“Bridging the Funding Gap”

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I have been asked to submit some proposals as to a means by which HMG may help its innovators to cross the notorious “funding gap” that often stifles technical innovation at a critical stage in its path to success.

Why is technological innovation so important?

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.

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.

What is the Funding Gap?

Sir Solly Zuckerman, one time Chief Scientist to HMG is often quoted as saying that the relative costs of the stages through which an invention must pass escalate by orders of magnitude. That is: -

Concept and patenting	**£1,000**
Feasibility prototype	**£10,000**
Demonstration prototypes	**£100,000**
Marketing, production engineering and approvals	**£1,000,000**
Quantity manufacture, sales and field support	**£10,000,000**

The excellent SMART Award scheme gets us through the first couple of stages - and with second mortgages and good management a struggling young company can get through the third stage too. But there has to come a time when the nature of the company itself has to change for the project to go to the next stage. To operate at the next level the company needs bigger premises, more staff, more tooling, more sales and marketing costs, greater warranty liabilities and so on.

The company cannot grow gradually through this change in its structure – it is a quantum transition, a step change, a gap that must be crossed in one leap. Funding to allow the transition has to come from an outside source and that source is usually a financial institution or a private investor. As a condition of the investment the company is compelled to change from “survival and steady growth” mode to “make substantial profits quickly” mode, - which means that even the management structure and ethos has to change as well.

The different cultures

Unfortunately, at least in the UK, there is a substantial difference in culture and understanding between the financier and the technologist/scientist/engineer. If an engineer or a scientist asks me the usual tough question "How do you know that it will work?" I show him the mathematics and he is happy. But a financier might 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 practical measurements)

Britain is recognised to be an outstanding source of new inventions and ideas but unfortunately it is also notorious for its inability to bring those ideas into large-scale production. This is certainly due, in part at least, to the general reluctance of most City financiers to support technology-based enterprise in its early stages.

I believe that a fundamental cause of this reluctance is a cultural gap that is as great as that between "Science" and "Art", where the thinking processes and the delights of one culture are almost incomprehensible to the other.

To a scientist or engineer, it is obvious that the future of the world depends on good science and technology and on the creation of wealth from products that continually improve productivity, pleasure and the quality of life generally. But to many financiers it seems that technology is a suspicious activity, a black art practised by strange people, in the same way that perhaps scientists see the world of financial investment.

Technical enterprise is considered to be a high risk investment because the layman cannot easily understand it and because it is notorious for its mysterious, unpredictable and poorly-explained cost-escalations and delays in initial development. Persistent progress, constant modification and improvement, the drive towards thorough understanding and ultimate success are strongly condemned by accountants as the costly results of "failure to get it right in the first place". Substantial and continuous investment in R&D and product improvement is begrudged as detracting from the short-term profitability of the enterprise

Causes of reluctance and disinterest by the City

Unfortunately, it seems that – in the UK at least – there is no chemical attraction between the two vital elements of the innovative process. There is 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. It might be helpful to consider some of the reasons for this.

1. **Grasping the value of the invention**. Financiers have no easy way of knowing the value of an invention before it has been developed and the market is responding to it. But substantial finance is needed to get to that point!

2. **Selling the opportunity to the financial world.** A financier - to whom the making of money is the central reason for living and the "buzz" comes from a big profit – finds it almost incomprehensible that a scientist should not even consider money in his/her decision-making process. (I once lodged a new patent to protect the vulnerability of earlier patents – and I was promptly accused of trying to make money from it. Until that moment I had never even thought about doing so!) For a scientist or an engineer, exploration and problem-solving (knowledge and understanding) are the drivers and money is only needed to oil the wheels of the process. So of course the technologist is not good at "selling" the value of his/her project in monetary terms – and money is not attracted to a poorly-promoted opportunity

3. **The Garden Shed image of the inventor.** The technically-based creative process is so cloaked with jargon, myth and mystery that if you say "scientific invention", to a financier, 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. Images of a white-coated “nutty professor” or of “garden shed experiments” spring forward easily. So when high-tech entrepreneurs like us have to talk to financiers about early stage scientific innovations, we have to overcome inbuilt prejudice and build commercial confidence. If we do not succeed in convincing our financier friends that we are normal, 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.

4. **Intellectual Property is 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 <u>without the exercise by that person of a similar intellectual activity.</u> Just buying the legal documents relating to the new technology does not in itself transfer the understanding that has allegedly been purchased. A formal document like a patent is not of itself the knowledge that is valuable to the future of the company. It is only the tip of an iceberg; much more valuable knowledge is still in the minds of the creators of the technology. I.P. is not only intangible; it is tied to specific individuals whose goodwill and enthusiasm are essential to the future of the enterprise. If any competitor should wish to get around the protection of a patent, he will know that the best person to achieve it is the original inventor, since from the start an inventor knows, even subconsciously, the weak area, the Achilles heel, of his intellectual concept. So for the first few years of the development of a technology-based company a financier has to invest in the person of the innovator. But financiers do not like to feel that their investment is strongly linked to the involvement of a particular – and mortal – individual.

5. **The conservative assessment of commercial risk** As a result of the above, without a true understanding of the relevant science and the mathematics, it is very difficult for a layperson to examine the intellectual property in the abstract, to understand its strength and value or to quantify the operating risks of a business based upon it. The financier can be easily bamboozled by scientific jargon and misinformation – and knows it. He/she also suspects that crooked businessmen know it too. So the safe course of action is to regard every scientific statement as being equally suspect. Unfortunately that means that the truth is valued the same as the lie. A sound technical proposition will often be considered as high risk, just as though it were a wild and unworkable proposal. Money for such a project is therefore made available only in small amounts and on extortionate terms.

