HUMAN CAPITAL DEVELOPMENT AND INNOVATION: THE CASE OF TRAINING IN SMALL AND MEDIUM SIZED-FIRMS

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ABSTRACT

This study examines the characteristics of small and medium-sized firms that perform training. It uses data taken from a recent Statistics Canada survey that permit firms' training decisions to be analyzed within the broader context of their many activities and strategies.

The study finds strong evidence for the hypothesis that human capital development facilitated by training is complementary to innovation and technological change. Training incidence is found to be closely related to the importance that a firm gives to research and development, the use of new technologies, and numerous other strategies that are related to innovation. Training is also greater where a firm emphasizes quality and a comprehensive human-resource strategy. The results point to the inherent complementarity of technology and human resources policy.

Keywords: training, innovation, quality, human-resource, technology.

EXECUTIVE SUMMARY

The *Determinants of Training in Small and Medium-Sized Firms* analyses the factors that influence the training decisions of firms. The results are based on a recent Statistics Canada survey that queried successful small and medium-sized firms on their strategies, activities and characteristics. This permits training decisions to be analyzed within the broader context of the firms' many activities and developmental strategies, including decisions about products, organizational structure, technological capabilities, financial structure, and marketing program. The general results are as follows.

Major Findings

Training as part of a cohesive company strategy

- Training tends to occur as part of a three pronged company strategy. Innovation and technological advance, emphasis on a range of quality products and superior customer service, and human capital development are strategies that are highly complementary. As such, firms that will be most receptive to training policies are going to be those where expertise in innovation and quality management and human resources already exist.
- Numerous measures are developed from the survey to represent the broad spectrum of innovative activities, the valuation of human resources and the stress on quality. These are used to test the hypothesis that training is related to innovation, and to the emphasis placed on human resource strategies and on quality.
- Training is found to be closely related to innovation. Due to the specificity of knowledge and the rapidity of change associated with innovation and technological change, training is necessary to upgrade the skills of employees.
- Training is also related to the importance attached by firms to labour skills. Hence, firms that attribute a large portion of their growth to the skills of their employees, that rank their labour climate and skills as highly competitive, and that offer innovative compensation packages are more likely to train.
- There is also a strong relationship between training and the emphasis placed on the quality of products and customer service and adherence to a total quality management strategy. This illustrates a link between superior quality and labour skills.

Firm characteristics that relate to training

- Larger firms are both more likely to engage in training, and to train a larger proportion of their employees than smaller firms.
- Firms that augment their capital per worker are more likely to offer formal training than other firms.
- When other factors are taken into account, manufacturing firms are less likely to offer training to their employees.
- After considering other factors, firms in Quebec are less likely to offer training programs

Incidence and intensity of training

- Approximately 59 percent of growing small and medium-sized firms engage in training. Slightly more firms perform formal training (44 percent) than informal training (40 percent).
- On average, firms that incur training expenditures spend 850 dollars per employee in the firm.
- As the percentage of women in the firm rises, the percentage of employees trained falls.
- Professional workers are more likely to receive formal training than other workers, while sales, technical, and other non-management workers are more likely to receive informal training.
- While training expenditures increase as the number of employees increase, the magnitude is greater for formal as opposed in formal training, men as opposed to women, and managers and professionals as opposed to other workers.

The Growing Small and Medium-Size Firm Survey

- The survey was conducted in 1992 using firms that grew in terms of employment and sales over the 1984 to 1988 period. Small and medium-size firms were defined as having less than 500 employees and less than 100 million dollars in assets. The sample was drawn from all major sectors with the exception of public administration. The survey of 2,157 was conducted by mail with telephone follow-up. The response rate was 69 percent. For the purpose of this study only those firms that responded to each part of the survey and for which there was administrative data, amounting to some 904 firms, were used.

INTRODUCTION

The training of workers contributes to an increase in the capital stock available to the economy. It is an extension of the process by which human capital stock is enhanced by the school system; however, this part of the educational process takes place within firms. Some occurs in a structured environment, often in a classroom. Other types involve a more informal learning environment, often as supervision and work associated with the production process.

Studies of the determinants of training typically use employee surveys to focus on characteristics of those who have been trained. Summarizing the results of these studies, the OECD (1991) concludes that it is generally workers with more education who receive training. Professional categories such as managers and higher skilled manual workers have a higher probability of receiving training. The pattern of training by age is less clear. Training associated with new hiring is greater for younger workers; but there is an opposite tendency in some studies to find that training increases with age, peaking in the 25-44 age class. Canadian studies by Picot (1986), Hum and Simpson (1993), and Simpson et al. (1993) confirm the picture that having a higher education, being a manager, and a male increase the probability of receiving training. Simpson (1993) finds that increasing job tenure leads to more training.

There are few studies that focus on the attributes of the firms that promote human capital development. Studies like those of Hum and Simpson (1993) and Simpson (1993) are based on employee surveys that sometimes collect data on a relatively small number of firm characteristics or that add characteristics of the industry in which the employee is located. These firm or industry variables are limited in their coverage. The only general conclusion that emerges from these and other studies is that larger firms are more likely to train workers.

The lack of firm-based studies is unfortunate since it is at the level of the firm that decisions are made to invest in training. Not all firms make such a decision. Less than half of firms in Canada commit to a formal program of training (Statistics Canada, 1987).[1] Without a complete picture of what drives firms to train, it is difficult to understand where public policy that attempts to encourage additional training might best be focused.

A recent Statistics Canada survey allows the factors that influence the training decisions of small- and medium-sized firms to be studied. The design of this survey recognizes that training is just one of many decisions that must be made by a firm. Firms must decide on their product line, organizational structure, technological capability, financial structure, and marketing program as well as the skills of the labour force and the extent to which training will be used to enhance those skills. Hence, this survey

permits firms' training decisions to be analyzed within the broader context of the firms' many activities and developmental strategies.

A central hypothesis of this paper is that human capital development is complementary to innovation and technological change. A few studies have attempted to test this or related hypotheses. Mincer (1989) has argued that the demand for human capital is complementary to technological change. This is a theme that has also been pursued by Lillard and Tan (1986) and by Bartel and Lichtenberg (1986). Although Mincer's work investigates the connection between technological change and an industry's use of highly skilled workers, his hypothesis may be extended to firms. Firms are not homogeneous. Some firms will exhibit greater technical skills and need more skilled labour. In each of these studies, however, in representing innovation by just one variable, the authors are only capturing a limited aspect of innovation.

Using the small-firm survey, this complementarity hypothesis can be tested with firm-level data that measure several aspects of innovativeness. Moreover, the survey provides measures of other strategies, particularly with respect to quality and valuation of labour skills and, thereby, permits an integrated picture of the firm to be developed and related to the training decision.

The paper proceeds in three parts. The first section describes the survey that provides new data to test the complementarity argument. The second section outlines the variables used for the multivariate analysis. The third section discusses the results.

The Small-Firm Survey

The small-firm survey was designed to give a broad description of activities, characteristics, and strategies followed by a set of generally successful small- and medium-sized firms.[2] It provides an overview of the competencies of these firms in a number of related areas—finance, innovation, and training. It also assesses the strategies being followed in areas such as product quality, management and marketing. As such, it generates a rich data base for a study of the determinants of training.

Questions in the survey on characteristics profile a firm's region of operation, ownership structure, country of control, its involvement in mergers and strategic alliances, its size, and its occupational distribution. The activities investigated include export performance, the capital structure, the source of financing, the investment intensity of R&D, training, and marketing, the sources of innovation, the number of workers trained by occupational category, and training expenditures.

Strategies are investigated in the survey with several complementary questions. Firms are asked to rank the importance of different factors explaining the growth of their company: management skills, marketing capability, cost of capital, access to capital, technological capability, R&D capability, and labour force skill levels. A second question probes the firms' assessment of their capabilities relative to their competitors

with regard to price, cost of production, quality, customer service, spending on R&D, labour climate, and skill levels of employees.

Another set of questions examine specific directions being pursued in marketing, technology, input utilization, management, and human-resources strategy. Questions on marketing strategies focus on the extent to which firms follow innovative strategies in developing new markets or new products. Questions on technology strategies delve into a firm's source of new technology—from the acquisition of existing technology to its development within the firm. Questions on input strategies focus on whether the use of new materials or increased efficiency in the use of existing materials, energy or labour receive the most focus. Questions on management techniques investigate the importance given to process control, just-in-time inventory control, compensation based management incentives, or total quality management. Questions on human-resource strategies focus on the relative importance of continuous staff training as opposed to compensation packages and other motivational programs.

The strength of the survey is the degree to which training can be compared to the other strategies, characteristics, and activities of the firm. In addition, the survey answers are linked to administrative data on firm employment, worker turnover, sales, profitability and productivity to provide a rich set of characteristics that are used for analysis.

The small-firm survey (Baldwin et al., 1994) was conducted in 1992 using firms that grew over the last half of the eighties. It was designed to examine firms that were not in decline.[3] Small firms were defined as having less than 500 employees and less than 100 million dollars in assets in 1984. The sample was drawn from all major sectors with the exception of public administration. The survey of 2,157 firms was conducted by mail with telephone follow-up. The response rate was 69 percent.

