CLIENTS DRIVING INNOVATION INTERNATIONAL CONFERENCE

VECTORS, VISIONS AND VALUES – THE ESSENTIALS FOR INNOVATION

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ABSTRACT

This keynote paper attempts to outline the nature of innovation and the essential ingredients for the climate of self-improvement to develop. It looks at a common pattern of investment which leads to long gaps between the original research and the take-up by industry and asks why this occurs. It examines in outline two case studies, one in the water industry and the other in IT to see whether there are lessons to be learnt from the innovation which took place. It finds that necessity is a strong driving force. The paper then goes on to examine generic issues related to all innovation and finds the need to understand the value systems of society as being a key factor in taking ideas forward into practice.

Keywords: Timing of Innovation, vectors, visions, values, lessons for innovation, new product development, nature of research.

***"It's the willingness to say a new idea out loud which is most valuable in fostering creativity" (Professor Jennifer Chatman, Haas School of Business, University of California, Berkeley (*Editorial, American Innovation, 2004))**

1. A PERSPECTIVE ON INNOVATION

Innovation is dead – long live innovation! With apologies to the royalty of Europe which tends to use a similar phrase when one of their number is deceased and another takes their place! The line of the monarchy is preserved and continuity prevails.

Innovation has certain of the same characteristics – it is continuous, often operates within a specified framework, is almost inevitable, and has the potential to improve on the one before! The issue is not one of whether we will innovate or how we should innovate but when the innovation will occur. Human history is one of innovation both in products and processes and has continued from the dawn of time through evolution and the intellectual capacity which humans bring to the drive for self improvement. It will happen, it does happen, and the question we are asking ourselves at this point in time is 'how can we make it happen more quickly?'

Not all innovations are positive and the modern world is full of well-meaning innovations which have seemed to provide a route for improvement only to find that in the ensuing years other factors have made that innovation harmful to the planet or those who inhabit it. Much of what the world considered improvement in the past century is creating problems which the present generation is trying to resolve. These range from energy plants to economic relationships between countries to methods of governance and many more.

In the last century the dominant innovation area has been technology, often addressed as a series of independent initiatives without considering the impact on each other. The result has been a massive increase in our ability to use tools but with some concerns about where those tools are leading us in the way in which the future of the human race will proceed. Weapons, the use of non-renewable resources, the challenge to value systems through information exchange etc are all examples of where this reductionist approach has provided advantage for some, but disadvantage for others. Much of what we call innovation relates intentionally or unintentionally to power. Through a new tool, those who have it are empowered but others are not. Some will be economically advantaged and some will not. Some will be able to exercise force over another and some will have to submit. Often it is the viewpoint from which these matters are considered that determines whether a new innovation will be considered positive or not.

Property and Construction are not immune from these forces and the market economy will favour certain innovations above others. In a world where quality of life is thought to be paramount, the Built Environment plays a massive part in how people perceive their living standards. The demand for improved standards will affect market forces considerably. Innovation is not neutral when it comes to the impact on humanity or the value systems which we consider to be important. In any consideration of what drives innovation we need to understand the values which are being challenged or reinforced by the innovation under consideration. It is this aspect which will be briefly explored in this paper.

2. WHY DOES INNOVATION TAKE SO LONG?

In the context of history, innovation today is progressing at an alarming rate, possibly challenging the speed at which humans can evolve to match the changes that are occurring. Nevertheless, as this conference illustrates, many wish for the innovation to increase at even faster speeds to 'maintain competitiveness'. A common pattern of development can be seen in the following graph.

