Technological Innovation Studies Program

Research Report

A STUDY OF MANUFACTURING FIRMS IN CANADA WITH EMPHASIS ON EDUCATION OF SENIOR OFFICERS, TYPES OF ORGANIZATION AND SUCCESS

by

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University of Toronto.
March, 1975

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The views and opinions expressed in this report are those of the author and are not necessarily endorsed by the Department of Industry, Trade and Commerce.

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with emphasis on education of senior officers, types of organization and success.

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sponsored by

THE OFFICE OF SCIENCE AND TECHNOLOGY
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INTRODUCTION

This report is concerned with a survey of manufacturing firms in Canada. The basic purpose of the study was to discover what relationships, if any, exist between education, past and continuing, of senior officers, types of organization, and success in these firms.

Current evidence suggests that there tends to be a relationship between education, the amount of technology used in manufacturing and the success of the firm. It would seem that changing technologies as well as requiring more adaptable organizational structures should also require more educational or training inputs in new hirings and the continuing education of employees. An attempt was made to see if this evidence is substantiated for the sample in the study and to gain some insight into what industries require more start-up education and continuing education in order to achieve success for the firm.

Because most people tend to equate education with formal credentials obtained from various universities or other institutions, and we are concerned with learning no matter how acquired, a new dimension has been added to this study. An attempt was made to include a measure of self directed, informal learning.

PROCEDURE

The questionnaire used in this study was devised from a previous one used by Hecht and Siegel.[1/] This particular questionnaire was modified and shortened to adapt it to the purpose of this study. The section concerned

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[1/] M.R. Hecht and J.P. Siegel. A Study of Manufacturing Firms in Canada. Faculty of Management Studies, University of Toronto. 1972.

with informal learning was adapted from the work of Allen Tough.[2/] The questionnaire used is appended as Appendix One.

This instrument was pre-tested in the field and then mailed to 500 senior officers of manufacturing firms across Canada. The same instrument was used in 20 personal interviews with senior management of small (less than 50 employees) manufacturing firms in the Toronto area. The data obtained from these interviews were compared to the information obtained from the other questionnaires. A look at the questions shows that it was designed for small to medium sized manufacturing firms. Some questions were not directly applicable to very small firms or to those with large complex organizational structures and several divisions or subsidiaries.

RESULTS

Of the five hundred mailed questionnaires, 105 replies were received in time for an analysis. Several others came in too late to be included. The 20 personal interviews were separate. The mailed response was thus 21 percent.

Characteristics of responding firms

•Structure

Size - the size of responding firms varied from 16,050, which was unusually high, to 3. Sixty-four percent of the firms had less than 100 employees and 30 percent had less than 25 employees. This gives a clearer

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[2/] Allen Tough. The Adult's Learning Projects. Ontario Institute for Studies in Education. 1971.

Special acknowledgement for great help in this study goes to Carlos Frewin, a doctoral student at the Ontario Institute for Studies in Education, who was research assistant on this project.

view of small firms than obtained in the Hecht-Siegel survey where only 31 percent of firms had under 100 employees. In Canada the number of such manufacturing firms is about 90 percent.

•Number of managers

Thirty-four percent of the firms had one or two managers, 18 percent had three or four managers and 25 percent of the firms had more than 10 managers. Strangely, some two percent reported five or six managers.

•Age of the firm

The age of 56 percent of the responding firms was fairly evenly distributed between one and less than 30 years while 34 percent of the firms were older.

•Number of levels of management from first line supervisor to president

Fifty percent of the firms had three or four levels of management; 33 percent had one or two and 14 percent had five or six. Under one percent had more than ten levels of management.

•Number of subordinates reporting to the chief executive officer

Twenty-eight percent of the chief executive officers had one or two subordinates directly reporting to them; 28 percent had three or four and 27 percent had five or six. Only three percent of the chief executive officers had more than ten directly reporting subordinates.

•Number of subordinates reporting to the first line supervisor

Thirty-one percent of the firms stated that one to five subordinates reported to a first line supervisor. The remaining firms were fairly evenly distributed between 11 and 15 percent for six to ten, 11 to 15, 16 to 20, 21 to 50 and more than 50 subordinates who reported to a first line supervisor.

•Kind of firm

Seventy-three percent of the firms were limited private companies, 16 percent were public companies listed on an exchange and eight percent were limited public companies.

