

"S" DOES NOT EQUAL "T"  
AND "T" DOES NOT EQUAL "I"  
The First United Kingdom Innovation Lecture,

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## INTRODUCTION

In the truest sense of the word, being here tonight is a great honour. But at the same time, to have been invited here to deliver the inaugural Innovation Lecture is also a source of profound humility. When I reflect upon the truly great thinkers and visionaries who have spoken at the Royal Society, such as Sir Isaac Newton and Sir Christopher Wren, I can only wonder if I just happen to be in the right place at the right time. I felt much the same when I became the first from my country to receive the Albert Medal from the Royal Society of Arts back in 1982. For tonight, in effect, I am being recognised for a second time in a country which - by any standard of measure - ranks both historically and currently as the home of truly great science. This is an honour which few may be fortunate to receive. Again, I thank you all.

It was without hesitation that I accepted this offer to address the importance of innovation. When I learned of this new initiative the DTI was undertaking I thought, "What a marvellous opportunity". The topic is not only of timely significance - which makes it quite attractive - but it is also a topic of little controversy - which makes it doubly attractive. Speaking for innovation is a lot like speaking for education and peace - who can argue against you? But, as with issues like education and peace, everyone approves of the goals but no one is quite sure how to reach them. A classic example of "easier said than done".

Nonetheless, I shall attempt tonight to bring some ideas - both new and fundamental - to the table in the hope of shedding more light on the elusive path to innovation. S does not equal T, T does not equal I Let me begin by explaining the title of my lecture: 'S' does not equal 'T', and 'T' does not equal 'I'. As a student of physics, I often prefer to conceptualise a problem in the style of a formula. Here, the symbol 'S' stands for Science - basic science - 'T' means Technology; 'I', Innovation. So to translate my title into layman's terms it would be: 'Science alone is not Technology' and 'Technology alone is not Innovation'. I should like to start with the former.

# SCIENCE ALONE IS NOT TECHNOLOGY

This nation, better than any other, understands the vital role science has played throughout the course of human history. Michael Faraday, James Watt, Sir Frank Whittle, are heroes to all of us who know science - and even to those who do not. Their legacy still lives here today in universities and research laboratories which continue to reach ever further into that realm of the yet unknown. However, whereas men like these were able to extend their scientific theories a step further into the field of working technology, it seems today that this step is harder to take. And to an industrialised economy, failure to make this step underlies the difficulty in transforming world-class science into viable, commercial technology. Why the difficulty? I believe we can say that it basically stems from an imbalance in priorities. While certainly it is good and noble to place emphasis on basic research and science, placing too many eggs in this basket takes away from the important work done by commercial engineers and applied researchers. This imbalance is not only a financial one, it is also a question of prestige; the image society has of engineers versus scientists. If my guess is correct, it would seem that scientists - like doctors and lawyers - are held in high esteem. The popular image of the lone Ph.D. in a lab. coat, seeking discovery of the unknown, is quite attractive - almost romantic. Basic scientific research provides us with information which, though previously unknown, only offers hints at the future. It is the engineer who can take these theories and basic building blocks and from them create technology. I believe that technology comes from employing and manipulating science into concepts, processes and devices. These in turn can be used to make our life or work more efficient, convenient and powerful. So it is technology, as an outgrowth of science, which fuels the industrial engine. And it is engineers, not scientists, who make technology happen. And the true visionaries who can really capture technology and use it to chart the future course of industry are what I call 'technologists'. I understand that in the UK this term means something like 'commercial scientist': but I define it differently. By 'technologist' I am referring to those rare individuals who have a wide understanding of science and engineering, as well as a broad vision and true commitment to the needs of society. People with this depth of understanding can adapt and apply technology with imagination, wisdom and humanity.

## THE ROLE OF THE TECHNOLOGIST

Thus, in order to succeed in maintaining and strengthening the vital manufacturing base of the economy, it is crucial that society helps to encourage the development of more engineers and 'technologists'. The key to competitiveness in a borderlines, 'high tech' world does not lie beneath the microscope lens of the laboratory scientist, but on the drawing boards and computer screens of electrical engineers, software developers and design experts. At the same time, I believe we should not only encourage more young people to pursue engineering studies, but we must also - on the corporate level - advance young technologists through the managerial ranks. Manufacturing and high technology corporations must be led by those who understand not just business but technology as well. Just as you wouldn't have a rugby

coach who never played the game, how can someone who doesn't understand the workings of technology take the reins of a manufacturing operation? How could that kind of person make the correct, intuitive judgements regarding R&D budgets, factory automation and the unseen potential of new technology? In Japan, you will notice that almost every major manufacturer is run by an engineer or technologist. However, here in the UK, I am told some manufacturers are led by CEOs who do not understand the engineering that goes into their own products. Someone once mentioned to me that many UK corporations are headed by Chartered Accountants. This strikes me as very curious. Though I have a great deal of respect for accountants and financial professionals I do not believe they should be at the helm of industry. For an accountant, the central concern is statistics and figures - of PAST performance. So how can an accountant reach out and grab the future if he is always looking at LAST quarter's results. Now if we can agree that science alone is not technology, and it is technology which drives industry, and it is the engineer who guides technology, we must also agree that the role of the engineer deserves more respect from society and a higher priority by industry. For no matter how many important initiatives government bodies like the DTI are able to launch, it is the corporate world which must take up the banner on this issue.

