FINANCING RESEARCH AND DEVELOPMENT FROM A BANKER'S PERSPECTIVE

by

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Mr Chairman, ladies and gentlemen, first let me thank you for inviting me here today to address you. I am honoured by the invitation. When I explained to Professor Headley that Friday was the only day on which I was available, he indicated that he would place my address in a slot in a technical session. I wondered how it would bear comparison with the heavy scientific papers likely to surround it, but I decided to be brave and to press on.

Since the financing of research and development generally occurs in two environments, the academic environment and the commercial environment, the raison d'etre of the research organisation generally serves to define these differences. It influences the manner and the extent of financing.

This presentation will address the financing of research and development delivered to academic institutions and to the corporate sector, and will view that financing primarily from a banker's perspective. Normally a central banker and a commercial banker do not view things through the same lens but I will assume today that they do.

While technological research tends to take the spotlight, and deservedly so, increasingly, more research undertaken at academic institutions and in the corporate world is about systems, relationships and processes which aid the process of technological development.

The first part of the presentation will therefore address the financing of research in the physical sciences and related technologies and the second will address the more difficult task of financing research in other disciplines.

In any field of research there should be two possible paths, the first should offer the opportunity for the current frontiers of knowledge to be extended without limit, that is, the opportunity for research to be undertaken for its own core value and the second should provide for that area of research that is driven by the needs of the society. In some circumstances the two converge.

In the field of science and technology institutions which embark on research principally for their core value and for the benefit of the additional knowledge itself, are mainly educational and research institutions. While traditionally these have been funded out of university budgets and by foundations and trusts, increasingly the corporate sector is forming alliances with universities or making arrangements which share in the type of research being conducted, provided some agreed level of market-driven research related to the donors's interests is also conducted. In such cases bank finance for the specific research may not be required but may be part of an overall finance package organised for the sponsoring company in which the research element is a part. The general credit worthiness of the company would then be vetted by the bank for the total amount of credit being financed.

Many large corporations around the world, both currently and in the past, have financed their research and development departments in this way. Today the changing nature of competition and the increasing pressure of globalisation make investment in research and development critical to maintaining or gaining competitive advantage and a greater number of corporations particularly those engaged in product development, have become interested in tapping into research in a more focused and organised way.

Many of these corporations have their own research arms, even in the Caribbean. However, where corporate research and development costs start to become a significant part of the company's budget, bankers will require full disclosure and will closely monitor the company's research expenses. Hybrid technologies and technologies based on technical fusion, that is not innovative but complementary types of scientific development, tend to be more marketable and hence more bankable, and are generally better candidates for funding, possibly because of the area of uncertainty about outcomes is narrower.

From a banker's perspecive, whether or not technology is hybrid, in order for financing to be successfully accessed, the market should drive the research and development. Developing such a market driven approach begins with demand articulation or identification. In some cases the environmental needs make the research highly relevant. In Barbados, we have the case of the solar energy research for which Professor Oliver Headley is highly acclaimed. This led to and the development of the solar water heater and has had a profound effecton the lives of every Barbadian. We have another instance of this in the mechanical sugar cane harvester patented by Dr. Colin Hudson which grew out of the chronic shortage of willing sugar workers at croptime. Indeed, it also demonstrates that it is very possible to stay at the forefront of technology by working at targeted developments. I would hazard a guess that the new products at Pine Hill Dairy and at Roberts Manufacturing Company were market driven. Some of these products were a result of a clearly evident growing concern about healthy eating and an increasing diet consciousness of the market.

I am not privy to the way in which product development at these companies was financed but I would imagine that a banker would have been very conscious of the fact that such research was market driven and hence the resulting product would most likely have been marketable. The price to the customer is an important part of the projected profitability of the project since the cost of research and development work, particularly where it is by way of corporate research, has to be measured against product price and product

value to the customer as well as against the functionality of the product. Don Ferry, a U.S award winner in technology, in referring to his work on gas turbines many years before and to his then disappointment on the termination of that project reflected many years later that "the functional and economic gains for the customer were not enough to justify Ford's spending the money." Customer gains and functionality are therefore very important in the case of corporate research - though less so in primary research.