Measures of Training

Several measures of the degree of training are available from the survey—whether formal or informal training is performed by a firm, the number of employees given formal or informal training by occupation and the total expenditure on training. Formal training is either on-the-job or off-the-job instruction in a place removed from the production process. Informal training is less structured and is done on the job.

Various measures of the amount of training that are derived from the survey are presented in Table 1.[4] On average, 59 percent of firms offered their workers some form of training, 44 percent delivered formal training, and 40 percent gave informal training. On average, 31 percent of the workforce in firms offering a formal training program received this form of training; some 41 percent of the workforce in firms offering a informal training program received informal training. Finally, firms with a training program spent $850 per employee on all forms of training.

Three separate measures of the degree of training are used for the analysis that examines the nature of the firm characteristics related to training. The first captures the incidence of training—a binary variable that is one when a firm offers training and zero when it does not. In order to investigate the incidence of training, three separate dependent variables are employed—whether a firm does any training, whether it does formal training, or whether it offers informal training. The second training measure is the number of workers trained. This variable is divided into the number of workers given formal training and the number of workers informally trained. The third training measure is the expenditure devoted to training of any kind—formal or informal. Each of these three variable—training incidence, numbers trained, and training expenditures- are regressed on a number of firm attributes that are hypothesized to affect the training decision.

Table 1

Training in Small- and Medium-Sized Firms

	Both Forms of Training	Formal Training	Informal Training
Percentageof Firms	59	44	40
Proportion of Employees Trained(%)	..	31	41
Training Expenditure in training firm ($/employee)	850	..	..

Note: Averages are unweighted for the 904 firm sample.

The Determinants of Training

a) Innovation and Technology

A firm's training decision is posited to be a function of its innovativeness and technological advancement. Innovation and advances in technology require knowledge skills that are difficult to acquire purely from external recruitment. This is due to the specificity of the knowledge required in high technology firms or because the rapidity of change associated with innovation requires upgrading of the existing workforce.

The connection between technology and training has been confirmed by several studies. Both Lillard and Tan (1986) and Mincer (1989) test the effect of technological change by correlating measures of multifactor productivity with the intensity of training at the industry level and find a positive relationship. Bartel and Lichtenberg (1987) find the mean age of capital in an industry is inversely related to the proportion of the labour force with higher education. Bartel (1991) examines firm data on training and finds it to be positively related to research and development intensity and the ratio of capital to labour in the firm. Hum and Simpson (1993) find that the probability of training for individuals depends on the growth of investment in their sector of employment and the prevalence of high technology inputs in that sector.

Measures of multifactor productivity, the age of capital, or capital-labour intensity at the industry level are proxies for the complexity of an industry; however, by themselves, these variables cannot capture the range of circumstances for which technological complexity and innovation require training. Research and development expenditure is probably more closely related to innovation—but still captures only one dimension of innovation within a firm.

In order to test the importance of innovation, this study employs several variables which capture both the intensity of innovative activities and the importance of innovative strategies to the firm. These variables focus not only on R&D but also on technological capability, organizational change, input plans, and marketing strategies. Use of a varied set of innovation variables recognizes that innovation involves several different dimensions. Some firms are at the cutting edge in an industry. Others are imitators and adapters. Firms in each category can stress different aspects of innovation—by placing emphasis on new products, technologies, new inputs, and/or organizational structures.

Previous work (Baldwin et al., 1994) demonstrates that many of these variables are related to measures of success that are based on market shares and profitability. The issue addressed here is the extent to which the varied facets of innovativeness are related to a firm's training decision. Six sets of variables are used to represent innovativeness.

Variables in the first group measure various aspects of the importance of research and development. These are:

RDGWTH: the score given to R&D as a factor contributing to growth.[5]

RDCOMP: the degree to which a firm surpasses its competitors in R&D spending.

RDPROD: the percentage of total investment devoted to R&D for new products.

RDPROC: the percentage of total investment devoted to R&D for new processes.

Variables in the second group measure technological complexity. These are the scores given by the firm to the importance of:

TECHGWTH: technological capability as a factor explaining growth.

TECHOTH: adopting technology developed by others.

TECHNEW: developing new technology.

Variables in the third group measure the strategy being followed to improve input efficiency. These are the scores given by the firm to the importance of:

CSTEN: reducing energy costs.

CSTLAB: reducing labour costs.

CSTMAT: using existing materials more efficiently.

NEWMAT: using new materials.

Variables in the fourth group measure the strategy being followed to improve management practices. These are the scores given by the firm to the importance of:

JIT: just-in-time inventory control.

PCONT: process control.

Variables in the fifth group measure the source of innovations for a firm. The source of innovations indicates whether a firm is inward or outward oriented, and whether it is committed to using proprietary information or not. Answers to these questions reveal the scores given by the firm to the importance of the following sources of innovation:

SIMKT: marketing.

SICDNPAT: Canadian patents.

SIFORPAT: Foreign patents.

SIRD: the R&D unit.

SICUST: customers.

SISUP: suppliers.

SIMANAG: management.

SIPAR: parent or affiliate.

SIGOVT: government contracts.

SICOMP: competitors.

Finally, variables in the sixth group measure the firm's attitude to general quality standards. If firms treat investment in human capital as an opportunity to develop skills that permit high quality standards to be met, then firms that stress quality management programs will also emphasize training. These variables are the scores given to:

TQM: the importance attached to total quality management.

QUALPROD: the degree to which firms rank themselves ahead of their competitors with regard to the quality of product.

CUSTSERV: the degree to which firms rank themselves ahead of their competitors with regard to customer service.

RANGPROD: the degree to which firms rank themselves ahead of their competitors with regard to their range of products.

b) Attitude towards skilled labour

The decision to undertake training is also hypothesized to depend on whether the firm has recognized the strategic importance of training. Previous work stresses the importance of a firm's receptivity to human-resource strategies in general. For example, Bartel (1991) finds that firms with active human-resource planning are more likely to train. Simpson (1984) and Hum and Simpson (1993) report that the probability of being trained depends on whether the worker is in a firm or sector that makes use of government training programs.

Questions on whether a firm appreciates the importance of labour skills and the emphasis that it places on human-resource strategies are used to test the hypothesis that attitudes in this area matter. These are the scores given by the firm to the importance of:

GWTHSKL: skilled labour as a factor behind growth.

COMPSKL: the skill levels of its employees relative to those of its competitors.

LABCL: the labour climate of the firm relative to its competitors.

COMPENS: the use of innovative compensation packages.

MANREM: management remuneration programs.

TRAIN: the emphasis given to continuous training programs.

GOVT: the value that is placed on government assistance for training programs.

The first two variables (GWTHSKL, COMPSKL) measure the attitude of the firm with respect to the need for skilled labour. The third variable (LABCL) indicates the receptivity of workers to opportunities for enhancing their abilities. Two other variables (COMPENS, MANREM) capture the extent to which the firm exhibits imagination in the development of a compensation package. In the case of training for general skills and for specific skills, appropriate compensation packages need to be devised to provide the incentive for employees either to take a training course or to entice them to stay with the firm so that training is profitable to the firm. Training is likely to be associated with firms that are willing to develop innovative remuneration packages. Consequently, the variable COMPENS, which measures the use of innovative compensation packages as part of a general human-resource strategy, is included. The other compensation variable (MANREM) captures the extent to which management receives special compensation packages. The sixth variable (TRAIN) indicates whether a firm has a commitment to continuous training or whether training is only occasionally supported. The seventh variable (GOVT) measures the extent to which the firm finds government assistance useful for training programs. The last two variables are taken to be additional indicators of receptivity to training programs. They are too closely related to the incidence variable to be included in the first equation; but they are employed in the equation explaining the intensity of training.

c) Other variables

A number of other variables are included in order to capture effects previously found to be important determinants of the training decision. These are:

SIZE: the size of the firm measured in terms of employees in 1991.

TURN: the turnover rate calculated as the percentage of employees in the firm in year t that are still in the firm in year t+1—measured as the average value in 1987-88.

GROWTH: the rate of change of firm size (employment) between 1984 and 1988.

INVCAPLAB the investment in machinery to labour ratio of the firm in 1991.

INVMKTLAB the investment in market development to labour ratio of the firm in 1991.

DCAPLAB: the change in the capital-labour ratio between 1984 and 1988.

DLABPROD: the change in labour productivity of the firm between 1984 and 1988 relative to the industry.

OCCUP: the occupational structure measured as the percentage of employment accounted for by managers.

ATLANTIC, **QUEBEC**, **ONTARIO**, **PRAIRIES**, **BC**: binary variables for each of five Canadian regions-the Atlantic provinces, Quebec, Ontario, Prairies (Manitoba, Saskatchewan, and Alberta), and British Columbia.

