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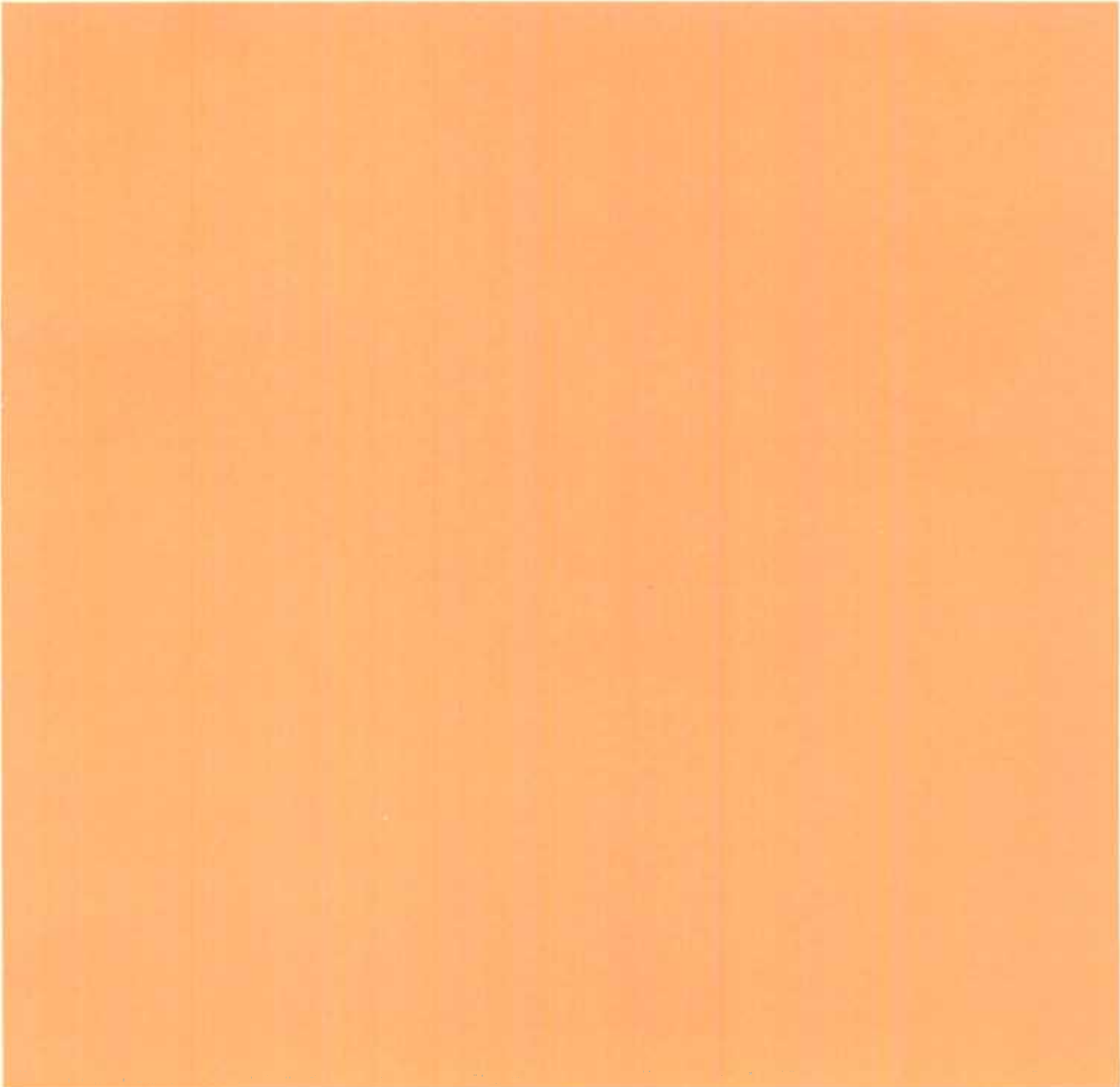
# Industrial research and development expenditures in Canada

1970



# Dépenses au titre de la recherche et du développement industriels au Canada

1970





STATISTICS CANADA — STATISTIQUE CANADA  
Education Division — Division de l'éducation  
Science Statistics Section — Section de la statistique de la science

INDUSTRIAL RESEARCH AND DEVELOPMENT  
EXPENDITURES IN CANADA

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DÉPENSES AU TITRE DE LA RECHERCHE ET DU  
DÉVELOPPEMENT INDUSTRIELS AU CANADA

1970

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## PREFACE

In 1956, Statistics Canada began a series of biennial surveys of R & D expenditures and manpower in Canadian industry. In response to the needs of science policy, these surveys became annual in 1969. This report contains the results of the second annual survey. The 1970 survey differs from its predecessors in that it was based on a sample rather than a complete coverage.

We wish to acknowledge here the assistance of the many business firms who co-operate with us in these surveys by providing the requested data, often at a considerable cost in terms of the time required of senior officials. For this inquiry, in which the regular R & D survey was combined with an experimental survey of technological innovation, we are especially indebted to the R & D Committee of the Canadian Manufacturers' Association, chaired by Mr. J.C.R. Punchard (Bell-Northern Research), and to Mr. Ted Davy (Commercial Intelligence Department of the C.M.A.).

