Invention, Innovation and Finance

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"Invention is the process by which the human brain changes the nature of human existence."

The statistics say that the UK produces a very high proportion of the world's most useful inventions. Most of these inventions are created in Small to Medium Enterprises (SMEs), which produce more successful inventions than the major institutions – and which create an order of magnitude more innovations than all the lone inventors put together. It is also important to understand that SMEs are more likely than any other source of innovation to create **new technologies**, not just new products. A new technology is valuable because it will spawn many different products - and even create whole new markets for products of a type that could not have existed previously. Science-based SMEs are therefore very important, because they have a most pervasive influence on everyone's personal lifestyle and on the wealth of the Nation.

Why Invention?

For business to be successful, there has to be a constant stream of inventions. Why? Well, if you run a business, your income depends on your customers – and there is always another company that is trying to take your customers away from you. To hold your customers – and to win more – you must constantly improve your product line. You need a constant stream of new and better products to replace the older ones, so you must invent these new products and you must find better ways to make them.

That is to say, invention creates new jobs and secures existing ones. It improves productivity and increases the income of the workers. It also creates new jobs in the supporting industries that pack, transport, ensure and sell the goods - and that process all the financial transactions involved. Invention creates new jobs in those industries that provide personal services to the workers and their families. And the inventions themselves often cut the cost – or improve the quality and variety – of everyday necessities like the clothes people wear and the food they eat.

I am sometimes amazed to meet people who say that Technology is inherently evil. Others say that there is really no need for any new inventions or new technologies. I am sure we have all

heard about the little old lady who opposed the early aeronautical engineering business because "If God had meant people to fly, he would never have given us the railways".

It seems to me that it is difficult to choose an invention that we could have lived without. The Jacquard Loom? The steam engine? Electricity? The telephone? Radio? The transistor? Radar? Computers? Satellites? TV? Float glass? The gas turbine? Plastics? Artificial fibres? Cars? Aeroplanes? Just try to imagine modern life if a single one of these inventions had not been made - civilisation as we know it quickly falls apart. People who have applied scientific knowledge to the creation of new products - like Watt, Trevethick, Faraday, Ferranti, Fleming, Bardeen, Brattain and Shockley, Baird, Daimler, the Wright Brothers, Watson-Watt and so on - have by their work actually built the fabric of the world in which we now live.

It follows therefore that "Invention" is not an eccentric sideline activity to the mainstream of life, as it is often thoughtlessly portrayed. Inventors are not oddballs that we can do without. Invention is the very process by which the human brain changes the nature of human existence. Through invention, human life is continuously and inexorably changed, enhanced, sharpened, made more powerful and more capable of producing still further change.

Intellectual Property.

Inventions don't happen on the workbench or in the laboratory – they happen inside the human brain. ***The human brain is unique in its capability for intellectual creation***. No other creature invents things.

Some while ago, I attended a discourse at the Royal Institution in which a series of humanoid and early human skulls were displayed alongside some of the tools and other objects found with them. The lecturer explained that the exhibits meant that at some time in our past there had been a dramatic change in our abilities, albeit with no noticeable difference to the external shape and size of the brain. Some non-human creatures had used tools and still do today, but such tools are unworked, natural objects that are merely selected from the surrounding environment. Several of the early human species used specially worked flint tools, but the shape and general design of those tools remained the same for millions of years.

Then one human species suddenly began to produce different and much better tools, increasingly more specialised, more finely crafted and more efficient, even beautiful. Body ornaments also appeared, and paintings in the caves. That emergence of new technology and of art was the beginning of the powerful contemplative consciousness that distinguishes Humans from all the other creatures living on the Earth. It was the start of our intellectual acceleration away from other living things with which we share DNA, the birth of real creativity and the first evidence of the creation of intellectual property.

It is significant that several species of biologically-similar humans arose, but the ones that were uncreative and carried on using the old tools did not survive. Sadly, it is fairly evident that the other types of humans with their traditional and uncreative way of life were actually wiped out – murdered or "ethnically-cleansed" - by the more intellectually advanced race. All of us here tonight are the descendents of the pioneers of intellectual property - and of the founders of our murderously-competitive species.