BUSERV, **DYNSERV**, **WHOLE**, **RETAIL**, **TRADSER**, **MANUF**, **CONST**, **PRIM**: binary variables for eight sectors-business services (BUSERV), dynamic services (DYNSERV), wholesaling (WHOLE), retail (RETAIL), traditional services (TRADSER), manufacturing (MANUF), construction (CONST), and primary (PRIME). [6]

Size (SIZE) has consistently been found to be positively related to the training decision. Several explanations of this phenomenon have been given. It has been argued that large firms have access to cheaper capital to finance the investment in training (Hashimoto, 1979), that large firms can reduce the risk of the investment by pooling risks (Gunderson, 1974), that large firms have a greater pay-off from training because their size and their exploitation of economies of scale have led to task specialization and, thus, a greater benefit for training (Doeringer and Piore, 1971). Alternately, it could be that the commonly found firm size effect stems from an aggregation phenomenon. If each firm has an equal probability of training its workers irrespective of firm size, large firms are more likely to train someone simply because they have more workers.

Turnover of employees (TURN) is included because it is seen to affect the need for training in two ways. High turnover brings new workers into the firm and, thus, increases the value of training. On the other hand, it reduces the benefits that a firm can expect to receive from a training program that teaches firm-specific skills. Simpson (1984) and Bartel (1981) both find that turnover increases the amount of training that is given.[7]

Measures of change or complexity have been found previously to be related to training incidence. Therefore, growth (GROWTH), the investment capital-labour ratio (INVCAPLAB), the emphasis on marketing (INVMKTLAB), the change in the capital-labour ratio (DCAPLAB), and the change in labour productivity (DLABPROD) are included. All are hypothesized to have positive signs.

Occupational structure (OCCUP) is included to test whether persons in the managerial class are more likely to receive training. Employee-based surveys have found that professionals are more likely to get training. At issue then is whether a firm with a greater percentage of its workforce in management will be more likely to have a training program.

Finally, binary variables are used to capture industry and regional effects. Industries are divided into eight major sectors. Canada's ten provinces are grouped into five major regions.

Patterns of Firm Strategy

Innovativeness

While the data base provides a rich set of variables that can be used to measure the innovative characteristics of firms, many of these innovation variables are interrelated. Consequently, including them all in a regression equation would lead to quite serious multicollinearity. A further problem derives from the frequent criticism that subjective questions are problematic as people may interpret them differently. However, subjective questions are critical to investigating the decision to train. It is the perceptions and beliefs of managers that affect the decision to offer training to employees.

In order to condense the dimensionality in the innovation variables so as to alleviate the multicollinearity problem, and to overcome the criticism of utilizing subjective responses, the variables are combined. Anderson et al. (1983) have suggested that when various subjective responses are centered on a particular theme, those responses, when combined in a more aggregate form, can reasonably be expected to represent that theme. For example, combining the scores on the importance of strategies related to developing new technology, improving others technology, improving own technology, and using others technology, and the importance of the ability to adopt technology as a factor in growth, gives a reliable measure of the degree of technological orientation of the firm.

There are several methods for combining variables, ranging from simply summing the scores across variables to principal component analysis. Principal component analysis creates new variables as weighted averages of the old. These new variables jointly have the same amount of total variation that existed in the original set of variables, but are independent of one another. The weights for the first component are chosen to maximize the total amount of variation accounted for by this component that is the broadest spread of all the variables. The weights for subsequent components are chosen to maximize the amount of residual variation for which each accounts, while maintaining independence with all previous components.

The first four principal components of the innovation variables are presented in Table 2, which includes the eigenvectors for each. The eigenvectors consist of the weights that are applied to the original variables to produce the components. The size and sign of these weights allow the component to be interpreted as representing a certain prototypical effect. The four components are named to capture the prototype that each represents. They are: *The General Innovator, The Passive Adapter, The R&D Driven Innovator,* and *The Outward-Oriented Innovator*. The four components are arranged in descending order of the variability in the sample that is accounted for by each. The first component accounts for 41 percent of total sample variability, the other three components for 8, 7, and 5 percent, respectively.

Table 2

Principal Components of Innovation Variables for Training Intensity Equation

Variable	GENINOV	PASINOV	RDINOV	OUTINOV
RDPROD	0.08	-0.02	0.35	0.26
RDPROC	0.07	0.05	0.21	0.18
RDCOMP	0.17	-0.04	0.33	0.26
RDGWTH	0.20	-0.06	0.34	0.22
TECHGWTH	0.22	-0.13	0.06	0.09
TECHNEW	0.25	-0.11	0.21	0.01
TECHOTH	0.22	-0.14	0.01	0.07
NEWMAT	0.26	-0.26	-0.02	-0.14
CSTMAT	0.26	-0.29	-0.09	-0.14
CSTLAB	0.24	-0.26	-0.14	-0.14
CSTEN	0.22	-0.28	-0.20	-0.17
JIT	0.20	-0.15	-0.09	-0.13
PCONT	0.20	-0.18	-0.01	-0.02
SIMKT	0.25	0.24	-0.05	0.19
SIMANAG	0.24	0.27	-0.13	0.20
SIPAR	0.12	0.28	0.08	-0.27
SICDNPAT	0.16	0.30	0.21	-0.46
SIFORPAT	0.16	0.24	0.28	-0.45
SIGOV	0.16	0.24	-0.09	-0.08
SICUST	0.23	0.29	-0.24	0.17
SIRD	0.22	0.09	0.22	0.11
SICOMP	0.21	0.18	-0.31	0.15
SISUP	0.22	0.16	-0.31	0.11
SIOTHER	0.01	0.03	0.01	0.05

The first component is *The General Innovator* (GENINOV). It weights most of the variables positively, except for R&D investment on product and process innovation. It is the general innovation component. It represents the many strategies that stress innovation—technological capability as a factor behind growth, R&D-innovation capability, R&D spending relative to competitors, the development of new technologies, the use of others' technology, reducing energy costs, the use of new materials, just-in-time inventory control, process control and obtaining innovative ideas from a number of sources (marketing, management, R&D unit, and patents).

The second component is *The Passive Adapter* (PASINOV). This component primarily weights innovation that comes from management, marketing, parents, Canadian patents, foreign patents, and government contracts. However, most of the R&D activity, technological, input, and management strategies receive negative weights. The emphasis on outside sources of innovation like patents suggests that the firms represented by this component passively adapt ideas from others.

The third component, *The R&D-Driven Innovator* (RDINOV), is comprised almost entirely of R&D-based factors. More specifically, investment in R&D for product and process innovation, the importance of R&D for growth, a firm's competitive positionwith regards to R&D spending, the R&D unit as a source of innovation, and developing new technology are predominant in this principal component.

The fourth component, *The Outward-Oriented R&D Innovator* (OUTINOV), is comprised of the same R&D variables as the third component but also includes dependence on the marketing unit, management, customers, and competitors as sources of innovation. It represents situations where innovation in technology, inputs and organization receive negative weights. Innovation then is limited here to other areas.

In an associated study (Baldwin et al., 1994), firms were ranked by their success in gaining market share and profitability over the latter half of the eighties and their innovative performance was correlated with these measures of success. A large number of innovation variables are closely related to these measures of success. When the innovation components are correlated with success, *The General Innovator* and *The R&D-Driven Innovator* have the highest and most significant correlations.

Human-Resources Strategy

The dimensionality of labour strategies is also investigated using principal component analysis. The principal component analysis is performed on the labour skills questions (GWTHSKL, COMPSKL), labour climate (LABCL), and compensation (COMPENS, MANREM) and is reported in Table 3. The first labour component represents a firm practising a progressive human-resource strategy. *The Comprehensive Human-Resource Firm* (HRCOMP) weights both compensation programs and labour skills, placing slightly more emphasis on the former. The second labour component, *The Wage Innovator*, (HRWAG) weights compensation packages positively but places a negative weight on labour skills and climate variables. The third component, *The Skills Modernizer (HRSKL)*, represents a firm which heavily weights the score that the firm gives

Table 3

Principal Components of Human-Resource Variables for Training Incidence Equation

Variable	Comprehensive	Compensation	Skills
LABCL	0.38	-0.52	-0.51
COMPSKL	0.39	-0.54	0.01
GRWTHSKL	0.43	-0.13	0.82
MANREM	0.49	0.50	-0.22
COMPENS	0.52	0.42	-0.10

to the importance of labour skills.

Dimensions of Quality

Dimensionality in the variables available to measure quality is condensed in a different manner. The quality term (QUAL) is created by summing the responses on three questions that provide scores on the quality of product, service to customers, and range of products—all measured relative to the firm's major competitors. These three variables are so closely related that a straight summation sufficed to capture the information that they contained. However, the variable measuring the importance given to total-quality-management (TQM) is sufficiently different from the emphasis placed on quality in general that it is maintained as a separate variable in the analysis.

Results

a) Training Incidence (Probability of Training)

The Pearson correlation coefficients between the dependent variable and each of the explanatory variables are presented in Tables 4 and 5. Table 4 contains the principal components for innovation and human-resources . Table 5 presents the underlying variables that enter the principal components. There are three sets of strategies that are related to training.

First, all four innovation principal components are positively correlated with overall training incidence; with the exception of *The Passive Adapter*, the correlation of each innovation mode with training is significant (statistically significant at the 5 percent level). Almost all of the individual variables included in the innovation principal components are positively and significantly related to training.

