Crisis? What crisis? Approaching information space: New dimensions in the field of architecture

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The paper describes the current situation concerning career opportunities in the field of architecture in developed western countries. Several aspects that are almost universal mark this situation. Firstly, there are too many architects chasing traditional work in competition with other engineers. Secondly, the needs of the building industry have changed over the past years so that the skills that architects are able to offer are not necessarily those that are sought. Lastly, the constant specialisation of work has continued unabated. Architects, as generalists, have seen their areas of expertise be usurped from neighbouring fields. The situation is not lost, so long as architects are able to recognise what is desired from the point of view of the client and what is desired from the point of view of the architect. For educators, it must be clear that the real potential architects possess is their encompassing knowledge of the building information. Architectural Information Management is a necessary skill to be taught alongside the more traditional architectural skills. A brief outlook as to how this might come about is detailed in the paper. The authors propose didactic steps to achieve this. Primarily, the education of computer supported planning should not simply end with a series of lectures or seminars, but culminate in integrated Design Studios (which include Design-Build scenarios).

Keywords: architectural information management, computer supported design studios, CSCW

1. Introduction

The architectural community is once again in a crisis. The chances for recent graduates are all but rosy. In Germany, for example, approximately 6500 graduates enter the job market each year. Independent of the current slump in the AEC industry, only 2000 to 2500 architects leave the field each year. True, the number of new students has been reduced over the past few years, but fierce competition has more or less remained. This, of course, has pushed entry salaries down while at the same time, raised the level of skills needed to even obtain employment. In order to be considered for a position, practical experience and excellent abilities in CAD are a must. Employers look upon real-world experience better than a portfolio full of design ideas. The demand is for generalists with specialist tendencies and economic realities dictate these conditions.

In education, this has not gone unnoticed, but has perhaps not been properly addressed. To be sure, the number of architects entering the field is over-proportional for one that is more or less stagnant. Nonetheless, there is a continuous (albeit smaller) demand for knowledgeable architects that are ready to apply their skills intelligently. This is in part due to the enormity of the building industry. In Germany, where the automotive industry dominates the economy, the building industry is approximately four times as large. Unlike the automotive industry however, the building industry is highly fragmented and thus, susceptible to large changes when economic pressure starts to exert itself. As members of this industry, architects need to be able to cope with these swings and to act rather than react. Clearly, the question needs to be asked, what kind of architects do we need, what kind of skills should they have and which of these should they be endowed with upon completion of their studies?

The continual usurpation of various tasks performed initially by architects has a long pedigree dating back to the 19th Century and has accelerated since the end of the Second World War. [13] Quantity surveying was one of the first; project management as well as site supervision are but the more recent tasks to be given up. The profession is marked by a continual "crisis", which can be traced to social, economic and technical factors. In an almost tragic fashion, the profession has long had the problem of having to justify its existence and to document its worth to society. This does not mean that this trend is irreversible. In some countries such as Finland, there exists a "National Architectural Policy, which works to instil the role of architecture in the society. In other countries, this seems a long way off. In fact, it could be said that one of the effects of the long pedigree of "task usurpation" is, that architects have come to accept it as almost normal, or at least as an un-winnable position. The authors are of the opinion that this does not necessarily have to be so and that the current crisis contains the seeds for a renewed optimism, especially in the era of communication and information technologies.

2. Causes

The discussion within the field about the content and form of the architectural education has, in recent years, concentrated on the "designerly" aspect of architecture. The universities and art schools have been especially hit with the accusation that they concentrate too much on design and educate the students for a job description that is all but explicit. But furthermore architects have to consider that both ends of the gap they expected to bridge with her profession are changing rapidly. Both the body of knowledge that they must use and the expectation of the society they must serve have changed from their origins due to the same common factor: technological change. [15] As a consequence, parallel decisions need to be made under uncertainty, in turbulent environments and consecutive to nonlogical processes. Harvey Rooks calls this the „Unprecedent requirement for adaptability".