SYLVIA OSTRY,  
*Chief Statistician of Canada.*

## PRÉFACE

En 1956, Statistique Canada a entrepris une série d'enquêtes portant sur les dépenses au titre de la recherche et du développement industriels et sur la main-d'oeuvre employée dans l'industrie canadienne. Pour satisfaire aux besoins de formulation des politiques dans le domaine des sciences, ces enquêtes, d'abord effectuées tous les deux ans, ont maintenant lieu tous les ans depuis 1969. Ce bulletin présente les résultats de la deuxième enquête annuelle. L'enquête de 1970 diffère des précédentes en ce que les résultats ont été obtenus à partir d'un échantillon plutôt qu'à partir d'un champ d'observation universel.

Nous sommes reconnaissants envers les nombreux établissements commerciaux qui ont collaboré avec nous pour mener ces enquêtes en nous envoyant les renseignements demandés, souvent à un coût élevé, si l'on tient compte du temps que les cadres supérieurs y ont consacré. Dans le cas du présent relevé, dans lequel l'enquête régulière sur la recherche et le développement a été fusionnée à une enquête expérimentale sur les innovations techniques, nous sommes particulièrement reconnaissants envers le Comité de la recherche et du développement de l'Association des manufacturiers canadiens, dont le président est M. J.C.R. Punchard (Recherche de la Bell-Northern) et envers M. Ted Davy (Service de renseignements commerciaux de l'A.M.C.).

SYLVIA OSTRY,  
*Le statisticien en chef du Canada.*

### SYMBOLS

The following standard symbols are used in publications of Statistics Canada:

- .. figures not available.
- ... figures not appropriate or not applicable.
- nil or zero.
- amount too small to be expressed.
- p preliminary figures.
- r revised figures.
- x confidential to meet secrecy requirements of the Statistics Act.

**Note:** Because of rounding, some totals will not correspond exactly to the sum of the items added.

### SIGNES CONVENTIONNELS

Les signes conventionnels suivants sont employés uniformément dans les publications de Statistique Canada:

- .. nombres indisponibles.
- ... n'ayant pas lieu de figurer.
- néant ou zéro.
- nombres infimes.
- p nombres provisoires.
- r nombres rectifiés.
- x confidentiel en vertu des dispositions de la Loi sur la statistique relatives au secret.

**Nota:** Certains totaux ne correspondent pas exactement à la somme des items composants à cause des arrondissements.

## FOREWORD

Statistics on resources committed to industrial research and development have been collected by Statistics Canada for 16 years. This information has several uses: for science policy, international comparisons, for economic and industry studies, and for the research policies of the firms themselves.

However, these statistics provide little more than a framework for further development. As the Senate Special Committee on Science Policy has recently noted, two high priority areas for study are, "research on research" and the processes of technological innovation. In both of these domains, the current statistical series of which this publication forms a part, will be useful; yet the series is definitely not sufficient. However, these statistics can provide an important part of the foundation required for the building of the total statistical base for launching studies of industrial research and technological innovation.

The range of statistics needed to carry out the necessary studies covers a broad spectrum of activities. A partial list includes: data on characteristics of industrial researchers; quantitative measures of the diffusion of knowledge; measurable research output; micro-economic and industry-wide data on selected instances of innovation; economic variables affecting innovation; indices of transfers of technology; and data on "nodes" or critical points in the process of innovation.

While it is most desirable that work be undertaken at once to develop statistical programmes which will shed light on the variables listed above, there are serious problems which must be solved first. For example, there has not been any authority with clear responsibility for encouraging studies of research and innovation. Another problem is the difficulty of formulating conceptual models which will provide the necessary orientation for statistical programmes. A third impediment is the nature of the existing data. Studies in these areas will often require free access to confidential company data collected by Statistics Canada. This implies that Statistics Canada must accept some responsibility for these studies. High priority has, in fact, been given to providing the Science Statistics Section of the Education Division with the resources needed to develop the capability which can produce the required statistics and their analysis.

The results of a 1970 experimental survey on some aspects of technological innovation are presently

## AVANT-PROPOS

Statistique Canada fait depuis 16 ans la collecte de statistiques sur les ressources consacrées à la recherche et au développement industriels. Ces renseignements servent à des fins multiples telles que la formulation des politiques scientifiques, la comparaison des données avec d'autres pays, la réalisation d'études en matières économiques et industrielles et même, l'établissement des programmes de recherches des entreprises.

Toutefois, ces statistiques n'offrent guère plus qu'un cadre de développement ultérieur. Ainsi que le notait récemment le comité spécial du Sénat sur la politique scientifique, deux domaines d'étude fortement prioritaires sont "la recherche sur la recherche" et le processus d'innovation sur le plan technologique. La série statistique courante, dont la présente publication constitue une partie, sera certes utile dans ces deux domaines: elle n'en demeure pas moins nettement insuffisante. Toutefois, ces statistiques peuvent contribuer largement à l'édification de l'ensemble des données statistiques nécessaires pour entreprendre des études sur la recherche industrielle et les innovations techniques.