Table 4

Correlations For Incidence of Training Using Principal Components

	Any Training		Formal Training		Informal Training	
	coefficient	probability value	coefficient	probability value	coefficient	probability value
Innovation principal components						
RDINOV	0.0807	0.0152	0.0964	0.0037	0.0524	0.1156
OUTINOV	0.1082	0.0011	0.1131	0.0007	0.1138	0.0006
GENINOV	0.3242	0.0001	0.2933	0.0001	0.2202	0.0001
PASINOV	0.0508	0.1270	0.0362	0.2768	0.0670	0.0441
Non-innovation variables						
Emphasis on quality						
QUAL	0.2469	0.0001	0.2095	0.0001	0.1787	0.0001
TQM	0.3039	0.0001	0.2786	0.0001	0.1930	0.0001
Emphasis on labour skills						
HRCOMP	0.3382	0.0001	0.2881	0.0001	0.2503	0.0001
HRWAG	0.0308	0.3547	0.0557	0.0939	-0.0068	0.8384
HRSKL	0.0363	0.2751	0.0183	0.5819	0.0036	0.9149
Other factors						
SIZE	0.2214	0.0001	0.2132	0.0001	0.1338	0.0001
OCCP	-0.2011	0.0001	-0.1663	0.0001	-0.1660	0.0001
QUEBEC	-0.0973	0.0034	-0.0774	0.0199	-0.1313	0.0001
BUSINESS	0.0718	0.0310	0.1047	0.0016	0.0585	0.0789
MANUF	0.0022	0.9468	-0.0091	0.7859	-0.0075	0.8215
CONST	-0.0497	0.1355	-0.0680	0.0409	-0.0312	0.3487
RETAIL	0.0140	0.6742	-0.0443	0.1832	0.0213	0.5231
DCAPLAB	0.0481	0.1489	0.0580	0.0812	0.0206	0.5359
INVMKTLAB	0.0445	0.1818	0.0413	0.2147	0.0647	0.0518
INVCAPLAB	-0.0301	0.3668	-0.0300	0.3674	0.0129	0.6994
TURN	-0.0440	0.1866	-0.0200	0.5486	-0.0026	0.9377
LABPROD	-0.0296	0.3745	0.0042	0.9004	-0.0540	0.1046

Table 5
Correlations for Incidence of Training Using Original Innovation, Human-Resource and Quality Variables

	Any Training		Formal Training		Informal Training	
	coefficient	probability value	coefficient	probability value	coefficient	probability value
Innovation variables						
RDPROD	0.1187	0.0003	0.0870	0.0089	0.0538	0.1060
RDPROC	0.1006	0.0025	0.1153	0.0005	0.1123	0.0007
RDCOMP	0.2587	0.0001	0.2379	0.0001	0.2048	0.0001
RDGWTH	0.2045	0.0001	0.2145	0.0001	0.1227	0.0002
TECHGWTH	0.2644	0.0001	0.2459	0.0001	0.1354	0.0001
TECHNEW	0.2359	0.0001	0.2314	0.0001	0.1664	0.0001
TEHCOTH	0.2555	0.0001	0.2301	0.0001	0.1870	0.0001
NEWMAT	0.1719	0.0001	0.1530	0.0001	0.0889	0.0075
CSTMAT	0.1852	0.0001	0.1701	0.0001	0.0952	0.0042
CSTLAB	0.1751	0.0001	0.1604	0.0001	0.1232	0.0002
CSTEN	0.0813	0.0144	0.0631	0.0581	0.0450	0.1764
JIT	0.1675	0.0001	0.1291	0.0001	0.0810	0.0149
PCONT	0.2130	0.0001	0.2084	0.0001	0.1470	0.0001
SIMKT	0.2677	0.0001	0.2480	0.0001	0.2136	0.0001
SIMANAG	0.2705	0.0001	0.2425	0.0001	0.2115	0.0001
SIPAR	0.1322	0.0001	0.1469	0.0001	0.1119	0.0008
SICDNPAT	0.1166	0.0004	0.0915	0.0059	0.0496	0.1363
SIFORPAT	0.1633	0.0001	0.1245	0.0002	0.1080	0.0011
SIGOV	0.1573	0.0001	0.1303	0.0001	0.0900	0.0068
SICUST	0.2407	0.0001	0.1918	0.0001	0.1860	0.0001
SIRD	0.1519	0.0001	0.1668	0.0001	0.1328	0.0001
SICOMP	0.1597	0.0001	0.1364	0.0001	0.1280	0.0001
SISUP	0.1349	0.0001	0.1015	0.0022	0.0911	0.0061
SIOTHER	0.0472	0.1565	0.0340	0.3073	-0.0129	0.6986
Non-innovation variables						
Emphasis on quality						
QUALPRD	0.2117	0.0001	0.2017	0.0001	0.1565	0.0001
CUSTSERV	0.1828	0.0001	0.1530	0.0001	0.1242	0.0002
RANGPROD	0.2009	0.0001	0.1551	0.0001	0.1493	0.0001
TQM	0.3039	0.0001	0.2786	0.0001	0.1930	0.0041
Emphasis on labour skills						
GWTHSKL	0.2512	0.0001	0.1999	0.0001	0.1729	0.0001
MANREM	0.2288	0.0001	0.2061	0.0001	0.1629	0.0001
TRAIN	0.4662	0.0001	0.3967	0.0001	0.3257	0.0001
COMPENS	0.3069	0.0001	0.2818	0.0001	0.2129	0.0001
GOVT	0.2600	0.0001	0.2775	0.0001	0.1338	0.0001

Second, the incidence of training is positively related to the emphasis that the firm places on quality of product. This is evidenced by the positive and significant coefficient on both total quality management (TQM) and the performance of the firm relative to its competitors along several dimensions of quality (QUAL). All of the individual responses to quality that are used to generate QUAL—QUALPROD, CUSTSERV, RANGPROD—also have positive correlations with training incidence.

Third, the probability of training is higher in firms that place a greater importance on the value of labour skills. Training is positively correlated with *The Comprehensive Human Resource Component*. Both measures of the importance of labour skills (GWTHSKL, COMPSKL) have significantly positive correlations with the incidence of training. Firms that place a greater emphasis on innovative compensation packages (COMPENS, MANREM) are more likely to have a training program.

While strategy variables, therefore, are closely correlated with training incidence, a number of firm characteristics are also related to training incidence. Larger firms (SIZE) are more likely to train. The percentage of managers in a firm (OCCUP) is negatively correlated with training incidence. Growth in the capital-labour ratio (DCAPLAB) is positively related to the incidence of formal or informal training; investment in market development relative to labour (INVMKTLAB) is positively correlated with informal training, but the results are only weakly significant (statistically significant at the 10 percent level). Other characteristics generally are unrelated to training incidence. The ratio of investment in machinery and equipment to labour (INVCAPLAB), and the turnover rate of a firm's workers (TURN) are not significantly correlated with training incidence.

Many but not all of the variables that are significantly correlated with training incidence are also significant when included jointly in a multivariate regression analysis. The results of the multivariate analysis are reported in Table 6. Due to the dichotomous nature of the dependent variable, the incidence of training has been estimated using a probit model.

This model does a relatively good job of estimating the incidence of training. When estimating the incidence of any training (formal or informal), the model predicted correctly 82 percent of the time when firms did no training, and 56 percent of the time where they offered training. The model performed slightly better for formal than for informal training; almost 77 percent of firms not offering formal training are correctly predicted, while 61 percent of firms utilizing formal training are predicted as doing so. Some 78 percent of firms not offering informal training are correctly estimated to have been doing so, while only 47 percent of those engaging in informal training are predicted to be offering such a programme.

Incidence of training is strongly affected by innovation. All principal components, with the exception of the *Passive Innovator*, have positive and significant coefficients both for the equation using training as a whole and for informal training. However, in all

Table 6

Incidence of Training

	Any Training		Formal Training		Informal Training	
	coefficient	standard error	coefficient	standard error	coefficient	standard error
Log- likelihood	493.299		522.378		539.203	
Intercept	0.0253	0.3725	-0.5993	0.3746	-0.6048	0.3714
Innovation principal components						
RDINOV	0.1583 ***	0.0376	0.1226 ***	0.0342	0.0802 **	0.0327
OUTINOV	0.1305 ***	0.0441	0.1317 ***	0.0417	0.1236 ***	0.0405
GENINOV	0.0922 ***	0.0264	0.0827 ***	0.0253	0.0457 *	0.0251
PASINOV	0.0548	0.0338	0.0196	0.0328	0.0637 **	0.0323
Non-innovation variables						
Emphasis on quality						
QUAL	0.0453 ***	0.0168	0.0445 ***	0.0172	0.0381 **	0.0170
TQM	0.0866 **	0.0351	0.0893 **	0.0350	0.0395	0.0346
Emphasis on labour skills						
HRCOMP	0.0747	0.0456	0.0382	0.0451	0.0858 *	0.0451
HRWAG	0.0049	0.0502	0.0399	0.0497	0.0047	0.0496
HRSKL	0.1279 **	0.0573	0.0770	0.0572	0.0709	0.0573
Other factors						
SIZE	0.0040 ***	0.0010	0.0031 ***	0.0008	0.0009	0.0008
OCCP	-0.0083 ***	0.0032	-0.0074 **	0.0032	-0.0130 ***	0.0036
QUEBEC	-0.4786 ***	0.1244	-0.3673 ***	0.1240	-0.5516 ***	0.1275
BUSINESS	0.0383	0.1801	0.0991	0.1707	0.0222	0.1655
MANUF	-0.4041 ***	0.1308	-0.5031 ***	0.1279	-0.1921	0.1249
CONST	-0.0597	0.1591	-0.2095	0.1576	0.0446	0.1593
RETAIL	0.1820	0.1478	-0.1170	0.1446	0.1669	0.1432
DCAPLAB	0.0001 *	0.0001	0.0002 ***	0.0001	0.0000	0.0000
INVMKTLAB	0.0277	0.1123	0.0399	0.1105	0.1422	0.1102
INVCAPLAB	-0.0156	0.0488	-0.0266	0.0514	0.0344	0.0479
TURN	-0.4390	0.3923	-0.1164	0.3878	0.1104	0.3877
DLABPROD	-0.0530	0.0367	-0.0116	0.0206	-0.0665 *	0.0370

Note: The signs attached to the probit coefficients have all been reversed to make the interpretation more straightforward.

