Making, Thinking, Knowing Architecture. Notes on Architecture as a Making Discipline and Material Practice

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NOTES ON ARCHITECTURE AS A MAKING DISCIPLINE AND MATERIAL PRACTICE

Fredrik Nilsson

Within contemporary developments in the field of architectural research and practice there are certain points of tension that trigger discussions, debates and create dynamics. One important notion here is the aspect of "making" – of actively doing, modelling, altering things in a mode which simultaneously engages thinking and ideas about future worlds as well as the practical transformation of present materials – which is a central aspect of architecture, both regarding the actual process of designing and regarding how knowledge and theories are used and generated. "Making" is part of how architects and designers think as well as how knowledge is generated and used. Artefacts play a central role in this thinking, both as bearers of knowledge and as results of processes of making. The act of making is a way to work with and integrate all the different perspectives which are characteristic of architecture and which have to be dealt with. It is an integral part of a design ability used to generate wholes of contradictory elements and aspects in order to produce heterogeneous objects and artefacts.

The built environment consists of materialised knowledge of many kinds which can be found in, for instance, the detailing, structure and assemblage of space and materials in vernacular buildings and villages as well as in contemporary design objects and infrastructural projects. It is possible to read these different types of knowledge in the built on different levels, e.g. as patterns of social and cultural contexts and processes as well as material and technical patterns and mechanisms. In trying to understand these objects, assemblages and processes, architectural research has often borrowed theories and methods from other disciplines, sometimes without reflection on the specificities of architecture and how to transfer the conceptual and methodological frameworks from one field to another. This has led to a strong critique of architectural research, both from the profession and the academia. (See e.g. Lundequist 1999, 7; Zaera-Polo 2005, 4; Formas 2006) Architecture has in this context been described as a "material practice" and a "making discipline" in an attempt as attempts to form more field specific scholarships. Central here is the practice of material makings, the aspect of transforming reality based on existing contemporary conditions with a direction towards the future. These conditions certainly include important historical aspects, but they are primarily concerned with performances and transformations, not just representations and interpretations.

In the following, my intention is to delineate a section of this field and to gather both some familiar and some less used points of reference in this context, in a way that hopefully indicates some direction for further development and research. Even though discussions and theoretical and methodological elaborations have been going on for several years, there is still a need to further articulate and strengthen the field of

architectural research in close interaction and exchange with the practice and approaches of the architectural profession.

Material practices and making disciplines

Stan Allen has described architecture as a material practice, and he defines material practices as activities that transform reality by producing new objects and organisations of matter, such as, for instance, engineering, urbanism and landscape architecture. He also makes a distinction between what he calls hermeneutic and material practices. Hermeneutic practices are activities that interpret and analyse representations, and which deal mainly with the past and with issues of interpretation and meaning. Material practices, on the contrary, analyse contemporary situations to create transformations towards the future. They work with concrete matters – not primarily with images, meaning or even with objects, but with performance – and produce concepts and theories from the material and practical procedures (Allen 2000, xvii–xviii; Allen 1999, 52–53). These theories and concepts are useful to apply to the specific transformations of concrete situations and contexts of application.

According to Allen, architects have a unique basis of methods, tools and techniques as well as a trained imagination and a capacity for constructing alternative realities. Architecture has always had an intimate connection with society and the construction of social reality, which is full of different perspectives and constant flux, and this often leads to a situation where architectural research finds it difficult to meet the demands of traditional scientific research. Architecture as a material practice deals with concrete materials and the forming of external reality – it works in contexts of application, it is constantly on the move and in close contact with specific material and social situations.

A strategy for developing architecture and architectural research into a stronger discipline is to acknowledge the strong relationship between academic, scholarly and professional design practices, and to lay the basis of architecture in what Halina Dunin-Woyseth has called the "making professions". These professions include the fields of art production, object design, industrial design, architecture, landscape architecture, urban design and spatial planning, and they represent a great variety and volume of artefacts and man-made environments. The making professions use a specific "making knowledge", which relates to the established distinction between knowledge-that and knowledge-how (Ryle 1971), and making knowledge belongs to the broader category of knowledge-how.

To develop a making discipline, the making knowledge has according to Dunin-Woyseth to achieve disciplinary viability and comply with the demands of two worlds – the world of the profession and simultaneously follow the rules of the academic world. A making discipline has to be of relevance to the practice of the making professions and has to have the ability to fulfil the criteria of science, which constitute disciplinary knowledge (Dunin-Woyseth and Michl 2001, 2).

