

R&D BUDGETING IN CANADIAN COMPANIES

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Introduction

The low level of spending on technological innovation in Canada by Canadian industry has been the subject of numerous reports (1-6). O.E.C.D. figures for 1969 show Canada at the bottom of the list of developed countries in percentage of Gross National Product devoted to research and development. It is estimated that when the figures are in for 1979 Canada will have spent less than 0.9% of its GNP on research and development.

What can be done about this low level of investment in technological innovation? Many briefs have been written by various groups and organizations suggesting solutions. The Innovation Management Institute of Canada (IMIC) supports the creation of Industrial Innovation Centres to provide management training and practical assistance to prospective innovators and entrepreneurs (8). The Canadian Advanced Technology Association (CATA) in a brief to the Federal Government in 1979 called for, among other actions, a 150% tax write-off on all R&D expenses as incurred, and asked that Canadian owned companies be given preferential treatment in the awarding of R&D contracts and grants (9). A recent 1979 joint committee of the Business Council on National Issues and the Canadian Manufacturers' Association also called for tax incentives (135% tax write-off) for large companies and grants for smaller companies along with a "Buy-Canadian" policy (10).

Most of the recommendations for increasing the level of Canada's technological innovation effort focus on, or include as a major factor, the actions of the Federal Government.

The major question to which this study was directed was "how do Canadian owned companies determine how much to invest in technological innovation in general, and R&D in particular, and how can the Federal Government positively influence this decision".

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Another important question which this study addressed was "what factors, internal or external to the company, would cause senior management to significantly increase their investment in technological innovation and does the government have any influence on these factors". Other questions concerning company innovation strategy, barriers to innovation, international environment for innovation, government actions and the role of associations were also examined.

Methodology

This study consisted of three phases: a review of pertinent literature dealing with the procedures employed by companies to determine the level of the innovation effort; interviews with senior R&D executives of twelve large Canadian controlled companies that undertake significant R&D activities in Canada; and the preparation of a draft report which, together with a short questionnaire, was circulated to the interviewees for comment. Comments and questionnaire replies were then incorporated in this final report.

The company officials interviewed were from nine industry sectors which included chemicals, aerospace, electronics and transportation. Because of the cross industry nature of this study, a wide spectrum of views was obtained.

An interview guide was used during the interviews to provide some consistency to the pattern of questions.

Literature Review

One of the few surprises in this study was learning that very little empirical research has been done on how companies determine their R&D budgets. This is in sharp contrast to the many empirically based articles on, for example, project evaluation and selection (11).

Several authors have described the procedures employed by their firms in determining their R&D budgets (12, 13). Dohrman (12), for

example, describes in some detail a systematic procedure used by the Babcox and Wilcox Company to identify and assess current and future technology needs. The level of technical expertise existing in the firm is determined and compared with what it needs to be to fulfil the corporate business strategy.

Other authors have suggested models (14, 15) or procedures (16, 17) to determine the optimum level of R&D funding. Gilman (14) suggests a model based on P/E ratios.

The "optimum" R&D budget appears to fall between two limits which are specific to a company; a minimum funding level or "threshold level" as Freeman (18) calls it, below which the level of R&D activity is ineffective in supporting the business strategy of the company, either support of existing business or new product development, and a maximum funding level beyond which the output of the R&D group cannot be utilized, or space, qualified personnel or equipment cannot, in the short term, be acquired to make use of the funds efficiently. Daniel Hamberg (19) suggests that prior R&D activity levels will strongly influence current and future levels, especially where stability and continuity of R&D are deemed desirable. Rettig, Sorg and Milward (20) have noted that the closer a company's technology is to being "state of the art", the greater must be a company's level of investment in R&D. McCosh and Kesztenbaum (21) in a detailed study of four British companies concluded that if a business is in a dominant position with respect to its market, then the research work will be of an incremental development or defensive nature with little technical risk. On the other hand, they conclude that a business facing a highly competitive market is likely to engage in more high technical risk projects with high potential payoff.

Quinn (22) states that most companies use one of the following guides to determine their R&D budget:

- a) percent of sales relative to industry average
- b) matching or exceeding key competitors' R&D expenditure
- c) tying growth rate of R&D expenditures to growth rate of the firm

d) projected rate of return on the R&D projects.

He considers that the most widely used broad guide to total R&D expenditures is the percent of sales guide.

Naslund and Sellstedt (23) in their study of 69 large firms in Sweden in 1973 found that the most used methods for developing R&D budgets were, in order of utilization:

- a) analysis of individual projects
- b) percent increase in previous budget
- c) percent of forecasted sales.