L'éventail des statistiques exigées pour effectuer les études nécessaires couvre une gamme étendue d'activités. La liste partielle comprend: les données sur les caractéristiques des chercheurs dans l'industrie, les mesures quantitatives de diffusion des connaissances; le rendement mesurable de la recherche, les données micro-économiques et industrielles sur des exemples déterminés d'innovation; les variables économiques touchant l'innovation; les indices des transferts de technologie; et les données sur les problèmes et les difficultés rencontrés durant la phase d'innovation.

Il est plus que souhaitable d'entreprendre immédiatement le travail d'établissement de programmes statistiques qui feront la lumière sur les variables citées plus haut. Toutefois, pour y arriver, il faut d'abord surmonter de graves difficultés. Par exemple, aucune autorité n'a été jusqu'ici explicitement chargée de favoriser les études sur la recherche et l'innovation. La difficulté d'élaborer des modèles théoriques qui permettront d'assurer l'orientation nécessaire aux programmes statistiques constitue un autre obstacle. La nature des données actuelles en est un troisième. Les études en ces domaines exigeront fréquemment le libre accès aux données confidentielles qui sont recueillies par Statistique Canada sur les entreprises commerciales. Il s'ensuit que Statistique Canada doit assumer en partie la tâche d'effectuer ces études. En fait, un des premiers objectifs visés est de fournir à la Section de la statistique de la science (Division de l'éducation) les ressources nécessaires pour qu'elle puisse produire les statistiques demandées et en faire l'analyse.

On procède actuellement à une évaluation des résultats d'une enquête expérimentale menée en 1970 sur

being evaluated; it is planned to repeat this survey next year with some modifications. The first experimental survey benefited from the advice and assistance of officers of the Canadian Manufacturers Association and of several government departments. It is planned to consult more widely and involve more individuals and organizations in future developments.

The present survey represents only a first step toward filling the statistical gap referred to earlier. As additional resources become available, the Science Statistics Section, under the direction of Humphrey Stead, will continue to develop an important body of statistical information.

Miles Wisenthal,  
Director, Education Division,  
Statistics Canada.

certain aspects de l'innovation technologique. L'enquête devrait être répétée l'année prochaine mais avec certaines modifications. La première enquête expérimentale a été menée à bonne fin grâce aux conseils et au concours des dirigeants de l'Association des manufacturiers canadiens et d'un grand nombre de ministères de l'État. En ce qui a trait aux développements futurs, on prévoit inviter la participation d'un plus grand nombre de personnes et d'organisations et accroître l'éventail des consultants.

La présente enquête ne constitue que la première étape visant à combler l'écart statistique dont il a été question précédemment. A mesure qu'elle aura accès à des ressources plus considérables, la Section de la statistique de la science pourra, sous la direction de M. Humphrey Stead, poursuivre l'établissement d'un imposant corpus de renseignements statistiques.

Miles Wisenthal,  
Le directeur de la Division de l'éducation,  
Statistique Canada.



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TECHNICAL NOTES

NOTES TECHNIQUES

The Sample

Two procedures are used for the survey. For odd base years (e.g., 1969), all firms believed to be performing or funding R & D are surveyed. For even base years (e.g., 1970), questionnaires are sent to only the 100 respondents with the largest current intramural expenditures, as determined from the results of the previous year.

The firms included in the present survey have, in the past, accounted for the following percentages of total current intramural expenditures:

L'échantillon

On a recours à deux méthodes distinctes pour mener l'enquête: les années impaires, par exemple 1969, toutes les entreprises susceptibles de participer ou de contribuer aux travaux de recherche et de développement sont enquêtées; les années paires, par exemple 1970, les questionnaires ne sont envoyés qu'aux 100 enquêtés qui, d'après les résultats de l'enquête de l'année précédente, ont effectué les dépenses courantes intra-muros les plus considérables.

Les firmes comprises dans la présente enquête ont constitué, dans le passé, les pourcentages suivants des dépenses courantes intra-muros:

Industry group Groupe industriel	Year - Année				
	1966	1967	1968	1969	1970
	%				
Mines and wells - Mines et puits .....	77	84	81	80	82
Chemical based - À base chimique.....	78	78	76	73	68
Wood based - À base de bois.....	79	75	74	75	74
Metals - Métaux .....	76	77	70	76	79
Machinery and transportation equipment - Machines et matériel de transport .....	89	85	84	81	78
Electrical - Électrique .....	89	89	88	87	86
Other industries - Autres industries.....	51	54	59	54	55
<b>Total</b> .....	<b>83</b>	<b>82</b>	<b>80</b>	<b>78</b>	<b>77</b>

The percentages of total capital expenditures attributable to these firms fluctuated rather more than those for current expenditures:

La proportion des dépenses totales d'immobilisations effectuées par ces firmes a varié plus fortement que celle des dépenses courantes:

