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A STUDY OF THE MANPOWER IMPLICATIONS  
OF AN EXTENDED "MAKE-OR-BUY" POLICY  
(OPTION III)

FEBRUARY, 1976

report no. 108  
rapport n°. 108



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## INTRODUCTION

This study considers how Option III of a current proposal for an extended "Make-or-Buy" policy<sup>1</sup> is likely to affect R&D employment patterns in federal government laboratories. In particular it concerns the manpower implications of a funding freeze for current intramural R&D activities in order to favour the growth of extramural activities. Because different departments would react in different ways to changes in funding patterns, projections such as those made in this study should be interpreted very cautiously.

### 1. The Policy Proposal

#### Payments to Industry for Mission Oriented R&D with Progressive Transfer of Funds from Partially Funded to Fully Funded R&D (Option III)

This proposal for funding is based on a combination of three elements:

- (i) a selective re-allocation of on-going intramural expenditures
- (ii) a re-allocation of funds from the cost-shared industrial grants programs
- (iii) a three-fold increase of on-going contract funds over the next five years.

The aim of dollar parity by 1980-81 between intramural R&D and payments to industry for R&D requires that:

- (i) intramural R&D funding be held at the anticipated 1976-77 level of \$375 million
- (ii) on-going contract program funds rise from \$50 million in 1975-76 to \$152 million in 1980-81
- (iii) new contract programs relating to major areas of government interest increase to \$132 million in 1980-81 by
- (iv) a progressive transfer of cost-shared programs for R&D and product innovation to the new contract programs above.

### 2. Assumption

For the purpose of this paper the method of holding the aggregate level of intramural R&D to \$375 million will be by an "across-the-board" freeze on all departments as opposed to selective advances and reductions.

---

<sup>1</sup> Ref. draft Cabinet Memo. furnished by Dr. P. Meyboom.

PART IINTERPRETATION OF THE FINANCIAL ASPECTS OF OPTION THREE1. The Global Picture

It is proposed to freeze the current in-house budget for R&D (capital costs excluded) at the expected 1976-77 level of \$375 million. Ignoring the question of employment for the moment, what are the financial implications of this freeze?

In a period of inflation, a program which devotes a steady \$375 million in current dollar terms for a period of several years actually constitutes reduced funding. This is illustrated in Table 1 below which presents estimates of the constant dollar value of a frozen \$375 million budget based on several rates of inflation.

TABLE 1  
CONSTANT DOLLAR EQUIVALENTS OF A FUNDING FREEZE ACCORDING  
TO VARIOUS RATES OF INFLATION

	75-76	76-77	77-78	78-79	79-80	80-81
Current \$	349	375	375	375	375	375
Constant \$						
- Inflation @ 6%	349	353	332	312	293	275
7%	349	349	325	302	281	261
8%	349	345	317	292	269	247
9%	349	341	310	282	257	234
10%	349	338	304	274	247	223

In subsequent calculations the inflation rate quoted will be 7% for the period 1975-81. This is suggested by the figures for the GNE price deflator and Consumer Price Index in the recent Economic Council of Canada Twelfth Annual Review<sup>1</sup>. At this rate the target year 1980-81 shows an estimated "real" dollar value of only \$261 million down from \$349 million in 1975-76. This represents approximately 75% of the initial allocation in constant dollar terms.

<sup>1</sup> Economic Council of Canada, *Twelfth Annual Review: Options for Growth*, Page 147 (Ottawa, Information Canada 1975).

If it is assumed that 7% will approximate the inflation rate in this period, then the current intramural R&D expenditures under Option III will be:

	<u>75-76</u>	<u>76-77</u>	<u>77-78</u>	<u>78-79</u>	<u>79-80</u>	<u>80-81</u>	<u>80-81 Budget as a % of 75-76 Budget</u>
Current Intra- mural R&D (con- stant 1975-76 dollars) - inflation at 7%	349	349	325	302	281	261	(75)

## 2. Departmental Budgets

The results of such a freeze on the eight major departments performing intramural R&D are shown in Table 2. The assumption made is that all departments hold their expenditures at the 1976-77 level rather than have certain departments grow and others fall back for an overall result of no increase. Table 3 shows the annual decreases in constant dollar terms for each department.

TABLE 2

PROJECTIONS OF DEPARTMENTAL BUDGETS IN CONSTANT \$ TERMS  
WITH 1976-77 AS BASE YEAR AND INFLATION @ 7% P.A.