Although no technology is evil of itself, we are constantly reminded that the more powerful the technology, the greater the damage it can cause when it is misused. Powerful technologies can cause enormous damage when persons ignorant of their power use them carelessly.

Nuclear energy is the ultimate source of all the energy we need to live on this planet, the source of all our food energy and of the creation of all our fossil fuels. Direct use of nuclear energy is probably our only hope of survival when our fossil fuels run out during this new century. Yet our misuse and our initial blunders in the use of nuclear engineering technology have frightened many people. It is difficult even to talk to such people to explain why they should not be so fearful. As a result our work to improve the technology of nuclear energy systems has been almost halted for a time, which seems to place at risk the survival of human civilisation as we know it.

Is IPR an oxymoron?

Technology-based IPR cannot be bought, sold and transferred like a physical object, so it should not really be called "property" at all. An intellectual creation of the engineering kind simply cannot become the property of anyone else *without the exercise by that person of a similar intellectual activity.* Just buying the documents relating to the new technology does not in itself transfer the understanding that has allegedly been purchased. What this means is that without a true understanding of the relevant science and mathematics, it is very difficult for a layperson to examine the intellectual property in the abstract, to understand its value or to quantify the operating risks of a business based upon it.

That is a real problem to inventors. If I have a new design proposal and an engineer or a scientist asks me the usual question "How do you know that it will work?" I only need to show him the mathematics and he is happy. But I have known a sceptical financier to respond: "That's all very well, but how do I know that you have not fiddled the calculations?" (Like accountants can do!) Or he might say "Well, that's the theory, but of course it could be very different in practice." (As though the theory was not itself derived from extensive experience and from practical measurement)

To a non-scientist "the invention" is the physical product. But to the inventor the product is just an imperfect expression of what lies beneath. This communication problem does not seem to apply to artistic creations. In the case of a painting, a sculpture, a film or an artistic design, the physical form is very close to the inner vision and so it can be transferred by that means to the mind of another person.

Music is rather interesting, because it is somehow ethereal, with no directly tangible form. It is created within the mind of the composer, in which only intellectual concepts of sounds can exist. But those sounds have to be made before they can enter the mind of another person, so musical instruments have to be played by other humans who mediate between the mind of the composer and the mind of the listener. So that the process can be carried out, the inventor of the music must prepare instructions for the musicians – the composer doesn't write music, he writes down instructions. Sheets of music make no musical sounds. So the very nature of the music that others hear depends on several stages of interpretation of that written material. The music that was in the mind of the composer (who may then be long dead) has to be expressed through other humans who may never have met the inventor of the music. If the conductor and the musicians of the orchestra fail to understand perfectly what was originally present in the brain of the composer, the music they produce will be different from the music that the composer originally heard in his/her mind.

And so it is with engineering, in the creation of new technologies. Inventions have to be nurtured by the inventor, or by engineers directed by the inventor. The first prototypes are always imperfect and they need to be "breathed on" by the inventor, who sees deep into the behaviour of the machine and is more able than most others to pinpoint the problems and to correct any deficiencies. Gradually, what was in the mind of the inventor has to be transferred to the minds of the team of engineers that bring the invention to physical reality.

The life story of a patent

The idea

Legally, an idea has no value and it cannot be owned by anyone. It cannot therefore be sold – *nor can it be stolen*. Ideas are worthless in themselves. Ideas cannot be patented. An idea is NOT an invention.

But the means to carry out an idea, to extract it from "brain space" and to express it in reality – that is where the value lies. Every Patent Application must therefore describe "a means" of making or doing something – and the patent description must show that the means of expressing the idea is practical, novel and demonstrates a commercial advantage.

Eureka!

At a certain date, usually under highly-memorable circumstances, the inventor gains the crucial understanding that leads to the invention. (I should emphasise that this is a **time of new understanding**, and is not necessarily a time of receiving some new knowledge) It is NOT the time when the inventor has a new idea! The Eureka event occurs when the inventor understands for the first time how his/her idea can be (literally) realised. The Eureka moment is the true moment of birth of the invention.

Now the baby has to be wrapped up and protected. The inventor's most important task is to write down at once what has been understood, as clearly as possible. The notes must

also say why the understanding is new and valuable. A Patent Application must then be lodged, describing the invention. There is no fee and there are good DIY guides published by the Patent Office.