A review of the literature shows that the formulation of the R&D budget is complex and contains many feedback loops in the decision process before the final budget is achieved. The following are some of the factors which must be taken into consideration:

- a) company strategy
 - i) first in with new product
 - ii) close follower to industry leader
 - iii) produce a "me-too" product
- b) technological effort
 - i) present size of R&D effort
 - ii) level of morale of R&D staff which in part is due to freedom to choose interesting and challenging projects
 - iii) state of the art of the technology utilized now and required in the near future
- c) financial considerations
 - i) availability of money from internal or external sources to fund both the technical segment as well as the commercial segment of the innovation
 - ii) return on investment in R&D projects versus investment in other projects such as purchasing new production machinery or building a new warehouse
 - iii) requirement for stable financial support for R&D

- d) production capability
 - i) availability or ability of the production facilities to produce the new innovation at a competitive cost

- e) market conditions
 - i) highly competitive versus stable market environment
 - ii) length of product life cycle
 - iii) profit opportunities or market niches

This list is not meant to be exhaustive but simply illustrative of some of the factors that senior management take into account when deciding the level of their R&D effort.

In the area of barriers to innovation Myers and Sweezy (24) in their study of 200 unsuccessful innovations found that the primary factors blocking innovation were in order of priority: market, management, government regulation, lack of money and technological deficiency. Management factors such as reluctance to take risks and poor market analysis was found to be the leading blocking factors of innovations that were judged by the study respondents to "still be good", while marketing factors such as limited sales potential and product price blocked many more "not still good" than "still good" innovations.

From an examination of the literature it would appear that companies arrive at their R&D budgets by either an analysis of their technological needs to support their business strategy, or an analysis of their competitors' technological activities. A mixture of both approaches may also be utilized by the companies.

Results

The format for presenting the results will follow the pattern of the interview guide. Because of the small number of participants in the study and the promise of confidentiality, many details that could result in the identification of a specific company will be omitted.

Present Level of Innovation Effort

The number of R&D projects being conducted by the twelve firms ranged from three to over fifty with the more technologically intensive companies having more long term R&D projects in their R&D portfolio than those companies in less technologically intensive industries. In 1979, the total expenditure in Canada on R&D of all twelve firms was estimated to be approximately \$215 million. Total employment in 1980 of scientists and engineers is approximately 1,775, up 750 from the total for employment in 1976. Two electronics companies account for most of this increase.

As expected, there was a range of opinion on the source of ideas for new innovative projects depending on whether the new project ideas were for minor product improvements or for major new products. Personnel in marketing and R&D either working together or separately were considered by the respondents to be the major source for innovative ideas. This finding is the same as that found by Dean (25) and Mansfield (26).

Eleven of the companies anticipated that their requirements for additional engineers and scientists would increase over the next five years but their total demand for new R&D personnel would not exceed 150 people per year. The two electronics companies mentioned earlier accounted for approximately 100 of that 150 per year increase. In addition, one company anticipated the need for 100 engineers on a temporary basis to work on a specific project.

Innovation Strategy of the Companies

With one exception, all the respondents felt that technological innovation was important to their company. This agrees with the findings of Grasley and Dermer (27) who in a 1978 survey of 53 Chief Executive Officers of Canadian companies found that a majority (78%) considered technological innovation to be important to their companies. All but one of the companies (the exception mentioned earlier) attempted to be a leader in a specific technical area. One respondent mentioned, however, that in his industry because of intense competition, the lead was never held for long by any one company.

The interviewees were asked to estimate how much of their R&D effort was allocated amongst support for existing business, new business development (defined as new product development) and exploratory type projects. One half said that they allocated at least 40% of their R&D effort to new business development and exploratory type activities, and one half allocated between 5 - 10% of their R&D effort to exploratory activities. No clear pattern was observed between the emphasis a company placed on new business development versus support of existing business and the level of competition the company faced, however there did appear to be a pattern of greater support for existing business and shortness of the product life cycle of the firm's product. It is as if the businesses were under so much pressure to make product improvements that they did not have the time or spare resources to put greater effort into new business development. An examination of the breakdown between long and short term R&D projects tends to confirm this tentative finding as those firms with long product life cycle products tended to have more long term projects in their R&D portfolio. It must be emphasized that conclusions based on such limited sample size must be considered as very tentative.

Ten of the companies considered themselves to have a corporate strategy of "first in with new products" as their primary business strategy with "close follower to industry leader" as their secondary strategy. One company has "close follower" as the primary strategy and another, the exception mentioned earlier, had a "me too product" strategy.

Ten of the companies did most of their R&D in Canada. Most of the companies' marketing research effort for their Canadian market was done in-house in Canada while their foreign marketing activity was done in the target country either in-house in their subsidiary or through agents.

Manufacturing under licence in Canada was only a significant component of competitive strategy in four companies and even this constituted less than 25% of their business.

