

05: A research based model as an alternative to the design based model of architectural invention

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I want to deal with this topic head on, so I won't show any of our office work. I am just going to speak about design research and, through a series of diagrams, try and explain some of the new working methodologies that we are using in the office. There is design of course and there is research and I think there is an intersection area between the two; that is what I am going to talk about. Like the other speakers I was a little uncomfortable with the topic "Design as Research" and originally I was going to change it to design versus research, but I think in the end it is a good topic because I am going to talk about the influence that research has in the role of design.

I will try to describe our working method in the office at present as a new model of architectural creativity. It is a research-based model and I will contrast that to the classical, design-based model. I will try and do this in a fairly simple way. I found when organising the talk a lot of the buzzwords around architecture, like generative, emergent, non-linear, networked, collaborative and chaotic all fall into place, so I will try and communicate this in a succinct and simple way.

First I would like to consider design. We all know what design is, but for a moment let's get very specific. I want to look at the design process and compare it to the research process. Design as defined by the dictionary is "To decide upon the look and functioning of a building, garment or other object, typically by making a detailed drawing of it". Here I am thinking about design in a very traditional sense; thinking of product designers and atelier-style 'signature' designers – it is often very much about an individual vision. Design in the classical sense has two distinct phases: the deciding-upon phase and the drawing phase. In fact, in Italian there is a separate word for each of these two phases: "projectati" is the imagining or deciding phase which is to project one's imagination and "designati" is the drawing phase.

Design is a process in which something moves from the designer's imagination, through his or her hand and onto paper, or some form of record document. Design is about establishing and documenting the designer's intentionality. It can be done alone or collaboratively, but it is always limited by the collective imagination, skill and knowledge of the participants and in that sense it can be seen as a closed system.