Industry group Groupe industriel	Year - Année				
	1966	1967	1968	1969	1970
	%				
Mines and wells - Mines et puits .....	31	75	46	25	41
Chemical based - À base chimique.....	90	83	81	80	61
Wood based - À base de bois.....	92	87	89	69	50
Metals - Métaux .....	95	88	82	91	85
Machinery and transportation equipment - Machines et matériel de transport .....	50	78	86	74	22
Electrical - Électrique .....	90	92	79	68	69
Other industries - Autres industries.....	79	73	69	72	78
<b>Total</b> .....	<b>87</b>	<b>86</b>	<b>78</b>	<b>71</b>	<b>64</b>

In 1969, the 100 firms included in the 1970 survey accounted for the following percentages of funds:

En 1969, les 100 firmes participant à l'enquête de 1970 ont représenté les pourcentages suivants de tous les fonds affectés à la R & D:

Industry group — Group industriel	Source of funds — Source de fonds			
	Own funds — Propres fonds	Canadian government — Gouvernement du Canada	Other Canadian — Autres canadiens	Foreign — De l'étranger
Mines and wells — Mines et puits .....	77	57	62	100
Chemicals based — À base chimique .....	73	49	8	94
Wood based — À base de bois .....	78	74	70	98
Metals — Métaux .....	78	44	56	98
Machinery and transportation equipment — Machines et matériel de transport .....	79	95	19	87
Electrical — Électrique .....	85	89	99	93
Other industries — Autres industries .....	70	13	21	61
<b>Total</b> .....	<b>77</b>	<b>84</b>	<b>67</b>	<b>91</b>

The "sample" was not chosen in order to provide estimates for all industrial R & D for all classifications. Such sampling is not practical for most classifications because of the small number of firms in so many groups — this is illustrated by the number of group aggregations necessary in the statistical tables of the preceding report. However, the estimated totals used for the General Review are believed to be fairly close to the actual expenditures. In any case, readers may use the data in the statistical tables for their own analyses. THE STATISTICAL TABLES CONTAIN DATA ONLY FOR THE 100 FIRMS SURVEYED.

L'"échantillon" n'a pas été choisi dans le but d'obtenir une estimation des dépenses de recherche et de développement dans toutes les catégories d'activité économique. Un tel échantillonnage n'est pas pratique dans la plupart des classifications en raison du nombre restreint de firmes dans des groupements aussi nombreux (ce qui explique les nombreux regroupements qui se sont révélés nécessaires dans les tableaux statistiques du rapport précédent). Toutefois, on estime que les chiffres estimatifs cités dans la Revue générale représentent assez bien les dépenses réelles. De toute façon, les lecteurs peuvent utiliser les données des tableaux statistiques pour faire leurs propres analyses. LES TABLEAUX STATISTIQUES CONTIENNENT UNIQUEMENT LES DONNÉES DES 100 FIRMES ENQUÊTÉES.

**Industry Group**

- A. Mines and wells:
  - Mines
  - Gas and oil wells
- B. Chemical based:
  - Food and beverages
  - Rubber
  - Textiles
  - Petroleum products
  - Drugs and medicines
  - Other chemical products
- C. Wood based:
  - Wood
  - Furniture and fixtures
  - Paper
- D. Metals:
  - Primary metals (ferrous)
  - Primary metals (non-ferrous)
  - Metal fabricating

**Groupe industriel**

- A. Mines et puits:
  - Mines
  - Puits de gaz et de pétrole
- B. A base chimique:
  - Aliments et boissons
  - Caoutchouc
  - Textiles
  - Dérivés du pétrole
  - Produits médicaux et pharmaceutiques
  - Autres produits chimiques
- C. A base de bois:
  - Bois
  - Meubles et articles d'ameublement
  - Papier
- D. Métaux:
  - Métaux ferreux semi-transformés
  - Métaux non ferreux semi-transformés
  - Produits métalliques

- E. Machinery and transportation equipment:
  - Machinery
  - Aircraft and parts equipment
  - Other transportation equipment
- F. Electrical:
  - Electrical products
  - Scientific and professional instruments
- G. Other industries:
  - Tobacco
  - Leather
  - Knitted goods
  - Clothing
  - Non-metallic minerals
  - Transportation and other utilities
  - Construction
  - Engineering and scientific services
  - Trade and industrial associations

**Ownership Group**

1. Industrial associations, research institutes, provincial and federal Crown corporations.
2. Subsidiaries of firms of the U.S.A.
3. Other foreign-owned subsidiaries.
4. Canadian-owned or controlled.

- E. Machines et matériel de transport:
  - Machines
  - Aéronefs et pièces
  - Autre matériel de transport
- F. Électrique:
  - Appareils électriques
  - Instruments scientifiques et professionnels
- G. Autres industries:
  - Tabacs
  - Cuirs
  - Articles tricotés
  - Vêtements
  - Produits minéraux non métalliques
  - Transport et autres services d'utilité publique
  - Bâtiment et travaux publics
  - Services techniques et scientifiques
  - Associations commerciales et industrielles

**Groupe d'appartenance**

1. Associations industrielles, instituts de recherche, sociétés de la Couronne des administrations fédérale et provinciales.
2. Filiales d'entreprises américaines.
3. Filiales d'autres entreprises étrangères.
4. Entreprises possédées ou contrôlées par des canadiens.