Due to these ambitious requirements the field does call for creativity and flexibility and an ability to work in an integrative way. "Architects must be able to understand the problem, find a good solution among many different solutions within a team, communicate this to people outside the field and last but not least, transform it into a built object". [14] These demands require that future architects be educated over a wide yet interconnected spectrum of knowledge based on an integrated grasp of the profession. In addition to this, the advent of the information society has added a whole new set of demands for the profession and the education of its practitioners.

The integrated aspect of architecture is generally accepted. So too is the need to bring specific knowledge from other fields into the architectural education and to train architects to synthesize this knowledge in order to formulate built form. The discrepancy arises when creativity is considered as a skill that only architects master. Creativity, by its definition, is not limited to any one field or specific endeavour. Rather, it is the general ability to intelligently find solutions to problems. The smallest of challenges can be invigorating and indeed, enlightening. [5]

3. Form

These challenges may or may not have to do with the overall form of a building, but it is exactly the affirmation of the predominance of form that has, in recent years, taken an overbearing role in the education of architects. This debate (or position) is certainly not new. What is new is the reason given for the obsession with form, which fuels the argument. Indeed, this argument has been used before to justify architectural form.

In the 1920s, as concrete became a feasible building material for dwellings and public buildings, the debate centred around the argument that new building materials implied new building form. [1] The argument

essentially gave the followers of this creed complete artistic freedom. Today, the argument runs that new design methods and new design tools mean that new form is needed. What is meant, of course, is that since we have computers and computer aided design (CAD) and computer aided manufacturing (CAM), the form of the building must be *new* in order to reflect these changes. The "blobs" and other non-rectilinear forms that current design software and computer aided manufacturing enable are the best examples of the argument made real. The authors argue that this debate is irrelevant to the future of the profession other than that it diverts the attention of architects and educators from the real problem: the growing irrelevance of architects in society. In order to counter this trend, its causes must be analysed and these appear, in part, to reside in the roots of architectural education.

4. History

The integrated education was first formulated in the École Polytechnique at the beginning of the 19th century. Characterised by a systematic course organisation, firmly based in science and the social dimension of creative work, this model has served as the basis for almost all "western" architectural education [11] The trend in the last twenty years has been to successively depart from an integrated and rational model in favour of one that puts a strong emphasis on "design". The question as what differentiates architecture from engineering is answered with the word "Design". That is to say, the engineer calculates, but the architect designs! This can lead to the situation where students become seriously convinced that the architects can, as designers, solve complex problems -such as the built environment- by purely formal design. Put another way, the aesthetics of the building dominate the solution; technologies are just following and supporting the form. This is not to denigrate the importance of well-designed buildings or even good-looking ones, but that in education especially, the students need to be made aware of where the real importance lies in the field of architecture.

5. Structural changes

This trend has been accentuated by hierarchical changes. The architectural education could be mostly characterised as a structured and successively placed combination of necessary courses. Art history and architectural history, visual geometry, surveying, engineering, principles of construction, scheduling, logistics and economics were all considered as important components of an integrated professional education. In short, this is anorganisational learning system to enable the future practinioners to make decisions under uncertainty, in turbulent environments under the conditions of nonlogical processes. Donald Schoen considered this already in the beginning 80's as "reflection in action". The synthesis of this learning system

comes together in the design studio. It has to be remarked that this multi-faceted aspect has been present and in part replaced with an accentuation on the design studio that emphasises its "artistic" qualities. This change has resulted in a reduction of the importance of other aspects of the curriculum. Furthermore, it has signalled to students as well as to persons external to the profession where the focus of the profession lies.

True, design means integrating the various aspects of architecture into a concept for a built solution. However, the weight given to form during the studies is quite far from the reality in the architectural office.