The date on which that patent application is lodged at the Patent Office is called the priority date. For many years to come the Law will uphold the inventor's right to the ownership of the invention, if it can be shown that nobody else sold, or lodged a document describing such a thing, before that date anywhere on this planet.

Patents grow.
A period of one year is allowed from the first lodging of a patent application to the date by which it has to be finally described for publication and international examination. That is because, however hard the inventor may try to get things right in his mind first time, he makes mistakes and forgets some subtle effect that needs correction in the design. The idea of the one-year period of grace is that a prototype can be made and tested - and new understanding can be gained. The new understanding might trigger modifications that require new patent material. At the end of the year, all the knowledge can be gathered together to form part of the final patent application, without losing the value of the priority date of the first patent lodging.

Patents die.
It is not just that Patents legally expire twenty years after they are granted. It is also that the intellectual property world is a very active, turbulent, seething cauldron into which new technologies and new thought processes are stirred continually. Sooner or later there will always emerge a better way to do what the inventor did first. To counter this ageing, the first patent must be "ring-fenced" by lodging new patent applications covering improvements that refer to the previous application or to alternative ways of achieving the same objective.

The original inventor is always in the best position to create the "ring-fencing" IPR. He is uniquely aware of the weaknesses of his first patent application and knows exactly where more protection is needed. (Of course, this also makes him very valuable to a competing company!)

Patents have children.
An engineering invention is created to meet a need – "Necessity is the mother of invention". An invention is a solution to a problem. The invention arises from applying a trained mind to that problem, with a broad awareness of science and technology in other areas of engineering. So when a new invention is created, it is added to the total understanding of the physical world that exists in the mind of the inventor. The knowledge automatically comes into consideration at a later time when the inventor is solving completely different problems. Thus new inventions can arise from the older solution to a different problem.

Inventions are independent of their ancestors

I am not talking about inventions that are just improvements, like changes in materials or key component parts. Inventions of a different kind, that nevertheless arise from previous work on other patents are in a sense the children of the earlier ones. Like human children they have a different and independent existence.

During my career many different companies have employed me and each subsequent employer has benefited from the knowledge I had gained previously. But the previous employer could not claim that it owned the IPR of my later work.

It is a common misunderstanding that there is some kind of "basic patent" or "core technology", to which subsequent inventions are mere variations. If that were the case, by the legal and commonsense definitions of an invention, those inventions that were in some respects similar to older ones could not then be patented, because they would not be novel. What matters is not *the similarity* of the new to the old, but *the difference*!

In one memorable meeting about ten years ago, a company lawyer did actually say to me that he thought my contract with a previous employer "had bought everything that your brain can conceive, without limit of time". He did not pursue the matter when I asked him to reflect on what he had just said!

The value of an invention

Most patented inventions are improvements – slightly better ways of doing things that have been done before. For example, an incremental invention might be an improvement to a tool, and a manufacturing company might use that tool. Such an improved tool design would give the manufacturing company a commercial advantage. (A longer product life, a better product quality, for example) In that case the value of the commercial edge is reflected by the increase in profit to the manufacturer over a long period of time – **and that is the true value of the invention.**

In order to create an incremental improvement, the inventor first has to learn all about the older product – and usually he/she gains that key knowledge and understanding by working for the manufacturer. The Law therefore says, very reasonably, that inventions of that type automatically become the property of the employer as quid pro quo for the salary of the employee.

But in fact the value of an invention is unpredictable and so has no direct connection with the salary of the person who creates it. Nobody can be employed as an Inventor. So the Law says that if any employee creates an invention that has an exceptional value, the employer must reward the employee appropriately. It is a legal requirement that an employee must confirm that adequate and satisfactory reward has been received when he/she signs the documents that assign an invention. Really valuable inventions cannot be simply claimed by the employer as an automatic right – but not many people know that!

Patents and Patents-in-application – what use are they?

A great deal of nonsense has been talked about patents and the imagined power that they give a company over any competitor. In fact, if a product is not in manufacture or close to being made ready for sale, a company is actually made weaker by its published patent applications.