( \$ MILLIONS)

Department	75-76	76-77	Projected Budgets in Constant 1975-76 \$ (Inflation at 7% p.a.)				
	Actual Exp. <sup>1</sup> (current \$)	Projected Exp. <sup>2</sup> (current \$)	76-77	77-78	78-79	79-80	80-81
Agr	83.6	89.6	83.3	77.5	72.1	67.0	62.3
DOC	15.1	16.1	15.0	13.9	13.0	12.1	11.2
EMR	34.8	37.5	34.9	32.4	30.2	28.1	26.1
Environment	83.4	89.6	83.3	77.5	72.1	67.0	62.3
Defence	46.7	50.3	46.8	43.5	40.5	37.6	35.0
HWC	8.2	8.6	8.0	7.4	6.9	6.4	6.0
NRC	58.5	62.6	58.2	54.1	50.4	46.8	43.6
MOT	3.9	4.1	3.8	3.5	3.3	3.1	2.9
Others	15.2	16.5	15.3	14.3	13.3	12.3	11.5
TOTAL	349.3	375.0	348.9	324.3	301.6	280.5	260.9

1 Expenditures as reported to Statistics Canada in early 1975

2 Projected departmental expenditures assuming an identical % distribution of Funds for 76-77 total of \$375 million to the pattern in 75-76.



TABLE 3

DECREASES IN DEPARTMENTAL BUDGETS (CONSTANT 1975-76 \$) RESULTING FROM  
FREEZE AT 1976-77 FUNDING LEVEL

( \$ MILLIONS)

Department	76-77	77-78	78-79	79-80	80-81	<i>Cumulative Decrease 1976-77 to 1980-81</i>
Agr	0.3	5.8	5.4	5.1	4.7	21.3
DOC	0.1	1.1	0.9	0.9	0.9	3.9
EMR	(0.1)	2.5	2.2	2.1	2.0	8.7
Environment	0.1	5.8	5.4	5.1	4.7	21.1
Defence	(0.1)	3.3	3.0	2.9	2.6	11.7
HWC	0.2	0.6	0.5	0.5	0.4	2.2
NRC	0.3	4.1	3.7	3.6	3.2	14.9
MOT	0.1	0.3	0.2	0.2	0.2	1.0
Others	0.1	1.0	1.0	1.0	0.8	3.9
<b>TOTAL</b>	<b>0.8</b>	<b>24.5</b>	<b>22.3</b>	<b>21.4</b>	<b>19.5</b>	<b>88.4</b>

## NOTES

- (Increases in Brackets)
- Totals may not add due to rounding

PART II

ESTIMATION OF THE REDUCED CAPABILITY  
TO SUPPORT INTRAMURAL R&D STAFF

1. Relationship Between Current Intramural R&D Expenditures  
and Manpower

Before an attempt is made to estimate the effects on manpower that this proposal is likely to have, a function is derived which relates the level of manpower associated with current intramural R&D expenditures. The hope is that this will provide a mechanism for predicting under current management practices the level of staff which can be supported for a given current intramural R&D budget.

Figures 1 and 2 plot the man-years engaged in intramural R&D versus the expenditures (excluding capital) associated with that R&D for 1973-74 and 1974-75 respectively.

By performing a linear regression using the "least-squares-fit" method the following relationships were found.

$$\text{Man-years} = 0.0532 \times \left[ \begin{array}{l} \text{Current Intramural} \\ \text{Expenditures on R\&D(\$000)} \end{array} \right] - 133.7 \text{ for } 1973-74$$

$$\text{Man-years} = 0.0494 \times \left[ \begin{array}{l} \text{Current Intramural} \\ \text{Expenditures on R\&D(\$000)} \end{array} \right] - 114.3 \text{ for } 1974-75$$

If these results are significant, and the statistical tests suggest they are, it allows us an estimate of the man-years that can be supported by a given expenditure according to present methods of managing departmental programs.