•Age of the respondents

Most of the respondents were either 40 to 49 years of age (36 percent) or 50 to 59 years of age (31 percent). Only four percent of them were less than 30 years of age and six percent were 60 years old or older.

•Ownership

Sixty-nine percent of the responding firms were Canadian owned, 22 percent were American owned and nine percent were foreign owned, other than in the United States. The bulk of these latter firms were owned in the U.K.

•Position of respondents

Seventy percent of the respondents were presidents, 13 percent were vice-presidents and 10 percent were managers. There were responses from two Chairmen of the Board.

Financial

•Accounting

Sixty-four percent of the firms prepared monthly statements while only 12 percent prepared statements only on an annual basis. Some 13 percent had quarterly statements and ten percent had semi-annual ones. Sixty-seven percent indicated that their financial statements yielded information about expansion needs, 43 percent about lending sources. Ninety-one percent stated the statements helped them determine what costs were cutting into profits and 95 percent could determine if sales were up to expectations.

•Profitability

On a very soft measure of profitability only four percent of the firms rated theirs below the norm for their industry, 58 percent said it was about the norm and 38 percent rated theirs above the norm.

•Financing

Sixty-nine firms made attempts to obtain financing during the last two years. Ninety-five percent said they were successful. Seventy-eight percent of the respondents obtained financing at chartered banks only. Another 12 percent used chartered banks and other sources, as family (six percent), venture capital firms (two percent) and trust and finance companies. Some ten percent used other sources only, mainly help from governments.

Competition

Thirty-five percent of the firms indicated that price was the most intensive area of competition, ten percent indicated product design, 20 percent stated quality, 14 percent said delivery, 15 percent said service while only six percent stated that flexibility to meet consumer specifications was the most intense area of competition. In response to which item represented their main competitive advantage, seven percent chose price, 17 percent said design, 30 percent said quality, seven percent said delivery, 19 percent chose flexibility and 20 percent said service.

Innovation

The principal source of innovation was internal (45 percent) with consumer demand being second at 28 percent. Competition was third with 11 percent. Other sources were minimal but most (87 percent) of the respondents indicated that they had introduced relatively major innovations in the last five years

with most of these being in product lines, marketing practices or manufacturing procedures.

Nature of the technological processes

•Extent of sequencing

The responses to the extent which the manufacturing process is sequenced are shown on the scale below. The responses indicate that almost half or 46 percent considered their processes to be moderately or highly sequenced. The median response was 4.5. on a seven point scale.

Very little Sequencing	1	2	3	4	5	6	7	A great deal
percent -	4	12	12	21	19	16	16	

•Technical sophistication

Responding firms rated the technical sophistication of their manufacturing equipment somewhat lower than the extent of the sequencing used. As the seven point scale below shows, 44 percent of the firms rated their technical sophistication below the mid point and 33 percent rated it above.

Not very Sophisticated	1	2	3	4	5	6	7	Very Sophisticated
percent -	4	11	29	23	18	8	7	

•Degree of automation

Eighty-five percent of the responding firms indicated that their production was semi-automated or less; only 15 percent indicated that it was mostly automated and no firm indicated it was fully automated. This ties in with the fact that there is more employment per sales dollar in smaller firms than larger ones in general.

The five point chart gives the figures obtained

	1 Manual	2 Little Automation 6-39%	3 Semi-Automation 40-60%	4 Mostly Automated 61-94%	5 Fully Automated 95% +
percent of firms	10	40	35	15	0

•Computer usage

A little over half (52 percent) of the responding firms indicated that they made use of a computer.

•Extent of computage use

Of the firms making use of a computer, 61 percent indicated their usage was moderate or slight, 29 percent indicated considerable use and 10 percent made extensive use of computers.

•Purpose of computer usage

Of the firms which made use of computers, the following are the purposes for which they did so, in order of frequency.

accounting	92 percent
sales	48
inventory control	30
production control	28
costing	17
design	15
production machinery	10
quality control	5
research	5

Education

•Formal education

Eighty-four percent of the respondents had completed high school. Of these 29 percent had completed technical or community colleges and 55 percent had completed university. Almost nine percent of the respondents had more than one degree.

Continuing education of employees

Thirty percent of the respondents indicated that they definitely encouraged management personnel to continue their work-related education as well as on-the-job training. An additional 53 percent replied YES while only 16 percent said NO and one percent responded with an emphatic NOT AT ALL.