In the design field these difficulties have been discussed for a long time. Already in 1969 Herbert Simon pioneered the design field by making a distinction between the natural sciences and design sciences in his seminal book *The Sciences of the Artificial*. Design sciences deal with artificial things, "how to make artefacts that have desired properties and how to design" and to design is to imagine and devise "courses of action aimed at changing existing situations into preferred ones" (Simon 1981, 129). Simon stresses ideas of modelling and simulation as important to the design of artefacts. Central to design is the construction and use of models as a way of making. The generation of different alternatives – often in large numbers – to be tested against a system of criteria –

in itself often something that needs to be constructed for the specific case – is a way to navigate in and manage the uncertainties of the situation. Simon defines design as the way to imagine and create alternatives, and to change the existing situation into a preferred one. It is not primarily about how things are, but how things could be, how they could be made. It is not about the essential, but the possible. In relation to academic norms of formalisation and well-defined disciplines, design and the science of the artificial seem loose, intuitive, informal and recipe-like.

Donald Schön developed further Simon's programme on design, especially with regard to knowledge in the design fields, and how knowledge is created, formed and used in a model world. His highly influential and still often referred to book *The Reflective Practitioner. How Professionals Think in Action* is very much concerned with thinking in the making. Here design in described as a reflective conversation with the situation, with its materials and with one's own sketches, models and design moves. Schön argues that when the designer reflects at the same time as s/he acts in a situation and when s/he uses reflection-in-action, the designer becomes a researcher in the practice context. The practitioner "is not dependent on the categories of established theory and technique, but constructs a new theory of the unique case", he or she "does not separate thinking from doing" and because experimenting is a kind of action, implementation and application is built into the inquiry (Schön 1983, 68). In the process of design a repertoire of artefacts and patterns of possible solutions are used, and this is emphasised by Schön as important for design knowledge. (Schön 1983, 138) These repertoires consist both of patterns of matter – material artefacts – and patterns of processes – design methods. The training of designers to a high degree relies on the transfer of sets of solutions and approaches which can be used for confronting new design problems.

The two criteria for reaching disciplinary viability of making knowledge – professional relevance and scientific status – require a base and Dunin-Woyseth proposes the triadic concept of History, Theory and Criticism as something which may provide this base and as a cornerstone of the knowledge of designers (Dunin-Woyseth and Michl 2001, 6). The importance of history is obvious, not least in relation to the repertoires highlighted by Schön. The importance of theory is paramount in all scientific disciplines, and criticism can be stressed as a central element in bridging practice and academic discourse. The challenge for the making professions of building a knowledge base which is on a level with academic disciplines can according to Dunin-Woyseth only be met by establishing a tradition of relevant discourse through the process of repeated critical discussions and debates that develop standards of quality. She also states that it is not about claiming the superiority of disciplinary knowledge over other kinds of knowledge; but the making disciplines can form a platform for fruitful dialogues with established fields of disciplinary knowledge. Organised scepticism and criticism within inter-subjective discourses will provide more informed and knowledgeable practices, as well as give rise to exchanges between fields where design can provide valuable contributions to academic development.

The dialogues between a making discipline and a specific academic discipline will vary according to the character of the making object of inquiry and the academic discourse in question, and the role of the making discipline can be to provide a platform for or frame those dialogues in other ways than traditional academic disciplines would. "The role of making disciplines is that of a quality supportive framework for making discourses rather than of a traditional academic discipline where methodology is the theoretical basis for the choice and application of methods." (Dunin-Woyseth and Nielsen 2003, 28) Developments in recent years in artistic research and discussions with regard to "research by design"

show that the making disciplines are on their way to achieving status as academic disciplines. Knowledge production in creative practice and contexts of applications have had difficulties in becoming integrated within the framework of traditional research and scholarship, but developments during the last decades and also interest from the scientific world have made it possible to start conceptualising the field of knowledge in design and architecture in new ways (Dunin-Woyseth and Nilsson 2008, 139–146), and also to find strategies for developing the needed research cultures (Dunin-Woyseth and Nilsson 2010, 71–80). And of course, what is considered scientific status is not something static and once and for all given.

The concept of transdisciplinarity has been the focus of several scientific areas for some years, and not least in relation to architectural research and issues of research by design. It can be fruitful for the development of research in close relation to fields of practice, but it also shows the interest of the established academia in design thinking as a way to broaden the scope of research and acknowledge types of knowledge and problems difficult to manage within traditional borders. In the seminal book *The New Production of Knowledge* the authors identified a new form of knowledge production – called Mode 2 – emerging along the traditional Mode 1 of knowledge production. The main feature of Mode 2 is that it operates within a context of application where problems are not set within a disciplinary framework (Gibbons et al. 1994, 3–5). Through the close involvement with practice this mode involves the interaction of many actors and sets of practitioners within broader social and economical contexts and therefore becomes more reflexive taking into account several perspectives.