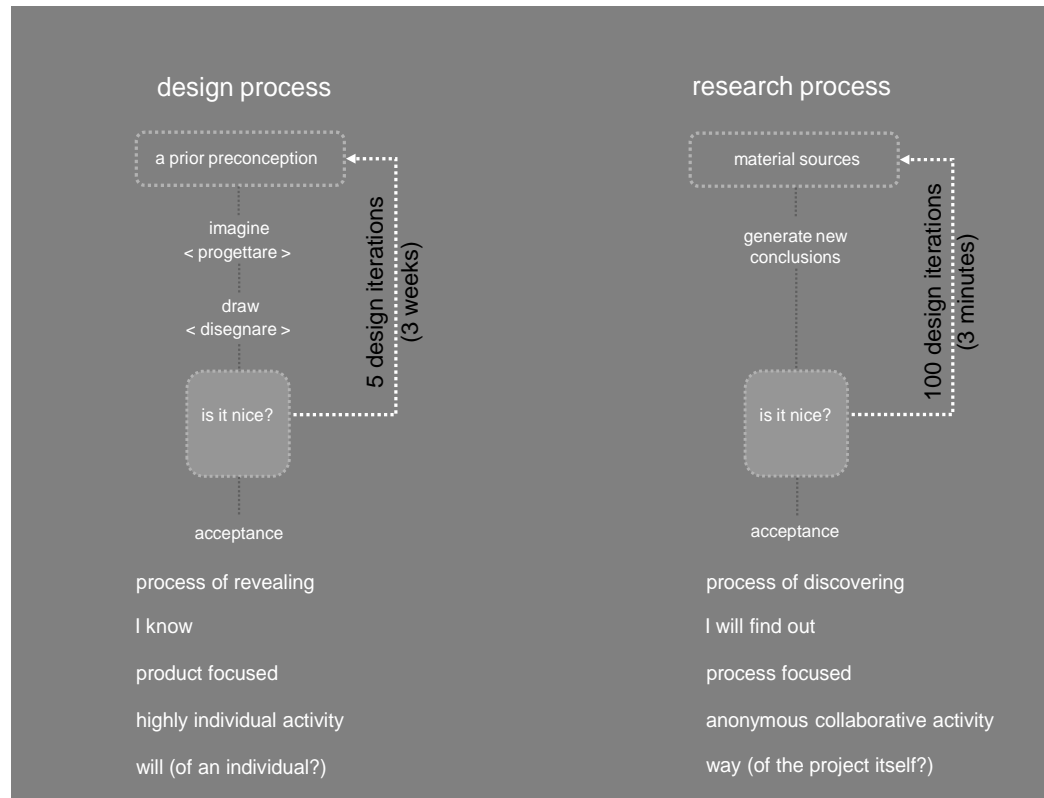


Illustration 1: The design process and the research process

On the left column in Illustration 1 we have the design process, beginning with the *a priori* preconception in the designer's mind, then he or she moves through the imaginati phase and eventually through the designati phase, and you come to the basic acid test of all architectural design. At that point you make a decision whether you are going to accept the design or whether you move into a feedback loop which is, I suppose, the iterative quality of design and perhaps you end up with five design iterations over a three-week period. This is concluded with the acceptance of the design.

Now let us think about research. Research is the systematic investigation into and the study of materials and sources in order to establish facts and reach new conclusions or accomplish new objectives. Here I am thinking about applied research – for example, the Staten V rocket programme at NASA. It is a collective, more than objective activity, possibly involving many people. There is rarely someone who can be named as its sole author or architect. Usually the research programme begins to take on a life of its own and to some extent you could be said to be working for the research programme itself. So there is a beginning point to research – the material and sources that form the input – and there is an end-point which is the output, usually consisting of new facts, new conclusions or achieving new objectives. There are two types of research: applied research which sets out to reach some specific and useful conclusion and speculative research which investigates a topic with a looser intentionality in order to allow otherwise unforeseen discoveries.

It is speculative research that we are considering here, so let us look at the research process which again begins with the material sources (illustration 1). There is a generative process that produces new conclusions and again you apply the basic acid test of all design and productivity and then there is a feedback loop, which is again iterative. I will go on to explain this later, but with this technique there is the

possibility of an automated iterative approach and this begins to touch on the kind of methodologies that we use in the office. Again, the process concludes with acceptance.

Design is an activity that renders the imagined on paper, while research is an activity that endeavours to establish new conclusions or discover as yet unimagined solutions.

These are some key points. I think design can be seen as a process of revealing this *a priori* conception whereas research can be seen as a process of discovery. Design is a process that says “I know”, the designer exerts their will to some extent; the research process is one of finding out. One is very much product-focused in that the intentionality always serves the end result whereas the other one is more focused on process and, in fact, the end result is to some extent just a result of the process employed. One can be seen as a highly individual activity while the other is an anonymous and collaborative activity. One is about the will, perhaps the will of an individual, whereas the other is about a way in which, to some extent, as I described earlier, the project might begin to take on a life of its own. Both processes have intentionality; however, one moves towards an *a priori* solution while the other takes a leap into the unknown.

I just want for a minute to think about the people who are involved in these processes and how they conduct themselves in the office. We all know who the designers are; in America offices are often split into design and production departments. The designers are a small group in the corner of the office; they draw nice pictures that are passed on to the production department for the production of working drawings. Years ago, when I was in training, you could always identify the designer because he invariably wore a bowtie, occasionally he would be seen wearing a long coat and perhaps a scarf thrown around his neck. In Germany the designer is the guy wearing the funny glasses. In the 1980s he wore a pastel-coloured tartan blazer and when he was designing he would push his jacket sleeves up over his shirt sleeves and he would draw with a very large, soft clutch pencil. In London the designer usually has a shaved head, presumably because of a premature receding hairline. He always wears black and occasionally arrives at meetings on a bicycle; he is a bit of an angry young man.

The researcher on the other hand is a little less familiar in the architectural office. I suppose the only mental image we have of him is a guy who walks around in a long white coat with a plastic pocket insert for holding his pens. He is recognisable but he is certainly not someone that we ever saw as creative.