•Nature of continuing education support

Firms were asked to describe the nature of their encouragement for continuing education of management personnel. The responses are indicated below:

Partial payment of expenses	24 percent
Full payment of expenses	28
Non-material encouragement only	30
Full payment plus time allowance	10
Full payment of expenses plus time allowance plus counselling	6
Partial payment of expenses plus time allowance	2

•Sources of education or information

The following is a summary of responses concerned with sources of education or information used to help managers keep informed about business conditions or to continue their formal or informal education.

	Definitely	Yes	No	Not at all
	- percentages -			
a. academic programs	11	37	41	11
b. major corporations supplying technical information	12	53	26	9
c. professional associations	16	67	15	2
d. trade publications	24	72	4	0
e. business periodicals	22	70	8	0
f. consulting services	5	42	43	10
g. government agency programs (courses)	6	27	52	15
h. government agency publications	12	55	24	9

The sources that appear most frequently are trade and business publications while government agency programs are the least used source of information with consulting services and academic programs running neck and neck for second last placd.

•Recall of informal learning attempts

Eighty percent of the respondents indicated they recalled informal, self-directed attempts to learn. (See Appendix 1 for definition used.)

•Number of learning attempts recalled

Those respondents who recalled informal learning activities indicated the following number of attempts over the past year.

Number	Percentage of respondents
1 - 2	28
3 - 4	29
5 - 6	11
7 - 8	15
9 -10	12
10 +	5

•Usefulness of informal learning attempts

The respondents were asked to rate the usefulness of their informal attempts. The distribution of the responses is indicated on the scale below:

Not at all useful	1	2	3	4	5	6	7	Very useful
percent	0	2	11	15	21	27	29	

Thus 73 percent of the respondents considered these informal learning attempts to be moderately to very useful.

•Assistance with informal learning attempts

The respondents were asked with which, if any, of the following tasks normally associated with an informal learning attempt they would have liked to have had more assistance. The responses are recorded below:

	Yes	No
	– percent –	
a) Deciding on activities	35	65
b) Dealing with difficult parts	54	46
c) Choosing a goal	14	86
d) Obtaining resources	62	38
e) Estimating own level of accomplishment	46	54
f) Deciding about time	22	78
g) Deciding about expenses	18	82

Obtaining resources shows up clearly as the place where most would like help, next in line are dealing with difficult parts and estimating own level of accomplishment. These replies are extremely interesting in that they point out some of the most serious flaws in continuing professional education at the present time, that is, lack of proper counselling services either in companies or educational institutions, and lack of sufficient

help in areas of difficulty (even in classroom situations this is a problem due to the lack of time of generally evening instructors). Level of accomplishment is also a problem but is common to all education.

°Government assistance with continuing learning or education

Ninety-three responses out of 125 were obtained to this question of what the government can do to help. A considerable number of these responses ranged from "nothing" to "stay out of it" or "quit encouraging freeloaders". The responses which addressed the question fit into three categories. These are:

1. Provide clear, concise, specific literature that addressed specific problems of the small businessman.
2. Provide more financial assistanct to small firms so they can afford to develop their employees.
3. Provide short seminars and workshops for small businessmen on an off-campus basis that deal with specific problems and most importantly, deal with solutions and implications.

CROSSTABULATIONS

The use of the computer greatly enhanced the comparison of variables for significant relationships. In the search 153 n X n tables were produced. The type of data generated necessitated the use of non-parametic statistics. The basic statistics of choice were chi square and an alpha level of 0.05 was considered adequate for this stage of inquiry.

Relationships to Formal education

Respondents were compared on the basis of completing high school, community college or technical school and university.

•Age

There is no significant relationship between age and formal education.

•Sources of information

Although there are no significant relationships between graduating institutions and sources of information, graduates of high school are less likely to make use of major corporations supplying technical information and graduates of community colleges and technical schools are clearly least likely to attend academic programs.

•Manufacturing processes

No significant relationships exist between graduate institutions and the degree of automation and sophistication although university graduates are more likely to be found in moderate to highly automated firms. University graduates are significantly (0.03) predominant in highly sequenced manufacturing firms. Community college and technical graduates are significantly (0.04) not predominant.

