A Personal Retrospective

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This is a Personal reflection looking back over the period from my initial involvement in Building Performance in the 1960s through to research in CAAD today.

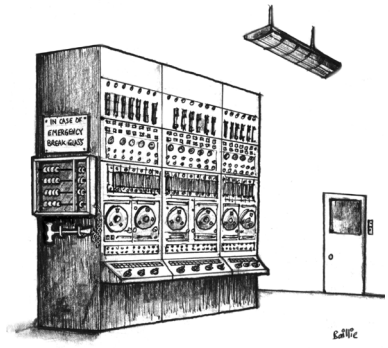
1. Introduction

In the mid 1960s, interest was growing in the idea of post-occupancy appraisal of buildings; the building boom in the UK in the post-war period had produced some disastrous outcomes and there were clearly lessons to be learnt. I joined the Building Performance Research Group in the Department of Architecture and Building Science at the University of Strathclyde in 1967 to help develop tools for post-occupancy appraisal but soon became obsessed by the prospect of *pre-occupancy* appraisal – the idea that the way a building might work could be predicted while the concept was still on the drawing board. Around this time two institutions came into existence – the Design Research Society in the UK and the Design Methods Group in the USA, both concerned to discover what Herbert Simon, in his 1968 book The Sciences of the Artificial, called "...a science of design, a body of intellectually tough, analytic, partly formalizable, partly empirical, teachable doctrine about the design process" [1]

It was clear that whilst building design had much in common with product design, there was a significant difference. In product design, the modus operandi was to construct and progressively refine a physical prototype prior to the production run – a methodology impossible in large capital items such as buildings. What was needed then, was what we would call today, a **virtual prototype.**

At Strathclyde, in 1968, a new research group – the Architecture and Building Aids Computer Unit, Strathclyde (ABACUS) – was formed to investigate the possibility of using the emerging but extremely primitive computing techniques of the late 1960s to construct virtual prototypes of buildings. The University had only one computer and programs and data could be entered only in binary form using paper tape or punched cards. Any prototype building had, therefore, to be laboriously described, by a lengthy sequence of numbers, in terms of x and y coordinates (for plan layouts) or x, y and z coordinates (for 3D forms); explicit instructions (in a language called FORTRAN) specified which coordinates were joined by lines, which lines formed planes and which planes made up volumes; there was neither graphical input nor output.

► Figure 1. An early skeptic's view of Computer Aided Architectural Design



◀ Figure 2. A tongue-in-cheek commentary on the reliability of early mainframe computers

Nonetheless, by 1970, papers were being published which described the process of appraising a simple building in terms of its cost (capital, recurring life-cycle) and its performance (daylight levels, energy consumption, plant size, etc). By 1973 the emergence of pen-plotters, combined with innovative algorithms, made it possible to produce drawn plans and 3D ("wire-line") perspectives; crude but affordable graphical input devices were beginning to come available. Overnight, the architectural profession – highly suspicious of the idea that computers could have anything less than a deleterious influence on design quality – embraced the technology as a means of automating production drawings; the emphasis for the next 5/6 years, shifted (some would regret) from better product to more efficient production.

2. The Achievements

The 1980s saw the evolution of highly sophisticated models of the energy behaviour of buildings, photorealistic colour imaging and animation; the 1990s saw the emergence of large scale urban models, multimedia, virtual reality, rapid manufacture and shape grabbing technologies.

So: there is much in which the CAAD community should take pride:

- of all the design professions, it can be argued that architecture has led the way in the effective adoption of the emerging information technologies; just as developments in artificial intelligence, however primitive, have informed an understanding of the sophistication of the human mind, so CAAD has informed our understanding of the complex human activity of design.
- the application of the technologies to the cultural issues which are central to the concerns of the profession (eg virtual heritage), and to our understanding of the relationship across the range of scale of operation of the profession – from interior design to the design of individual buildings, through neighbourhoods to cityscapes _ offers, in the words of Frank Gehry in his acceptance speech on receipt of the RIBA Gold Medal, "a great opportunity for architects to become master builders again"