6. Challenges

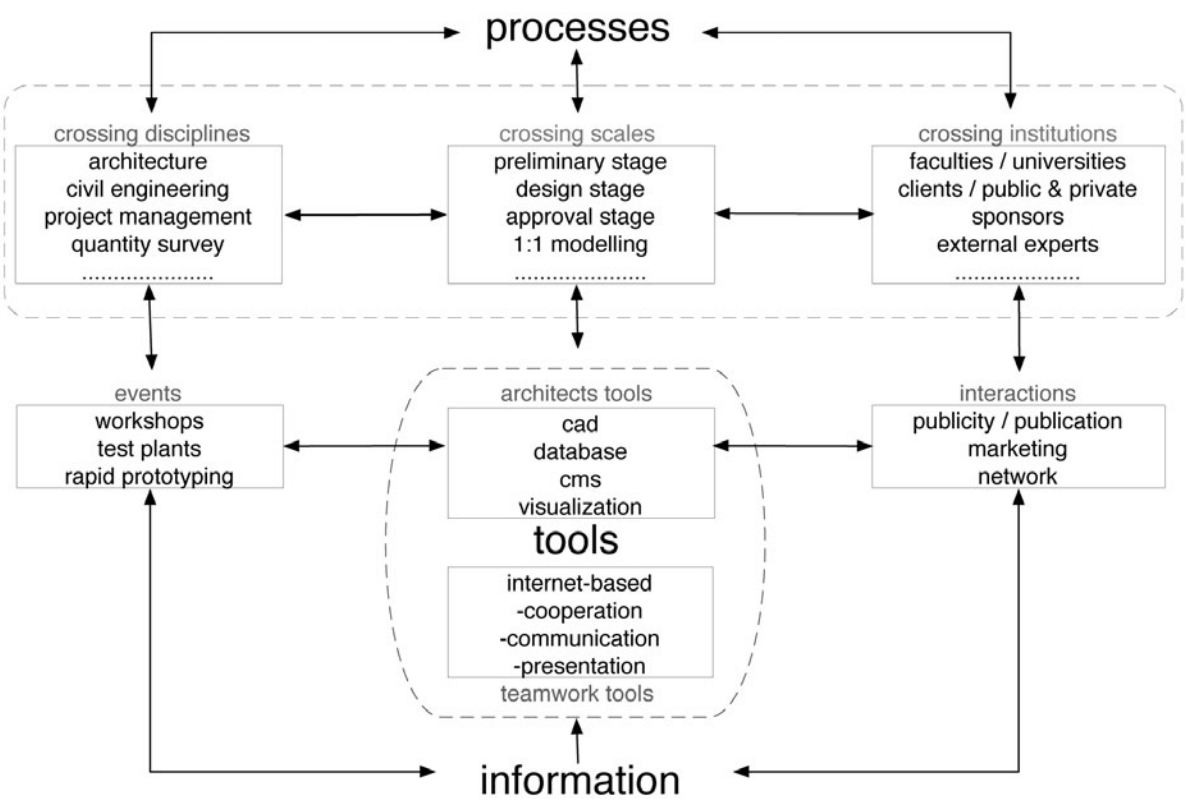
Once relatively robust economic conditions changed, the role of beauty or aesthetics played a definitely reduced role in the building industry. This is not entirely new. It was postulated in the 19th century, that soon all that architects would do is be the purveyors of good taste [13]. What is perhaps new is that economic conditions have, in recent years, brought an enormous pressure to not only further reduce costs, but to also speed up the planning and building process. This is practically only realisable with the help of information technologies such as databases and internet-based project organisation.

It must also be remembered that architects were never solely responsible for the form of a building and so form was never an end in itself. Architecture has always had a social dimension and this is better understood by the relationship of society to architecture instead of architecture (or architects) to society. This relationship can change quite quickly. In times of crisis or rapid change, the importance of certain aspects of architecture has completely different values. Architects do not establish the relationship between architecture and society, but they contribute a great deal to it through their attitude to the built form and its role in society and as to where their responsibility lies.