A strong feature of an experimental, innovative attitude is also emphasised, including an interest in specific, concrete and ordered structures and processes, rather that general, unifying first principles. Innovation and the search for knowledge through design is central; computers and information technology have played important roles in this (Gibbons et al. 1994, 43–44). Computers have become new and powerful tools of science, generating new languages and images capable of connecting and linking fields in new ways. Examples can be drawn from images of fractals, visual modelling of data, the development of GIS, image analyses in medicine, all of which show, in different ways, how images and communications cut across disciplines.

The transdisciplinary Mode 2 of knowledge production implies a shift from a search for fundamental principles to enquiry oriented towards contextualised results reached through experimental practice (Gibbons et al. 1994, 19). The focus is on following the problem and its concrete materials and actors through an experimental process guided by design principles.

Knowing in design and research practices

The discussion on transdisciplinarity and Mode 2 shows a will within academia to recognise other ways of producing knowledge and communicating it. The verbal is often regarded as the most appropriate and legitimate way to produce and communicate scientific knowledge. Design knowledge is often “tacit” or articulated in other languages that are more implicit and contextual, and design also involves a special kind of thinking and a fundamental intellectual ability. Nigel Cross has described the particular design ability as a multifaceted cognitive skill which everyone has. This design ability relies fundamentally on non-verbal media of thought and communication. This is perhaps why designers seem to be so reluctant, or unable, to verbalise their skills and knowledge.

In the specific “designerly ways of knowing” employed by designers, knowledge is

embodied both in the *processes* of designing and in the *products* of designing. Designers have trained abilities for solving real-world, ill-defined problems and abilities for nonverbal thinking and communication where certain "codes" are used to translate abstract requirements – formulated in the brief, in the visions of the client or in the wishes of the users – into concrete objects. These "codes" or non-verbal thoughts both "read" and "write" in "object languages" (Cross 2007, 26–29).

The important question is how to use these "object languages" developed and used by designers in more inter-subjective critical discussions and discourses. This is one of the most crucial questions and challenges for the development of the making disciplines as well as research within or close to architectural and design practice. How can we formalise these languages in ways communicable to a broader scientific field without losing their generative capacities?

The question of different ways of formalising within the scientific field is of course a reoccurring one, and Deleuze and Guattari have discussed two contrasting scientific models: one uniting, comparing and formal; the other dispersing, transient, generative and informal (Deleuze and Guattari 1987, 369–370). One is royal science – searching for laws through constants and relations between variables, finding forms and first principles; and the other is nomad science – concerned with the relation between material-force rather than matter-form, not concerned with finding constants, but with producing change, transformation, the making of new worlds. Royal science tries to control the world by counting and measuring at a distance, and it works with a homogeneous, striated and formalised space. Nomad science, on the contrary, explores the world by travelling through it, with the material – it envisages a heterogeneous, smooth space of contact; close to the material, tactile and manual rather than the visual.

Two types of science or scientific procedures are also contrasted by Deleuze and Guattari: to reproduce or to follow. One is concerned with reproduction, iteration and re-iteration; the other can rather be seen as itineration, journey, guide or map. Reproduction is part of the royal science according to Deleuze and Guattari, and reproducing "implies the permanence of a fixed point of *view* that is external to what is produced: watching the flow from the bank" (Deleuze and Guattari 1987, 372). To follow is not the same as to reproduce, it has a different purpose. You are forced to follow when seeking "singularities" in the material and not general forms or first principles, when you are concerned with the world's continuous variation instead of finding constants.

The two scientific procedures have different ways of formalising their knowledge. Royal science primarily has a static perspective reducing all heuristic, ambulating and transforming characteristics. But there is also an important play, tension and interchange between the different procedures. Both sides are interdependent, putting pressure on each other; they are both always within each other – inspiring and bringing to order, challenging and displacing. It is not a dualism or polarity, but rather a matter of established and ruling procedures which are constantly being influenced and transformed from their margins while, at the same time, they provide the needed formalisation of explorations. They provide different perspectives using different attitudes and modes of thought, putting more abstract ideas and norms in relation to material thinking, processes, actors and objects.