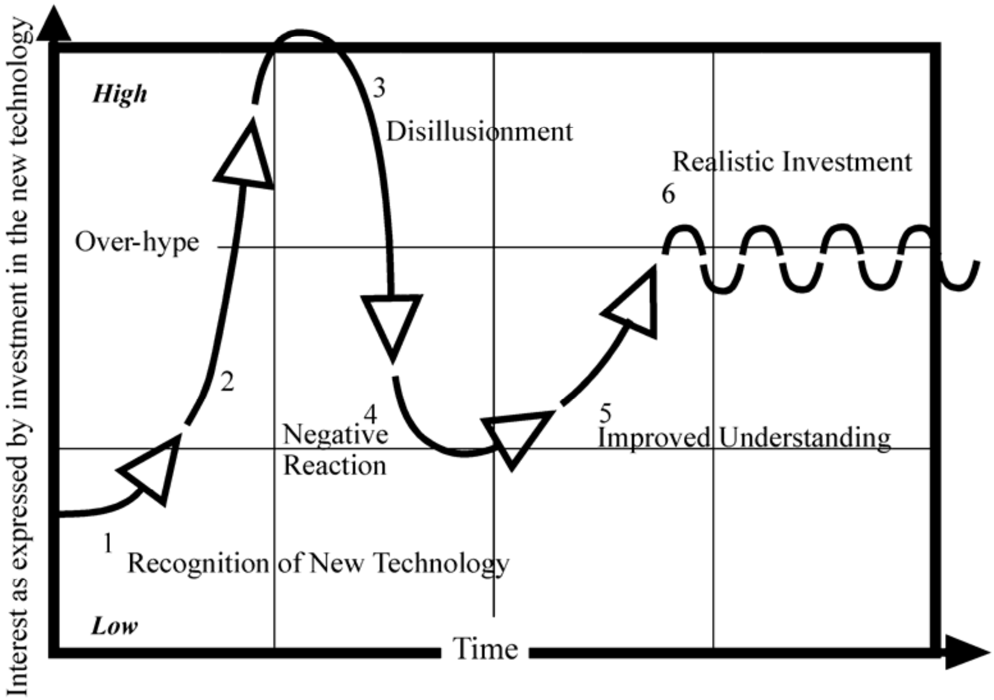

Figure 1: Common pattern of development of new technologies over time.

In this conceptual graph, a new technology is invented and recognised by those who wish to develop their competitiveness/performance. People become excited about the technology (especially research funding agencies) and investment pours in to the point where the potential is over-hyped for that point in time! The technology fails to meet the unrealistic expectations and disillusionment sets in followed by a severe negative reaction and investment dries up. In time it is realised that the potential is still there and we gain an improved understanding of what it will do and how it links to all sorts of other issues related to human development. Investment begins to increase until it reaches a sustainable level and is subsequently overtaken by the next innovation. Then the cycle begins again.

To those engaged in research and development this is a familiar pattern. There are far too many examples where the gap between recognition and sustainable development can be measured in decades and the question must be why this is so. We will all have our own views but it may be worth considering what one research study has revealed about the process of transferring ideas into practice. Undertaken by the Industrial Research

Institute. Inc. Washington DC (1999) it shows that in manufacturing industries it takes about 3000 ideas to generate a single new product or service and there are various stages along the way. In some organisations such as Boeing such a process is more formalised and at each stage of the process additional resource is added to take the development further. In the early stages it might be nurtured by involving a mentor/manager to explore the idea further. As time goes on more 'hand holding' might be added and then cash and other resources allocated to examine, test and create prototypes until the decision can be made to manufacture. An interesting comment made by the study is that it is almost never the original idea that is enacted. In other words it is the process which is important and there is learning and feedback throughout the innovation trail.

