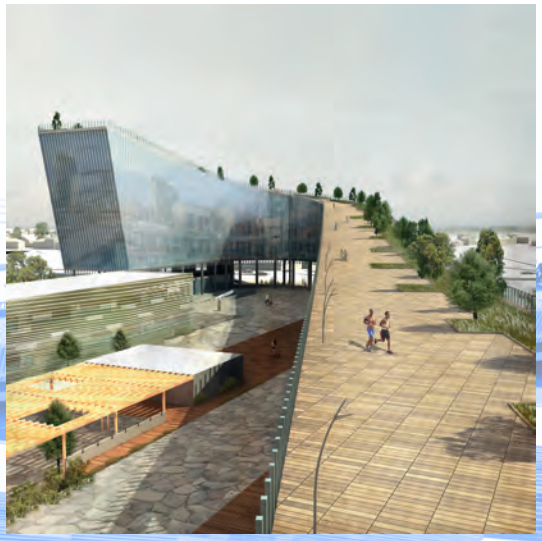
HEALTHY BUILDINGS: INNOVATION, DESIGN & TECHNOLOGY

ICAT 2016

ANTONIO GALIANO GARRIGÓS
TAHAR KOUIDER



CONFERENCE PROCEEDINGS OF THE 6TH INTERNATIONAL CONGRESS OF ARCHITECTURAL TECHNOLOGY UNIVERSITY OF ALICANTE 12-14 MAY 2016

UNIVERSIDAD DE ALICANTE

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CONTENTS

ARE DRAWINGS DEAD?

...and performance over aesthetics?

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Abstract. When the act of *'drawing'* became what can only be called formalised, (whose growth can be said to have blossomed during the Renaissance), there developed a separation between the drawing and its procurement. Recently, David Ross Scheer, in his book *'The Death of Drawing, Architecture in the Age of Simulation'* wrote:

'...whereas architectural drawings exist to represent construction, architectural simulations exist to anticipate building performance.'

Meanwhile, Paolo Belardi, in his work *'Why Architects Still Draw'* likens a drawing to an acorn, where he says:

'It is the paradox of the acorn: a project emerges from a drawing – even from a sketch, rough and inchoate - just as an oak tree emerges from an acorn.'

He tells us that Giorgio Vasari would work late at night *'seeking to solve the problems of perspective'* and he makes a passionate plea that this reflective process allows the concept to evolve, grow and/or develop. However, without belittling Belardi, the virtual model now needs this self-same treatment where it is nurtured, coaxed and encouraged to be the inchoate blueprint of the resultant oak tree. The model now too can embrace the creative process going through the first phase of preparation, where it focuses on the problem. The manipulation of the available material can then be incubated so that

it is reasoned and generates feedback. This paper serves to align this shift in perception, methodologies and assess whether the 2D paper abstraction still has a purpose and role in today's digital world!
Keywords: *2D Representation, Abstraction, Performance, Digitalisation.*

1. Introduction

For many, drawings are synonymous with architecture, whether they are objects of beauty or technical efficacy. Architects and everyone involved in the design team know and appreciate their worth, and all disciplines invest time and effort in their respect of the medium. This is painstakingly acknowledged in David Ross Scheer's book 'The Death of Drawing, Architecture in the Age of Simulation' *(Scheer 2014).*

That said, he goes on to say:

'This long tradition of drawing in architecture, with its influence on the thinking of architects and on the very nature of architecture, is in question for the first time since the Renaissance. Whereas architectural drawings exist to represent construction, architectural simulations exist to anticipate building performance.'

What he is alluding to here, is that change is upon us and that a paradigm shift is happening. He is stating that simulation is predicting building performance. Whereas aesthetics used to be all-consuming in the best architecture, a rider or a qualified subset is raising its head. Performance is being mandated by thermal comfort environments, by climate change and not least by diminishing fossil fuels (Harty, Miller 2014). It brings a balance and appropriateness to the equation, so that we are '*able* to *sustain'* (i.e. sustainable).

This means that there is *'a new kid on the block'*, where increasingly drawings are being overlooked, with the Building Information Model (BIM) taking centre stage and becoming the *modus operandi*. At a micro level, the most obvious example is where Integrated Concurrent Engineering (ICE) is making inroads to design team meetings and on-site.

ICE is *lean* conceptual design, where it can determine value parameters that are useful; update parameter values immediately; transfer parameter values automatically; link parameters seamlessly; perform analysis while, all-the-time, checking accuracy and applicability of the analysis, as it is performed (Coffee 2006).

In practice, it amounts to all design team participants making their models available to each other, in a confederated model, in whatever medium, so that each's model can be superimposed against all others, meaning there is a concurrent real-time model available for the meeting. With each participant able to see the implications of their efforts overlaid on the others' work, faster solutions can be found and moreover immediate decisions can be taken, and not banked for discussion back at the ranch, as it were, meaning the solution does not need to be first tabled at the next design meeting, with all the repercussions associated with that process.