One can compare this to the two idioms for thinking about science that Andrew Pickering delineated: the representational versus the performative. The representational idiom sees science as an activity that seeks to represent nature and to produce knowledge that maps, mirrors or corresponds to how the world really is. But one can start from the

idea that the world, rather than being filled with facts and observations, is filled with *agency*, that the world is constantly *doing things* that bear upon us not as observations of disembodied intellects but as forces applied to material beings. In the performative idiom science is regarded as a field of powers, capacities, and performances, situated in machinic captures of material agency. Much of everyday life is about dealing with material agency that comes at us from outside of the human realm, and Pickering suggests that we should see science as a continuation and extension of this business of coping with material agency – and that we should see machines as central to how scientist do this. (Pickering 1995, 6–7)

But, in this case, it is also a matter of interplay and interdependence between the two idioms, and Pickering stresses that thinking about material performativity does not imply that we should forget the representational, and conceptual, aspects of science. In Pickering's view the move to the performative implies a certain strategy for thinking about scientific knowledge where the performative idiom can include the concerns of the representational idiom and can be seen as a rebalancing of our understanding of science away from a pure obsession with knowledge and toward a recognition of the material powers of science. Here the machine is conceived as a balancing point between the human and the non-human, and between the worlds of science, technology and society. Pickering's image of science is a performative one, in which performances, the doings, of human and material agency come to the fore, but they are also reciprocally intertwined. The contours of human and material agencies emerge in the temporality of practice where they both define and sustain each other (Pickering 1995, 21). One could add that this must also entail more temporal and situation dependent intertwinings of different practices and ways of thinking.

Thinking in design and research

We constantly use different ways of thinking and these different modes of thought use different components which are put together differently. The three main modes of thought Deleuze and Guattari describe in their last book *What is Philosophy?* are: science, which works with functions put together on planes of references, establishing relations like cause and effect; art, which uses percepts, combined sensations of perceptions and affections, in planes of composition; and philosophy, which works with and creates concepts in consistent planes or systems, what they call planes of immanence. The objective is not to establish clearly separated disciplines, but, in my view, the opposite: to show that different modes of thinking are at work simultaneously in all disciplines.

One of the things they emphasise as the most important difference between science and philosophy, and I would also add art to the side of philosophy, is their different attitudes towards chaos. Here chaos is not disorder, but the infinite speed with which every form takes shape and vanishes. "Chaos is an infinite speed of birth and disappearance" (Deleuze and Guattari 1994, 118). Philosophy, as well as art, I would add, tries, according to Deleuze and Guattari, to keep the infinite speed, but simultaneously to have consistency in thought. Science, in contrast, gives up the infinite speed and movement, it is a freezing, a fantastic slowing down. Maybe one could argue that the establishment of the Making Disciplines is a slowing down, but one which also tries to keep some transformational speed and movement, and not least a strong relation to the core of the material practice.

In order to understand, grasp and gain knowledge about the often chaotic world we live in, several strategies have been developed by humanity. These have become what we

today know as the established modes and approaches of science, art, philosophy, etc., which all aim, in different ways, to help us settle in the world and change it. Science, art, design and other approaches have different tools and ways of preferred expression and forms of elaboration and communication of thoughts, like texts, drawings, models and images.

Art and science have always been in a creative and fruitful interplay, and this has been studied by Martin Kemp in several books in which he discusses the central role of visualizations and different modes of representation in science. The history of science is full of thinking through visual insights, the construction of visual models and visual communication, for which the creative interplay between different modes like words and images has also been crucial. There is no clear distinction between the creative arts and creativity in science, engineering and technology, and the examples where artistic and designerly thinking have supported scientific developments are many. There is also a constant interplay between words and images, and Kemp argues that there are some constant currents in our human quest for visual understanding, and that we all have a propensity to articulate acts of seeing through what he calls 'structural intuitions'.

With the term 'structural intuitions' Kemp tries to capture a way of thinking through which painters, sculptors, architects, engineers, designers and scientists often share a deep involvement with the alluring structures in the configurations and processes of nature – both complex and simple – and when looking at nature we use mechanisms of intuitive extraction of underlying patterns, drawing out certain aspects of geometrical order from the objects of inquiry (Kemp 2004, 37). Kemp underlines these structural intuitions as being of particular applicability when dealing with engineering solutions in architecture, where an instinctive sense of what might be stable and strong is obviously central to the processes of architectural design, especially at the conceptual stage of projects that push at the boundaries of existing solutions.

We constantly structure reality in relation to perceptual experience, pre-established criteria, acts of interpretation and conceptualisation, and deeper structures operating at a pre- or subverbal level. This is also the case in scientific work, and under all kinds of science lie, according to Kemp, deep structures of intuition which often operate according to what can be described as aesthetic criteria. This involves the 'look' of visual demonstrations, as well as the more approved verbal modes, and the recent developments in computer graphics have served to unleash the aesthetic instincts of researchers and research teams (Kemp 2000, 2–3).