Unfortunately, the system drives investors and bankers to focus on easily measurable attributes such as current earnings and return on investment as the bases for decision making. In addition, shareholders tend to be interested in near term appreciation of shares and less in long term performance. This also influences corporate inclination to short term gains.

As a result, many decisions may not take the long view and do not necessarily reflect the true contribution of an investment in research laboratories. Yet the reality of research is different. In a study of 8 cases of technological innovation George Mechelin, a former vice president of research and development at Westinghouse (and honoured for his work on the launching of polaris missiles), observed that out of the 8 cases which he studied each took an average of 19.2 years to move successfully from the laboratory to the market place and work on a super conducting generator had taken 30 years. The compact disc is a case in point. I have learnt that laser vision and capacitance electronic disc technologies were developed in corporate research programmes in the 1960s and demonstrated in the early 1970s to prove the feasibility of the techniques, but did not really take-off on a major commercial basis until the 1990s - some twenty years later.

In approaching a bank for research funding, the objective of the borrower is to get the least expensive funds while suffering the least restriction on his flexibility. However, when funding takes the form of longterm debt, banks will wish to evaluate the borrower's long term earning power. The bank will expect its principal and interest to be met, firstly out of the future stream of earnings before interest and taxes, normally calculated as sales, less cost of sales, less selling general and administrative expenses. Cash flow projections and estimates of the current ratio or net working capital position will indicate the company's ability to meet its payment obligations as they fall due and the amount of liquid assets which the company has available to repay debts without resorting to a forced sale. The bank will evaluate the product line itself for product risk, e.g. rapid obsolescence, dependence on a single distributor, competitiveness of that segment of the market, etc. A third and very important factor will be the company's historical earnings record. The company's balance sheet will also be scrutinised. This is a most important financial indicator because the company's assets are the banks's secondary source of repayment should earnings ever become inadequate to repay the loan. The banker is also likely to investigate the liquidity (salability) of fixed assets. This becomes an important factor in the event of bankruptcy. The company's leverage will be important as well, that is, the bank will wish to examine the extent to which the company is already in debt or whether it is adequately capitalised.

In marginal cases the offered finance might carry strict conditionalities, such as restrictions on the payment of dividends or other measures introduced to preserve the company's equity base. Reduction in the amount invested in a particular product or products, or limitation on capital expenditures are other possibilities. In some circumstances the loan might be advanced as a call loan - not at all a reliable type of finance. In such cases the bank has the right to call the loan completely or to change its terms as to interest rate, collateral or to rewrite conditionalities.

The banker will of course be concerned with the continuing profitability of the operation. A single technological achievement will not always be sufficient to provide a lasting competitive advantage. The product or product may therefore have to be continually upgraded. This kind of cycle development does not entail a brand new product but involves ways of incorporating new technologies into old products. Financing of such product development costs is likely to find favour with bankers where there is a strong demand for the product. In fact, product leadership can be built where companies excel at design and the management of production and forego cutting edge technologies.

Indeed at the corporate level, and particularly in developing countries, the "break through" approach to research which focuses on replacing older generations of technology or on introducing brand new technology, involves costs which tend to be often beyond the budgets of the corporate sector, certainly beyond the budgets of the Caribbean corporate sector and have to be left to the universities. Often such heavy costs are incurred before breakthroughs occur or a new product makes it to the market that the company with slim resources may not survive. However, not all research is at the primary level of innovation and does not have to be at that level to be valuable. In fact research labs should welcome discoveries in other countries and labs should serve as a point of entry for inventions from all over the world.