•Informal learning

University graduates are significantly (0.05) less likely to seek help with deciding on activities. Community college and technical graduates are more inclined to seek help with obtaining resources although this relationship is not significant. Those respondents who had at least completed high school were less likely to seek help with choosing a goal than those who had not graduated from high school.

•Extent of computer use

Those who had completed at least high school clearly made more extensive use of computers but this relationship was not significant.

•Continuing education of employees

High school graduates gave significantly (0.02) more emphasis to the continuing education of employees although it should be noted that high school graduates predominate in the medium to large size firms which typically give large support to this matter. The same relationship holds true for the nature of support to those employees interested in continuing education.

•Size of firm

University graduates tend to be predominate in large firms but not significantly. There were very few respondents who did not complete high school and the portion of the sample may have been too small to represent a significant difference. High school graduates tend to be slightly more predominant in smaller firms but again not significantly.

Relationship to ownership

This particular study does not indicate the large differences that have been reported between Canadian owned and American owned firms. American firms tend to be more concentrated in the more sophisticated and very sophisticated firms but this relationship was not significant. The same holds true for highly automated firms, although Canadian firms do predominate in the 'slightly automated' range and American firms are more in the 'highly sequenced' range, but again not significantly. The Hecht-Siegel study showed Canadian firms behind their American counterparts in the extent which they made use of computers. This study carried out two years later shows no observable difference between them.

Relationship to the type of firm

The extent of automation and sequencing appear related, although not significantly, to the type of firm. Both of these variables begin to show up at moderate levels for the limited private company and increases for the limited public companies and further increase for public companies listed on an exchange. The lack of significance may be due to the low number of the latter two types in our sample. The sophistication of the manufacturing process does not appear to be related to the type of firm. The extent of computer usage is significantly (0.001) greater to the type of firm, with public companies listed making much more extensive use of computers than say, proprietorships. But this is no surprise.

In education the only item to note is that officers of the larger firms report a greater number of learning attempts than do those of other firms. And the listed firms are the larger firms. However, there is no significant relationship between the type of firm and the usefulness of informal learning attempts.

Relationships to the continuing education of employees

One might postulate that the support given to continuing education of employees would be related directly to the number of informal attempts by the senior officer. However, those respondents who reported a low number of learning attempts significantly (0.01) provided the most support for the continuing education of employees. As no other variables were significantly related to this item including size, type of firm and profitability, one could question this finding.

Relationships to informal learning attempts

Aside from the finding mentioned above, there are no variables which significantly relate to the number of learning attempts, the usefulness of these attempts and assistance with these attempts. There are some noteworthy trends. Owners of small firms often reported that they were learning most of the time but lacked time and more frequently requested help with obtaining resources and dealing with difficulties than officers of larger firms.

It is interesting to note the large number of learning attempts reported by the respondents as this information has been typically gathered by the interviewing. Senior officers of firms with highly sequenced manufacturing processes tended to report the largest number of attempts which were highly useful and tended to request the least help of any group. This was particularly noticeable with respect to choosing a goal and deciding on activities.

Relationship to success or profitability

There were no variables which significantly related to profitability although more small firms tend to rate their profitability below the norms of their industry.

Interviews

A comparison of the date obtained by mailed questionnaire and that obtained from personal interviews failed to produce any differences, with two exceptions. First, the personal interviews greatly increased the number of small firms in the sample and typically produced more information, quantitatively, about informal learning attempts.

CONCLUSIONS

The results of this study did not reveal any significant relationships between the education, past and continuing, of senior officers, types of organizations and success in manufacturing firms.

Significant relationships resulted from comparing education, past and continuing, and one of the measures of manufacturing technology - sequencing. Firms which report a fairly high degree of sequencing have a significant number of senior officers who are univeristy graduates and a significant lack of senior officers who are community college or technical school graduates. Firms with a high degree of sequencing also appeared to have more flexible organizational structures but this finding was not significant. This study, however, did not attempt to collect much data on organizational structure.

Large firms tended to rate their profitability somewhat higher than small firms as did firms with a high degree of sequencing, compared to those with a low degree of sequencing. The relationships did not show up as significant, however.

No significant relationships were found for continuing education or training input compared to size of firm, type of firm, manufacturing technology or informal learning of senior officers. However, high school graduates gave significantly more emphasis to the continuing education of their employees. Larger firms also tended to place more emphasis on this item.