Factors Influencing the Size of the R&D Budget

The number of R&D projects in the innovation systems of the companies surveyed was determined firstly by the availability of money and secondly by availability of qualified employees. Shortage of facilities was mentioned only twice as a factor in limiting the number of projects.

Eleven of the respondents mentioned that lack of financial and manpower resources had caused projects to be delayed. Four respondents said that such delays had involved important projects where delay had caused considerable problems, five respondents said that such delays had involved projects of significant potential benefit to the firm but where delay caused little or no problem, and two respondents considered that delays had affected projects of the "nice to do" variety. Langrish et al (28) also found that a shortage of manpower and capital were important factors in delaying innovation.

Six respondents felt that R&D personnel shortages in their organization were due to there being an acute scarcity of available experienced senior personnel in Canada. Experienced R&D personnel in the areas of design, computer software, materials engineering, microwave engineering and electrochemistry were mentioned as being hard to locate.

The general size of the R&D budget for the companies surveyed was determined by:

- 1) the availability of money (four companies)
- 2) a fixed percentage of sales (three companies)
- 3) a combination of historical costs, availability of money, and competitor's actions (four companies)

Only one company stated that their R&D budget was determined by the business needs of the firm independent of, at least in the short term, availability of currently generated funds.

Thus in this study, no single or common method of determining how much to spend on R&D was identified although in the final analysis the amount spent depends on how much a company can afford to spend drawing from cash flow or retained earnings.

It is not surprising that there is no clear answer, no formula that can be mechanically applied to provide the appropriate dollar amount. The optimum level of funding is specific to a particular company and cannot be generalized to even the industry that the particular company is in. An additional complicating factor is that "it is difficult to predict the returns from many R&D projects" (26). R&D expenses are an investment in current dollars spent against the probability, not certainty, of gaining future financial benefits.

When asked, in the questionnaire, how the "percentage of sales" technique is used in the determination of R&D budgets, six respondents said that it was used to compare a company's R&D expenditures with its competitors' or as one respondent put it as "one test of reasonableness in setting an R&D budget". Since R&D budgets are set before the beginning of the company's fiscal year, cash flow resulting from current sales would only be important in firms with low retained earnings or low borrowing power. Thus the use of "percentage of sales" by large companies as a determinant of R&D effort appears to be just a simple way of determining a general guide for R&D expenditures as previously noted by Quinn (22). One firm in the study that uses the "percentage of sales" technique has experienced very poor sales this year. They will be augmenting the traditional percentage of sales funds allocation with money from retained earnings.

A common pattern of formulating the R&D programs, and thus indirectly the R&D budget, was noted with individual projects being proposed and subjected to assessment criteria related to prospective profitability; these projects were then costed and ranked in some priority of benefit to the company with the total cost being compared to some general R&D budget figure thought to be sufficient to the company's requirements. Since the cost of the proposed projects in support of both existing and new business normally exceeded the target

R&D budget, a selection process is undertaken with low priority projects being dropped or shelved for the moment. This selection is usually carried out by the senior R&D management and then the remaining projects are recommended to the company's chief executive officer and the board of directors for final approval. This pattern of developing the R&D program has also been noted by Quinn (22), Naslund and Sellstedt (23) and Hanson and Nason (29).

The ability to exceed significantly the general target figure for R&D expenses set by senior corporate management appears to depend upon an R&D project directly supporting a new profitable market opportunity, and the ability of the R&D manager to convince senior management of the merits of a project.

Only two companies indicated that tax incentives would cause them to increase their level of R&D expenditures. This should not be construed as an argument against tax incentives as availability of money has been shown to be a major determinant of R&D effort and tax incentives do increase the amount of internal funds that a company could make available for R&D activities. This view that availability of funds is a major determinant of R&D effort was noted by this author during discussions at a recent meeting of the Canadian Research Management Association held in Calgary.

Tax incentives appear to have an indirect effect on R&D expenditures by making available funds that can be used to support increased R&D activity if a new market opportunity calls for R&D effort. Tax incentives, in the main, do not (and should not) encourage increased R&D expenditures just because they are there. A business opportunity should be at the heart of any increased R&D activity whether encouraged by tax incentives or specific innovation grants.

Only one respondent felt that nothing could convince his senior management to increase their R&D effort.

Barriers to Technological Innovation

Barriers to technological innovation can be divided into two general categories: internal to the company and external to the company.

The company officials reported the following as internal barriers to innovation: (Multiple barriers were mentioned by each respondent)

- 1) insufficient money (eight companies)
- 2) lack of qualified personnel (seven companies)
- 3) negative attitude of senior management (four companies)
- 4) R&D personnel's time being used on production (firefighting) problems (three companies)

The solutions to these barriers suggested by the interviewees were for the company to experience increased profits and sales, and for the government to provide increased tax incentives, all of which would increase the amount of funds available for R&D. Several respondents felt that the negative attitude of senior managers towards technological innovation could be overcome by educating the managers in the need to innovate to meet market requirements.