CURRENT INTRAMURAL EXPENDITURES ON R&D VERSUS  
MAN YEARS IN FULL TIME EQUIVALENT, 1973-74

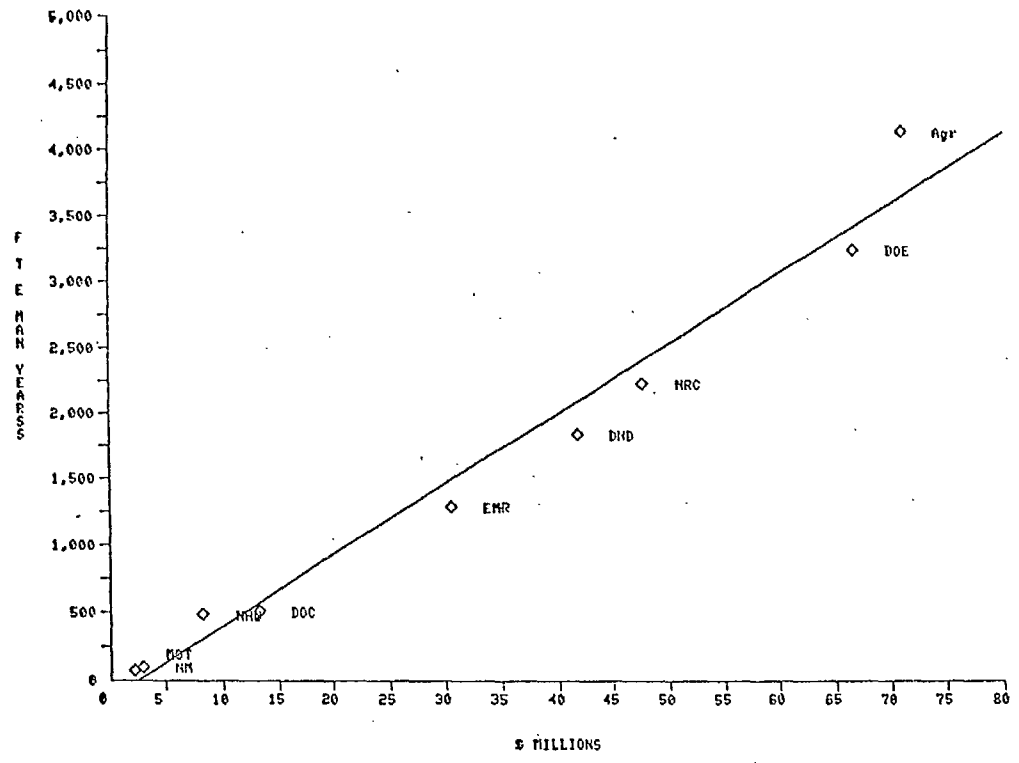


FIGURE 1

CURRENT INTRAMURAL EXPENDITURES ON R&D VERSUS  
MAN YEARS IN FULL TIME EQUIVALENT, 1974-75

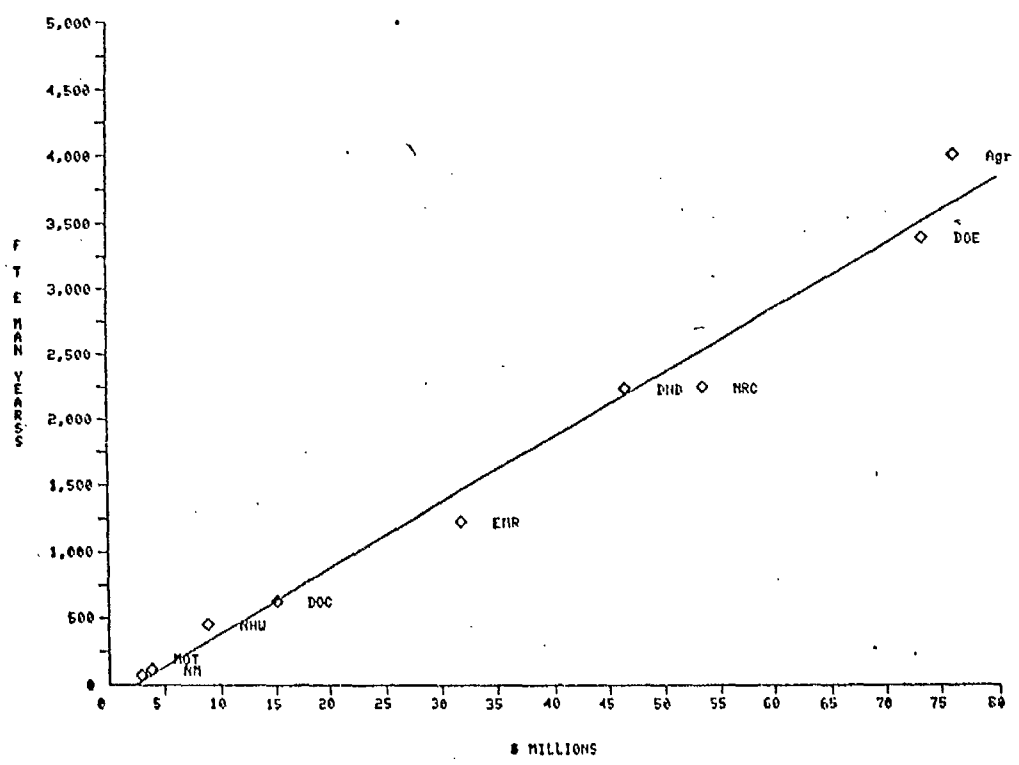


FIGURE 2

2. Initial Estimate of the Reduced Capability to Support Intramural R&D Manpower as a Result of Option III

Using the relationship in the previous section for the most recent data available for scientific manpower, 1974-75, the number of man-years engaged in intramural R&D in 1975-76 is estimated from the expected budget of \$375 million in current dollars. Then this total is divided among the departments in the same percentage distribution exhibited in 1974-75, the results are shown in Table 4.

Working from this base for 1975-76 for Agriculture for instance it is found that in 1976-77 a drop of \$0.3 million (see Table 3) the model estimates that according to past practice the department would have operated with 15 fewer man-years. In the next year with a drop of \$5.8 million (Table 3) the department returns to an expenditure level which previously supported 286 fewer man-years. Continued through to 1980-81 the cumulative reduction in funds, due to inflation, of \$21.3 million means that the department has lost money which previously had been capable of supporting 1,051 employees.

Done for all departments it appears that without taking any other factors into account (separations etc.) Option III indicates a reduced R&D capability of approximately 1,000 man-years per year or 4,369 over the five years to 1980-81.

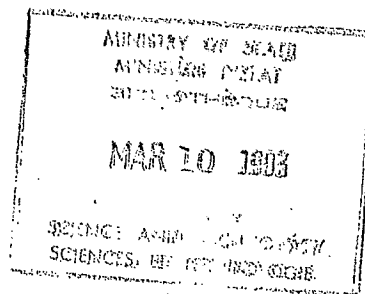
TABLE 4

"UNADJUSTED" DECREASE IN MAN-YEARS SUGGESTED BY BUDGET FREEZE AT 1976-77 LEVEL OF \$375 MILLION  
EXPRESSED IN FULL-TIME EQUIVALENT