Any visual product possesses the quality we call 'style', and it is of course not only in art, architecture and design that works exhibit 'styles'. There are always choices of design, of how to represent and present – choices greatly extended by computer graphics – even if the chosen style is automatic and unconscious. Every age of science and technology has its own rhetorics of communication, both internally within the disciplines and with the external world. Here the visual plays a key role, both concerning its importance to observation and representation, and because it is an effective way of communication with non-specialist audiences (Kemp 2006, 3). Style is one of the ways through which we can gain access to issues about makers, materials, power relations, dissemination and reception. "The visual demonstrations in science – alongside the verbal formulations, the mathematical expression, the table, and the graph – have its own job to do in building the edifice of scientific understanding." (Kemp 2000, 5)

Images, visual representations, visual thinking and making have the potential for opening up new vistas, lines of thought and compositions. Leonardo da Vinci used drawings and models as tools in his investigations; Johannes Kepler built models of

planets and the solar system; Descartes used sketching as part of his reflections on how to envisage and represent the ways nature works through both "seeable" and unseen mechanisms; Galileo Galilei made ink drawings of the moon long before telescopic photography was used for similar investigations (Kemp 2000, 20–21, 36–41). The development of photography made possible the study of things that are difficult to grasp and observe due to motion and speed, and became a refined tool which allowed science to see things before unseen. But visual techniques have also been used to envision phenomena and relations which are not only passive observations. Abstract models and diagrams were central in Richard Feynman's explorations within the arduous field of quantum mechanics, for which thinking and communication through diagrams and drawings were crucial. Feynman was able to combine complex and demanding equations in diagrams that enable both intuitive and analytical thought, they both preceded and even directed calculation. (Kemp 2006, pp.311-312). Irvin Geis was another scientist who built tree-dimensional models of molecules making their structure graspable through artistic renderings where skills and knowledge on how to use colours, perspective, light and shade support understanding (Kemp 2000, 100–101, 118–119; Kemp 2006, 311–312).

The visual model has a specific position, and the tree-dimensional model has proven a vital tool in the development of different disciplines, e.g. in the 'engineering' of new substances. These three-dimensional models often have 'styles' characteristic of their period – a certain 'look' or visual 'feel' of the object – including the choice of materials, constructional techniques, colours, textures, scales, and vocabulary of shapes. One can see obvious connections between scientific models and the systems of representation or characteristic design parameters of the specific age – from how molecules were modelled in the nineteenth century, with their polished balls, firm rods, and turned mahogany stands, to the way recent computer images mirror the high-tech rhetoric of electronic graphics. Kemp finds a parallel between the way molecules and architecture were envisioned and visualized at a certain time: "The haemoglobin model has its own 1960s look – assertive and futuristic, like a visionary model for a concrete block of layered residences. As in any work of architecture, more is involved than mere structure." (Kemp 2000, 121) The styles of the periods are choices and permutations of utility, technology and aesthetics, with specific aesthetics, procedures of making and also rhetoric as important parts of the scientific models and means of communication. These are important aspects to be aware of and discuss, not least in our digital age which enables new design experiments and the development of new visual and material languages and model worlds.

There is a constant need to reflect upon how knowledge is generated and communicated in architecture and design, and in that context inquire about the contemporary situation where other forms of working and collaboration are needed. New relations between theory and practice, between research and practical designing, between academia and architectural practice are emerging, but are also in need of articulation and conscious strategies. Today, we should talk about "reflective practices" rather than the "reflective practitioner", taking into account the emergence of architectural practices in networks that are flexible, adaptive and responsive to changing real life and everyday situations. These practices often consist of complex sets of "collaborative constellations" that produce and share knowledge and methods through cooperation between many disciplines as ways to deal with the complex issues of the contemporary world. Issues of communication and inter-subjectivity are in these contexts of great importance and crucial for further development.

We also need deeper reflection on and discussion of how we collaborate and work within and between academia and practice, and what roles these "making" and "material" aspects of architectural thinking can have, in architectural research and the production of knowledge about our societies as well as in the production of the material world and its multitude of cultures. When dealing with the challenges faced by contemporary and future sustainable societies, knowledge and solutions materialised in the built environment could be used in more conscious and critical ways. The specific capacity of design thinking to manage complexities may provide important contributions to exploring and gaining knowledge for contemporary situations. Crucial for the further development of architecture as a discipline are the constant interplays and "tensions" between the formal and the informal, between mode 1 and mode 2 ways of knowledge production, between the existing material cultures and the making processes of architectural projections and production.

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