6. **Financiers invest in people** A person who is a top-grade scientist/engineer often prefers to work alone much of the time and, as a result of a strong preference for the objective over the subjective, he/she is rarely also a good manager of people. But to bring any product to market there must be a team of persons who work in the different disciplines of sales, manufacturing, accounting and product development. These people must be managed by someone who really enjoys management and by whom people are pleased to be led. As well as the presence of the original inventor, a financier will want to see – perhaps as the highest priority – a well-structured management team that understands the business of making money from technology. The original innovator has to be prepared to step aside from that team – in the words of Sir Winston Churchill, the best innovators should be “on tap but not on top”

Crossing the funding gap

As a result of all the causes for uncertainty and suspicion that are listed above, there is a big problem for innovators who want to move from being a small business to one that makes products in quantity and sells them worldwide. That usually requires a capital injection of several millions of pounds – perhaps £5 million or £10 million – and it seems to be very difficult to attract such funding from UK sources.

The perceived risk/reward ratio What often happens is that the technical innovator gets support from overseas instead – most often from the USA. If we point to only one central reason for the difference between the UK and the USA, it is that US financiers seem to us to be prepared to accept a higher level of perceived risk. It may be, of course, that the difference is really because US financiers do not actually perceive the risk to be so high as their UK counterparts! And it should be remembered that it is not perceived risk that matters in absolute terms but perceived risk relative to the perceived reward, and in the USA people tend to "think big".

It follows therefore that the best way to increase the participation of UK investors in technology-based projects is to reduce the perceived risk/reward ratio. That is to say, the process of investment will be encouraged by work that clarifies the technical problems of development in terms that are understandable by a non-scientist. It will also be encouraged by work that clarifies the market potential – again in terms that are understandable to a non-scientist. Both of these tasks need a special sort of person with mix of talents - or a team of people that together provide those talents in an independent review body. The independent review body needs to be able to call upon a team of experienced technical innovators, street-wise to the problems of marketing, management and business survival, not just to the academic merits of the technology involved.

Assessing the technical risk To assess the commercial risks relating to the development of an invention, it is necessary to spend time with the innovator to gain a clear understanding of the basic sciences involved – physics, chemistry, materials science, biology, or whatever. It is also necessary to understand where the boundaries are between what is accepted knowledge and certain and what has to be discovered and is uncertain – and to judge how difficult it is likely to be to cross those boundaries. Such work is necessary because the business of the innovator has hitherto probably focussed on the careful construction of the invention in small quantities for use by clients who respect its novelty. Large-scale exploitation means redesign, certification and international approvals, which bring forward new problems. Finally, all that thought and understanding has to be translated to monetary terms in a clear and unambiguous way in the form of a report to the financier. It should not be forgotten that the value of the report to the financier will depend absolutely on the technical and commercial reputation of the persons who sign it

Assessing the potential reward For the second part of the task some similar skills are needed – but this time the committee needs more marketing knowledge. What is required is that the innovator must be stimulated to consider what other businesses will be affected by the invention, over and above the business of the primary market for which it was first conceived. It will be necessary to assess the value of the invention (which is unrelated to its cost) in every potential market that might be

entered worldwide, and to assess the possible competition and the product life cycles. It should be noted that most marketing or market survey companies are unable to do this work unaided – it does need expert technical knowledge to assess whether a perceived new market is realistic or a just a wild fantasy. Again, the expert technical knowledge has to carry weight in the eyes of the financiers.

A venue for presentation and interaction

Written reports from assessors or assessment committees will not of themselves attract finance. It is important to create an atmosphere in which the innovator and his/her management team can speak with potential financiers in a relaxed and interactive way, and in which the financiers may also explore areas of the assessment reports for clarification as necessary. Such an environment should of itself convey authority - the Royal Institution in London has been suggested in earlier documents – perhaps an "RI of the South West" can be found for this purpose.

An outline of the proposal

There should be a regular forum in which high-tech entrepreneurs may present to a number of potential financiers, in strict confidence, the fundamentals of new science-based projects that require substantial new investment to move into commercial profit.

No project would be admitted to the forum until accredited individuals had carried out a careful examination and were prepared to state that 1) the underlying science was sound and 2) that the ultimate use of the invention was likely to be pervasive and substantial.

The forum would be a "Kite Mark" for the technical aspect of the inventor's proposal and thus it would reduce the perceived risk for the potential funders. The "market feasibility" function of the forum would be to expand the vision of both the inventor and the financier and thus increase the perceived value of the innovation. Such a forum would allow the inventor to expose the potential business opportunity in confidence to a number of sources of finance at the same time and thus accelerate the finding process. It would begin to close the "equity funding gap" that slows the growth of many high-tech SMEs in the UK.

A secondary function of the organisation of the forum would be to give advice to a high-tech SME on the structure of its management and the quality of its business plan, which are other key factors in the funding decision process.

An estimate of its potential costs

(It is suggested that some of these costs might be absorbed by sponsorship by Venture Capital institutions)

Annual rent of venue – say monthly meetings from commencement.	£2000
Fees of review body – say six persons for 30 days each	£50,000
Salary and expenses of full time coordinating scientist	£80,000
Miscellaneous support costs, publicity etc	£25,000
Contingency	£15,000
Total Budget	**£175,000**