### GENERAL REVIEW

"Industrial research and development" refers to R & D carried out by Canadian industry, whatever the source of funds. In the survey it was defined as:

"... investigative work carried out:

- (1) to acquire new scientific and technological knowledge,
- (2) to devise and develop new products or processes, or
- (3) to apply newly acquired knowledge in making technically significant improvements to existing products or processes."

It is therefore, only the first part of the process of technological innovation: not included in this survey are the expenditures on items such as new product marketing, product or design engineering, tooling and industrial engineering, and manufacturing start-up.

Since 1967, expenditures on industrial research and development (R & D) have probably not kept pace with price and wage increases. For example, if current intramural R & D expenditures had increased annually by only 5%, they would total \$370 million in 1972 rather than the forecasted \$350 million (a compound

### REVUE GÉNÉRALE

"La recherche et le développement industriels" comprend les travaux de R & D exécutés par l'industrie canadienne, sans égard à la provenance des fonds. Dans l'enquête, la R & D fut définie comme:

"... des travaux effectués en vue:

- (1) d'acquérir de nouvelles connaissances,
- (2) de créer et perfectionner de nouveaux produits ou procédés, ou
- (3) d'appliquer les connaissances nouvellement acquises au perfectionnement technique de produits ou procédés existants."

La R & D ne comprend donc que la première partie du processus d'innovation technologique. On n'a pas inclus dans cette enquête les dépenses pour des activités telles que la commercialisation de nouveaux produits, la conception technique ou graphique de produits, la conception d'outils et le génie industriel, et le démarrage de la production manufacturière.

Depuis 1967, les dépenses de recherche et de développement industriels n'ont probablement pas évolué au même rythme que la hausse des prix et des salaires. Si par exemple, les dépenses courantes intra-muros de R & D s'étaient accrues de seulement 5% par année, elles auraient atteint \$370 millions en 1972 au lieu des \$350