It is important to understand ***that it is only a granted Patent*** that gives one company legal power over another company – ***and that power is strictly limited***. There seems to be some idea that a granted Patent gives the owner of the Patent great power and authority to prevent others from using his invention – unfortunately that is wildly untrue.

For example, any engineer can design and build in his own laboratory – and any person may make for his personal use - whatever he may wish, without regard to the patent rights of another company.

A person may even set out deliberately to copy the exact details of the patented machines of another company in order to conduct experiments and perhaps to begin the design of an improved machine. That is one of the reasons why patents are public documents - their purpose is not just to protect the owner, but to advance research and development generally, in the interests of the Nation. So lodging a patent application is a risky business, because after about a year it becomes a public document that betrays the secret thoughts of the inventor. All that a patent application does is to establish a priority date for a Patent that may be granted a few years later.

The owner of a granted patent only has the power to charge any other person or company a fee – which must be a reasonable fee – for the use of his invention. If he finds out that the patent is being used in an unauthorised way, the extent of the damages that he can claim in Court is restricted to that fee. Although his business may have been ruined by the unauthorised actions of an infringing company, he cannot claim compensation in any form. So it is never worth going against a patent infringer until the collectable fees are large enough to pay for the cost of legal conflict.

A Patent is usually granted between three and five years after the original application is lodged. Until the time of Grant the document is just a patent-in-application – and that gives no power whatever over any third party. After all, the Patent may never be granted, because it may be found that it does not satisfy the strict conditions necessary to prove that it describes a truly novel and valuable invention. In the UK, at least, it is a legal offence to obstruct the business of another company on the basis of a claim to own patents-in-application. (And rather stupid, because it blocks a future source of royalties!)

The person and the vision

Large companies have a large inertia – an inbuilt resistance to change and especially to radical change. That is why they tend to produce many incremental inventions and very few revolutionary ones. It is not generally in the interests of a manager working in a big company to take a risk on something very new. Newness means unknowns of costs, revenue and staffing structure and the manager might risk his/her personal career.

So every innovation in a big company must have its own champion – someone who is prepared to be personally identified with the innovation, to take the personal risks and to disappear if the innovation flops, or to be promoted if it succeeds.

It can be very difficult to be the Champion of a technical innovation in a big company. It can be like swimming upstream, like walking against a gale, like turning your back on your friends. It can sometimes seem that you are the only person alive who understands that the innovation is very valuable. Most of those around you see the invention as of no particular importance, or its development as a drain on scarce resources, as an unnecessary disturbance to the present well-planned course of the company, or as a risky investment that would be difficult to justify to the shareholders. The champion of the new invention has to take all this on board every working day - and must not be discouraged!

The birth of Enterprise

The inertia of big companies is in fact the chief cause of the creation of new companies. It is certainly the reason why I left an international engineering company over thirty years ago and struck out on my own.

It is a major personal and emotional decision to move away from the (apparent) security of a big company for the sake of the invention. But as I have already explained, the invention arises from an inner vision and the inner vision generates great passion and commitment. People like us (I speak for the South West SMART Club, but probably also for most high-tech entrepreneurs) seem to be prepared to face great hardship and to take huge risks to bring our inner visions to commercial reality.

We start new companies from scratch and we work in the bedroom and the garage. We put our finances at risk and inevitably that risk increases. We work long hours and we lose out on our relationships with our wives and children. We don't let up as frequently or for as long as we should - and our health suffers. Being thoughtful people, we sometimes think that we must be mad to have changed our lives in this way!

We don't do it for money at first. We think about money later on. I don't think financiers understand how anyone can possibly do that!

More about the Invention process

We can all remember where we were when we heard that President Kennedy had been assassinated, or when we heard about the death of Princess Diana. Similarly, inventors can always remember the instant that the intellectual leap of invention came upon them – the Eureka moment. It is always a big surprise! I think the surprise is very significant.

The intellectual event never seems to come logically, like the solution to a mathematical problem. It does not arise from any controlled and conscious progression from the known to the unknown. When I solve a difficult problem in maths and physics, I know exactly how the process works and I can see the result coming together before I get there. When I finish the work, I feel that I have climbed a sort of mental mountain and the result is a direct consequence of my recent effort.