7. Architectural information management

Information management in the building industry is becoming a task, which is recognized as such. It can take many forms such as workflow modelling, shared databases or groupware communication. Through internet-based communication technologies this information is accessible at all times from almost anywhere, especially from the building site itself. This creates fourth and fifth dimensions of architecture, time and information, which are no longer separated from the spatial information or even the planning partners. This allows the whole of the planning team to participate in the information management and enables the multi-faceted communication and cooperation processes to be economically organised. This means as well that they are actively and sustainably integrated into the building design process. It must be noted that the integration of information technology in the planning

process is not a panacea for all problems in the profession. An initial diagram of this "architectural information space" is illustrated in Figure 1.



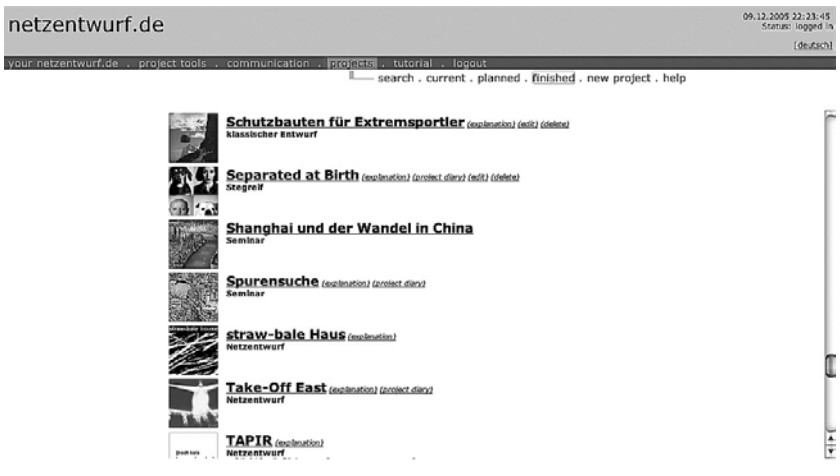
▲ Figure 1. Architectural Information Space

However it has to be considered that auspicious technologies are arising constantly which does not imply that technological progress happens by itself. A specialist is needed to coordinate the integration and to steer the planning environment. The specialists who are suited to oversee this integration are architects because they are the ones who understand not only the separate aspects of buildings but also their relationships. Not least, they are also answerable for the results of these processes: the finished building.

This, of course, has consequences for the education of architects. The use of applicable tools (or the adaptation of the tools and media) must be taught within an architectural education. This must not be done at merely an abstract level, but in practice-relevant situations such as integrated design studios that simulate the planning process. The design studio has a long pedigree as an effective didactical method in architectural education. This must be extended to include the information tools and processes so that the students also are able to develop a relationship to the aforementioned additional dimensions (time and information) in architecture. These skills

must be conveyed in the design studio setting, as it is clear that these skills can only be trained: lectures about planning or management are endangered to fall on deaf ears without real situations to accompany them.

The basic use of information technologies must be taught in education but cannot simply end with the use of CAD software. Instead, the detailed modelling and simulation of the building planning as well as the building processes are needed. Under such conditions the necessary work could be defined as a process between attendant and tool decomposed into clearly defined (or as clearly defined as possible) units of activities. A real-world example: The building project is to be realised on a site in one city; all of the main planners are dispersed through other cities and have not worked previously together. The interesting (and perhaps most important) problem is to organise the internal and external communication, to structure the knowledge transfer, to bring this to life and all the while focus on the building project. The different components of such communication processes have been defined since the 1940s as follows: "Who says what with which media to whom with which consequences?" [8]. In addition, the communication with contractors and authorities on the so-called third-level demands certain social competencies. The experience from the use of relevant technologies in professional practice and the experimentation with this in the design studio context (to which the authors also bring certain experience) show quite strongly, that relationships in this planning methodology are not transferable with standard teaching methods; they must be trained like in the framework of the netzentwurf.de.



◀ Figure 2. www.netzentwurf.de

Naturally, the question as to what further consequences of an almost runaway development in information technology will have for architecture is relevant. Perhaps most important is the metamorphosis of the computer from a tool to that of a medium. This means that the computer is no longer just a replacement for a pencil and a straight edge through the use of the

plotter as an output medium. The alphanumeric and iconographic message has begun to free itself from material substance and to switch to the electromagnetic field [6].