* indicates that it is significant at 10% level using a 2-tailed test.

** indicates that it is significant at the 5% level using a 2-tailed test.

*** indicates that it is significant at the 1% level using a 2-tailed test.

cases, the coefficients on the two R&D components (RDINOV, OUTINOV) are the largest and most significant. Despite the difference in the prototypical firm that is represented by each of these components, both formal and informal training are associated with innovation. This confirms the existence of strong complementarity between the human capital that is created by training and other innovative inputs.

When the innovation variables are included individually in the regression (not reported here), many have positive coefficients that are significantly different from zero. One aspect of innovation that is consistently found to be important is R&D activity. The coefficients attached to the percentage of investment devoted to R&D for new processes and the firm's spending on R&D relative to competitors are positive and significant. There are other aspects of innovation that are significant as well. Firms that place greater emphasis on using existing materials more efficiently and reducing energy costs are more likely to do training. Training is also more likely where firms stress just-in-time inventory control and have a large percentage of production workers.

While not included directly in the innovation principal components, the score given to quality is probably indirectly related to the innovative capabilities of a firm. Improvements in quality require attention to improved technologies, new organizational structures, and other innovative activities. The stress placed on quality is significant for both formal and informal training. In addition, total quality management (TQM) is significant for formal training incidence.

Two human-resource principal components are related to formal training. The first (HRCOMP), which represents *The Comprehensive Human-Resource Firm*, is weakly significant for informal training. The *Skills Modernizer* component (HRSKL) is significantly related to training incidence as a whole, but not to formal or informal training incidence separately.

This picture is confirmed when regressions are calculated using the labour variables separately in their original form (not reported here). When the variable that measures the importance that the firm gives to innovative compensation packages (COMPENS) is entered along with the labour skills variables, its coefficient is positive and significant in the formal training equation. The two variables that measure the importance to the firm of labour skills (GWTHSKL, COMPSKL) have positive signs as hypothesized, but only GWTHSKL is significant in the informal training incidence equation. Both of these variables are strongly correlated with the incidence of training. In the multivariate analysis, their significance disappears because of their multicollinearity with other human-resource related variables and innovation itself. Innovative firms are those where skilled labour is highly valued and where training programs are implemented.

As before, a small number of firm characteristics are significant. Firm size has a positive and significant coefficient for formal training but not for informal training. The percentage of employment in management (OCCUP) has a negative effect on both informal and formal training incidence and is significant in both cases.

While previous studies have found that some measures of technological change are related to the training decision, when measures of technological complexity and change at the firm level are included here, they have only mixed success. The growth in the capital-labour ratio (DCAPLAB) is related to formal training. The growth in labour productivity (DLABPROD) is weakly related to informal training but has a negative coefficient. The uneven performance of these firm level variables stands in marked contrast to the responses for the innovation components and illustrates the importance of collecting more comprehensive measures of firms' innovative activities and strategies.

Labour force turnover is also a measure that has been given a great deal of emphasis elsewhere. It is not always possible to obtain direct measures of turnover and proxies have often been used. In this study, turnover is measured directly using administrative data that track workers over time. Despite having an accurate measure of the degree to which a firm's workforce turns over, this variable (TURN) is not found to have a significant effect on the probability that a firm will offer either formal or informal training.

Differences at the industry level in training intensity are large. Upwards of 60 percent of firms in business services offer either formal or informal training; but only 40 percent offer training programs in the construction industry. After firm characteristics are taken into account, industry binary variables are rarely significant. Firms in manufacturing and construction are least likely to offer formal training, although only in manufacturing is the effect significant. There are no significant industry differences for informal training.

Finally, there are few significant differences across regions after firm characteristics and industry differences are considered. The one exception is Quebec where the incidence of both formal and informal training is significantly less than in other regions after firm characteristics are considered.

The multivariate analysis demonstrates that innovation is strongly related to training. This is true in the case of formal, informal or either type of training. The importance of innovation in firms' training decisions is best illustrated by the differences in the incidence of training among firms with different innovation tendencies.

The multivariate analysis demonstrates that innovation is strongly related to training. This is true in the case of formal, informal or either type of training. The importance of innovation in firm's training decisions is best illustrated by the differences in the incidence of training among firms with different innovation tendencies.

The innovativeness of a firm varies continuously. Some firms do little R&D, are not technologically advanced and do not innovate on the input side. Other firms adopt a limited number of strategies. Still other firms adopt many of these strategies. These variations define a gradient of innovation types. In order to capture this gradient of

innovativeness, firms are sorted according to their scores on the first innovation principal component—that of the general innovator. Firms are then divided into four equal-sized groups—the top group representing firms with a heavy emphasis on innovation, those in the next group having a moderate/heavy emphasis on innovation, followed by a moderate/low emphasis on innovation, and finally, those with a low emphasis on innovation.

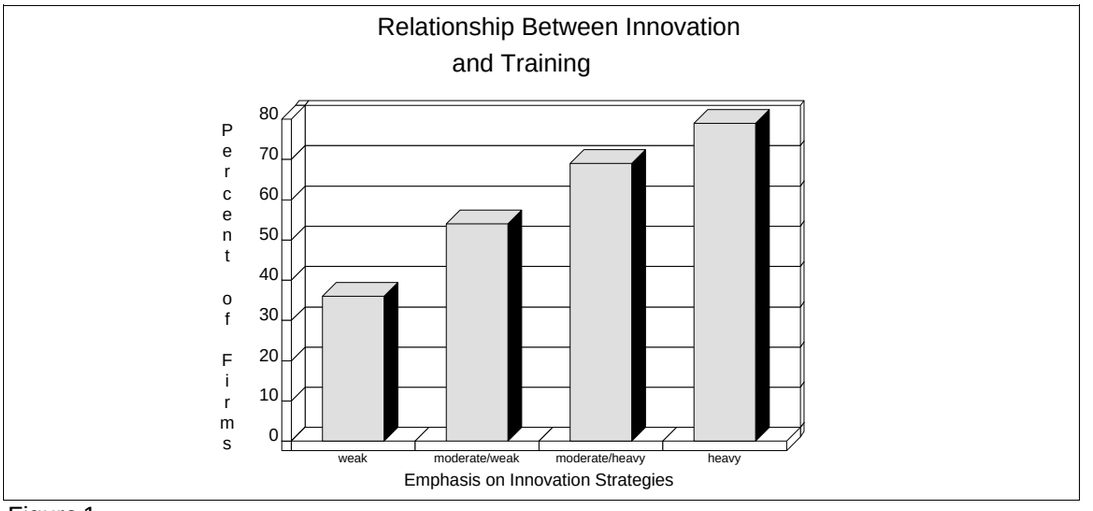

Figure 1

Figure 1 illustrates that the more emphasis the firm places on innovation, the more likely it is to train. Only 36 percent of the weak innovators offer any training; some 79 percent of the most innovative provide training. Firms in the latter category are more than twice as likely to offer training than firms in the former category.