I think you can see that I am beginning to question the central role of design in architecture. I am proposing a research-based model of architectural creativity; I think design alone delivered many of the great buildings of the last 20 years, since post-Modernism – I am thinking of museums, office buildings, cultural buildings, but today we are more interested in housing, we are interested in communities and I think the signature architects do not have a great deal to offer here because it is likely that a research architect, perhaps interested in the social sciences or patterns of human social interaction, is more likely to make a breakthrough in this area. There are many areas on which research can be focused and we have seen some examples this morning: it can be focused on pedestrian movement, social interaction, the nature of the workplace, so what kind of research do we do? My colleagues and I at the AGU were interested predominantly in geometry. There is an old and long relationship between architecture and geometry through proportion and, in particular, the use of the golden mean. Architects have always tried to establish a perfect mathematical proportion and

for structural engineers the geometry of the building is of even greater relevance as it is the organisation of the structure that is our specific area of responsibility. We are therefore interested in new organisational strategies and, as architects, we are interested in it at a fundamental level in new strategies for structuring space.

We use research as the methodology for doing this work. The material sources that we draw upon are mathematics and geometry and the methods we use to operate on this source material involve computers and writing software-scripting tools to manipulate and operate on the material, arriving at new structural arrangements and speculating on their potential for architectural space. There is intentionality but we do not have a specific preconception or any notion of where we would like to arrive.

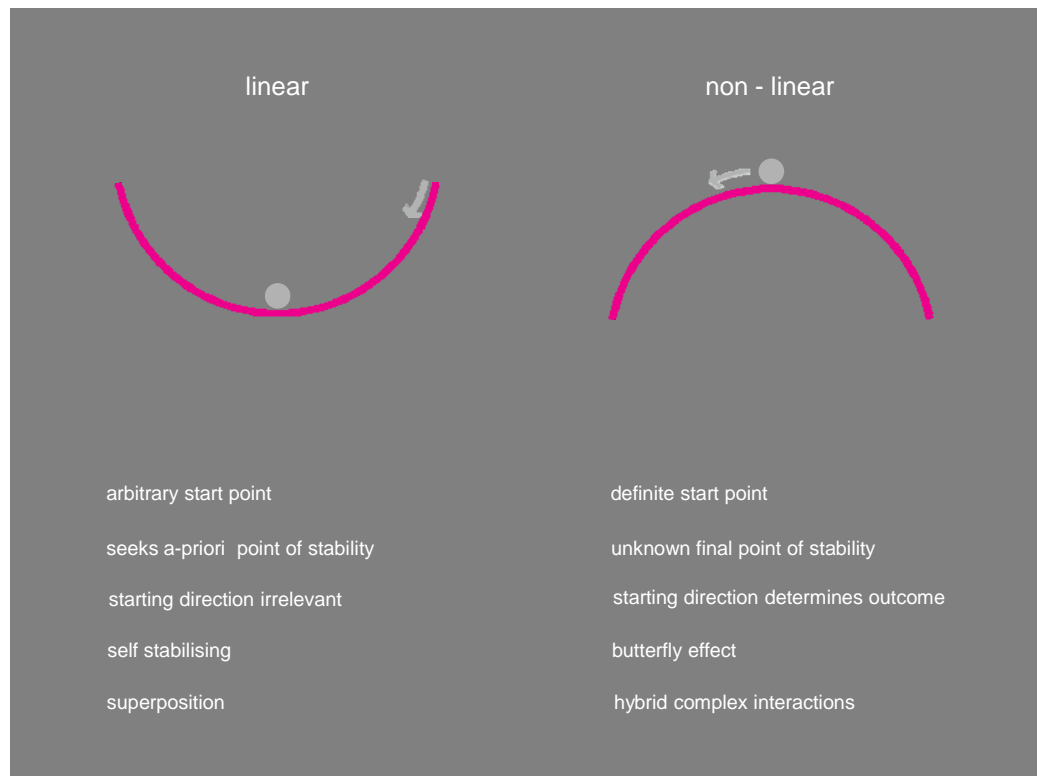


Illustration 2: Diagram showing the distinction between linear and non-linear systems