Attempts have been made to establish "virtual" design [16], "virtual design studios" [3] and even "virtual schools of architecture" [2] in order to enable the training needed to prepare future architects for the profession that awaits them. The word "virtual" has, however, been rather widely used of late and so can mean an immersive method to experience three-dimensional space or simply using the computer to draw and model the building [16]. Partly this has to do with the euphoria that accompanied the "new economy" and all that was digital that also spilled over to the schools of architecture. However, some of the more sedate internet-based education projects have shown to have a longer life than many highly rated or highly funded projects. Lessons can be drawn from these in order to establish infrastructures that support and foster a better education over the long term.

The question appears to be not whether the architect uses computer technology but how and to what degree communication and information technology is integrated into the planning process. The replacement of the drafting board (but not the pencil) with CAD systems is no longer a question. Cooperation with planning partners (especially with the building owners on one hand and the field-specific specialists on the other hand) is where information technologies can assist the architects. Indeed, these partners can be efficiently included in the planning process resulting in time saved with a potentially large reduction of misunderstandings. This is exactly the kind of development that will allow the architect to reassume the role of coordinator. The difficulty therein is that we cannot follow the message completely: we are dependent on the medium to show what is "virtualised".

8. Visual and non-visual information

As humans, we are rather dependent on our visual senses for the bulk of the information we take in. In the field of architecture, this is all the more so as a good deal of the information is not transferred as a written language, but as codified series of visual symbols: the architectural drawings. The classical architectural drawings are not the whole architectural information. In fact, when one considers the amount of spreadsheets, correspondence, specifications and tender documents, it could be said that most of the architectural information is non-visual. That is, the information does not represent spatial geometry and is not graphically displayed. Furthermore, a good deal of the information is time dependent, a dimension rarely depicted in architectural drawings.

Time, as stated earlier, is perhaps where the construction industry is under the most pressure. The cost control is, as always, a fundamental factor that needs to be managed and controlled. The effective management of

planning information through shorter or fast-track planning processes, just-in-time processes on the building site, and faster construction methods all add to the increasing complexity in getting an architectural design built on time and on budget. When one adds the dispersed nature of current planning teams, one can see how the complexity of the architectural information and especially how it is to be handled has changed.

The increasing volume of information that is produced by each planning partner as well as an increasing complexity can lead to what Toffler [17] describes as information overload. The information needs to be managed, controlled, evaluated and then further dispersed. The problem is not unsolvable, but the advent and combination of several technologies may allow the architect to not only manage the information, but to play a dominant role in its management.

The computer is where the design resides, where it is structured and often where it is displayed. This de-materialisation (or virtualisation as it is often referred to) means that the architects have to ensure that the image is true to the information behind it. Indeed, the display of architectural information can be enticing so that architects need to maintain a strong vigil against seduction.

The images on the computer screen can become quite powerful as a method to convince planning partners of the value of an idea. There is the case where these images start become a sort of self-seduction. As Leach puts it: "In the age of MTV and Pop Culture, one must be brave to turn your back on seduction" [7]

The Internet's widespread use means that there is a multi-channel communication medium available that all of the project participants can use. The widespread adaptation of broadband technologies (ADSL) means that larger volumes of information can now be easily transferred. As well, the combination of databases, websites and internet-based communication allows the project team to have a "virtual" or spatially independent platform upon which to work.

The factors mentioned above pose a unique chance for architects in that different aspects of society, the building industry and the perception of the role of the architect in both all are at a turning point. The concurrent march of information technologies has provided the tools with which architects can reassert their role as the shapers of the built environment. This, of course, must also be reflected in the education of architects in order to cement these skills.

9. Towards architectural information management in education

Two other factors allow us to be optimistic about the field. Firstly, the Bologna Process will dictate some forms of harmony across the European educational landscape. Secondly, the march of progress means that first

semester students arrive for their studies equipped with laptop computers. Between these two mini-revolutions lies further potential for the renewal of the architectural education.