Senior officers of firms with highly sequenced manufacturing processes tended to report the largest number of informal learning attempts, tended to rate them as useful and tended to be quite self-directed in this learning.

Education, past and continuing, tended to receive the highest priority in firms where the process was highly sequenced.

The small firm is clearly educationally disadvantaged. These senior officers tended to have fewer formal credentials and reported fewer informal attempts to learn. They typically appeared short of time, resources and energy to learn or at least be aware of this learning. Education of this group is inefficient. Aside from their difficulties in obtaining resources, several indicated that learning experienced by them produced too few implications or solutions. Formalizing education for them in some way of financial aid might be harmful to their entrepreneurship although it could be useful if applied to their employees. Improvement in the understanding of how to approach informal learning and benefit from this would be helpful.

Senior officers of small firms often expressed their learning and attention were entirely directed to the solution of immediate problems. Nevertheless, as indicated just previously, they could benefit from education if the proper means were found to help them. Possibly a form of tax credit for related education could be used, provided a good percentage of it could be used for counselling purposes and informal learning activities. Further investigation into this area is indicated.

A look at the British system in aiding education in businesses could also throw light on this matter and help formulate plans to enable Canadian firms overcome obstacles caused by lack of aid to their efforts at continuing education as well as encourage more senior managers to make proper use of educational activities. Learning is the key, not necessarily formalized education. If one small fraction of the monies spent unthinkingly

in formal education could be used for informal learning, and ways found to implement this almost unawares of some of the learners, it would produce better businesses in Canada.

SURVEY FORM

STRUCTURE

1. Approximate number of employees? _____

2. Of these employees, how many are managers? _____

3. Age of the firm? (in years) _____

4. How many levels of management are there in your organization from 1st line supervisor to president? _____

5. How many subordinates report to the chief executive officer? _____

6. How many subordinates report to the 1st line supervisor(s)? _____

7. Is this firm: (please check one)

   a) A proprietorship? _____
   b) A partnership? _____
   c) A limited private company? _____
   d) A limited public company? _____
   e) A public company on the exchange? _____

8. What is your approximate age?

   Under 30 ____, 30-39 ____, 40-49 ____, 50-59 ____, 60 or over ____.

9. What is the majority of this firm's ownership?

   Canadian _____, American _____, Other (please specify) _____.

10. Position of respondent _____
    Title

FINANCIAL

11. How often does your accountant and/or auditor prepare financial statements?

a) monthly _____

b) quarterly _____

c) semi-annually _____

d) annually _____

12. Does your financial system provide information for answering the following questions to your satisfaction?

	Yes	No
a) should the business be expanded?	_____	_____
b) what lending sources should be tapped?	_____	_____
c) what cost areas are cutting into profits?	_____	_____
d) are sales up to expectations?	_____	_____

13. How would you rate the profitability of your firm with respect to your industry's norm. (Circle appropriate answer.)

below norm about norm above norm

1 2 3 4 5 6 7

14. Have you made any attempts to obtain additional financing during the last two years? _____Yes _____No

15. If yes were you successful? _____Yes _____No

16. From what sources was this obtained? (Please check.)

a) Chartered Banks _____

b) Trust Companies _____

c) Venture capital organizations or merchant banks _____

d) Finance companies _____

e) Family, friends _____

f) Other (please specify)_____

_____

COMPETITION

17. Please answer each part of the following question by placing each of your ratings on the single scale below. For instance, if price was the most intensive area of competition you would place an "a" in the section of the scale above 7, and so on for each of the remaining parts. You may have more than one answer in any section of the scale.

How intensive are the following areas of competition in your industry?

a) price

b) product design

c) product quality

d) delivery

e) flexibility to meet consumer specifications

f) service

I	I	I	I	I	I	I	I
	(1)	(2)	(3)	(4)	(5)	(6)	(7)

least intensive — less intensive — more intensive — most intensive

18. Which of these areas of competition represents your main competive advantage? (Please check only one.)

a) price _____

b) product design _____

c) product quality _____

d) delivery _____

e) flexibility to meet consumer specifications _____

f) service _____

INNOVATION

19. Has your firm been successful in introducing any relatively major innovation in the last five years?

	Yes	No
a) in your product line?	_____	_____
b) in your marketing techniques?	_____	_____
c) in your manufacturing facilities	_____	_____
d) in the amount and direction of your research effort?	_____	_____
e) in the background, training, and technical skills of your employees - sales, manufacturing, research, or management?	_____	_____