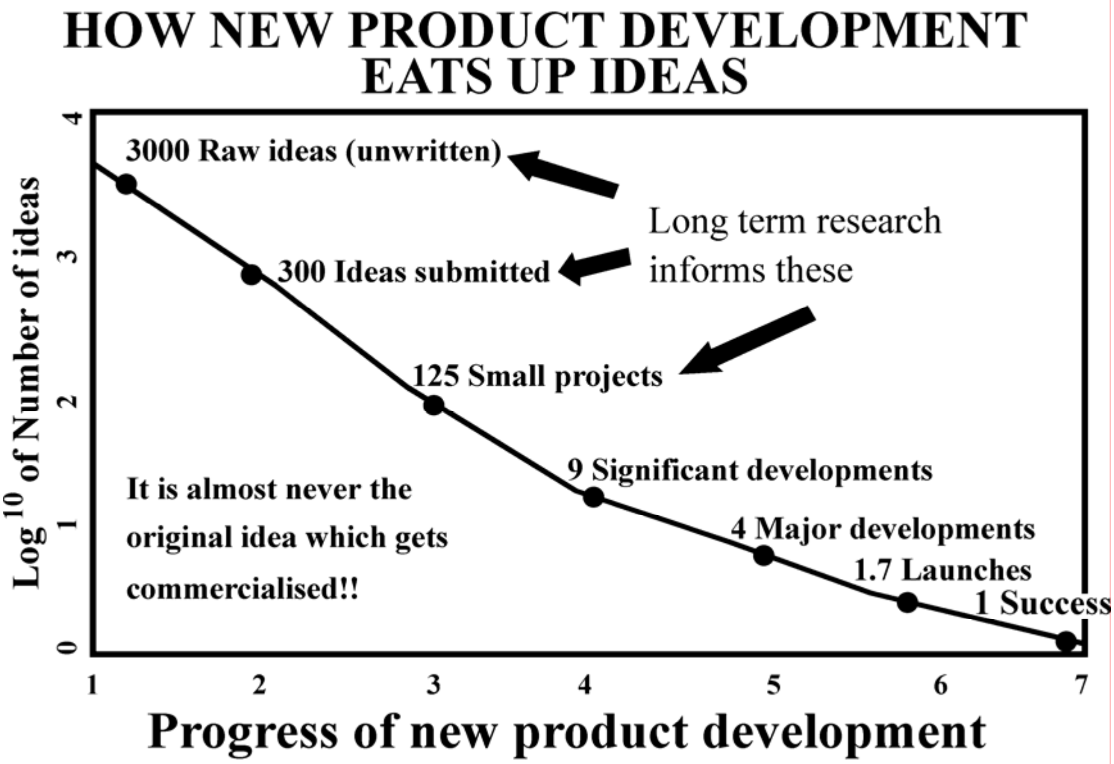

Figure 2: Progress of new product development (Industrial Research Institute Inc, Washington, 2000)

It is also important to realise that there are few ideas which are generated which are completely new. Most arise from other work which can lead to a new juxtaposition of ideas and which then leads eventually to the new product. The ideas arise from a complex inter-action between established knowledge, new research and a context of self improvement and practical experience and the balance between these aspects will depend on the individual with the idea and the nature of the problem being addressed.

Service industry improvement and innovation is likely to follow similar lines although the formal stage by stage approach is seldom there. However, the filtering and investment requirements must exist even if they are not made explicit. One major difference may be that the linearity inferred in the graph may not actually be as clear as is shown. There tends to be an iterative process along the way involving feedback loops and new insights which may be the reason that the original idea gets modified to the point where it is almost forgotten by the time the product is commercialised.

Many of the books relating to innovation talk about the need to "Think, Play, Do" (Gann D. 2004) or words to that effect. In practice this means that ideas are presented, some kind of simulation where experimentation can be undertaken follows, and then implementation occurs. There are parallels in some other work such as Lester Thurow's 'Zero Sum Society' (1980) where he uses the analogy of road building to identify different types of research. He describes the first stage as *Scientific Research* where the terrain is explored to see the direction a road might go. This is followed by *Engineering Research* which determines 'How' the road should be built and whether it is possible to do it. Lastly he suggests a form of *Implementation Research* whereby it is discovered whether it is possible to build the road effectively in terms of economic cost and time. There is inter-dependence between these different types and it would be unwise to assume that the latter can exist without the preceding types being enacted. In the case of the applied industries such as Property and Construction it is usually the use of generic research developed independently of the industry which is then harnessed for application in the applied domain. A familiar example would be the adoption of general software in the IT industry and making it applicable and useful for construction design and management professionals to use.

Nick Valery is quoted in an editorial (R&D Efficiency 2004) in his summing up of the 2nd Annual Innovation Summit for the Economist in San Francisco 2004 as suggesting that change can come in many forms:-

- From the unexpected
- From an incongruity between what is supposed to happen and what does
- From a refusal to accept the inadequacy of a product and process
- From a sudden change in the structure of the market

It is the third and fourth of these in which clients or stakeholders are largely engaged in promoting change and innovation.

Valery also echoes the content of Figure 2 when he describes one approach to an innovation strategy to be:-

- Scan the environment
- Select the ideas which give the best chance of giving a company a competitive edge
- Resource those ideas
- Implement the result
- Review the strategy to see if it needs to be altered. This he considers to be the most important!

He goes on to say:-

"The real test of an innovation strategy is sustained growth from continual innovation."