Within the next five years, almost all architectural studies in Europe will be conducted as Bachelor and Master degree programmes. It should be noted that for educators, the revision of the architectural education as a consecutive degree system does have advantages.

Firstly, architectural curricula must now be revised to meet the Bologna requirements. This is especially welcome to practitioners of CAAD. The evolution of architectural education is relatively slow. In fact, the main aspects of architectural education have remained unchanged since the École des Beaux Arts in the 1850s, [11]. For educators of computer supported planning, the arguments for incorporating CAAD early in the curriculum are often still met with the response that there is no place or time for it. A curriculum revision allows the chance to allocate more time and place for an integrated digital curriculum.

Secondly, the specialisation with a Master of Architecture degree allows focussed computer supported coursework. The Master of Architecture will likely continue to retain the generalist aspects of the ten-semester architectural curriculum. However, within these specialised Master programmes, it is also possible to cultivate new generations of "digital masters" who show the way forward through innovative use of digital technologies or through research carried out to better the tools architects use. This can enable specialised aspects such as Rapid Prototyping, "Smart Buildings" and Virtual Reality to find an audience and hence, continue to be developed.

At the other end of the dialogue between students and educators are the students who now come armed to the teeth with digital equipment. Although this is a long desired situation, in some ways, it is not necessarily desirable. Digital curricula have previously relied on the scarcity of resources to control the content taught to students. Now, with mobile computers and ubiquitous Internet access, it appears there is a problem not in a lack of resources, but in having too many. This means that aspects of the curriculum that were based on resources such as computer pools and 19th century didactical methods will need to be refined in order to take advantage of this situation or at least to prevent unwanted behaviour.

Most first year students are equipped with laptop computers and have what can be called "better than rudimentary" computer skills. However, their use of the computer has been previously limited to singular projectsand to personal. Very few have used their computers as a critical tool and in the digital curriculum, they need to be professional about using the computer.

It becomes clear that the initial course that is needed in a digital curriculum is not an "Introduction to CAAD", but rather one entitled

"Good Habits with Computers." The students need to plan how they structure their data, how to backup and secure their work and how to effectively use the network. Once the students are inoculated with these types of good habits, they are then ready to learn how to use various computer applications to support their work as architects.

The other aspect of the digital curriculum that is essential to convey is the idea of a building information model. This means more than just a three-dimensional CAD drawing. The students need to be aware that their primary activity is to manipulate information. In a digital-work-environment, this means creating, maintaining and using information in ways that foster the long-term usability of the information. Sustainability applies not only to buildings, but also to the building information.

This kind of integration is best taught directly in the design studios. By connecting the information management with the goal of creating good architecture, the students learn the interconnectedness of the two. Indeed, in the extreme case of dispersed networked design studios such as the netzentwurf [12], this means creating not only information, but also an information infrastructure for the project. These infrastructures must allow all of the planning partners to see and use the information transparently. And they must enable if not foster the planning process to progress.

10. Learning information management

Naturally, the infrastructure is only effective when it is used correctly. Architects, as stated above, are the natural partners to coordinate and steer the planning process methodologies. This means architects will need to know how to use the infrastructure and to convince the other partners that they have this knowledge.

This is only possible through the demonstration of competency in this area. It will not be an easy task as architects have previously shown a certain disregard for management in general. The recovery of this field will require work from three sides. For currently practicing architects, there is a definite need to acquire these skills, either through training or by simply "jumping in". Naturally, the architect's associations can play a major role in educating their members as to the short-term gains and the long-term advantages possible through the use of internet-based technologies. Tactically, architects must do this in order to retain the control of the building process. Strategically, architects should do this to recover some of the territory that has been lost to some extent more because of attitudes than of competences.

11. Teaching information management

The second side where architects need to work on the problem is in architectural education. It must be made clear to future practitioners that the overwhelming part of the architect's work is not just to design buildings.