Edwin Mansfield an economist and statistician who conducted research into product development efforts and their probability of success, found only a 12% average probability that an R&D project would result in an economically successful product or process. Mansfield, having surveyed 19 laboratories in the petroleum, chemical, electronics and drugs industries, found that the likelihood of projects reaching technical completion to be 50-50. By contrast, commercial risk - the possibility that a new product or process will not merit commercial introduction or application or that it will not be an economic success - he found to be often substantial. In the companies cited 60% of R&D projects reached technical completion, 30% were commercialised, but only 12% earned an economic profit. He concluded that an R&D projects's likelihood of success is the product of three separate factors: (1) the probability of technical success, (2) the probability of commercialisation (given technical success, and (3) the probability of economic success (given commercialisation). While few bankers are likely to analyse probabilities with the same precision as Mansfield, an evaluation of the progression of the product from technical success, to commercialisation, to profitability will almost certainly be taken into account in any financial analysis by most bankers.

Because research and product development have long gestation periods and because money has a time value, bankers, and financial controllers in research companies resort to methods of discounting. The general approach used in such case is the discounted cash flow approach. It is a technique used quite frequently in calculating funding costs where funding is obtained from international financial institutions, including, I believe, the Caribbean Development Bank and most other banks involved with large projects which extend over long periods. Critics claim that DCF techniques have inherent weaknesses that make them inappropriate for evaluating projects whose payoffs will come years down the road. James Hodder and Henry Riggs in an article on the pitfalls in evaluating risky projects, disagree but feel that DCF techniques are often misapplied and misinterpreted, arguing that what is needed are techniques that recognise that cash flows occur at different times. They suggest that the pitfalls of DCF procedures are:

1. Improper treatment of inflation effects particularly in long lived projects

2. Excessive risk adjustments, particularly when risk declines in later phases of a project, and

3. Failure to acknowledge how management can reduce project risk by diversifying.

They argue that some cash flows do not adjust fully with inflation, for example, many lease payments and fixed price purchase or sales contracts.

A second flaw in the DCF may be the use of a single discount rate for a project in which risk declines dramatically over time, so tending to show the project as less attractive.

In practice virtually all DCF calculations are performed using a constant discount rate, but use of a single discount rate (or IRR) blends time discount and risk adjustment factors. A more appropriate procedure for evaluating such projects, they suggest, is to separate timing and risk adjustments using the concept of certainty equivalent value.

Since projects that are rejected are seldom re-valuated, they argue that some good projects are lost this way.

I am not sure, however, that the difference in results in using a single discount rate as opposed to several discount rates over the project life is as important as the impact of other imponderables, such as the unexpected uses to which the research may eventually be put. In reality work on many technologies which did not prove to be immediately profitable have turned out to have commercially viable uses in simple ways.

Without resorting to DCF techniques, it can be argued that the techniques of return on investment do not always reflect the true contribution of an investment. In fact, even negative results from a current project may add substantially to overall knowledge and produce unexpected dividends long after project completion. Also, the social rate of return often exceeds the private rate of return. Many of the benefits may accrue to the industry in general or the consumer, often, the innovator cannot appropriate them because competitors can imitate them, sometimes cheaply, easily and quickly. Unfortunately, it is not the role of the banker to take into account either social return or social value.

The ability to move a product from concept to market quickly and efficiently is critical in today's changing business environment, both for reasons of cost and competitiveness. No individual has a monopoly on ideas and some other researcher somewhere may be working on a similar project - hence the need for rapid progress. The banker also will be very conscious of the time likely to be taken to develop a product since longer development time means greater costs. In addition to inventions and innovations therefore, companies are also looking to invest in processes, and systems that render innovation manageable. Where these reduce development time, provided the product is marketable, an astute banker would tend to view such developments favourably.

It is at this juncture that the soft skills of marketing, planning and project management become important and more closely linked to success in product development. In fact, some researchers are of the view that the risks in research and development in industry are more commercial than technical, and that the economic success rate of research and development projects would increase tremendously if marketing and production people successfully exploited them. Today, in order to be successful, industrial research must almost by definition be linked to successful marketing. This is as true of research in the social sciences as it is of technological research.