Department	Man-Years in 75-76 According to model	Annual Decrease in Man-Years					Cumulative Decrease 76-77 to 80-81
		76-77	77-78	78-79	79-80	80-81	
Agr	4,012	15	286	267	252	232	1,051
DOC	631	5	54	44	44	44	193
EMR	1,603	(5)	123	109	104	99	429
Environment	4,002	5	286	267	252	232	1,042
Defence	2,191	(5)	163	148	143	128	578
HWC	290	10	30	25	25	20	109
NRC	2,773	15	202	183	178	158	735
MOT	78	5	15	10	10	10	49
Others	636	(5)	49	49	49	39	183
TOTAL	16,216	40	1,208	1,102	1,057	962	4,369

Notes: 1 (Increases in brackets)

2 Totals may not add due to rounding



PART III

REFINEMENTS TO ESTIMATES OF MANPOWER IMPLICATIONS

In the previous section it was indicated that the capability to support over 4,300 man-years would be lost during the period 1976-77 to 1980-81. The purpose of this section is to estimate how many man-years are expected to be vacated under normal circumstances. Then the number of hirings that are necessary to bring about the required strength can be estimated.

1. Examination of the Separation Rate of Employees

Each year approximately 11% of the employees on strength in the Public Service leave their jobs due to retirement, resignation, etc.<sup>1</sup> Table 5 shows that the rates differ for each category.

The scientific and professional category shows a rate of 11.1% in 1974-75. However, the many groups which comprise the category are not all to be effected by the proposal in relation to Make-or-Buy. Specifically the Nursing and Education groups are not to be considered and since both these have high separation rates the corrected rate for scientific and professional drops to 7.4%. The technical category shows a rate of 7.2% and the other two groups representing equal parts of the personnel engaged in R&D namely, administrative support and operational are combined at a rate of 13.3%.