3. CLIENTS DRIVING INNOVATION

The usual definition of innovation (Websters) is *to make changes by creating something new.* This is a rather all-embracing definition and does not distinguish between innovation and invention very well. The CRC in Construction Innovation in Australia suggests that it is to do with 'driving ideas into practice' but again this does not clarify the situation. The nature of 'clients' is also difficult to define as during the life of an asset many hundreds of people can claim to be the sponsors or users of projects to varying degrees. This is why the term 'stakeholder' seems to be gaining more acceptance. However the concept is one of the 'demand side' of the industry driving the 'supply side' to do better. Even this runs into problems when the demand requires something original from the service provider and therefore the appointment of a professional who has demonstrated that they can innovate. Who is doing the driving? In this case the demand side is responding to innovation already demonstrated by the service supplier. This is particularly the case with the appointment of signature architects. Many happy, but fruitless, hours can be spent discussing these issues! Looking at significant case studies can however be useful.

3.1 CASE STUDY 1: MICRO-FILTRATION MEMBRANES IN THE WATER INDUSTRY

In this example the client was the water supply company for the North West of England called 'United Utilities'. In 1996 there was a drought in the UK and current water stocks were exceptionally low. This required a quick response which needed to be cost effective. The problem they faced was that the conventional way of purifying water was basically to add chemicals to coagulate the impurities, then let the solids settle out by creating 'quiescent' or very still conditions. This requires the construction of very large open structures and it is not unusual for the construction and commissioning of these tanks to take two to three years. It was not possible to wait that long.

The response from United Utilities was to adopt the process of micro-filtration which had been researched and developed in the 1970s but it was not until the 1990s that it was taken up by the water industries. This required a completely different process and plant and was more like a chemical processing plant than the heavy engineering traditional approach.

In February 1996 a decision was made to build a 80 million litre a day plant. The plant was delivered in July 1996 and it was the world's largest micro-filtration plant at that time. It went into immediate use and the cost effectiveness of the technology was demonstrated. This innovation produced considerable savings in land use and the elimination of sedimentation. The modularisation of the process increased flexibility plus speed of construction and the water quality improved as there was a physical barrier to contaminants. In addition there was a retrofit capability allowing use of different membranes and a reduction in chemical usage.

Barriers to this innovation did exist. Previously there had been only limited large scale demonstration projects. It was difficult in a cost-cutting environment to investigate and develop the new technology. There was the problem of social consensus – would the public trust the new technology? There was no risk-sharing mechanism as nobody wants to be the first example of anything which has an impact on health! There was insufficient training and education of the industry personnel to assimilate the new technology and the existing infrastructure was not suited to the new approach which was more related to production engineering. There were not many benefits for linear scale up and revenue costs were higher.

However the lessons for adoption of innovation of this type are clear:-

- A real need must exist
- The client must be prepared to shoulder a substantial portion of the risk and not be risk averse.
- The technology must be mature enough for an informed decision to be made.
- The potential for improvement must be significant
- In matters of public concern, health and safety must not be part of the risk.

3.2 CASE STUDY 2: INTEGRATED DESIGN, MANAGEMENT AND MANUFACTURE THROUGH IT

Design is the discipline which probably has more impact than any other on the process of innovation of the product and to some extent the processes of property and construction throughout the life cycle. Almost by definition a new and often novel solution must be found to a particular clients' problem. In this case the designer is the agent of the client bringing his or her skills to drive towards something new which satisfies the clients' requirements. Often there is a mismatch and the question of 'meeting client needs' arises as a key issue in many future studies (e.g. Hampson K and Brandon P (2004)). The role of information technology in understanding, communicating, recording, testing, simulating and demonstrating ideas and solutions is considered by many to be the key to real advancement of the industry and the role of clients.

One of the best exponents of the use of technology is the firm of Frank Gehry Associates who have taken established technology used by other industries. in this case it was the CATIA system developed by Dassault Systems, originally for the aircraft industry, and they applied it to new building design and construction. Frank Gehry is one of the world's foremost architects and has produced a string of exciting designs including the Guggenheim Museum in Bilbao and the Walt Disney Concert Hall in Los Angeles. Frank Gehry (Gehry, 1999) works through a number of phases which includes sculpturing, drawing, analysing function, determining needs and experimenting with new materials. The design process defies normal conventional design and the complexity of the product requires new methods of representation and manufacture. This is particularly so with regard to future planning and alteration of the finished product.

The designer, in this case, required a technology which would not hinder his process in producing original novel designs but also supported him in the method he adopted to realise his imaginings and to evaluate his proposals. It should also be linked to the manufacturing process so that materials and fabrication can be manufactured off-site to tight tolerances and be easily assembled. In addition the designs were so complex that it was important to take the client with him on the journey of design and therefore visualisation was important. It was these significant factors which led to the choice of a technology from another industry where these matters were already being resolved.