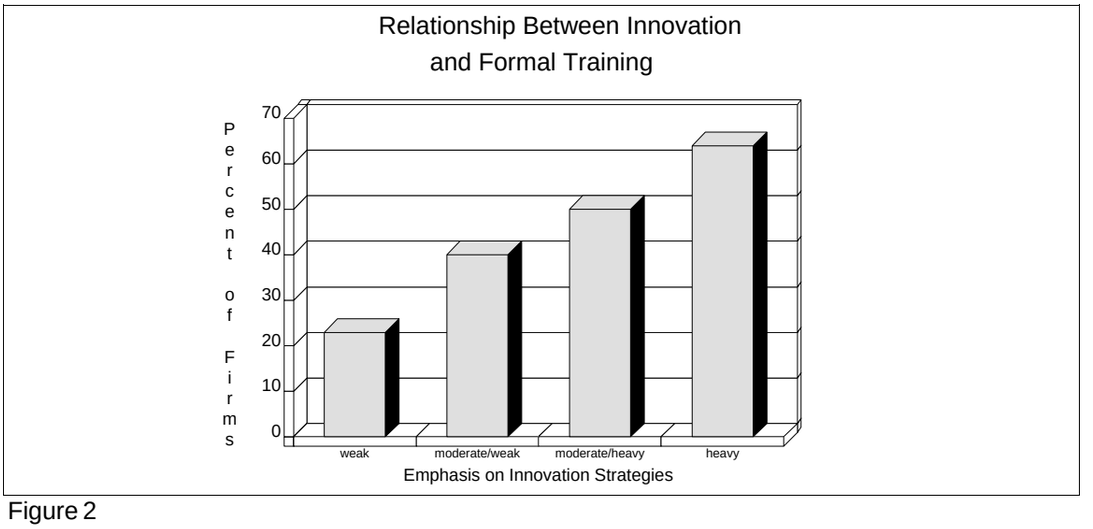

Figure 2

The relationship between innovation and formal training is even stronger (see Figure 2). Some 64 percent of the most innovative firms offer formal training; 23 percent of the least innovative group offer formal training. The most innovative firms are almost three times as likely to engage in formal training than the least innovative firms. The probability of engaging in training increases steadily as innovation becomes more important to the firm.

The importance of training to innovation-related activities and strategies is also evident for informal training. The relationship between training and innovation is more important as the firm moves from having a low emphasis to having a moderate/heavy emphasis on innovation. The tendency to train doubles between these two groups. However, firms that are highly innovative do not engage in significantly more informal training than those with a moderate/heavy emphasis on innovation.

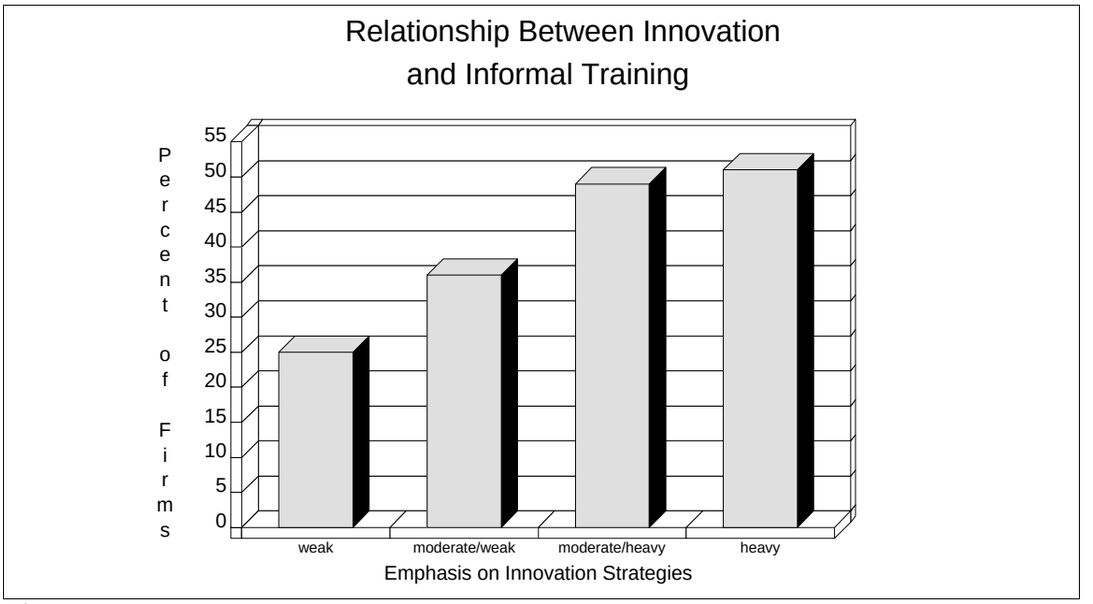

Figure 3

b) Number of Workers Trained

To investigate the determinants of the number of workers trained, several additions are made to the set of independent variables.

First, the size of firm is replaced with the number of workers divided by gender and by occupational classes. Five classes are used — management, professional, technical/production, sales, and other. The distribution of employees by gender and occupation is given in Table 7. Managers and professionals account for about one-quarter of all employees. Overall, women make up a third of the labour force, but have a higher proportion than this in the sales and management categories and a lower proportion in the technical/production group.

Table 7

Occupational Breakdown (percent)

Occupations	Males	Females	All
Executive-Management	12.2	5.2	17.4
Professional	4.2	2.1	6.3
Sales	20.2	5.2	25.4
Technical-Production	7.8	5.1	12.9
Other	24.4	13.7	38.0
All	68.7	31.3	100.0

Note: Unweighted average taken across 904 firm sample used in the multivariate analysis.

The coefficients attached to each category in the training regression indicate how the intensity of training varies by type of worker. These variables are:

MANAGM: the number of male managers.

MANAGF: the number of female managers.

PROFM: the number of male professionals.

PROFF: the number of female professionals.

TECHM: the number of male technicians.

TECHF: the number of female technicians.

SALESM: the number of male salespersons.

SALESF: the number of female salespersons.

OTHERM: the number of other male personnel.

OTHERF: the number of other female personnel.

In addition, firm size squared is entered to test for a non-linear relationship between the number of workers trained and firm size.

Table 8

Principal Components of Human-Resource Variables for Training Intensity Equation

Variable	HRCOMP	HRWAG	HRSKIL	HRGOV
LABCL	0.30	-0.56	-0.54	0.15
COMPSKL	0.31	-0.51	0.08	-0.10
GRWTHSKL	0.38	-0.15	0.75	0.13
MANREM	0.42	0.34	-0.28	-0.30
COMPENS	0.46	0.15	0.15	-0.09
TRAIN	0.47	0.29	-0.12	-0.25
GOVT	0.25	0.26	-0.13	0.89

Second, the principal components for the labour strategies are re-estimated with the inclusion of GOVT—the importance attached by a firm to government training programs—and TRAIN—the importance of continuous staff training programs. Both variables are expected to have a positive affect on the number of workers trained. When the principal components are re-estimated, the first three components have the same interpretation as before (Table 8). The fourth component is the *Government Trainee* (HRGOV), which primarily weights the score assigned to the use of government training programs.

The regression results for both the number of workers given formal training and the number given informal training are presented in Tables 9 and 10. The first of these uses only an occupational breakdown. The second uses an occupational breakdown by gender. Ordinary least squares regressions are used for estimation purposes. The sample consists of some 401 firms for formal training, 364 for informal training.

When the number of workers in each category are included in the formal training equation, the coefficient attached to the management category is the largest (1.45), followed by professionals (.37), sales staff (.07), technical and production workers (-.003), and other personnel (.10). When the number of workers in each category are included in the informal training equation, the coefficient attached to the sales category is the largest (.66), followed by the technical (.37), other (.21), management (.21) and professional (.15) categories. Only the first three occupational groups are significantly different from zero. The size of these coefficients generally reflects the proportions of employees trained according to occupation. In general, proportionately more managers and professionals receive formal training than do technical, sales and other workers. Similarly, sales, technical and other workers typically are more likely to receive informal training than managers or professionals.

Table 9

Number of Employees Trained

	Formal Training		Informal Training	
	coefficient	standard error	coefficient	standard error
F-stat	13.960 ***		14.900 ***	
R^2 adjusted	0.4572		0.4989	
Intercept	-1.0244	8.6241	2.8425	14.268
Innovation principal components				
RDINOV	0.9953	0.6712	2.0403 *	1.1207
OUTINOV	1.2160	0.8506	1.9684	1.3332
GENINOV	-0.3284	0.5608	-0.7141	0.9095
PASINOV	0.9072	0.7427	0.6031	1.1978
Non-innovation variables				
Emphasis on quality				
QUAL	-0.0058	0.4041	0.4750	0.6732
TQM	1.5572 *	0.8262	0.1232	1.2530
Emphasis on labour skills				
HRCOMP	1.5453	0.9683	0.8373	1.6159
HRWAG	0.2240	1.0686	-1.3438	1.7412
HRGOV	1.4104	1.0067	1.2725	1.6544
HRSKL	1.6644	1.3246	0.9448	2.1587
Other factors				
SIZESQ	0.0003 ***	0.0001	0.0005 **	0.0002
MANAG	1.4459 ***	0.2113	0.2111	0.4182
PROF	0.3701 ***	0.1202	0.1536	0.2286
TECH	-0.0033	0.0461	0.3667 ***	0.0833
SALES	0.0737	0.0614	0.6647 ***	0.1173
OTHER	0.0964 **	0.0403	0.2127 ***	0.0765
QUEBEC	-2.1027	2.8463	-4.8472	5.1895
BUSINESS	-6.0453 *	3.4534	-10.8785 *	5.7220
MANUF	-2.1636	2.7834	-6.0006	4.6275
CONST	-1.6207	3.7971	-5.1094	5.9250
RETAIL	-3.8750	3.3370	-8.4393	5.2286
DCAPLAB	-0.0004	0.0012	-0.0033 *	0.0017
INVMKTLAB	2.2790	3.7300	0.8820	3.6500
INVCAPLAB	2.1330	1.3700	2.5120	1.7800
TURN	-2.7799	8.8058	-2.0552	14.8004
LABPROD	-0.0499	0.7278	-0.0729	0.5387

* indicates that it is significant at 10% level using a 2-tailed test.
** indicates that it is significant at the 5% level using a 2-tailed test.
*** indicates that it is significant at the 1% level using a 2-tailed test.