CHART - I

GRAPHIQUE - I

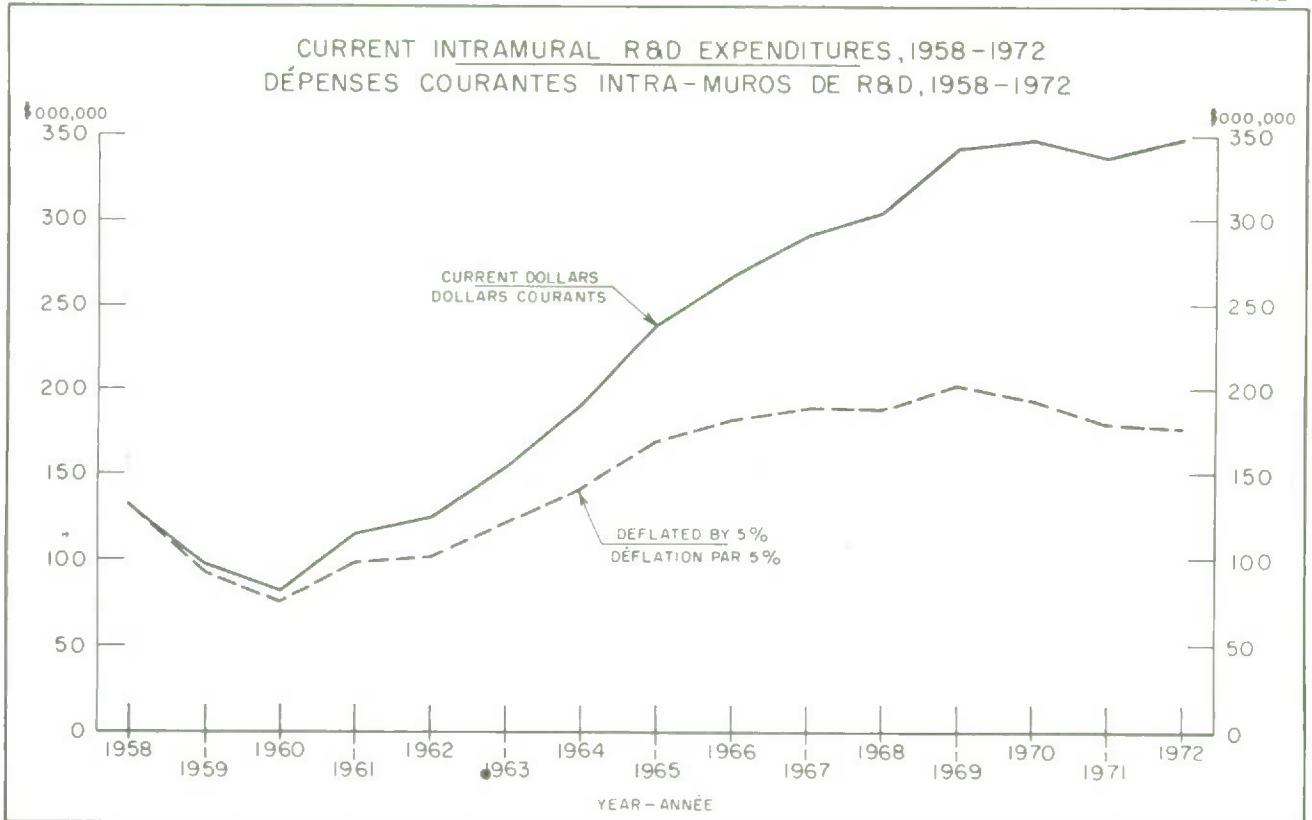
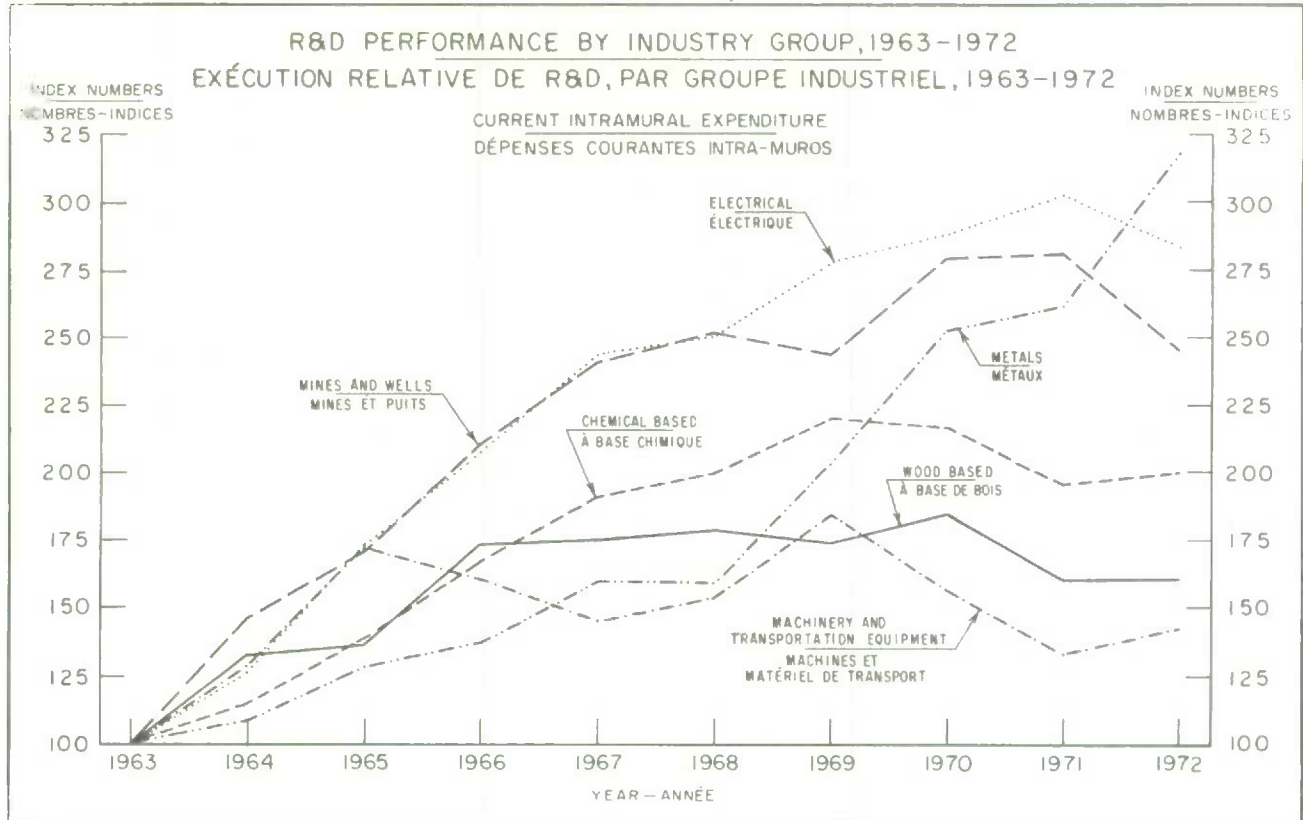


CHART-2

GRAPHIQUE-2



growth rate of less than 4%). Chart 1 shows the pattern for the last 15 years. The trend has been noticeably affected by two large projects: the termination of the Arrow development contract in 1959 and the *Bras d'Or* development contract (1963 to 1971).

