to other representations, they can more easily be recognised and related to each other by a computer system. We therefore use the words jotted down by the architect as an extra handle to establish connections in a network of design data: system-defined relations. Like Simoff and Maher we use semantic relations, but we supplement these with lexical relations (Simoff & Maher 1998). As we see it, architects do not only use jargon, but also natural language as a means to express ideas. We do not intend to build design domain knowledge in the Idea Space. Instead, we intend to represent a frame of reference, which is not necessarily related to domain-specific subjects. In relating these ideas we make use of a thesaurus called WordNet<sup>®</sup> (Fellbaum 1998). WordNet<sup>®</sup> is an online lexical reference system, developed at Princeton University, whose design is inspired by current psycholinguistic theories of human lexical memory (Miller et al. 1990). WordNet<sup>®</sup> enables us to connect words in meaning (semantic or lexical) more easily.

Idea Space focuses on stimulating and supporting associative reasoning. The system, meant for private use by the architect, should stimulate creativity by allowing free generation and exploration of the design data. The envisioned system is able to generate new associations, to relate and restructure information, and to keep track of all ideas made explicit. WordPlot, a first prototype of Idea Space, can name the relations between two words in a semantic and lexical way (Figure 3).

### 5 Community and privacy

Whereas Idea Space provides architects with an overview of their own design ideas, DYNAMO can provide examples – both successes and failures – of how related ideas have been developed into built artefacts by other architects. In order to interweave retrieval of these examples with the architect's activities during concept development, we propose to establish an explicit connection between both (Figure 4). To some extent, this connection is analogous to the Shift+F7 shortcut in Ms<sup>®</sup> Word. Just like this shortcut allows authors to look up synonyms in a thesaurus without having to leave the text they are writing, linking Idea Space to DYNAMO enables architects to retrieve relevant cases 'en passant', that is during the very act of designing.