The following were given as external barriers to technological innovation:

- 1) market size (five companies)
- 2) government regulations (five companies)
- 3) government program administration (three companies)

In addition to these, several companies felt that the Federal Government had not created a business climate where risk was adequately rewarded and competition encouraged. Of the five companies concerned about government regulation, two expressed dissatisfaction with immigration rules which made it difficult for them to hire, or to transfer internally from their foreign subsidiary, specialists from outside of Canada. The remainder were concerned with safety and pollution regulations.

The complaints about government program administration were aimed at programs administered by the Department of Industry, Trade and Commerce. In particular, the "significant burden" criteria of the Enterprise Development Program of I, T&C came in for criticism. This criteria that a proposed project be a significant financial burden to the company seeking government R&D support tends to screen out large companies. Several interviewees commented that this loss of financial support (this criteria has only been applied in the past two years) puts their R&D projects at a disadvantage when seeking internal company funds in terms of the perceived riskiness and payoff of R&D projects versus non-R&D projects. This makes it more difficult for the R&D manager to sell long range or high risk, high payoff projects to his senior management.

In the subsequent questionnaire follow-up seven respondents said that the significant burden criteria should be either dropped or modified. Suggested changes were for the modified criteria to take into account the level of payoff of the project to the company and to Canada.

The solutions recommended to overcome these external barriers were tax incentives, export financing on par with that received by foreign competitors, government policies supportive of the free enterprise system, more consultation with industry prior to establishing new industrial policies or programs, better trained government program managers and information on imports of manufactured products entering Canada.

International Environment

The majority of the respondents felt that the tariff changes under the Tokyo Round would not significantly affect their operations.

The majority were sensitive to changes in monetary exchange rates because of the high price of their products, severe price competition, or the higher cost of importing parts used in their products.

Almost all of the repondents felt that the provision of exchange rate insurance would not have a significant impact on their company's attitude towards exporting, mainly because they were already in the position of having to export or go out of business. Because of this they saw their innovation activities as being in close support of their world wide markets and not just their small Canadian market.

Government Initiatives

The respondents thought the following to be the most important actions the Federal Government could take to improve the general business climate for technological innovation in Canada by their companies:

- 1) grants for R&D expenditures
- 2) 150 % tax write-off incentives
- 3) capital grants for equipment and buildings required to commercialize an invention
- 4) increase assistance to companies competing in world markets
- 5) curb inflation
- 6) provide policies supportive of the profit motive
- 7) improve working relationship with Canadian industry.

It should be noted that important actions that are specific to only one industry, even though vital to that industry, would not be highlighted by this cross industry survey. The above proposed Federal Government actions, therefore, represent the common concerns of respondents in the nine industry sectors examined.

The only actions suggested for the provincial governments were:

- 1) provision of grants for acquiring building facilities; and
- 2) increase the quantity of well trained personnel.

Most of the respondents did not consider that there was any significant difference between the interests of foreign controlled subsidiaries and Canadian controlled firms in their particular industry. This view might have been different if small Canadian controlled companies had been surveyed.

The majority of the companies considered that industry associations served some useful purpose as a lobby to get their message across to government but not much good as a source of information on how to improve the effectiveness of innovation in their member companies.

Conclusions

It would appear from this study that the final R&D budget is determined through an accommodation of a number of factors: availability of money and qualified personnel, number of potentially profitable projects generated in the main by the marketing and R&D groups, identification of market opportunities promising good profits, the level of R&D expenditures by competitors, and the innovation strategy of the firm as determined by the attitude of senior management towards technological innovation. The cross industry nature of this study precluded the identification of any industry specific preferences for one factor over another.

Federal Government action to encourage greater investment by Canadian companies in technological innovation should include:

- 1) provision of innovation grants and tax incentives at a higher and broader level than presently offered in order to increase the amount of capital available to a company for investment in technological innovation,
- 2) increased assistance in identifying and capturing profitable market opportunities abroad at a level commensurate with that received by foreign competitors from their governments, and

- 3) increasing the understanding of public servants to the problems faced by Canadian companies competing in domestic and world markets in order to ensure the development of industrial policies and programs which reflect the reality of the market place and the free enterprise system.

Provincial government action appears to lie mainly in the provision of an adequate number of qualified personnel in the labour force through increased support of educational institutions to alleviate the shortage of highly qualified manpower needed by technology-based companies in order to take timely advantage of market opportunities.

Thus combined Federal and Provincial actions are required to improve the overall climate in Canada for technological innovation and to encourage and support increased R&D expenditures by Canadian companies.

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