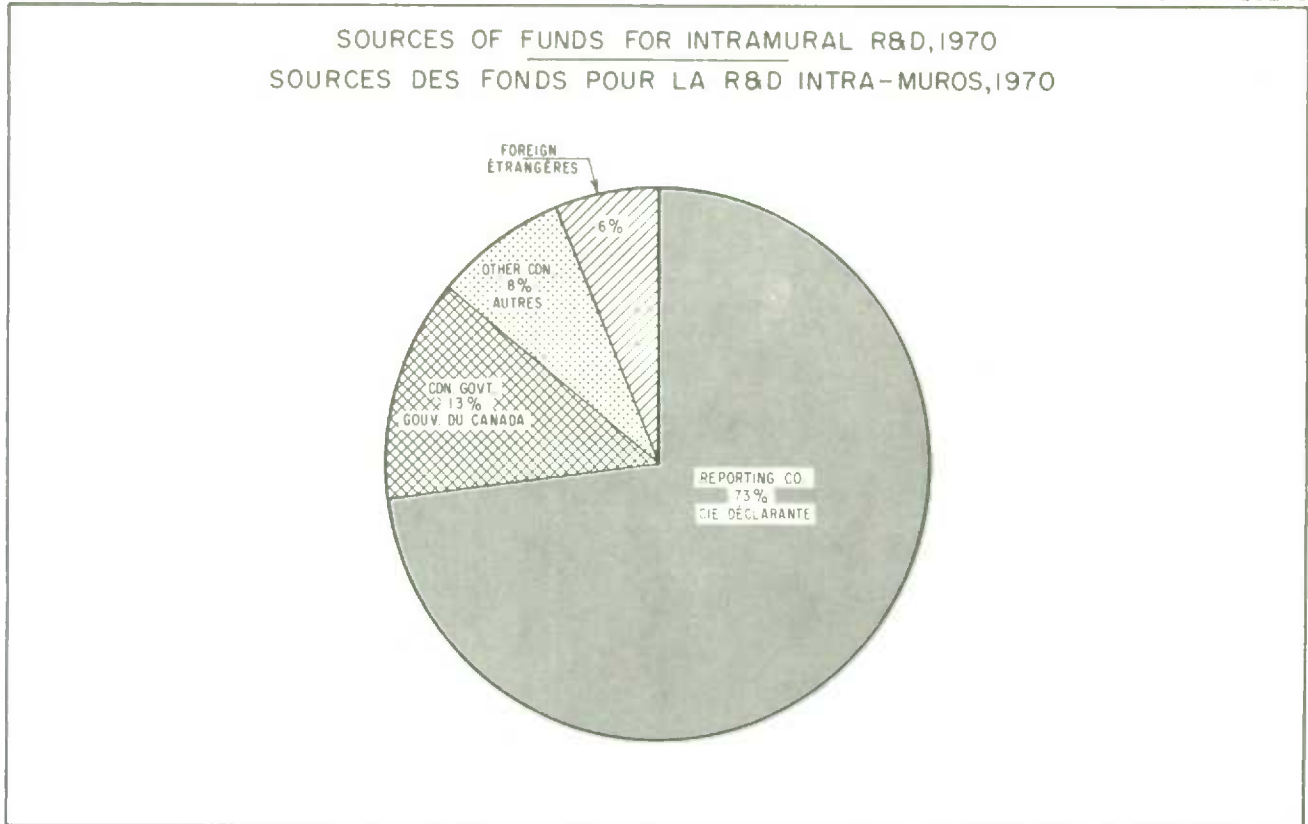
The relative performances of the industry groups are quite different. Any comparison, such as that in Chart 2, depends, of course, on the base year. The one chosen, 1963, has no particular significance - it is a convenient year because of our present records. The electrical group is the largest performer of R & D (estimated current intramural expenditures of \$106 million in 1972). This group is composed of firms in the electrical and electronic products industry as well as those manufacturing scientific and professional instruments. For such firms, throughout the world, competition through technology is often more important than advertising or style. These are also the firms heavily involved in satellite development and nuclear power production. Besides the largest expenditures, the electrical industry group has also usually had the greatest relative increases during the past few years. However, one industry group, metals, forecasts unusually high activity in 1972. This is due to firms processing non-ferrous metals. Expenditures on R & D by the ferrous metals industry have grown much more

millions prévus (un taux d'accroissement composé de moins de 4%). Le Graphique 1 schématise les tendances générales des 15 dernières années. Le mouvement a été sensiblement influencé par l'activité de deux grandes entreprises: l'achèvement en 1959 des travaux de mise au point de l'avion Arrow et l'exécution des travaux de mise en valeur de *Bras d'Or* (1963 à 1971).

L'importance relative des travaux de R & D diffère considérablement entre les groupes industriels. Toute comparaison, comme celle dans le Graphique 2, dépend naturellement de l'année de base. L'année choisie, 1963, ne revêt aucune importance particulière; elle constitue simplement une année pratique à cause de nos dossiers actuels. Le groupe "électrique" est le plus important exécutant de travaux de R & D (les dépenses courantes intra-muros sont estimées à 106 millions de dollars en 1972). Ce groupe se compose d'entreprises spécialisées dans la fabrication d'appareils électriques et électroniques ainsi que dans la fabrication d'instruments scientifiques et professionnels. Partout dans le monde, ces entreprises doivent rivaliser avec leurs concurrents sur le plan technique plutôt que sur celui des moyens publicitaires ou de l'attrait du style. En outre, ce sont ces entreprises qui se consacrent largement à la mise au point de satellites et à la production d'énergie nucléaire. En plus d'être les plus grandes, les dépenses de ce groupe ont, dans l'ensemble, connu des accroissements relatifs plus importants que les autres groupes dans les dernières années. Cependant, un

CHART-3

GRAPHIQUE-3



slowly. The fluctuations in the R & D activity of the machinery and transportation equipment industry group are due mainly to changes in the amount of R & D carried out by the aircraft industry.