'It is an approach, fostering dynamic communication and cross checking, tightly integrated tools with their users and with each other, and focusing participants on the critical information pathways feeding design deliverables' (Coffee 2006).

As a methodology, it allows tasks to be conducted in parallel rather than serially, forming a critical path, whereas previously each discipline would release drawing sets in a round-robin fashion, for them to be coordinated locally. Normally, this would lead to clashes and conflicts being raised in subsequent design team meetings, if not on site, for resolution. This loop is now removed.

2. Building Performance

David Miller, of David Miller Architects states:

'At the moment design decisions are all about reputation. A design that is seen as 'good' will enhance your reputation as a designer. In the future designs will be measured against performance. And that performance has a

very direct effect on the financial reward you can expect from good design, from(Malleson 2016) commissioning a good designer' (Malleson 2016).

Naturally, everyone does not adopt the new systems and technologies at a uniform rate. New and recent BIM adopters will have to go through a managed process of change in their internal organisations as well as the external processes. They will also have to reconsider how they interface with the supply chains, clients and consultants (Johansen 2015).

Because of these variations, differing levels have been defined to inform and help users assess the value and quality of the information being offered and shared (NBS 2014). Level 0, as it suggests is at best 2D draughting. Output sadly is paper based without collaboration. Level 1, moving forward, is digital with 2D computer aided design (CAD), often with 3D conceptual embellishments, usually in the form of renderings and perspectives. Sharing of data happens here to a degree, but mostly in finished formats, thus lacking cross discipline collaboration in its truest sense.

Level 2 is mandated in the procurement model being sought in the UK for all public buildings from 2016 (Waterhouse, Morrell et al. 2011). Collaboration is required here, but it takes the form of federated models only, so that information can be shared. ICT contracts are needed to address issues of copyright and liability, and to allay fears and offer robust appointment documents (NBS 2014). These protocols are governed by processes described in PAS 1192-2:2013 and PAS 1192-3:2014. The first is a specification for information management for the capital/delivery phase of construction projects using building information modelling. The latter controls the operational phase of building assets using BIM but parsed from objects to assets, meaning they can populate a spread sheet and be useful to users, owners and facilities managers (FM) (NBS 2015). PAS means a Publically Available Specification, which essentially fast tracts standards, specifications, codes of practice or guidelines developed by sponsoring organisations to meet market needs (Design Build Wiki, 2015).

Using the Level 0 to produce 2D drawings, with a lack of coordination can be said to increases costs by 25% through waste and rework. Between

Level 1 and 2, 2D and 3D have a better probability of removing errors and reducing waste by up to 50%. Under Level 3, it is then possible to reduce risk throughout the process and to increase the profit by +2% through a collaborative process (Calvert 2013).

While the majority of the BIM users are still working in the Level 1 process, the more experienced users are seeing significant benefits by moving up to Level 2 (Bew, Underwood 2010). It also shows that it is important to improve competences, and try to reach Level 2 before the majority does, in order to gain a market advantage. *'It is clear that organisations adopting BIM now will be those most likely to capitalise on this advantage as the market improves'* (Johansen 2015).

It all begins with BIM; the architect uses 3D modelling to investigate options and test building performance early on in order to optimise the building's design. The design is then handed-off to the contractor who streamlines the building process with BAM (Building Assembly Modelling). This allows for a significant decrease in construction costs. Once complete, BAM is turned over the owner and becomes BOOM (Building Owner Operator Model). This allows the owner to manage the building over time and ensure optimised building performance throughout its entire life cycle. The real promise of 'BIM-BAM-BOOM!' is *'better design, better construction, (and) better operation'* (MacLeamy 2010).

The term 'BIM-BAM-BOOM' explains how we should address and think about the model throughout a project. Whereas, BIM is related to the building's information and the design's development, BAM is related to Integrated Project Delivery (IPD) in the Construction management, where BOOM is in the Facility Management phase (Harty 2012). Increasingly, large public clients are mandating the use of BIM in open formats, to have a better overall picture.

Thomas Johansen writes, from his experience during his internship in Oslo, that;

'Meanwhile, we are placing ever-greater demands on our built environments, and by adding multiple components to our buildings, we increase the risk and probability of errors. The ability to just delete or

change something in the model is much easier than with paper drawings. The model also allows better control over:

Buildability

Progress

Access to solutions

Project Economy

Typically, a project manager might hold fortnightly project review meetings. This might occur on Thursday, even weeks. This would require delivering updated models Tuesdays, even weeks. BIM coordinators then would assemble federated models and begin collision reports to be ready for the review.