To describe this process I have just got to touch on the idea of the linear and the non-linear. As I said earlier, I think the unknown is very important and I want to draw a distinction between linear and non-linear systems. To some extent the design process can be seen to have the characteristics of a linear system in so far as it is self-stabilising. Illustration 2 shows a small diagram of a linear system (on the left hand side) and here we see a kind of linear self-stabilising process. The qualities of this process are that it does not matter where you begin because the system will always seek the *a priori* point of stability, the pre-determined point of stability, but in fact the starting direction is irrelevant because the kind of kinetics of the system is always going to reach a self-stable point.

I just want to contrast that diagrammatically to a non-linear system (on the right hand side of illustration 2). Non-linear systems can demonstrate what can be described as chaotic behaviours, so in this case you have a definite starting point which is the initial input material from which the process is initiated. The outcome or the resting point at which one will arrive is totally unknown at the outset, it is beyond the horizon, and

in that sense initiating the process is rather like a leap of faith. The location of the resting point where it all arrives will depend completely on the direction in which one begins, and any influences along the way – a small change of direction can result in a vastly different outcome. That is the chaotic quality, a small change in input results in a major change of outcome or what is known as the butterfly effect.

Finally and briefly I want to talk about super-position. Linear systems can be superimposed, which is to say: $A + B = A + B$, there is a straight cause and effect relationship such that the two systems can be superimposed. Non-linear systems cannot be superimposed. Their complex interaction between various causal inputs and their resultant effects cannot be predicted – in other words $A + B = K$. The outcome K cannot be predicted and this is the emergent quality that people talk about today. This is where the sense of discovery lies.

Carrying that analogy forward into my design and research metaphor, when I talk about non-linear geometric research, we are really talking about scripting - scripting using a computer, possibly in a language like Visual Basic, or at a more rudimentary level using an Excel spreadsheet and cutting and pasting into Rhino for 3D visualisation. All of this is supported by and enabled by the computer and it is this new phenomenon of computer modelling, visualisation and scripting that allows us to explore this kind of complexity.

But 3D alone is not the answer. It is the ability of the designer to utilise these tools and, in particular, to modify or invent one's own tools. Inventing one's own tools has always been a higher level of craftsmanship. Script-writing is our modern language of tool-making, so what becomes available is a new approach to form that is rule-based. In the design process we move from an arbitrary starting point towards this *a priori* design intent while in the research-based approach we begin from the material sources and move outwards, considering multiple solutions rather like a branching structure that could potentially lead to hundreds of solutions. Automating this process using scripts accelerates the whole study and this is what enables the 100 three minute iterations described on illustration 1.