Gehry (1999) makes the following point :-

"The new computer and management system allows us to unite all the players …..with one modelling system. It's the Master Builder principle. I think it makes the architect more the parent and the contractor more the child – the reverse of the twenty first century system……In Europe there is a person called the mettier that takes off the quantities of the building. We don't need him anymore. The computer does that in an instant….as we design we have an instant mettier that takes off as we go. Consequently I am designing with specific conditions and I don't go out of bounds".

Traditional CAD systems did not seem to meet the needs of the client's agent. As Lawson (2004) has said 'real computer aided design will support the *thinking* of designers rather than the superficiality of their drawing actions.' The CATIA system and its companion systems allow representation more easily, can use laser scanning to input physical models, evaluate from a variety of different perspectives, transmit data to manufacturing plant, can provide a common model for the whole of the design team, can simulate process, allow immersive visualisation, facilitate setting out direct from the model using laser technology and a variety of other tools.

The Gehry partnership, in which Jim Glymph is the technical partner responsible, is relatively small with perhaps 60 employees. However, it has transformed its process of design and opened up new avenues for creativity through technology which has not constrained the methods of the creative designer. This is an important point when it comes to innovative design. Changing the thought process of the designer to suit a technical requirement can result in poorer design or possibly complete frustration. As Gehry (1999) says regarding CATIA *"They're tuned into understanding the way architecture is practiced* and can make new buildings possible – more exciting shapes in the landscape instead of just plain boxes."

The lessons for innovation from the use of CATIA by Gehry are as follows:-

- The need for technology to support imaginative processes to meet the client's demands was paramount to the client's agent, the designer. It could not be achieved by conventional means.
- It was necessary to go outside the construction industry to find a mature technology to meet the needs of the designer.
- The technology enabled risk to be understood more easily through visualisation and simulation to enable 'try before you buy'.
- Integrating models allowed a reduction in risk by designers and contractors in complex and new situations. The interface problem at this level was removed.
- The technology company was willing to adapt to the designer's need for flexibility and improved manufacturing tolerances.
- The culture of the company was one of continuing innovation. This latter point is key. As Jennifer Chatman is quoted as saying (Editorial, American Innovation, 2004) *"Sustainable innovation requires embedding the value*

of innovation in your company culture". She goes on to point out that a culture will form anyway and it is too important to be left to chance.

These were all important drivers for innovation and subsequently a new product is being developed known as Digital Project, based on CATIA, which will be specifically tailored to the construction industry.

4. VECTORS, VISIONS AND VALUES

The above case studies have illustrated some of the key factors that relate to getting ideas into practice. A key factor is necessity or meeting a particular need at a specified point in time. If there was not a drought, would the micro-filtration technology be adopted? If Gehry had not wanted to create new and exciting designs, would Digital Project be on its way? In this case necessity is the mother of innovation. The technology needed to be available but its application needed to wait until a whole series of circumstances were brought together in a benign union. The case studies are just examples but there are underlying generic issues which can be identified related to the innovation process.

Firstly, there needs to be tools available which are sufficiently mature to be adopted for commercial development and implementation. These tools are usually measurable and indicate a general direction for improvement. In a general way (admittedly rather loosely) they might be called '**Vectors**'. A Vector might be defined as 'a quantity completely specified by magnitude and direction'. Many of the technologies which are used for innovation are physical or virtual tools which can be represented and quantified giving a sense of direction to the improvement that can be expected. They have been created and tested and their performance can be assessed, perhaps not completely, but certainly in such a way that a level of confidence can be placed in their use. They provide a part of the kit which is absolutely necessary for the innovation and implementation to take place. Without them a vague wish list would be created without the means to realise the demands being made. In the two case studies it was the research and development which had taken place which produced tools which could not only do the job required but also give a sense of direction as to where the improvement might lie. It is not always evident what the total future benefit might be.