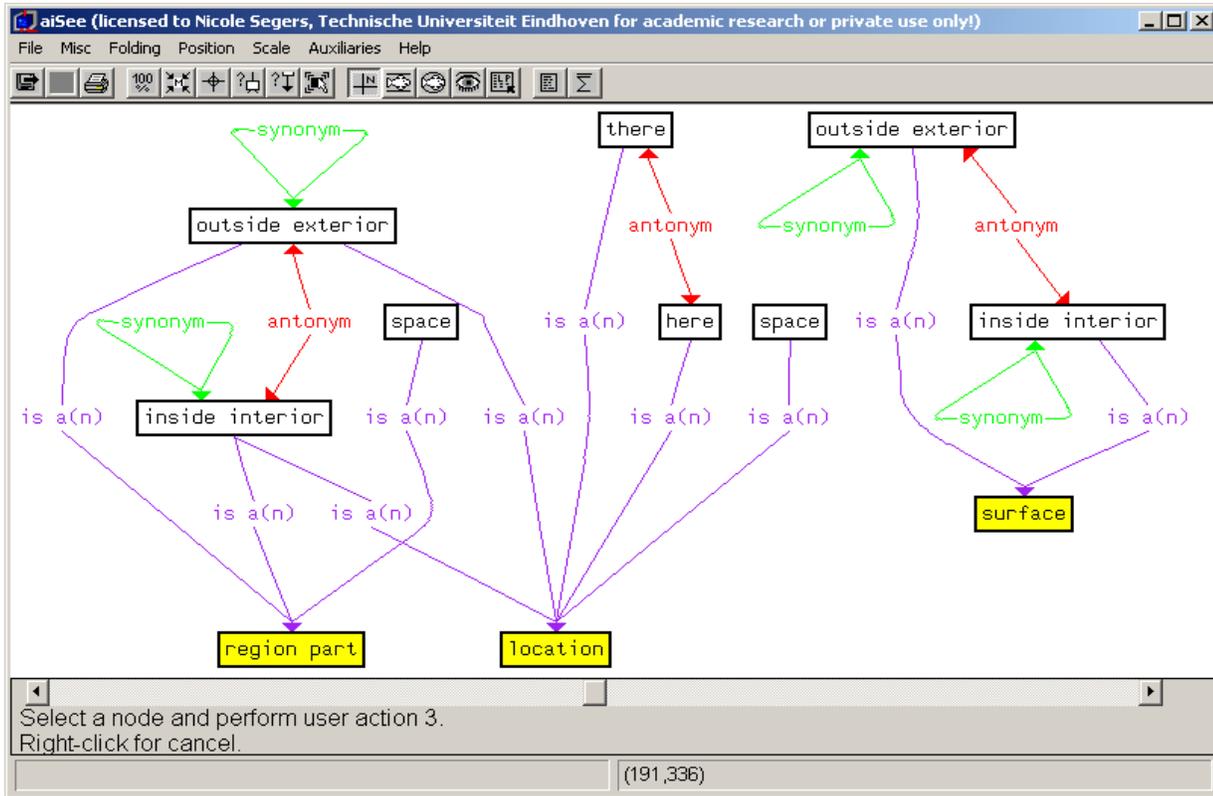


Figure 3. **WordPlot**, a first prototype of Idea Space

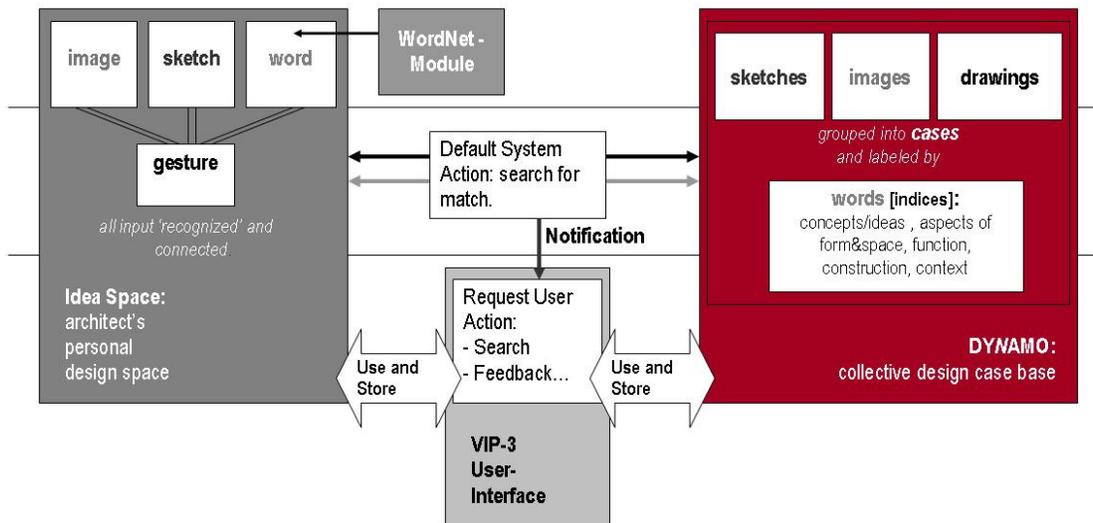


Figure 4. Scheme of the architectural Shift+F7.

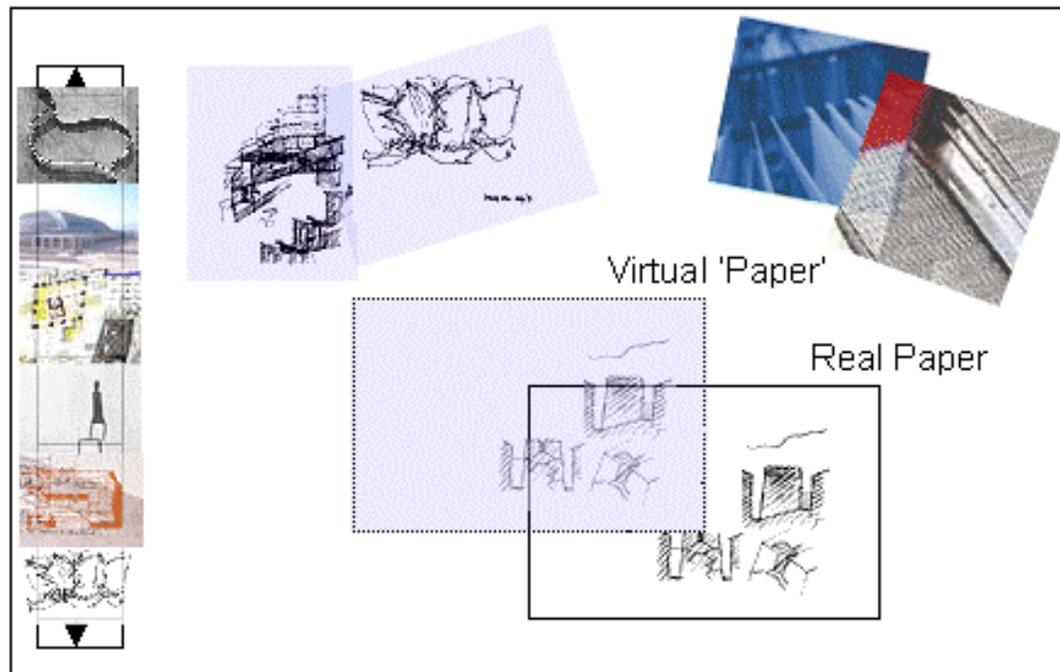


Figure 5. Augmenting real paper with the projection of virtual paper.