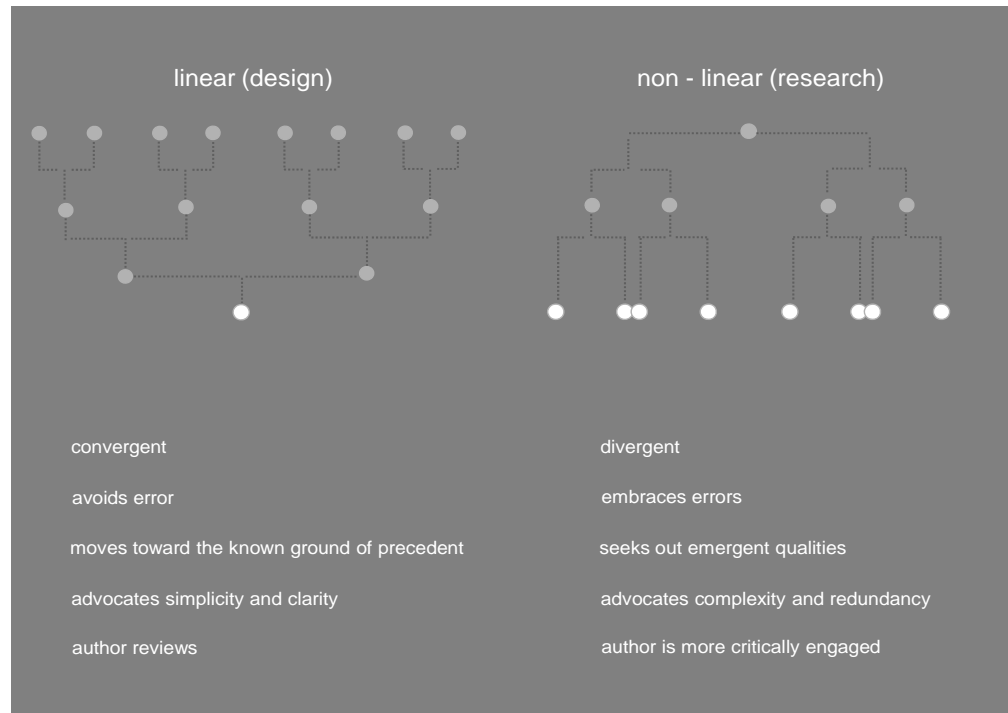


Illustration 3: convergent and divergent

I would say that where design is convergent, research is divergent as shown in illustration 3. I remember a colleague of mine working in a prestigious London office and one day the chief *d'atelier* walked past his desk and looked down with the remark “We would never draw anything like that in this office”, clearly pointing out that he had moved beyond the envelope of acceptable form. So design is about reducing the number of solutions to one, it is about rejecting the unacceptable. In our office the remark uttered with everyone gathered around a desk or computer monitor is “Wow, I have never seen anything like that before.” We are seeking the new and we are looking for the unprecedented, and in this process we embrace error.

We are not looking for purity, simplicity or clarity. This is an interesting expression to use; it is complexity and contradiction that we seek. In this process very different demands are placed on the author. Typically in design the author is critically engaged in the result, the solution, but in a divergent process where there are hundreds of potential solutions the author becomes more critically engaged in the process, making value judgments at a number of points along the way. It is rather like making it up as you go.

I just want to talk briefly about rigour. In the new world of amorphic shapes people struggle with the arbitrariness of form. Greg Lynn wrote a good paper about intelligent surfaces that have embedded performance criteria – he uses the example of the lines of a ship’s hull that has an embedded hydrodynamic performance. Hugh Whitehead mentioned this morning the idea of embedding parametric properties of flat panels in doubly curved surfaces, but architects struggle to find such a strong rationale for formal decisions in buildings. It is usually the engineer who has the knowledge and expertise to give this kind of input; it is the engineer who has the analytical skills to assess the form against some established performance criteria.

This is the kind of creative input that Alan was mentioning this morning, in the project in Trafalgar Square that Space Syntax are involved in. Embedded rigour does not need to be strictly performance-related; it can be tectonic, compositional, spatial

or aesthetic. Looking at the example of the Ito Pavilion that the group was involved in a couple of years ago, Ito was interested in working with algorithm but from his initial design-based conception of a beautiful and immersive box, Cecil Balmond and Daniel Bosia scripted a number of algorithms which introduced the ziggurative squares (shown in illustration 4).