Based on the percentage mix of scientific and professional, technical and other personnel engaged in R&D the resulting weighted separation rate for the purpose here is 9.6%.

<u>Category</u>	<u>% of R&amp;D Personnel</u>	<u>Separation Rate (%)</u>	<u>Relative Weights</u>	<u>Weighted Separation Rate (%)</u>
Scientific & Professional	29.0	7.4	2.15 )	9.6
Technical	32.1	7.2	2.31 )	
Other	38.9	13.3	5.17 )	

The number of separations for each category is calculated for a given year and then the net hiring required to replace these vacancies is calculated taking into account the required drop in manpower calculated in the previous section.

<sup>1</sup> "Separations in Relation to Strength", published by the Personnel Policy Branch of the Treasury Board Secretariat, November 1975 (Confidential).

TABLE 5  
Separations In Relation To Strength By Occupational Category  
1972-73 To 1974-75

(Man-Years)

Category	1972-73			1973-74			1974-75		
	Separation	Strength Sept.72	Separation Rate (%)	Separation	Strength Sept.73	Separation Rate (%)	Separation	Strength Sept.74	Separation Rate (%)
Executive	36	661	(5.5)	78	833	(9.4)	82	1,104	(8.1)
Scientific & Professional	2,106	18,264	(11.6)	2,113	19,699	(10.7)	2,341	21,167	(11.1)
Admin. & Foreign Service	1,894	30,602	(6.2)	2,473	34,091	(7.3)	2,748	38,286	(7.2)
Technical	1,232	20,116	(6.1)	1,338	21,521	(6.2)	1,649	22,902	(7.2)
Admin. Support	7,047	57,307	(12.3)	7,950	62,809	(12.7)	8,291	66,224	(12.5)
Operational	8,468	78,152	(10.8)	9,306	79,136	(11.8)	12,063	85,951	(14.0)
Others	-	-	-	-	-	-	-	1,785 <sup>1</sup>	-
<b>TOTAL</b>	<b>20,784</b>	<b>205,072</b>	<b>(10.1)</b>	<b>23,258</b>	<b>218,089</b>	<b>(10.7)</b>	<b>27,174</b>	<b>237,329</b>	<b>(11.4)</b>

1. Employees from Defence Research Board in groups not converted at time of reporting.

Source: "Separations in Relation to Strength", published by the Personnel Policy Branch of Treasury Board Secretariat, November, 1975 (Confidential)

## 2. Estimation of Hirings Required

### Examples

Table 6 shows for the years 1976-77 to 1980-81 the pattern of separations and hirings.

An estimated 15,500 man-years will be engaged in intramural R&D in 1975-76. This estimate is on the basis of a total of 14,972 man-years in 1974-75 as reported to Statistics Canada and a modest increase of 3.5%. The percentage distribution among the categories is estimated at 29.0% for scientific and professional, 32.1% for technical and 38.9% for others. The number of separations for the year 1976-77 total 1,493. From Table 4, it is known that forty man-years are to be dropped so the hirings number 1,493 minus 40 or 1,453.

The assumption here is that each occupational category assumes its share of the reduced capability according to the percentage each category total represents of total manpower.

The more serious consequences of Option III begin to occur in 1977-78. From Table 6 it is estimated that in order to effect a "reduced capability to support" over 1,200 man-years, the number of hirings must plunge to only 281. If all occupational categories consume their share of the drop, some "lay-offs" would be indicated for the scientific and professional and technical categories. Naturally departments are free to manage this problem in another fashion, i.e., neglect to hire in the operational category or administrative support so that technicians may be hired.

The results of this estimation technique are plotted in Figure 3.

## 3. Conclusion

The investigation of the departments reactions to a period of "frozen" funds has not been presented. Rather, another aspect of the proposal has been evaluated, one which attempts to define in terms of manpower what is being asked of departments. How they react to this proposal and how they implement effectively a program of reduced funding is not predicted. However, whatever the management practices employed, the outcome must be to accommodate a saving of the magnitude suggested here.



FEDERAL EMPLOYEES ENGAGED IN INTRAMURAL R&D AND HIRINGS REQUIRED  
BY CATEGORY, 1976-77 TO 1980-81

13.