Ongoing R&D activities also tend to generate other related needs such as a need for consumer and marketing research and other exploratory research. When there is uncertainty about conditions

relating to the research, the background or the commercial context, or if there is a recurring obstacle to progress in the technologies of interest to the organisation, a need for background research is often indicated. Invariably this does not occur at a point close to commercialisation and is therefore unlikely to have much appeal to a banker, but it is often essential and hence may need to be funded out of corporate profits.

For many years the Japanese have understood the importance of these non-technological aspects of production. They accept that it takes more than the basics of high quality, low cost and differentiation to excel in today's competitive market. It also takes speed and flexibility and much more. One view is that the major difference is between the traditional sequential or linear approach and the team approach which emerges from the constant interaction of a multi-disciplinary team whose members work together from start to finish. Several Japanese and some North American companies have used this approach successfully.

Size is also an important factor in the financing of research and development. As a result small firms are increasingly moving toward pooling resources with other institutions and universities. In fact, research consortia and joint research ventures are likely to be increasingly useful in small countries like the Caribbean, since for each technical area of research there tends to exist some minimum critical mass which makes for optimum efficiency. Foreign firms with branches in the Caribbean are likely to be keen to show their commitment to the region by entering such collaborative arrangements. Questions of proprietary ownership of the research would need to be made clear up front in order to avoid subsequent problems.

Such collaboration may take several forms, all of which have been used by Caribbean researchers but which could be more actively pursued. Researchers, for example, take sabbaticals with large corporations to work on in-house research projects. In North America the corporations scout the universities, but in the Caribbean the university may need to scout the corporations. In addition to working in-house in a corporate environment young researchers may find it a useful means of being recruited. The coop method where students work with companies as part of the system of accumulating credits may also be structured to include joint-venture research and can have spin-off recruitment benefits as well.

Consortium financing tends to be undertaken mostly at the level of fundamental research or with the objective of improving the corporation's general understanding of the science. Questions of proprietary ownership of the output and patent rights tend to arise as the research becomes more specific. In such cases the company and the university could enter specific contracts which would define the areas of intellectual property rights of the university and the company respectively. Even so, I am advised that there is often a major gap between patentability and commercialisation of the output, so that contracts in which the corporation cedes certain rights may still permit spin-off benefits from the main research.

The trade-off is often one of choice between the university's continuing collaboration with the corporate sector and total enforcing of its rights to intellectual property. The more liberal the university the more likely is continuing or increased collaboration and vice versa.

Much of the presentation up to this point has centred on physical and technological research and on marketing and management research in so far as it affects science and technology. There is as great a need for other disciplines to access finance for research and development. However, the output is often less saleable - for example in the social sciences.

Other areas are opening for these disciplines. In recent years, though increased emphasis is being placed on self sufficiency by most international financial institutions, and there is a greater reluctance to provide direct funding to developing countries where certain sectors are deemed to benefit from special incentives, on the grounds that it institutionalises dependence, there has been, at the same time, a greater willingness to provide consultancy support for studies which will ostensibly further develop self sufficiencies. Funding for such studies cuts across all sectors - finance, agriculture, information systems, human resource management, productivity improvements, etc, but is usually based on the needs of the sector to be studied and requires the happy coincidence that the skills of the researcher and the needs of the various countries are directed through these international institutions or find themselves in the same data base for selection.

The researcher is not so much finding funding for his research as he is providing research and consultancy services based on the needs of the client or sponsor. Many universities now encourage international agencies and the corporate sector to use their staff in such projects. In some cases, I believe the university may even benefit from part of the proceeds.

These sources do not however, meet the funding needs of research departments or organisations which have special pre-agreed research agendas, either in process or on the drawing board. In addition to the conventional foundations, trusts and philanthropic corporate donors non governmental organisations are also willing to fund studies which conform with their agendas- these include areas like gender studies, environmental studies, behavioural studies etc. Non profit organisations also tend to direct many of their requests to Foundations and trusts, but the horison of Foundations tends to be short term and they are rarely geared to monitor ongoing research in particular fields where studies are likely to extend over long periods.