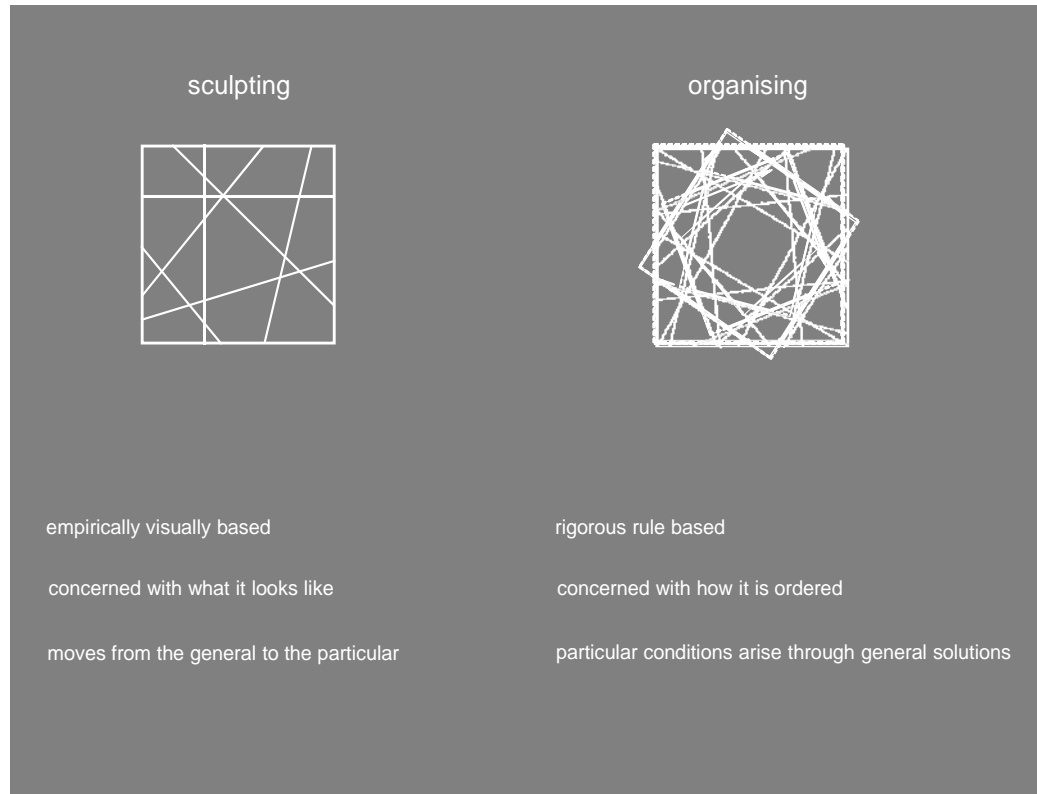


Illustration 4: Sculpting vs organising

Basically it is a generative algorithm and it moves from half of the square to a third along the opposing edge and then it develops the full square around that, then it again moves from half to a third, developing the full square again and again and again. From this point the lines are extended out to infinity, and in fact this is a ziggurat structure in terms of its structural performance, it is a series of beams that form a ziggurat, so although it is algorithmically based, it has this embedded rigour.

What is interesting about contrasting Ito's original expression of his design intent with this generative algorithmic method used is that the first method is empirically based, it is focused on what it looks like; it is an additive process in which one moves from the general overall intent towards detail. With the addition of each line there is an individual choice. The second method is algorithmically rule-based and the choice of how to structure the algorithm can be studied, but once established the rules place every line and the critical engagement is in the nature of the algorithm and a concern for how it is ordered, not what it looks like. Finally, every particular condition arises as a specific consequence of the general solution chosen, and that is the power of algorithm. You do not have to design the building, you design the algorithm and then virtually every choice is taken for you within that system, it is a rigorous rule-based system.

I want to speak briefly about the individual versus the collaborative working methods demonstrated in illustration 5.