TABLE 6

1976-77					
Category	Strength	No. Separations	Decreased <sup>1</sup> Capability	New Hirings	New Level of Staff
Scientific & Professional	4,495	333	(11)	322	4,484
Technical	4,975	358	(13)	345	4,962
Others	6,030	802	(16)	786	6,014
<b>TOTAL</b>	<b>15,500</b>	<b>1,493</b>	<b>(40)</b>	<b>1,453</b>	<b>15,460</b>
1977-78					
Category	Strength	No. Separations	Decreased <sup>1</sup> Capability	New Hirings	New Level of Staff
Scientific & Professional	4,484	332	(350)	(-18)	4,134
Technical	4,962	357	(388)	(-31)	4,574
Others	6,014	800	(470)	330	5,544
<b>TOTAL</b>	<b>15,460</b>	<b>1,489</b>	<b>(1,208)</b>	<b>281</b>	<b>14,252</b>
1978-79					
Category	Strength	No. Separations	Decreased <sup>1</sup> Capability	New Hirings	New Level of Staff
Scientific & Professional	4,134	306	(319)	(-13)	3,815
Technical	4,574	329	(354)	(-25)	4,220
Others	5,544	737	(429)	308	5,115
<b>TOTAL</b>	<b>14,252</b>	<b>1,372</b>	<b>(1,102)</b>	<b>270</b>	<b>13,150</b>
1979-80					
Category	Strength	No. Separations	Decreased <sup>1</sup> Capability	New Hirings	New Level of Staff
Scientific & Professional	3,815	282	(307)	(-25)	3,508
Technical	4,220	304	(339)	(-35)	3,881
Others	5,115	680	(411)	269	4,704
<b>TOTAL</b>	<b>13,150</b>	<b>1,266</b>	<b>(1,057)</b>	<b>209</b>	<b>12,093</b>
1980-81					
Category	Strength	No. Separations	Decreased <sup>1</sup> Capability	New Hirings	New Level of Staff
Scientific & Professional	3,508	260	(279)	(-19)	3,229
Technical	3,881	279	(309)	(-30)	3,572
Others	4,704	626	(374)	252	4,330
<b>TOTAL</b>	<b>12,093</b>	<b>1,165</b>	<b>(962)</b>	<b>203</b>	<b>11,131</b>

1. Taken from Table 4 . The distribution of the loss in man-years is among the manpower categories in the proportion they represent of the total i.e., scientific and professional 29.0% of total, technical 32.1% others 38.9%.