The connection we propose makes use of the Visual Interaction Platform (VIP), developed at IPO/Center for User-System Interaction (Aliakseyeu et al. 2001). VIP's major advantages are that action and perception spaces coincide, two-handed interaction is possible, and multiple users can interact collectively and simultaneously through separate interaction elements. Using VIP feels like working on real paper, be it that this paper is augmented with a projection of a virtual paper (Figure 5). In case of the architectural Shift+F7, the latter contains both Idea Space and DYNAMO. Since action and perception spaces coincide, there is no interruption of the design process. The architect/user writes things down, makes sketches, and can consult Idea Space and/or DYNAMO whenever s/he likes. By adding all information on the real paper (captured by the system and made virtual as well) and the 'virtual' paper, the Idea Space of nodes and links is being constructed on the fly.

How then does this architectural Shift+F7, i.e. the connection between Idea Space and DYNAMO work? Idea Space recognizes the different representations used by the architect, whereby words are treated in a special way: the WordNet<sup>®</sup> module searches for word-pairs, having a semantic or lexical relation. DYNAMO for its part uses these words or word-sets as input to continuously search the case base. If a word(-set) coincides with the content of a case's index (i.e. with its underlying idea or an aspect of its form and space, function, construction or context), a notification pops up in the perception space (Figure 6). If interested, the architect can study the case in more detail and/or browse to related cases. Moreover, the architectural Shift+F7 allows inserting images, sketches, or text from DYNAMO into the Idea Space, either by making a reference or by simply dragging the material into the network. The advantage is that, at all times, the architect can trace back which information from other cases was used as hint, source of inspiration or solution. This also works the other way around: starting from material (i.e. an image, sketch or text) from DYNAMO one can detect when and where in the design process this information was used, since this is all stored in Idea Space.

DYNAMO offers access to cases through various issues that are at stake during design. Suppose, for instance, that the architect is thinking of using windows that provide a wide view for the user. If this quality, of windows providing a wide view, is not explicitly mentioned in the case base, the architect can browse through the cases and label and link the relevant ones by this new issue. While DYNAMO is meant for collective use – all architects can add to the case base and have access to the corresponding

ideas – Idea Space is personal like a diary. Nobody but the architect using the system can access the ideas in his/her Idea Space, even if they are connected or related to cases in DYNAMO. Only what s/he feels comfortable with to submit, will be displayed to other platform users. Submitting but a selection of material about a case (the main concept, a few photos, a simple plan) and mentioning the possibility to inquire further particulars allows for tuning what is released to the user in question. Just like Mase et al. deal with creativity in conversation, the architectural Shift+F7 has the advantage of combining a personalised design space – where architects can feel free to jot down just anything – with a collective space – where they can find and share with others interesting insights and ideas (Mase et al. 1998).



**Figure 6.** Case retrieval ‘en passant’: a notification pops up in the perception space.

## 6 Summary and future work

Supporting the consistent development of design ideas through interaction on a collective platform turns out to suffer from at least two thresholds: a physical threshold that separates the platform from the designers’ working environment, and a psychological threshold to share their ideas and insights with others. In order to cross these thresholds, we have proposed an architectural Shift+F7 that connects the platform to a private design space. This should allow architects to access the platform during the very act of designing, and to regulate to what extent they ‘give away’ their ideas. The latter regulation is literally meant as a stepping stone to if not prime, then at least pave the way for a sincere shift in mentality. Awaiting this shift, our purpose in presenting this stepping stone is twofold: first, to underscore the need for creating a more comfortable design environment where designers can develop their ideas in equilibrium; second, to propose a possible scenario for such an environment where reflection and collaboration can complement and fertilize one another.

We are the first to admit that further evidence is needed for the value of our scenario. Therefore, we are planning first of all to build a prototype interface between Idea Space and DYNAMO. A further step is to use the prototype in a pilot study with architects in different contexts and at different levels of expertise. Although this scenario still lies largely in the future, we are already aware of some important problems to be dealt with, such as the ambiguousness of the information the architects will provide the system with – architects can interpret words, ideas or sketches in multiple ways – and the identification of relevant information to provide the user with. Indeed, finding or tracing the ‘right’ information in a structure as

large as Idea Space plus DYNAMO is far from trivial a task. We do not want the system to find exactly the same as the architects have in mind, but to provide them with relevant ideas that can help advance their design process. The key challenge here will be to find material that is both sufficiently like and unlike the architects' design ideas.

*This paper is based on the paper 'An architectural Shift+F7', presented at the ARCC/EAAE2002 International Conference on Architectural Research in Montreal, May 22-25, 2002. The 1<sup>st</sup> author is a postdoc fellow of the Fund for Scientific Research Flanders; the 2<sup>nd</sup> author is a PhD-student at the Technische Universiteit Eindhoven. Special thanks go to Raf Segers and Pieter Morisse for the implementation of DYNAMO and to Prof. Bauke de Vries and Prof. Herman Neuckermans for their comments on earlier versions of this paper.*

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