f) Other (Please specify) _____

_____

_____

20. From what source or sources did the innovation originate?

a) academic _____

b) trade journals _____

c) consultants _____

d) competition _____

e) result of consumer or industrial demand _____

f) internally generated _____

NATURE OF TECHNOLOGICAL PROCESSES

21. How much is the manufacturing process sequenced in your company's work flow?

Very little Sequencing	1	2	3	4	5	6	7 A great deal

22. How (technically) sophisticated is the manufacturing equipment in your company? (Circle appropriate number)

Not very sophisticated						Very sophisticated
1	2	3	4	5	6	7

23. To what degree is your production automated? (Circle appropriate number)

1	2	3	4	5
Manual	Little Automation 6-39%	Semi-Automation 40-60%	Mostly Automated 61-94%	Fully Automated 95%

24. Does your firm make use of computers? _____Yes _____No

If yes, to what extent does your company use computers?

1	2	3	4	5
None	slight	moderate	considerable	extensive

If applicable, for what purposes does your company use computers?

Please specify _____

_____

_____

_____

FORMAL EDUCATION

25. Did you complete high school? _____Yes _____No

26. Did you obtain a certificate or diploma from a community college or technical institute? Yes_____ No_____

If yes, please specify certificate or diploma and area of specialty.

	Certificate or Diploma	Specialty
1)	_____	_____
2)	_____	_____

27. Did you obtain a degree or degrees from a university?

Yes_____ No_____

If yes, please specify degree or degrees obtained and area of specialty.

	Degree	Specialty
1)	_____	_____
2)	_____	_____

28. Please specify any additional formal education credentials not given above.

1) _____

2) _____

CONTINUING EDUCATION

29. Does your firm encourage management personnel to continue their work related education outside of their on-the-job learning?

Definitely _____ Yes _____ No _____ Not at all _____

If definitely or yes, please specify. _____

_____

_____

30. Do you use any of the following sources of education or information to keep you informed about business conditions or to continue your education?

	Definitely	Yes	No	Not at all
a) academic programs (courses)	____	____	____	____
b) major corporations supplying technical information	____	____	____	____
c) professional associations	____	____	____	____
d) trade publications	____	____	____	____
e) business periodicals	____	____	____	____
f) consulting services	____	____	____	____
g) government agency programs (courses)	____	____	____	____
h) government agency publications	____	____	____	____

It has become very clear that the majority of adult learning or the aquisition of knowledge or skill takes place outside of schools, classrooms, courses, etc. Businessmen, a special group of adults, also do the majority of their learning outside of any formal educational enterprise.

Stop a minute or two and try and recall any attempts you have made to gain knowledge or skill directly related to increasing your ability to function in your present position. These attempts should meet the following criteria:

a) you had fairly definite and clear goals for your learning

b) you should have spent at least eight hours at any single attempt to learn in the past year.

c) you assumed the primary responsibility for planning and carrying-out this learning

31. Could you recall any attempts that you made to learn?

____Yes ____No

If yes, would you please answer the following questions as best you can.

32. How many specific attempts to learn did you recall? _____

33. Give a brief title or explanation of 1, 2, or 3 of your more outstanding attempts to learn about business.

1) _____

_____

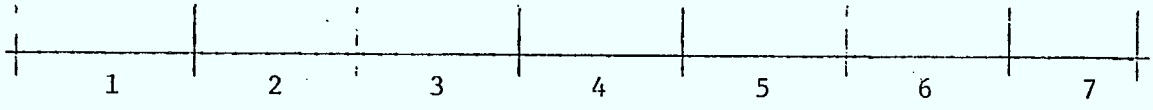
2) _____

_____

3) _____

_____

34. How useful to you in your business was this self-directed learning?



Not at all useful

Very useful

35. Would you have liked assistance with any of the following activities which are usually part of a learning attempt?

	Yes	No
a) Deciding on activities	_____	_____
b) Dealing with difficult parts	_____	_____
c) Choosing a goal	_____	_____
d) Obtaining resources	_____	_____
e) Estimating own level of accomplishment	_____	_____
f) Deciding about time	_____	_____
g) Deciding about expenses	_____	_____

36. Name 1, 2 or 3 things that the government could to to help with your continuing learning or education.

1) _____

_____

2) _____

_____

3) _____

_____