ICE is this relatively new design management system that has had the opportunity to mature in recent years, to become a well-defined systems approach towards optimising engineering design cycles. It encourages an idea that all elements of a product's life-cycle can be taken into careful consideration in the early design phases. Secondly, the concept is that the preceding design activities can all be occurring concurrently. This includes establishing user requirements, propagating early conceptual designs, running computational models, creating physical prototypes and eventually manufacturing the product.

In practice, this can mean all technical stakeholders at a design meeting might be wielding hand held devices as they, in real time, address issues normally noted and taken home from meetings to be rectified by in-house staff and presented at the next meeting.

Beyond the design team meeting, the debate was about 'if, why and how', the model might be given to contractors. Today contractors are demanding models in any way, shape or form, as it provides some sort of flow across the process. Needlessly, the better the model the better the flow. If there are high demands for facilities management information, and if there is not, why not, then the debate now progresses to how to deliver the model to the client/user. Here there is a translation need from objects to assets. Paper abstractions do not, in any way, assist this process' (Johansen 2015).

2. Disruptive Technologies

The fact that paper does not facilitate this process leads to a major issue. Paper, sadly becomes superfluous to the process and this has a profound consequence. David Shepherd, author of the BIM Management Handbook, in an article entitled *"Ahead of the Game"* (Malleson 2016) states:

'Where a disruptive technology emerges – and BIM is a disruptive technology – its effects on the mainstream is not always clear. What we might be seeing is the early stages of disruption, and in those early stages it's very difficult to know what the effects will be. We don't have the breadth of vision to see where, and for whom, the benefits of BIM will emerge' (Malleson 2016).

The most notorious example is in the car industry. Before the advent of automobiles, the equine (horse) trade had a plethora of support industries supplying and serving the splendid beast. Saddlery was a bespoke industry supplying handcrafted saddles to all and sundry, covering both gentry and everyone who needed a horse. There were bridleries and blacksmiths, all in service, and ultimately hitching posts for stage coaches to reload horsepower and replenish travel weary passengers.

All changed with the advent of the all-conquering automobile, the leather workers moved on to factory assemblies producing leather seating and trims. Blacksmiths diversified into metal works. Hitching posts became petrol stations and roadside eateries. The ultimate insult, Bugatti reduced the symbol of the horseshoe influence, into the shape of its radiator grill. In 1898 delegates from across the globe met for an urban conference, where the issue of the day was horse manure in an urban context. Two decades later the automobile vanquished this planning nightmare, and was hailed as an environmental saviour (Morris 2007).

More recently, in the newspaper industry, the eighties also experience a most cruel comeuppance. Typesetters, basically, became redundant, as computers replaced them in formatting newsprint. The Wapping dispute in 1986 saw Rupert Murdock take on the might of the unions, as he implemented a clandestine manoeuvre, building a huge printing plant,

unbeknownst to them, in Wapping, east London (Neil 2006). Indeed, not only typesetters, but also compositors, linotype operators, machine room personnel, publishing room employees, clerical staff and copytakers numbered the 5500 workers who were called out on strike by the then very strong print unions, who like the coalminers a year before ultimately perished.

The assimilation of the journalists away from the 150 year old *'hot metal'* system to the new streamlined digital method was also interesting. Tony Bevans, The Times political correspondent told his colleagues, deadpan:

'I want my stories to be published… When you are faced with overwhelming pressure and you are in a cul-de-sac... you must either fight to the death or lie down… we have a gun to our heads. I believe most of you will go with ashes in your mouths' (Macintyre 2016).

Such a scenario could be framed for the current situation in the construction sector, of those seeing the media of choice as paper, with all its support structures and the digital solution, with which they do not want to engage (into meaningful discussion), and those reaping the benefits of collaboration and trust, bringing certainty and surety to the engagement (Harty, Laing 2011).

New Demands

A drawing *(per se)* cannot plot the temperature line-loss across a construction, typically in an external wall. True, it can be made to show the loss through the cross section, but it is an abstraction that must be applied to it by a third party, performed from a third party calculation. Likewise, a key junction cannot show depreciation over time, of the robustness of the assembly, for life cycle analysis purposes.

A 1:20 cross section cannot show the bearing capacity of the major structural elements to make the building stand-up. Granted, to the trained eye assumptions can be made, and the drawing can act as *a container* displaying the work done elsewhere to size those critical members. A

virtual bucket of water cannot be thrown at a detail to test its waterproofness. No, rather the trained professional uses the presentation before him or her to apply their experience, and only their experience, in assessing the vigour and durability of the construction.

Generally, the differing professional disciplines take pride in pin-pointing their knowledge to the presentation, in red-lining the draft before them in a time honoured method of viewing and reviewing others' work, in order to harmonise the construction, and drive toward a consensus during the design process. But this process is fundamentally flawed, it is open to human error. It requires many reviewing sessions, and it is open to challenge and misinterpretation.