Industry must encourage and advance the engineers within its own ranks in order to draw young talent back into manufacturing. By placing greater value on engineers, we demonstrate our commitment to place greater value on high and new technologies. But before I concentrate too much emphasis on the importance of technology, let me move to my second formula:

## TECHNOLOGY ALONE IS NOT INNOVATION

I find this point to be fundamental though some people may disagree. From a corporate perspective, just having innovative technology is not enough to claim true innovation. I see true innovation to be made up of three key elements which I call "the three creativities". Creativity in technology, of course, plus creativity in product planning and marketing as well.

Creativity in product planning is so important, though many do not seem to recognise this. What difference does it make how fantastic and innovative your new technology is if you do not have the ability to design a useful, attractive, 'user-friendly' product? Videotape recording technology was first introduced to the consumer market in 1965, but the home video market was not born until 1975. That was when innovative product planners took the tape out of the reels and put it into a convenient Betamax cassette for home use.

Creativity in marketing also cannot be overlooked. Again, if you have great technology and even a great product, you will only find success if the market is informed to welcome your product. If I may again borrow an example from Sony's history, take a look at the case of the Walkman. Many have called it an innovative marvel, but where is the technology? Frankly, it did not contain any breakthrough technology. Its success was built on product planning and marketing. I note these examples not to be nostalgic, but to emphasise that even if you achieve excellence in technology that alone will not ensure that an industry or a

single company will become innovative. True innovation requires all three types of creativity and again, from a corporate perspective, this is going to require innovative management.

## INNOVATION IN MANAGEMENT

On a structural level, innovative management demands that all phases of the operation be seen as links in a single chain of innovation. Each link allowed to pursue its own challenges - By links I am talking about applied research development, design. production engineering, manufacturing, sales and services Each link vitally important but equally so. It is important that the 'prestige level' of each link It is be similar in order to keep high achievers motivated in each group. And the creation and promotion of this approach is the responsibility of top management - so I am glad to see many industrial leaders lucre tonight.

## THE INNOVATION MANDATE

The innovation process does not begin by bubbling up from the research and development laboratory, or from brainstorming sessions by the product planners. The innovation process begins with a mandate which must be set at the highest levels of the corporation by identifying goals and priorities: and once identified these must be communicated all the way down the line. The targets you set must be clear and challenging because you cannot wait for innovation to just show up at your company one day. But you need not, and should not, possess the entire solution to the challenge you set. You just have to be sure that the target you raise is realistic, though it might appear impossible. The classic, and still the best, example of this is when President John Kennedy proclaimed that the United States would have a man on the Moon before the end of the decade. He raised the target, some called it fantasy, but a man did walk on the Moon in the summer of 1969.

The innovation mandate, as determined by top management, can only succeed in an environment which nurtures it. That corporate environment must promote goal sharing, unity of purpose, and the sense that everyone from the CEO to the factory operator are 'all in the same boat'. To sail, or sink, as one. Creating this environment is not an easy task, but without it innovation does not have much of a chance. And if I might briefly mention again about how, at Sony, we are striving to keep the innovative spirit alive, I would like to note a bit about what's going on in Wales as I was there just yesterday. As some of you may know, we have been manufacturing colour televisions in Bridgend for 18 years now. During that time we have continued to expand our operations which now includes the production of picture tubes - the most important added value component in a television. The Bridgend plant has won the Queen's Award for Export an unprecedented three times as its production serves not only the UK, but markets throughout Europe and the eastern hemisphere. Sony Bridgend has fulfilled its innovation mandate and is now working to help share its expertise with local suppliers and vendor industries in the UK -over 40 in Wales alone. By creating the Sony Quality Award, they hope to encourage their business associates to innovate ways

to improve quality, reliability and delivery in order not only to strengthen their relationship with Sony, but also to make their local suppliers more competitive in their own right. Sony Bridgend hopes it can help get the quality and innovation snowball rolling. Because once it starts rolling it is very hard to stop.

## CONCLUSION

Perhaps that is rather like this DTI lecture and my role here tonight: to help get the "innovation snowball" rolling. It is something I am very happy to participate in, though I feel as if I have been at it for over 45 years. But I still find the challenge exciting; and here in the UK, I can see that these issues are receiving the highest priority. The MacRobert Award for Innovation in Engineering, the Queen's Award for Technological Achievement and the Prince of Wales Award for Innovation all demonstrate the collective commitment of the British people to meeting the challenge at hand. I am proud to be a small part of the process, and am thankful to have been given this opportunity to be here tonight.