Secondly, there is a need for '**Vision**'. If the thought processes of the client or the industry are fixed on the current position in today's practice then it is unlikely that the potential for the future will be realised. The industry will fossilize around its own set of problems and solutions. Indeed, it could be said that the history of construction has been one of creating and solving its own problems without considering how technology could help. Too few people have looked up and seen what has happened in other industries and developed a clear vision of what can and should happen to property and construction. There is no reason why construction could not have been the lead industry on so much innovation but its structure and attitudes have made it a perpetual runner up. Many of the people now driving innovation in construction have come from other industries and seen the weaknesses of our processes. The length of construction's history and its craft nature are probably major factors in why innovation and sensitivity to research are not high on the construction industry agenda. Directions are needed and quoting

Steve Betros (CEO of the Facilities Management Association of Australia), *"I think it is pretty hard to get somewhere if you don't know where you're going"*. This is one of the reasons why the CRC undertook a 2020 visioning exercise engaging a wide spectrum of contributors. Innovation needs this understanding of the future potential to give it purpose, encouragement and a fertile ground for operation. Without this vision the industry will focus on tactical issues based on the here and now and forget the strategic potential for change that will give it competitive edge. In the case of construction it is not only competition in markets across the globe but also in attracting the best personnel who have the ability to move the industry forward.

Thirdly and finally, the industry must address the '**Values**' of the society in which it performs. If innovation is to take root then it has to be sensitized to the needs of those who can benefit from it. At the same time it must not undermine the interests of others, unless society too can see some longer term benefit related to its value systems and possibly make amends to those who suffer from the change. If the values are those of the market then meeting demand will prevail over all other issues. On the other hand, if society believes that the market forces need to be modified (e.g. to consider the needs of future generations as expected in sustainable development) then the market forces will be modified through a whole variety of social forces such as the legal and regulatory framework and the education system.

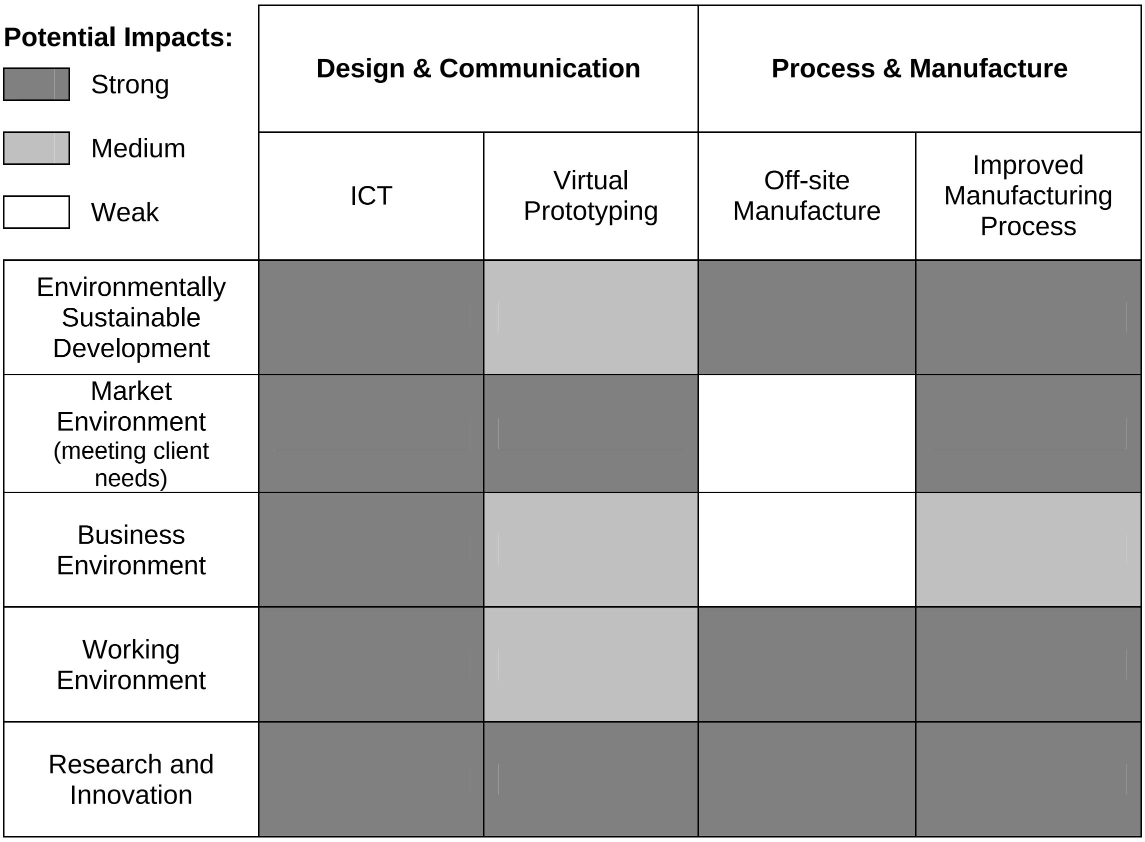

Figure 3: The relationships between the main themes of the CRC Construction Innovation visions. (Hampson and Brandon, 2004)