Sarah Davidson, Gleeds Property & Construction Consultancy (Malleson 2016) says:

'This is a much better platform to defend a design process. Tests, simulation and performance can be carried out and recorded, and there is an audit, meaning accountability is added, and certainty is increased'.

In the same vein, David Shepherd (Malleson 2016) saw fittingly to say:

'So Level 3 won't be about being paid to produce a coordinated model, it will be about demonstrating the payback, the bottom line value, of a design. This could be about performance of the building over its life, but it could be about the time it takes to create a building too'.

Shephard is pointing towards performance as being as important as aesthetics to the user, the client and society in the long run. This is a serious paradigm for architects and design professionals to address. Therefore, it must be asked, how well prepared they are (architects) to deliver this important requirement? Where is the drawing's role in this abyss? How can it provide the power to communicate these parameters?

In addition, Elizabeth Kavanagh, of Stride Treglown (Malleson 2016) says:

'Knowledge is power, but with Level 3 BIM, power will lie in the ability to effectively share information, not in the ability to hoard it. Level 3 BIM will be about sharing the gain in a project, not allocating blame'.

Looking at current practices, construction projects have often unwittingly accepted unacceptably higher waste levels, going above and beyond a generally accepted 25%. Waste, in this context, can be understood to include redundant document production, unused materials, idle workers, reworking and many other factors (Mays 2014). Patrick Mays goes on to say:

'Design-Bid-Build (DBB) contracts make it difficult for owners to derive project efficiency because of a lack of transparency in business processes and cost management systems'.

Because no one is in position to take over the management of the life cycle analysis of the project, Design-Bid-Operate (DBO), similar to Design & Build (D&B), contracts provide an acceptable alternative. He says here that owners can co-ordinate the work of general contractors, subcontractors, supply chains, operation and maintenance as well as all stakeholders, to better deliver projects.

Foundation Louis Vuitton is a new museum by Frank Gehry in the Bois de Boulogne in Paris, commenced in 2006 and completed in Oct 2014 for US$ 143 million (Wikipedia 2016). In its procurement, three models were deployed: a design model to develop the design, a contractor (real-time) model fleshing out details and a high fidelity model, blending the two former while providing life cycle information for the owner in the building in-use phase (Buffa, Eastman 2014). In the same article, Andrew Witt of Gehry Technologies went on to state:

'One of the objectives of the project was to create a 3D process that was for everyone to be involved. People that came on board to work on it, knew in advance that 3D was a major component for the whole process, and for those that did not have a 3D capability, Gehry Technologies had the role to consult in either training them and also to support this overall cultural change. Gehry Technologies not only provided technical support, but also helped build up a relationship of trust among the teams'.

The structure can be divided into two parts; 11 exhibition galleries, encapsulated by *'icebergs'* rising up into the firmament, which were then crowned by 12 billowing glass sails, forming a transparent cloud above the

solid objects, which are elegantly held in place by a masculine glulam pivotal structure, so that the whole ensemble reflects on the surrounding parkland, demarking the site and forming a gateway to the environs.

The intention towards lightness through the structure and transparency through the landscape was achieved by a rigid design procurement, with a continued process of unrelenting involvement of 10 differing disciplines, numbering over 400 individuals, working collaboratively in the development of the model and the procurement process.

The process involved taking Frank Gehry's forms and capturing their shapes digitally. This then developed into building the forms into components. These were achieved by engaging with the contractors and subcontractors, to massage the forms into buildable parts. Code was written to best serve the design intentions in the most buildable fashion. The data was transferred digitally, and computer numerical control (CNC) allowed for the robotic delivery of the building elements. As each component was lifted into place, scans were taken of the building site and overlaid on to the model. Where inaccuracies manifest themselves either the model or the site was corrected, meaning the model was up-to-date at all times and the handover model was as built, rare by most standards.

Both the complex form and juxtaposition of differing elements, demanded the development of all-embracing nonstandard components (of over 200 adaptive components), which were to validate key details and produce unique solutions that were both automatic and generative descriptions of the practical instances as they were encountered.

Conclusion

Steve Lockley (Malleson 2016) says:

'It looks like the genie is out of the bottle. BIM will happen. It might not be because of the mandate coming into force. But having had the mandate coming means we have become world leaders in BIM'.

A telephone book has no place in today's animated lifestyle, full of hustle and bustle. In fact many do not know what Yellow Pages are? To find and drill through a printed list, to find a pertinent number for what (again: what is that) is an anathema to them. Would you rather have a Filofax or a smartphone (apologies to those who have never seen the former)? Drawings are analogue too, and their fate too is sealed.

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