# MANPOWER IMPLICATIONS OF OPTION III, 1975-76 TO 1980-81

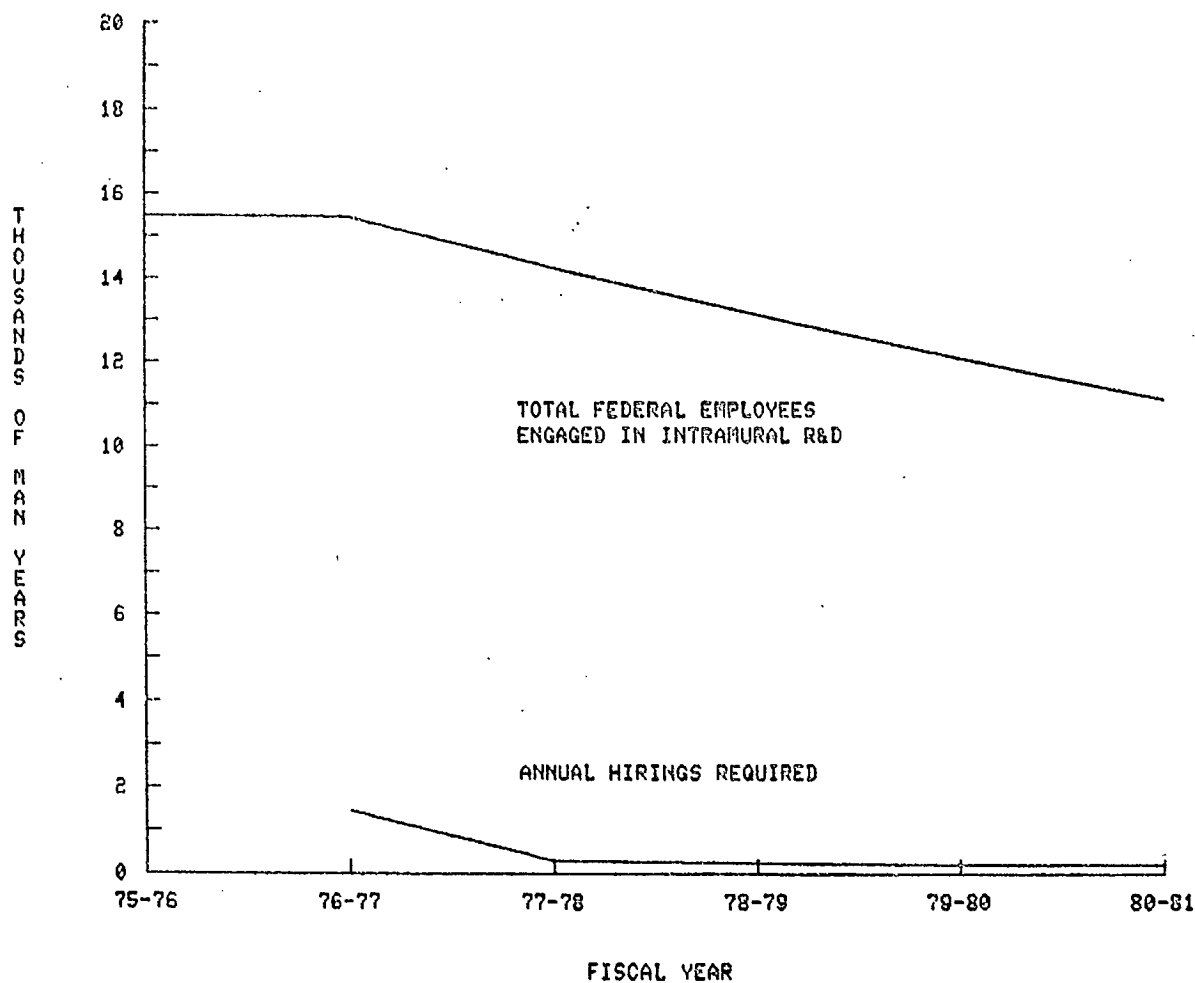


FIGURE 3

## MANPOWER IMPLICATIONS OF OPTION III, 1975-76 TO 1980-81

	<u>75-76</u>	<u>76-77</u>	<u>77-78</u>	<u>78-79</u>	<u>79-80</u>	<u>80-81</u>
Total Federal Employees Engaged in Intramural R&D	15,500	15,460	14,252	13,150	12,093	11,131
(Decrease)	-	(40)	(1,208)	(1,102)	(1,057)	(962)
Hirings Required	-	1,453	281	270	209	203

SUMMARY

1. The Significance of the Funding Freeze

For the examination of the proposed funding option it was determined that the only relevant aspect for the study of its federal scientific manpower implications was that the intramural R&D budget (excluding capital costs) be held, for the period through to 1980-81, at its expected 1976-77 level of \$375 million. In order that the level of future manpower requirements be estimated, it was necessary that this freeze be interpreted in constant dollar terms with an adjustment for the anticipated inflation rate. (Part I)

Expenditures on Intramural R&D (Capital Costs Excluded) in  
Constant 1975-76 Dollars

(\$ Millions)						80-81 Budget as
75-76	76-77	77-78	78-79	79-80	80-81	% of 75-76
349	349	325	302	281	261	75%

*By the end of the period the current intramural R&D budget will have fallen to 75% of its level in 1975-76, assuming an inflation rate of 7%.*

2. Man-year Equivalence of Decreased Funding

Then with the indication of the severity of decreased funding it was possible to estimate the reduced "capability" to support a research population. The function which makes the translation from "dollars" to "manpower" was derived from the historical relationships of these two quantities over several fiscal years. (Part II)

"Unadjusted" Decrease in Research Population Capable of  
Being Supported by Option III

(Man-years)					Cumulative Decrease
76-77	77-78	78-79	79-80	80-81	76-77 to 80-81
40	1,208	1,102	1,057	962	4,369

*The dollar equivalent of over 4,300 man-years would have to be saved in this period 1975-76 to 1980-81 according to the proposal. This amounts to over one-quarter of the personnel engaged in intramural research and development in 1975-76.*

