The ascent of man- and woman-kind can be related to our progressive ability, collaboratively, to amplify our very limited individual human capabilities. Three classes of amplifiers have been identified.

1. Amplifiers of our physical power.  
The lever, the wheel, the steam engine - the rocket engine and nuclear fusion have so amplified our physical powers that we have it within our capability to completely transform the surface of the earth - for better or, regrettably, for worse.

2. Amplifiers of our senses.  
The telescope and the microscope transformed our understanding of the natural world and its place in the universe. The radio telescope and the electron microscope are allowing us to look out to other universes and down into the fundamental atomic structure of our material being.

3. Amplifiers of the intellect.  
There is a view that the huge impacts which are amplifiers of physical power and amplifiers of the senses will pale into insignificance in comparison to the profound impact on the human condition wrought by the third class of amplifiers, which are those that amplify the intellect - i.e. computers.

The relevance of computers - the amplifiers of the intellect - to design lies in the facility they offer to model design concepts. For most designed artefacts, from the toothbrush to the motor car, it is possible and appropriate to construct and interactively modify a prototype prior to a large production run. For capital intensive design, applications, like buildings, the interactive design investigation has to be done on some abstracted model.

Highly focused, if underfunded, research development over the last three decades has resulted in computer software which allows architects and engineers to "build" the design concept - its geometry, construction, materials - within the computer and to anticipate its cost performance and quality.

It is important to make a distinction between those applications of the computer which improve the productivity of the design practice (e.g. drafting systems and management systems) and those applications addressing issues of design quality. The former are well established even ubiquitous. The latter much less so. In the case of the latter a distinction (academically) can be made between the modelling of form and the modelling of function.

The earliest research and development in computer aided architectural design (before the abbreviation CAAD was in common currency) was focused on the simulation of function such as energy consumption, movement efficiency, cost prediction) but within the extraordinary developments in computer graphics, interest rapidly transferred to the visualisation of building form.

The level of sophistication in the representation of form and prediction of functional performance is now extremely high. Photorealistic images and animations of proposed buildings and urban interventions are in regular use by progressive practices and the use of computer-based energy
models by the Energy Design Advice Scheme has evidenced savings in energy in new buildings in excess of £100 million.

The current challenge is to make these sophisticated tools more useable and more accessible in an integrated way in architectural practices and architectural education. Nonetheless, the benefits accruing from the use of computer based modelling are already in evidence:

1. the possibility to explore more and more innovative design options
2. increased integration within the design team and improved communication with the client
3. enhanced understanding of cause and effect, i.e. how particular design decisions impact on cost and performance
4. traceability and audit of design decisions, particularly useful in the context of facilities management

Within the last two or three years the scope of application of computers to architecture has expanded dramatically. Recent innovations are summarised as follows.

1. Multimedia
   The facility to conflate, within one affordable computing environment all the media commonly deployed by architects - drawings, photographs, computer images, computer animations, video, text, audio etc. - gives unprecedented quality in the communication of design concepts and architectural ideas. Already this is the preferred medium for the presentation of student schemes in progressive Schools of Architecture.

2. Virtual Reality and Telepresence
   Virtual Reality (VR) and Telepresence (TP) are opposite sides of the same coin. VR can be considered as a real person in a virtual world while TP can be considered as a virtual person in a real world. In conventional computer graphics the user appears to be viewing the computer generated world through the window of a 19" diagonal monitor screen; in VR the user has the enfolding sensation of being and moving within the virtual world. Telepresence allows the remote user the enfolding sensation of being and moving within a distant, real world and has major applications in construction site supervision.

3. Virtual Heritage
   The combination of Multimedia and Virtual Reality is being used to great effect in the investigation of sites of architectural and archaeological significance. In the case of vulnerable sites like Skara Brae, the combination of MM and VR can provide a degree of interactive experience of the site denied to the visitor who makes the long journey north. In the case of an urban environment, like Glasgow, the technology can, over the Internet, let the virtual visitor browse the city and visit the interiors of its finest buildings.

4. Distributed Design Decision Support
   The conjunction of the technologies of computer aided design, high bandwidth telecommunication networks and developments in "soft" operational research is yielding increasingly robust opportunities for collaborative design carried out synchronously and as asynchronously by many different stockholders in many different locations.

As the instrument for the amplification of the intellect it is not surprising that the computer will have its most profound effect in education. But just as those countries around the world for which IT is currently not an option, so Schools of Architecture unwilling or unable to embrace the new technology, will struggle to keep pace with best practice, educationally and professionally.

In the top schools around the world, students have access to all the computing options summarised in this short paper. More importantly, they are, enthusiastically and effectively contributing to the accelerating development of the subject areas. Additionally, the technology is
offering new pedagogical challenges and opportunities. The Scottish Higher Education Funding Council (SHEFC) invested some £80K in an experiment to allow the two Schools of Architecture in Glasgow to enhance their education provision by exchanging lectures, crits, exhibitions and student contact over the ultra-high-bandwidth network which makes Scotland, on a par with Singapore, the most cabled country in the world.

For those of us in education SHEFC investment represents a major opportunity to re-affirm Scotland's pre-eminence in education. We can do this in the context of architecture, only by commitment to:

1. an abiding idea that the quality of the built environment can be secured and sustained by a better understanding of how the decisions made by designers, architects and engineers impact on the cost, performance and quality of the product.

2. adopting evaluating and evolving the tools which make causes and effect in design decision-making more explicit.

3. creating an intellectual environment which breaks the mould of the last 50 years of architectural education.