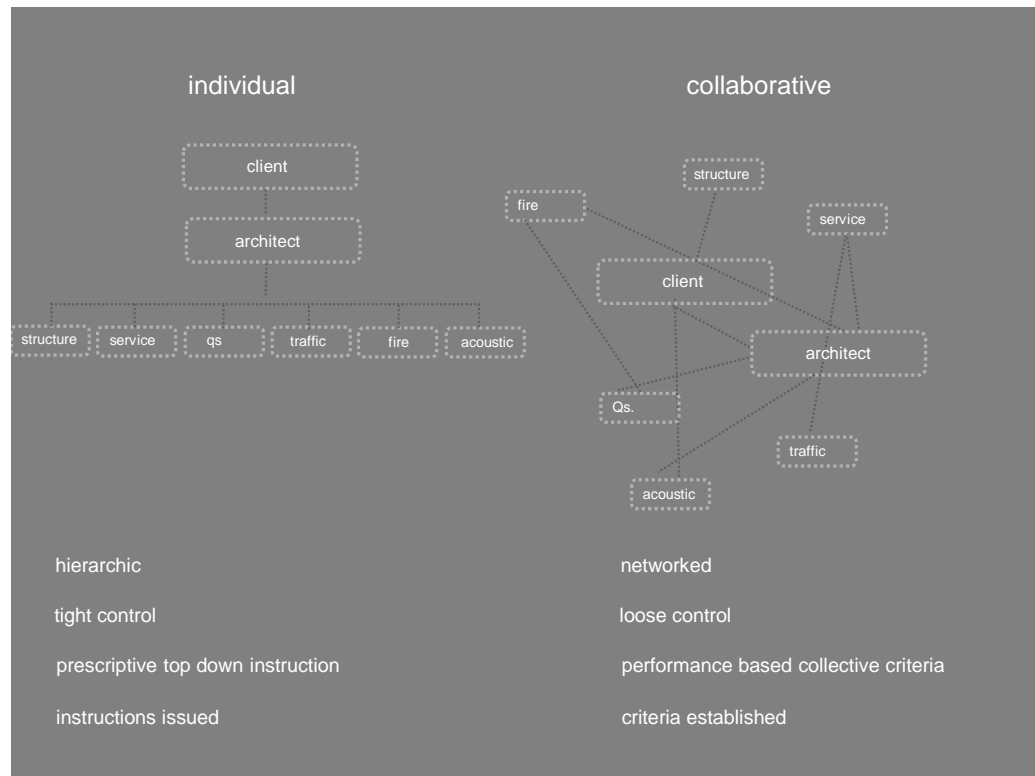


Illustration 5: Individual vs collaborative

Engineers have always collaborated, we have always shared credit for our work with other strong, like-minded designers and sometimes we have shared more credit than we wish to, but we have always collaborated, working openly with others; that is our nature. As I have already stated, the design process can be seen as more individualistic. On the left of illustration 5 is the traditional design team structure. The architect always held prime position with the other members of the design team as his sub-consultants. Increasingly, however, we see this is not the case. We get increasingly complicated client bodies, increasingly complex team structures, and today our business relationships, I believe, are closer to a network model in which specialist practices are brought together on a project by project basis. The architect can be seen as one node in a complex network of inter-relationships.

As network replaces hierarchy, the exchange of information becomes less hierarchic and it is a looser form of control that develops. You still control and this still requires professionalism; however, information is allowed to flow in a decentralised way and with a higher level of redundancy. This network relationship is less about control and more about creating the space in which new exchanges of information and ideas and uncontrolled conversations are able to take place, hopefully allowing new conclusions to be reached. Of course this is paralleled by new developments in media and business communication, like email and Rhino sketch modelling that can be distributed instantaneously team-wide, but the most important thing that happens here is an integration of the design team. Whilst the multidisciplinary architecture and engineering office of the 1970s may have failed, because clients preferred pick and mix, this network team model allows the assembly of several specifically chosen specialist practices that can work in a seamless and integrated way. It is this looser,

integrated way of working that allows clear, performance-based criteria that lead to new solutions.

I think of stories like Lee Iacocca and his group of buddies from the Ford Motor Company who conceived of the Ford Mustang over drinks at the bar. Built on an existing Ford chassis, this was an idea for a car that could never have come from the boardroom and yet it virtually saved the Ford Motor Company. Interestingly, this morning Alan presented his studies in augmented reality, noting that through these new technological methods the group became more collaborative.

The last thing I am going to talk about is aesthetics.