The candidates for the profession need to be made sensitive to the role of architecture in society and the consequences of their work. They also need to understand how complex the building process is as well as how this complexity can be effectively mastered. This is not a single course, but a contiguous message that must permeate the entire curriculum.

Here the authors can offer real solutions. Over the past decade, it has become apparent that individual coursework dealing with issues of information and communication have a solid impact on the students when these culminate in design studios that embrace, enable and to some extent, require the application of IT skills learned earlier. The adage about learning-by-doing has relevance when it comes to teaching teamwork and other "soft" skills. The internet-based design studio platform used by the authors (www.netzentwurf.de) has helped to provide a vehicle where students can carry out design exercises with fellow students from other universities. This requires the students to communicate using the Internet and requires them to utilise other skills (e.g. 3D Modelling), when they are useful.

This is not to say that the Netzentwurf concept has all the answers, but rather that we as educators have had to do a lot of learning-by-doing ourselves. The netzentwurf means training certain skills instead of lecturing about them. In this respect, the concept has helped to focus didactic efforts in teaching teamwork quite effectively. This has also led to the conviction that in teaching "responsibility" and "the role of the architect", similar training methods are also effective.

As a result, the last three years have incorporated the building process itself as a didactical method. The students have not only designed over the Internet, but have also planned the building process and then (usually within one week), built their designs. The consequence of which is that the students come away with a sense of the real problems facing architects. As a bonus, it is immensely satisfying them to see their ideas manifest as real.

► Figure 3. "The Light", Karlsruhe 2005

It must be said firstly, that the idea of carrying out design/build scenarios in the design studio is not new. Projects have been carried out at many Universities over the past decades. What is perhaps new is the attempt to seamlessly bring the information technologies and the process of teaching

them to the process of building. It must also be said that these projects are hugely dependent on acquiring financial backing. In an atmosphere of budget cuts in education, it is well nigh impossible to fund built projects out of the school budgets. This means seeking projects that have some worth to external partners. The temporary nature of the student projects has meant seeking users of temporary structures and to some extent; we have been lucky to find these users. Funding has been, suffice to say, another learning-by-doing experience and that has always been made transparent to students. In some respects that has been a reason why the students have stuck with the projects; we as tutors have made it clear that there are no ready answers to many of the problems facing architects be they short, middle or long-term. There are however, strategies to tackle these kinds of problems and that is why the design studios in general and the netzentwurf in particular are offered: to teach and train strategic thinking about the management of architectural information.

The focus on the netzentwurf illustrates one or two aspects of the general Architectural Information Space described in Figure 1. Further elaborations of other aspects such as "crossing disciplines", running "events" or developing "teamwork tools" go beyond the scope of this paper.

12. Doing information management

Unlike other products or consumer goods, architecture has large and long-term consequences for the society in which it resides. The long life of buildings means that the responsibility of architects cannot lie simply with the impetus to be clever. Furthermore a tremendous responsibility has to be accepted and arranged within an active role concerning client, user and the building's surroundings. Very intensive and sustainable results can be achieved in the authors opinions and experiences by offering what William J. Mitchell is actually defining as "Design Laboratory": Peer to peer learning and sharing intellectual capital, crossing disciplines and scales. Combining digital networking, 3D modelling and CAD/CAM-fabrication as well as large scale modelling. To bring back the "engineering mind" to the architectural design studio by defining attractive and multidiscipline projects in the framework of institutional flexibility and to advance the relation between academia, research and practice.

In this sense, a re-examination of the role of architects supported by new and old technologies, might be a start in a long process to lift the relevance of the profession not only from the perspective of the architects, but also from the society that architecture affects. As educators, there also exists a chance to illustrate at least two things to our students. Firstly, we can try to educate them for the world they will experience when they leave the school, which will likely be much different than the one we experienced. Secondly, we can cultivate the idea that the crisis that exists at many different levels within our profession should be seen not as a series of crisis

threatening our profession, but as an opportunity and a chance to earn the respect we feel we deserve.

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