It is not that way with inventions! That may be difficult to understand. It is reasonable to think that invention is "development" and that it results from day-to-day work. But more – or harder – work does not lead to more or better inventions. If anything, the reverse is true, since invention is definitely linked to quiet contemplation and to mental relaxation.

Very few of us were "at work" at the time of our inventions. Personally, I remember opening a bathroom door and "seeing" the new machine for the first time, and I remember on another occasion that my first waking thought was an understanding of a completely new mechanism. *Archimedes, of course, was relaxing in the bath!* Most of my learned colleagues have had similar experiences – we realise that the brain likes to roam free from the circumstances of the moment and we deliberately let it do so when we can - hence the stereotype of the "absent minded professor".

My point is that there is *no direct relationship* between everyday work and the inventive process. Those that believe that invention is the inevitable result of trained effort have not understood the difference between manufacture and design, between calculation and understanding, between reality and vision.

The creative frame of mind

Nevertheless, *there is a special frame of mind that we learn to recognise as being essential for making inventions, for achieving new insights.* If we avoid this mental state, we can be quite sure that no invention will occur. In a contentious legal situation, or when there is no protective contract in position and a problem is being discussed with another company, for example, I have always been careful to avoid the creative mental state, so as to be able to say with certainty and truth that no invention was made at the time.

But when creative problem solving is the desired objective, it seems to be necessary to open the mind, to avoid every prejudice and to read anything and everything that seems to have the least relevance. It is helpful to talk to all those people who might know something about the problem, or who know about the previous unsatisfactory attempts at

a solution. And for me it is also necessary to sit down and calculate a number of general parameters that relate to the problem. Looking at the relationships between the numbers seems to sharpen my instincts of physical possibility and impossibility. All this might all take a long time with many yawns and long walks and feelings of impatience, of stress and looming defeat. I might give up – at least for the moment, for the evening, or for the weekend.

And then suddenly the solution is obvious. I know immediately and with a great certainty that a certain novel solution is consistent with all the information that I have stirred into my mind and allowed to stew whilst I relaxed – or worked on something else instead. When the new solution is analysed, the maths check out correctly, or at least closely. This confirms that the solution is a practical one and it always seems to be glaringly-obvious.

Why things happen that way is a mystery to me, but I remember that when I first ran an electronics development laboratory after I left University many years ago, I would work all day on some tough problem and get nowhere – but when I was on my bike and half way down the hill on the way home I knew the answer! It seems to me that the brain – well at least my brain - works better at problem solving when it is "off line". So it likes to be stuffed with information, relationships and data and then left to do its own thing in its own time. This is, of course, rather inconvenient and sometimes unsociable!

The development of an invention

The "invention made in the garage" is not itself a new product. It is just a demonstration of the general principles from which the real product will later arise. We call the first working demonstration unit a feasibility prototype. It is just one step on from the abstract idea.

I am amazed that the myth of the "poor, exploited, lone inventor" is still so common. It should be obvious to everyone, even to the inventor, that his creation at that stage is like a helpless baby. It is not ready to be what it is intended to become and it has to be nurtured for some time. Unlike the music of a genius like Mozart, inventions do not leap from mind of the inventor, perfect and complete, into the hands of the user. They have to go through a costly, never-ending and re-iterative development process. Then they have to be made to the correct quality standards and in quantity, at the right price.

The nurturing process needs MONEY, PEOPLE and TIME. So unless the inventor has the resources - and is properly qualified - to add those essential ingredients himself and to control them, he must stand aside and let others take over the task. Those that do this honourably and professionally are entitled to a large share of the reward from the exploitation of the invention. The work of financiers, marketing personnel and administrators is an essential and very expensive part of the innovative process – the invention is not stolen from the inventor just because his own role becomes smaller!

Money and 'Magination

The root cause of the inventor's problems, as wryly described above, is that he places technical achievement above financial success.

That is to say, the inventor doesn't usually have enough money to do what he feels driven to do - but even though he realises that, he still attempts the impossible. Having dug himself into a financial pit, he is then in a weak position to negotiate a good financial deal ***on the basis of finance alone*** and he knows it, so he asks for too little money. By these actions he actually devalues his invention and his own dignity and he loses the respect of the financial community whose support he seeks.