Table 10

Number of Employees Trained

	Formal Training		Informal Training	
	coefficient	standard error	coefficient	standard error
F-stat	12.107 ***		13.618 ***	
R^2 adjusted	0.4626		0.5187	
Intercept	-1.5057	8.6541	1.4295	14.063
Innovation principal components				
RDINOV	0.8862	0.6722	2.1419 *	1.1102
OUTINOV	1.2066	0.8510	1.9457	1.3112
GENINOV	-0.3351	0.5607	-0.9245	0.9034
PASINOV	0.9253	0.7413	0.7433	1.1769
Non-innovation variables				
Emphasis on quality				
QUAL	0.0297	0.4045	0.3524	0.6643
TQM	1.5807 *	0.8277	0.4680	1.2414
Emphasis on labour skills				
HRCOMP	1.4434	0.9687	0.5802	1.5956
HRWAG	0.3863	1.0662	-1.6154	1.7123
HRGOV	1.1187	1.0138	0.8492	1.6396
HRSKL	1.7581	1.3403	1.1376	2.1182
Other factors				
SIZESQ	0.0003 **	0.0001	0.0005 ***	0.0002
MANAGF	1.4671 ***	0.4409	-0.8006	0.9604
MANAGM	1.7145 ***	0.3078	0.9187	0.5693
PROFF	0.0075	0.2914	0.2603	0.4514
PROFM	0.4834 ***	0.1606	-0.1513	0.3205
TECHF	-0.0911	0.0626	0.1057	0.1237
TECHM	0.0436	0.0553	0.5576 ***	0.1094
SALESF	0.1386	0.1566	0.8994 ***	0.2347
SALESM	0.0270	0.1203	0.3787 *	0.2028
OTHERF	0.0307	0.0634	0.3644 ***	0.0992
OTHERM	0.1314 ***	0.0442	0.1020	0.0824
QUEBEC	-2.7842	2.8549	-3.4235	5.1068
BUSINESS	-6.7845 *	3.5247	-9.0114	5.8134
MANUF	-2.7283	2.8089	-6.3992	4.6035
CONST	-2.6552	3.8237	-4.2443	5.9045
RETAIL	-4.1050	3.3685	-7.7111	5.2447
DCAPLAB	-0.0001	0.0012	-0.0029 *	0.0017
INVMKTLAB	2.2280	3.7300	1.0960	3.5800
INVCAPLAB	1.8240	1.3700	2.4430	1.7500
TURN	-2.9070	8.8409	-1.3650	14.7149
LABPROD	-0.1109	0.7266	-0.0670	0.5280

* indicates that it is significant at 10% level using a 2-tailed test.
** indicates that it is significant at the 5% level using a 2-tailed test.
*** indicates that it is significant at the 1% level using a 2-tailed test.

It should be noted that these coefficients represent the additional number of all workers trained with the employment of an additional employee in an occupational category. The additional worker trained may not be in the same occupational category. As such marginal and average effects may differ. This is particularly true in the case of formal training for managers. The marginal effect of an increase in the number of managers on the number of employees trained is much greater than the effect of an increase in the number of professional workers. However, professional workers are, on average, more likely to receive formal training than managers. This implies that the marginal effect of more managers is to train relatively more non-managerial employees.

In Table 10, the coefficients for women in the managerial, professional, technical and other categories are less than for their male counterparts for formal training; these differences are significant for the professional and other categories. The results for informal training indicate that the coefficient attached to women in the sales class is significantly higher than for men; that for women in the managerial class is negative, significantly below the coefficient for males. Thus, women appear to suffer a disadvantage relative to their male counterparts for informal and formal training.

Finally, the squared-size-of-firm variable is positive and significant for both formal and informal training. This non-linear size effect means that larger firms tend to train a higher proportion of their workers. Large firms do not have a higher incidence of training just because of the agglomeration effect. They have a higher probability of training a worker.

While all of the innovation principal components, with the exception of *The Passive Innovator*, have a positive influence on training incidence, the effect is statistically significant in explaining the number of employees formally trained only when the firm's occupational breakdown is excluded from the model. This suggests a relationship between the innovativeness of a firm and its occupational breakdown. On the other hand, *The R&D-Driven Innovator* has a positive impact on the number of employees trained informally, which is weakly significant.

Other variables that had a significant influence on the probability of training do not influence the number of workers trained. For example, the firm's attitude towards human resources does not affect the number of workers given either formal or informal training. In addition, the emphasis that is placed on quality does not positively influence the number of workers given formal training, although there is a weakly significant positive correlation between training and adherence to the TQM philosophy. Finally, none of the technological change variables significantly affect the number of workers trained.

c) Training Expenditures

Two variants of the training expenditures equation are estimated. The first (Table 11) uses number of employees trained, broken down first by type of training, second by occupational group, and then by occupational group and type of training. The second

(Table 12) uses the number of employees, divided first by gender, second by occupational group, and then by occupational group and gender. The variables that were previously used to determine whether or not the firm chose to engage in training are also employed.

The first column of Table 11 reports the results when total employees receiving formal training and informal training are included. The coefficient for formal training ($425) is larger than for informal training ($302), though the difference is not significant. When the number trained by occupation is included (column 2), the coefficients are: $1775 for professionals, $463 for managers, $532 for technicians, $233 for sales, and $180 for other workers. When numbers are divided both into occupation and type, then informal training receives higher coefficients for managers and technicians; formal training has higher coefficients for professionals, sales and other groupings.

The results from the second model of the number of employees trained are given in Table 12. The coefficient attached to the number of male employees is more than twice the size attached to female employees ($466 versus $224). The relative size of the coefficients (a ratio of 2:1) is comparable to those estimated for these variables in the equation for the number of employees trained. When number of employees by occupation are included, the coefficients are: $659 for management, $1122 for professionals, $431 for technicians and production workers, $131 for sales personnel, and $268 for others. The number of managers and professionals trained formally have the largest coefficients both for numbers trained and expenditures. Consequently, it appears that both managers and professionals are more likely to receive formal training and more is expended per worker in these classes. When these occupational classes are divided into male and female workers, the coefficients on females is below that for males in every category—although none of the differences by itself is significant.

The firm-size-squared variable is negatively correlated with training, indicating that it follows an inverted U shape. This effect is significant for all equations in the second variant of the model (Table 12), but only weakly significant for the first equation (including only the aggregate number of employees trained formally and informally) in the first variant (Table 11). There are no significant sector effects. Moreover, none of the labour, quality, or innovation variables is significant.

Table 11

Training Expenditures

	coefficient	standard error	coefficient	standard error
F-stat	3.5600 ***		3.9860 ***	
R^2 adjusted	0.1252		0.1576	
Intercept	19471.0	21325.2	22469.0	20968.7
Innovation principal components				
RDINOV	699.9	1663.9	-226.0	1650.6
OUTINOV	1822.7	2085.7	1189.9	2063.8
GENINOV	549.1	1379.5	678.2	1355.9
PASINOV	-436.6	1799.1	-1278.9	1785.3
Non-innovation variables				
Emphasis on quality				
QUAL	-1317.9	962.7	-1005.4	950.3
TQM	-2400.4	1966.8	-1967.0	1935.5
Emphasis on labour skills				
HRCOMP	2169.7	2416.2	799.2	2392.6
HRWAG	-3491.2	2638.2	-2216.9	2598.7
HRGOV	-1145.7	2471.3	-1836.4	2435.3
HRSKL	835.9	3274.1	680.3	3222.8
Other factors				
SIZE	-0.5 *	0.3	-0.2	0.3
SIZESQ	182.4 *	103.2	111.0	102.0
FOR	425.1 ***	119.0		
INF	302.1 ***	98.5		
MANAG			463.1	617.0
PROF			1775.3 ***	428.3
TECH			531.8 ***	144.2
SALES			232.7	253.4
OTHER			180.1 *	105.5
SALES	195.0	218.0	261.0	214.9
QUEBEC	1583.0	6743.9	539.3	6635.1
BUSERV	10487.0	8665.4	3523.5	8653.1
MANUF	10106.0	6751.5	8082.2	6723.9
CONST	1483.6	8677.4	-175.5	8562.0
RETAIL	-11437.0	7519.4	-11984.0	7559.8
DCAPLAB	0.8	3.3	0.5	3.2
INVMKTLAB	2747.8	5935.5	2932.5	5843.2
INVCAPLAB	2565.5	2914.2	2134.3	2874.5
TURN	9977.7	21815.9	2912.8	21519.1
LABPROD	110.7	891.9	133.8	875.6