In most cases, bank finance for such studies is rarely available, and where it is, is based on the financial standing and general credit worthiness and not on the project itself but of the borrower. Where any advance in these non-technological fields of research is going to be considered on the basis of the research project, the banker would expect it to contribute to the company's bottom line either through increased output, greater costs savings or improved productivity of the company as a direct result of the research or its application. Even so the borrower more likely than not, must still be credit worthy.

Very often while the social value of the research may be significant, the private financial benefit to the researcher and to the sponsor may be insignificant. Hence, it is most unusual for funding for such projects to be by way of bank finance.

I was requested to make this presentation from a banker's perspective. Having looked at the prospects of bank finance for the non-technical disciplines, it becomes clear why the main thrust of the presentation was centred on funding of research and development in the field of science and technology. From a banker's perspective, this area of research is the more bankable.

Industrial legislation can also provide a form of financial assistance. Some observers argue that the mega-electronic wave out of Japan was born out of the industrial legislation sponsored by the Ministry of International Trade and Industry in Japan in 1971 and 1978 which encouraged joint research between precision machinery and electronics industries. In the Barbados case the research and development incentives which permit 150% of research and development costs to be expensed against income, apply only to

the export and tourism sectors. Consideration might be given to extending these further. However, while it could encourage profitable businesses to engage in greater research and development, it would not meet the needs of those researchers and scientists without resources, as there must be income against which to expense these research costs.

Other possibilities are tax credit concessions which allow for the company to write off R&D expenses(or some percentage of expenses) directly against tax payable. The relative benefit to the company would depend on the percentage allowed and on the company's profitability. If there are no profits the tax credit is of no benefit in that year - even if carrying-forward is permitted. In such cases the R&D allowance may be a preferred option as it allows rapid expensing of the outlay as against depreciation over several years.

Generally, one of the greatest difficulties in bank funding of research and development is dealing with outlay on the failed project. If the project fails the process of recovery of the loaned funds can be painful. Banks tend therefore only to touch high risk applications where there are bank guarantees. Private guarantees for high risk projects are not the norm. Normally, guarantees are available for projects through special schemes set up to fund productive investment, but only where projects can demonstrate their earning potential. There are no guarantees available to banks who receive applications from companies or individuals interested in pursuing research into the feasibility of projects or project development, unless the researcher can take the proposal beyond the level of research to commercialisation. This is irrespective of the level of skills of the researcher and applies both to scientific and technological research and product development as well as to other fields.

The banker who entertains funding for primary research which is not output based would not be a banker for too long. Yet in the interest of the development of new products and services in the Caribbean these skills need to be matched by funding. The answer may lie in greater collaboration with the stronger companies in the Caribbean and the universities and research organisations. The tax benefit could then be extended to expenses of companies funding such research and development with universities and even individual researchers in collaborative research projects.

Provision of bank guarantees for research and development would also encourage bankers to take on board this type of product development funding, but such funding institutions would have to be prepared to write-off substantial sums each year given the typical ratio of research expense to successful production of a marketable and profitable product or service. Such "called" guarantees would have to be considered necessary losses incurred in pursuit of higher goals. Only one entity is likely to be able to do this with impunity - Government. Whether it is fiscally affordable given the competing claims on government's resources, is a question of priorities. A little lobbying might provide the answer. That leaves three other possibilities, two of which also rely on government - expanded write-off facilities for R&D expenses and the use of tax credits for R & D. The fourth avenue depends on the initiative of the researcher and of the university, that is, greater collaboration and alliances in various forms between the corporate sector (local and foreign) the university and research organisations.

The banker is likely to provide finace only after the research has been conducted and the product is well on its way to commercialisation. Who therefore funds the type of research so dear to the heart of the researcher - that which offers the opportunity to extend the current frontiers of knowledge for its own sake? In addition to the university's conventional contributor; alliances with the corporate sector can also provide for some portion of

corporate contribution to finance core value or fundamental research. In this way the researcher gets the best of both worlds.

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