In the Construction 2020 exercise (Hampson K. and Brandon P. 2004) the prevailing visions were those related to meeting the needs of society and the industry and the remainder related to the technologies which would enable these value systems to be put into effect and improved more easily. (See Figure 3.)

In the diagram above the items on the vertical axis relate to values and in particular meeting different peoples' needs. Sustainable development is related to meeting the needs of future generations; market environment is meeting the needs of clients; business environment meets the needs of industry; working environment meets the needs of personnel; research and innovation meet the needs for self improvement. The horizontal axis on the other hand provides technologies which have the potential to facilitate the meeting of these needs. Without these value systems the technologies would have little value. It is these driving forces which provide for innovation to take place and drive ideas into practice.

One of the major problems today is that we live in a world which has technology and ideas available in plenty but they do not necessarily relate to the values which society (or in this case, the part of society relating to the Property and Construction industries) considers to be important. This link with societies values is seldom made explicit in research of whatever kind and therefore a gap exists between what is provided and what is wanted. We have our tools and we have a vision of what we would like to be but the value systems which underpin our choices are often understated.

In much research we create the tools and techniques but do not place them within the framework of society and the values which that society holds. Consequently the value of that research is not recognised until some time later when that connection is made. This brings us back to Figure 1. Why is there the gap between periods recognition and improved understanding in so many projects? If the above discussion holds good then it can be summarised as follows:-

- The research on the tools, technologies and techniques must continue and be made available otherwise the means by which the expectations can be realised, will fail. These provide the mechanisms by which progress can be made and give direction to what is possible in the future.
- To achieve take-up of these tools the industry needs a vision of where it wants to be and this provides the aspiration and driving force which will take it forward.
- The final cog in the wheel is the values which pertain to that society and which provide the fertile ground on which the innovation culture can grow. These also determine the value which will be placed on the innovation and the level of investment which will follow.

All three are essential for innovation to take place but the most important is understanding the values of the people and society from which the stakeholders for the built environment are found. If they have already or can be convinced that change is necessary for improvement then innovation will follow. Perhaps we need to overtly include in all applied research projects an assessment of how the research is expected to impact on the values of society.

A final thought for those who want to remain with the status quo……

"Soon you will attain the stability you strive for. In the only way it's granted. In a place among the fossils of our time" (Jefferson Airplane)

References

Editorial, (2004). *American Innovation, R & D Efficiency*, Vol 13, Issue 1, January 2004

Gann D. (2004) *Think Play do,* Inaugural Lecture, Imperial College, London, June 2004

Gehry, F. (2002). *Architecture and Process Gehry Talks*, Universe Publishing, p 50

Hampson, K. & Brandon, P (2004) *Construction 2020, A Vision for Australia's Property and Construction Industry,* CRC Construction Innovation, QUT, Brisbane. Australia

Lawson, B (2004). *Oracles, Draughtsmen and Agents: The Nature of Knowledge and Creativity in Design and the Role of IT* in Designing, Managing and Supporting Construction Projects through Innovation and IT Solutions, Editors Brandon et al, CIDB Malaysia, p 15

R&D Efficiency 1999

Thurow, L. (1980). *The Zero-Sum Society*, Basic Books, USA p 78

Useful Background Reading

Chesbrough, H. (2003). *Open Innovation*, Harvard Business School Press, Boston, USA

Drucker, P. F. (1985). *Innovation and Entrepreneurship*, Heinemann, London

Greenfield, S. (2003). *Tomorrow's People*, Penguin Books, London, UK

Lawson, B. (2003). *Intentions, Practices and Aspirations: Understanding Learning in Design,* Design Studies 24, pp 327-339

Shrage, M. (2000). *Serious Play*, Harvard Business School Press, Boston, USA

Thomke, S. H. (2003). *Experimentation Matters*, Harvard Business School Press, Boston, USA