Table 11 ... continued

Training Expenditures

	coefficient	standard error
F-stat	3.9530 ***	
R^2 adjusted	0.1790	
Intercept	27258.0	20769.6
Innovation principal components		
RDINOV	-88.3	1635.5
OUTINOV	1042.0	2044.6
GENINOV	841.2	1340.7
PASINOV	-1164.2	1764.4
Non-innovation variables		
Emphasis on quality		
QUAL	-1173.7	941.8
TQM	-1856.4	1920.6
Emphasis on labour skills		
HRCOMP	729.2	2367.7
HRWAG	-2334.9	2581.0
HRGOV	-1069.5	2420.1
HRSKL	13.9	3210.1
Other factors		
SIZE	-0.3	0.3
SIZESQ	130.6	102.3
MANAGF	-125.9	804.3
MANAGI	1148.8	1025.9
PROFF	3377.6 ***	1043.9
PROFI	261.9	915.6
TECHF	-52.5	262.2
TECHI	837.9 ***	185.0
SALESF	782.2	540.6
SALESI	-30.2	352.1
OTHERF	445.6 ***	161.6
OTHERI	-29.2	136.4
SALES	210.0	214.1
QUEBEC	2359.1	6581.3
BUSERV	84.9	8637.6
MANUF	5486.3	6703.1
CONST	-1120.9	8466.7
RETAIL	-12891.0 *	7570.7
DCAPLAB	0.1	3.2
INVMKTLAB	2528.9	5772.2
INVCAPLAB	828.9	2869.6
TURN	716.5	21272.7
LABPROD	121.2	865.3

* indicates that it is significant at 10% level using a 2-tailed test.
** indicates that it is significant at the 5% level using a 2-tailed test.
*** indicates that it is significant at the 1% level using a 2-tailed test.

Table 12

Training Expenditure

	coefficients	standard error	coefficient	standard error
F-stat	2.9760 ***		2.9890 ***	
R^2 adjusted	0.0959		0.1073	
Intercept	11718.0	21624.6	12761.0	21504.8
Innovation principal components				
RDINOV	1272.2	1684.8	1090.5	1679.9
OUTINOV	2694.5	2106.7	2861.9	2102.7
GENINOV	449.7	1401.9	586.3	1396.9
PASINOV	362.0	1824.0	-71.3	1822.7
Non-innovation variables				
Emphasis on quality				
QUAL	-1138.7	980.5	-821.6	982.3
TQM	-1843.0	1997.1	-1999.4	1992.2
Emphasis on labour skills				
HRCOMP	2962.4	2447.9	2218.9	2448.8
HRWAG	-3648.0	2674.1	-2937.3	2668.7
HRGOV	-1433.6	2519.0	-2183.0	2523.8
HRSKL	2403.3	3313.1	2201.5	3292.6
Other factors				
SIZESQ	-0.7 ***	0.3	-0.6 **	0.3
WOMEN	223.6 **	109.9		
MEN	466.1 ***	105.2		
MANAG			658.8	545.6
PROF			1122.0 ***	314.8
TECH			430.6 ***	116.6
SALES			131.4	160.1
OTHER			268.0 ***	102.7
SALES	241.0	220.8	330.0	222.6
QUEBEC	-2963.2	6837.0	-3926.9	6808.6
BUSERV	8640.3	8800.9	172.5	9111.2
MANUF	7444.6	6835.5	5846.7	6896.9
CONST	-1399.5	8841.5	-1036.9	8789.7
RETAIL	-10917.0	7654.5	-10767.0	7810.9
DCAPLAB	1.1	3.3	-0.3	3.3
INVMKTLAB	3566.7	6032.1	2719.8	6006.9
INVCAPLAB	3905.0	2938.7	4230.5	2921.1
TURN	15877.0	22122.5	11736.0	22130.2
LABPROD	-21.3	906.3	-1.4	900.7

Table 12 ... continued

Training Expenditures

	coefficient	standard error
F-stat	2.7290 ***	
R^2 adjusted	0.1101	
Intercept	13208.0	21631.9
Innovation principal components		
RDINOV	829.2	1685.3
OUTINOV	2691.1	2112.7
GENINOV	696.0	1401.0
PASINOV	-124.3	1824.1
Non-innovation variables		
Emphasis on quality		
QUAL	-665.1	985.2
TQM	-2194.5	2007.0
Emphasis on labour skills		
HRCOMP	2154.5	2446.7
HRWAG	-2723.3	2670.2
HRGOV	-2172.8	2544.2
HRSKL	2360.2	3325.2
Other factors		
SIZESQ	-0.6 **	0.3
MANAGW	1040.1	1046.2
MANAGM	901.7	769.9
PROFW	510.6	753.0
PROFM	1400.4 ***	421.9
TECHW	386.7 **	165.4
TECHM	438.2 ***	139.5
SALESW	66.2	324.3
SALESM	210.0	310.1
OTHERW	47.6	141.9
OTHERM	378.7 ***	114.0
SALES	271.0	234.6
QUEBEC	-5087.6	6834.5
BUSERV	-934.5	9351.0
MANUF	4786.1	6955.4
CONST	-3760.8	8870.0
RETAIL	-11485.0	7906.1
DCAPLAB	0.8	3.3
INVMKTLAB	2513.9	6006.8
INVCAPLAB	3808.7	2924.9
TURN	10101.0	22302.4

* indicates that it is significant at 10% level using a 2-tailed test.
** indicates that it is significant at the 5% level using a 2-tailed test.
*** indicates that it is significant at the 1% level using a 2-tailed test.

CONCLUSION

Firms experiment with a variety of strategies as they vie for advantage with their competitors. Not all firms adopt an aggressive training strategy. While there are many factors that influence training, the preceding analysis highlights the finding that training tends to occur as part of a cohesive company strategy. Training is one component of a package of strategies pursued by knowledge-based firms. Consequently, human capital that is developed at the firm level strongly complements technological capability. Second, training also occurs where firms recognize that labour skills are important and where they focus on devising innovative compensation packages. Third, firms that stress quality and total quality management are more likely to implement a training program.

Numerous dimensions of innovativeness and the technological intensity of a firm influence training. All four of the innovative compensation prototypes - *The General Innovator, The Passive Adapter, The R&D-Driven Innovator* and *The Outward Oriented Innovator* are more likely to have implemented a training program.

Two additional competencies of a firm influence its training decision. A firm that stresses total quality management will be more likely to train workers. Similarly, a firm that develops innovative compensation packages and that stresses labour skills will be more likely to offer training. It is not coincidental that these two areas are associated with greater training incidence and higher levels of training. Both are extensions of innovative capabilities writ broadly. Total quality management requires new commitments, technologies and organizational structures. Compensation packages that facilitate loyalty and stimulate performance also require new patterns of performing traditional functions. That capabilities in these two areas promote training confirms the hypothesis that training is one of the inputs found in innovative firms in general.

This paper has treated training as a three step decision process. Initially, the firm must decide whether or not it will engage in training at all. It is at this stage that the complementarity between innovation, technological advancement, emphasis on quality products and service, valuation of human resources and human capital formation is visible. Firms that are more innovative and that place a greater emphasis on quality and labour skills are more likely to engage in training.

Once the decision to train has been made, however, the number of employees trained depends almost solely on the number of employees in each of five broad occupations. Other activities, strategies and characteristics are less important at this stage, with the exception of the occupational breakdown of employees, which is related to the innovativeness of the firms. More innovative firms generally employ a higher percentage of professional and technical/production workers and a lower percentage of other workers than do other firms. In turn, a greater proportion of these employees are trained.

The third and final step in the training decision process involves how much will be spent on training. This is in turn predominantly a function of the number of employees trained broken down by occupational group.

The results of this paper point to the importance of environment in a firm's training decision. Training programs do not appear to be equally useful for all firms. Firms that will be the most receptive to training policies are going to be those where expertise in innovation and quality management already exist. Consequently, policies which are directed at stimulating the complements to training - innovation and attention to quality - are also likely to be effective in encouraging firms to train. However, focusing on just innovation policy or just on training policy, without consideration of the connections between the two, is likely to have a lesser impact than a coordinated approach that recognizes the inherent complementarities of both to the firm.

NOTES

1. See Economic Council of Canada, 1991, pp. 124-26 for a summary of the results of training incidence from other Canadian surveys. The 1991 National Training Survey that was performed for the Canadian Labour Market Productivity Centre found that about 50 percent of firms spent money directly on structured training of employees.

2. A copy of the survey is included in Appendix I.

3. While the survey was taken only of growing firms, the training characteristics, the R&D intensity, and the occupational distribution of the sampled firms all are broadly representative of the population as a whole.

4. These training characteristics are calculated only for those firms used in the multivariate analysis. Some 904 of the 1480 firms in the survey provided answers to all the questions required for the analysis.

5. Answers to the importance of strategies in the small-firm survey are scored on a six-point scale.

6. These classifications come from the Economic Council of Canada (1991). Dynamic services are defined here as the remainder of the ECC's dynamic-service category after business services and wholesaling, both of which are classified as dynamics services, are removed. The category consists of communications, finance, and transport. Traditional services is the ECC's traditional-service category after the retail sector, a traditional sector, is removed. It consists of accommodation, and other services. Primary is made up of agriculture, fishing, trapping, logging, forestry, mines and oil wells.

7. Simpson (1984) uses a turnover rate derived from the answers given by personnel directors, while Bartel (1992) uses average length of tenure to capture turnover effects.

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