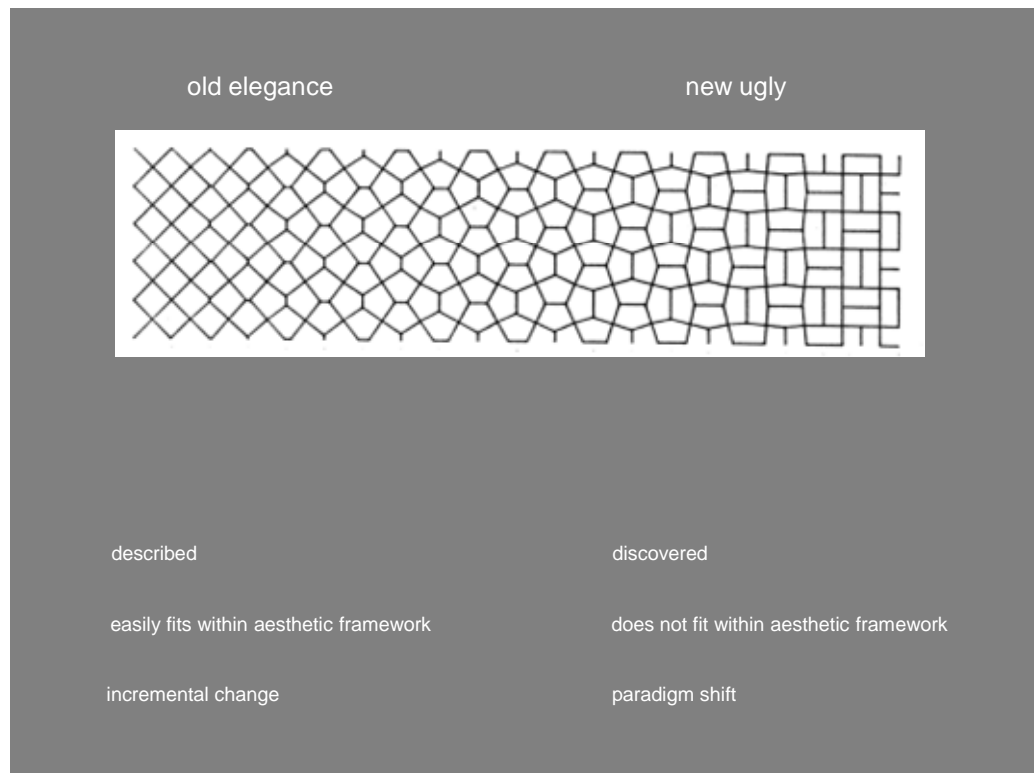


Illustration 6: Old elegance – new ugly

When Frei Otto lectured at the AA last year he was asked how it felt to discover these beautiful shapes of minimal film surfaces in the early 1970s and he replied that he had not found the shapes beautiful at the time, but only unfamiliar. We all have theories about aesthetics but I would like to pose the idea that beauty is familiarity. In fact, beauty research into human faces carried out in the 1990s by Langlois and Roggman using facial morphing techniques, indicate that facial configurations closer to the population mean are fundamental to attractiveness. In the study they morphed a whole series of faces together and they found that if you took a morphed face from 32 face composites it would score higher in a beauty test than a morphed face of 16 composites or one of eight composites; in other words the conclusion of their research is that beauty is averageness. It is postulated that the reason for this is that we are looking for partners who have a rich and diverse genetic background, and it may also be why people of mixed race are often very beautiful. Beauty is averageness, beauty is the familiar. In the visual arts we also have an aesthetic framework for assessing beauty and this is formed by our education, our personal experience and by precedent. I do not know how many times architects use the word “elegant” – this

immediately refers to familiar territory and immediately we are discussing something that is not new. I am very distrustful of elegance and I am immediately interested in anything that can be termed ugly. Elegance is about the incremental step change within the boundary of a fixed aesthetic framework. While ugliness does not ensure that something is new or interesting, it does at least afford the possibility that something could be truly new and indicate a potential a paradigm shift.

I want to conclude by asking the question - does it matter what architecture looks like or is it more important to understand how it is organised? Is it design in a traditional sense that is important or is it the research into new organisational strategies that will open the way forward?