To the technical entrepreneur, the purpose of the company is to provide an environment in which the invention can grow to maturity. The money is merely a tool for this job. To the financier the reverse is true – the purpose of the company is to provide an environment in which the value of his financial investment can grow and the invention is merely a tool to be used for this job. *Unfortunately for the inventor, it is the financier who is in control of the process.*

It takes two kinds of people to make a scientific invention into an innovation – to create a commercial success that allows the world to benefit from the invention. First – *really first* – there must be the inventor, who will be a scientist or an engineer. *But closely second* there must be the financier, who contributes the next most vital resource – money. Without money, nothing happens. Like the flowers in the famous churchyard at Stoke Poges, without financial backing even the most excellent of inventions is doomed to "blush unseen and waste its fragrance on the desert air" - it will never get made in quantity and sold to return a profit to the inventor

Unfortunately, it seems that – in the UK at least – there is no chemical attraction between the two vital elements of the innovative process, no mutual understanding and proper communication that draws together the financial world and the high-tech innovators. Chaps like us have the devil's own job to attract money into our working environment.

I think it is because financiers who are interested in backing technical innovation have no easy way of knowing the real value of the invention before it is already developed and the market is responding to it. Unfortunately, it takes a lot of investment to get to that point!

As inventors, our part of the business is the "Imagination" bit. Many years ago I went to an interview for the job of Technical Director of a certain company and the interviewer asked me at some point what I thought had to offer that would distinguish me from the competing applicants. I was not expecting the question, but after a short pause I answered honestly that I believed that I had a very accurate imagination. The personnel officer looked blank and then incredulous! Perhaps he did not believe that an adult and mature individual should confess to relying on his imagination - and I certainly don't think he understood the difference between a vivid imagination and a very accurate one.

The personnel officer had never had to solve a really tough technical problem and he didn't know what on earth I was talking about. I didn't get the job! But his question – and his facial response - made me think hard about my training and my work; and what it is that makes the difference between good and bad engineering. It is, in fact, a very thorough understanding of physics and mathematics, rigorously and extensively applied to the design problem.

I realised that, in order to carry through that discipline, I had learned how to think myself into a piece of metal and feel the strong and weak points of its shape, to think myself into a signal passing through an electronic circuit and know what changed my response time, to think myself part of a chemical reaction and sense what helped it to progress and what stopped it – and so on. That's how I have learned to do my job, and I don't think I am different from any other creative engineer or scientist.

There is not the slightest doubt that a vivid, fertile and **accurate** imagination is vital to a successful inventor. He needs to exercise it frequently and very thoroughly. His imagination must be fast-acting, highly-tuned and wide-ranging, constantly checking its formulations against all the basic principles of physics and its past experience of forces, masses, energies, costs, times and environmental effects. That quality of detailed and accurate imagination is not magic or mystical – it just comes from long practice and frequent use.

Intellectual Property that has real value is created and developed by the disciplined workings of a trained mind.

I have already said that people like my colleagues and me are not the "mad scientists" or detached nerds that the media finds it so easy to portray. We don't work in a garden shed or wear a white coat or use tunefully bubbling coloured liquids in glass vessels or build huge electric spark machines. Although we make our money by being creative, we do not think that we are "Artistic". We are ordinary hard-working chaps that run businesses, handle large sums of money and work carefully through masses of legal documents.

But I am sorry to say that the technically-based creative process is so cloaked with myth and mystery that if you say "scientific invention", to a financier, the media images are what pop into his mind. The words "science" and "invention" conjure up completely wrong stereotypes for a person who is not himself an experienced scientist or engineer. So when high-tech entrepreneurs like us need to talk to financiers about early stage scientific innovations, we have to begin each presentation in such a way that we overcome that inbuilt prejudice and build commercial confidence. If we do not succeed in convincing our financier friends that we are normal, cautious, rational and understandable people - and that our overriding objective is to make a lot of money from our technical talents - we will waste their time and our own.

Small-mindedness

One of our worst failings is that, with typical British modesty and self-effacement, our high-tech entrepreneurs cannot usually admit, even to themselves, the true value and importance of their work. They have a vague ambition to make money from their inventions, but they do not dare to consider just how much money might be made **if making money was actually their foremost objective**. So entrepreneurs frequently fail to attract financiers who would be interested in backing them.