### 3. Refined Estimate of Man-Year Significance

As a final step this estimate of a reduced intramural R&D population capable of being supported by Option III was treated in a flow fashion by examining the departures expected due to the normal causes such as retirement, resignation etc. The categories of personnel which are of concern in this policy have exhibited a weighted separation rate of 9.6% according to Treasury Board figures. That is, 9.6% of the personnel on strength each year leave for one reason or another. Finally a prediction was made for the number of hirings or separations required to achieve the overall level. (Part III)

	(Man-Years)					
	<u>75-76</u>	<u>76-77</u>	<u>77-78</u>	<u>78-79</u>	<u>79-80</u>	<u>80-81</u>
Intramural R&D Population	15,500	15,460	14,252	13,150	12,093	11,131
(Decrease)	-	(40)	(1,208)	(1,102)	(1,057)	(962)
Hirings Required	-	1,453	281	270	209	203
% of Total Strength		9.4%	2.0%	2.1%	1.7%	1.8%

The achievement of this reduced strength in personnel engaged in intramural R&D is brought about by allowing many positions left vacant to remain so and re-hiring at a rate of less than 2% p.a. It may also be that in certain categories, specifically the scientific and professional category, positions would have to be dropped in addition to those left vacant. This situation, which may also arise in the technical category, may be avoided if the hirings allowed for the other categories are sacrificed in preference to the scientific and professionals. This naturally would result in a different "mix" of personnel engaged in R&D.

### MANPOWER IMPLICATIONS OF OPTION III, 1975-76 TO 1980-81

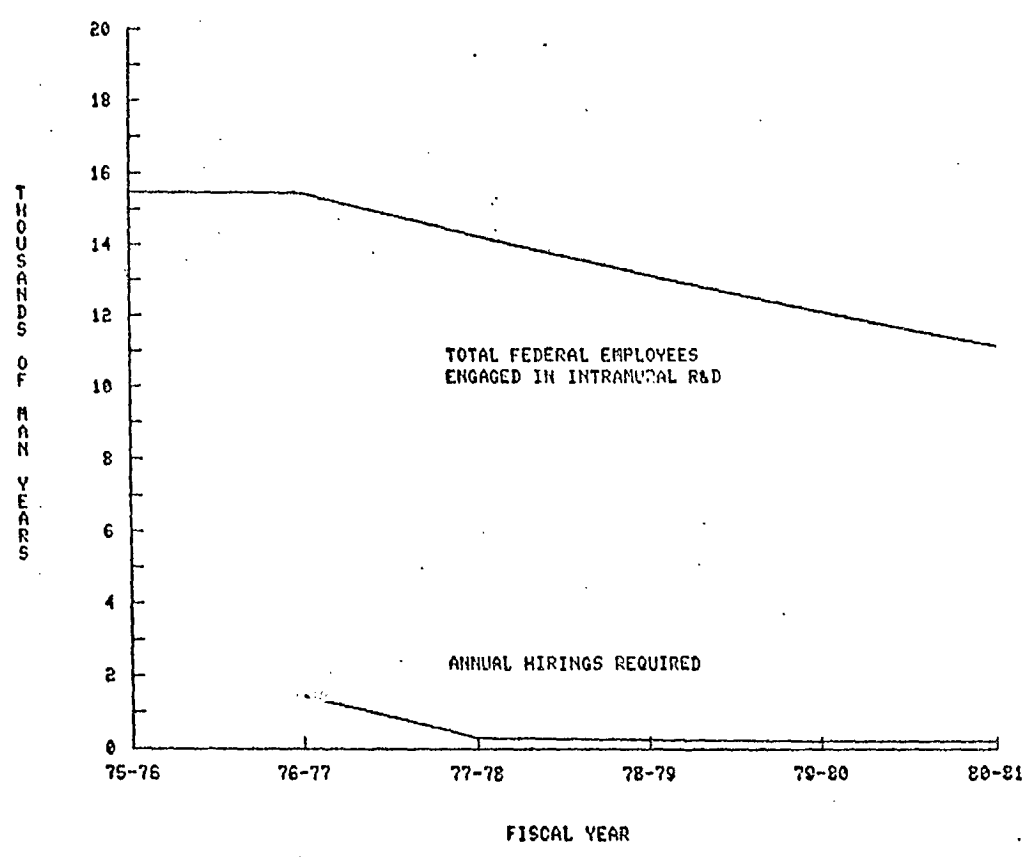


FIGURE 3

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