- the extraordinary advances in verisimilitude of the still and animated imaging of the visual characteristics of interiors and exteriors of individual building and entire neighbourhoods, surely gives, as never before, confidence to practitioners and their clients that what is intended, formally and aesthetically, is what will be delivered.
- the power of advanced dynamic models of the thermodynamic behaviour of buildings, in response to diurnal and seasonal variation in weather and climate, has the potential to save millions of Euro, and, more importantly in the long run, dramatically reduce atmospheric and stratospheric pollution; these models have the potential to provide us with a new vernacular of sustainability.
- the recent emergence of robust and powerful decision support systems which allow synchronous design across continents, time-zones, professions and agencies will enable the next generation of architects and engineers to design from within the virtual world which can link virtual reality to rapid manufacture and shape grabbing technologies in a seamless transition amongst modelling modes.
- the establishment of a number of hugely effective and inter-related initiatives to secure and promote communication within and across the academic and practical community, viz: the formation of eCAADe (in Europe), ACADIA (in North America), SIGRADI (in South America), CAADRIA (in SE Asia) and CAAD Futures (intercontinental), complemented by the meticulously maintained CUMINCAD database of over 4,500 abstracts/papers in the subject area, and, last but by no means least, the initiative to bring into existence the International Journal of Architectural Computing; these initiatives are quite unprecedented in the recent history of the profession and in my view herald a new model for cooperation and consensus in the academic and professional community.

3. Future Goals and Directions

So, there have been significant achievements, but equally, there is much which the community needs to address:

- little or no objective evaluation is made of the benefits (or for that matter the perceived threats) which have accrued and, increasingly, will accrue from developments in CAAD; if the building industry is to raise the level of investment of research and development funding from the paltry half of one percent of turnover (compared to 40% in the computing industry), we have to get better at evaluating the efficacy of what has been achieved (through a rather random process) and estimating what could be achieved through a more coordinated and focussed R+D endeavour which excites those who want to invest in sustainable futures.

- the virtual prototyping tools which currently exist to predict the cost/performance characteristics of specific buildings are increasingly being adopted by progressive architectural practices to confirm the environmental credentials of innovative design proposals; yet they are not being used, as they might be, to explore, systematically, generalised relationships between design decisions and cost/performance consequences; establishment of these causal relationships could provide an invaluable educational resource and move the profession and its clients towards the notion of "performance specification".
- explicit appraisal of design options, through virtual prototyping, helps inform design decision-making, but, as Simon said, taking a design decision involves subjective as well as objective value judgements; a recurring theme in some of the most interesting research over the last 3 decades has been the degree to which virtual prototyping – and the power of VR and multimedia – has the potential to facilitate the effective participation of the clients and users of buildings in the *forming* of these value judgements; this issue needs to reappear at the top of the CAAD research and development agenda.
- it is difficult to shake off the suspicion that, had not our best students got seriously excited about, and made significant contributions to, CAAD, many of our colleagues (some of whom recently appear to be desperate to take over ownership of the topic) would still be resisting the "heretic" notion of CAAD; the profundity of the notion of virtuality, and in particular, *virtual environments* cannot be over-estimated and our biggest challenge is to ensure that, *in partnership with our students*, the challenges and opportunities are addressed; we would be at great risk in the advancement of what I believe to be a fundamental shift in the education paradigm, if we were to forget that we are *all* learning, even those of our colleagues who failed to see the writing on the screen

4. Conclusion

The Leverhulme Trust generously gave me some resources over the last 18 months to reflect on the short but extraordinary history of our subject area and to suggest where we might go from here. I am especially grateful because the period of reflection has reminded me of how privileged I have been to share ideas with an expanding, like-minded international community, to have enjoyed the close company of supportive colleagues and muses, and, importantly, to get to play with lots of new toys.

The last three decades have been fantastic, and, in my view, represent only the first faltering steps in our amplification of the intellect; those of you who will contribute to the next three decades, will be privileged indeed. Charles Babbage, working in 1833 on the first mechanical programmable

computers with *his* muse, the mathematician Ada Lovelace, prophetically offered to give up the rest of his young life if he could come back in 100 years, for one day only, to see how the idea of computing had worked out; its application to the complex and important area of sustainable, innovative and virtual architecture – should he and Ada turn up at next year's CAAD Futures – will surely convince them that his deal was worthwhile!

References

1. Simon, H.A. *The Sciences of the Artificial*, (1st Ed.) Cambridge, MA: The MIT Press, 1968

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