I have already pointed out that Invention is not a strange thing, but that it is perhaps the most powerful distinguishing feature of the human race itself. I have pointed out that Civilisation itself is built upon the inventions of past times - and I have argued that the wealth and power of a nation depends on the general quality of its technical innovation and the speed with which it is exploited.

Invention is important. Invention is powerful. Invention is valuable. Why are we so small-minded about it?

About six years ago I was talking to a young chap from the Press, who marvelled at the electromagnetic ram technology and the process by which it came into reality. He said "I suppose that, when you invent something like this, you must sell it on a small scale first. Do you offer it for sale in the local ironmonger's shop?"

I explained first that the proverb says, truthfully, that Necessity is the Mother of Invention. Solutions are *not* first created and then sent looking for a problem. Inventors are people who specialise in solving problems, which means that I know who my customers are going to be, before I create something to sell to them. I also explained that investment is justified only by the potential return, so that I normally study the US and Pacific Rim markets before spending much money on anything!

I have not had a similar conversation since, but I have met many British companies who think only in terms of their local contacts. To them Scotland is a distant country with strange customs and France is out of reach. No wonder that DTI financial support for invention is generally budgeted around £10,000 – and that there are prestigious Government awards of only £45,000! I am sorry to say that this attitude is typical of small-minded UK thinking. Everything is focussed on mere survival and on a minimal proof of the reality of the invention – not on making money and changing the world.

It is a mistake to think of small investment and of slow growth for high-tech products. By their very nature, high-tech products soon become superseded by the next generation, based on further advances in the technology. High-tech products are "perishable goods". ***So it is vital to get high tech products developed and out into the world markets as rapidly as possible*** if the investors are to see a good return on their investment. Company Plans should always be written for rapid-growth and vigorous marketing.

A role for a major scientific Institution?

I was once asked by some venture capitalists to go with them to a presentation by a Japanese company that was seeking financial backing. The Japanese company said that it had a VERY powerful and secret new magnetic material that would make a fortune. The presenter told a story about long hours of work in a chemical laboratory and the accidental mixing of a new ingredient late at night, and so on. Then, as part of its presentation, the company showed a video in which a motor using this amazing new magnetic material was started by a battery, then used to drive a dynamo using the same powerful magnets, whose terminals were connected to the motor and then the battery was disconnected. You guessed it – we were then told that the motor kept going and would drive machinery forever, because the magnets were so VERY powerful! I was astonished to find that my financial friends did not immediately fall over laughing.

It gave me a problem, because I could not just laugh myself without insulting the financiers who had invited me to go with them. I had to wait until later and to write a report assuring the financiers that there was a simple and very fundamental equation about entropy that physicists call "the arrow of time". If it is violated, the whole universe would have to change instantly – so that particular Law cannot be broken. The law of entropy says, in effect, that you can't get energy for nothing – in fact you can't even get back all the energy you put in to begin with.

I explained that the Japanese company was, in effect, claiming that it could make a Time Machine. That meant that the company was obviously deceitful and its claims fallacious. I said that the financiers should not spend another penny on the proposition. The Japanese company did not get its money – my investor friends were not fooled, for a variety of reasons – but I was interested that such an unscientific proposition could even be presented with an expectation of success. I realised that other companies had asked me to comment on similar propositions earlier in my career and I understood another reason why small high-tech innovative companies have problems attracting finance.

The financier is in danger of being bamboozled by scientific jargon and misinformation – and he probably knows it. So the safe course of action for a non-scientist is to regard every scientific statement as being equally suspect. Unfortunately for those of us with a really sound innovation, the cautious approach results in the truth being valued the same as the lie. A sound technical proposition must be considered to be just as risky as a wild and unworkable proposal. Money for every high-tech project is therefore made available only in small amounts and on extortionate terms.

My colleagues and I are very pleased to learn of the efforts by the DTI to bring together private and Government-backed Venture Capital for high-tech investment, with the DTI providing the "Kite Mark" of the true quality and value of the invention.

Phillip Denne January 2001