The companies carrying out R & D finance most of the work themselves. However, the Federal Government is also a major source of funds. Besides providing development contracts and assistance grants, it also encourages industrial R & D by reimbursing firms for certain of their expenditures in previous years. This program, the Industrial Research and Development Incentives Act (IRDIA), since it consists of payments after the fact, is treated differently than the other programs. Payments under IRDIA are not included in Chart 3, although they are shown below.

The figures shown in Chart 4 are not the same as those used throughout the rest of the report. They are provided by agencies of the Federal Government in

groupe industriel, celui des métaux, prévoit un accroissement exceptionnel pour l'année 1972. Ceci est principalement attribuable aux firmes engagées dans la transformation des métaux non ferreux. Les dépenses de R & D affectuées par le groupe industriel de transformation des métaux ferreux se sont accrues à un rythme beaucoup moins rapide. Les fluctuations de l'activité de R & D du groupe des machines et du matériel de transport est attribuable aux variations des activités de R & D de l'industrie des aéronefs et pièces.

Les sociétés qui poursuivent des travaux de R & D financent elles-mêmes la plupart de leurs travaux. L'administration fédérale constitue toutefois une autre source importante de fonds. En plus d'accorder des contrats de développement et des subventions, l'administration fédérale encourage également la R & D industrielle en contribuant à une partie des dépenses encourues l'année précédente. Étant donné que ce programme, qui est établi en vertu de la Loi stimulant la recherche et le développement scientifiques (L.S.R.D.S.) consiste en l'octroi de sommes après exécution des travaux, il est traité différemment des autres programmes. Les versements faits aux termes de cette loi ne sont pas compris dans le Graphique 3, mais apparaissent ci-dessous.

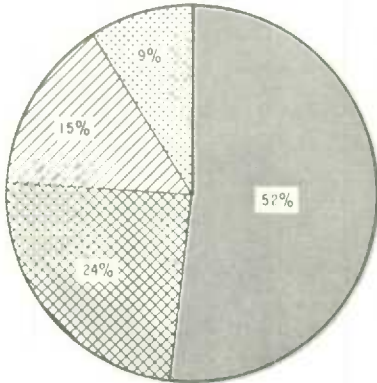
Les chiffres indiqués dans le Graphique 4 ne sont pas les mêmes que ceux employés ailleurs dans ce rapport. Ils proviennent d'organismes de l'administration fédérale







GOVERNMENT FUNDS FOR INDUSTRIAL R & D, FISCAL YEAR 1969-70  
 FONDS DE L'ADMINISTRATION FÉDÉRALE POUR LA R & D INDUSTRIELLE, EXERCICE 1969-70

R & D CONTRACTS—CONTRATS DE R & D

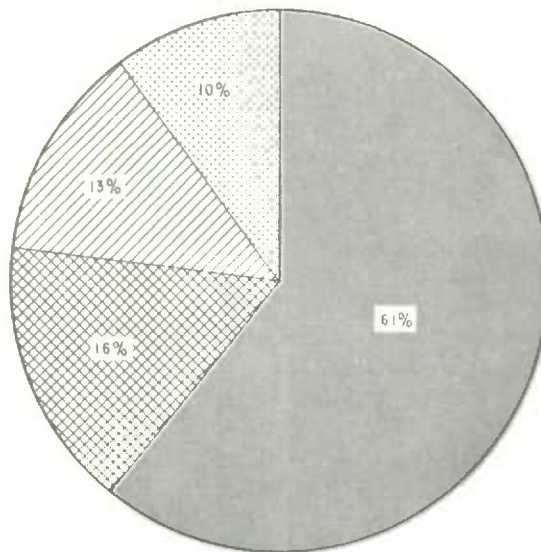
\$18,600,000







-  DEPT OF NATIONAL DEFENCE  
MIN. DE LA DÉFENSE NATIONALE
-  ATOMIC ENERGY OF CANADA LTD  
ÉNERGIE ATOMIQUE DU CANADA LTÉE
-  DEPT OF COMMUNICATIONS  
MIN. DES COMMUNICATIONS
-  OTHER—AUTRES

R & D ASSISTANCE GRANTS—SUBVENTIONS DE R & D

\$39,300,000



-  DEFENCE INDUSTRY PRODUCTIVITY PROGRAM  
PROGRAMME DE PRODUCTIVITÉ DE L'INDUSTRIE DU MATÉRIEL DE DÉFENSE
-  INDUSTRIAL RESEARCH ASSISTANCE PROGRAM  
PROGRAMME D'AIDE À LA RECHERCHE INDUSTRIELLE
-  DEFENCE INDUSTRIAL RESEARCH PROGRAM  
PROGRAMME DE RECHERCHE INDUSTRIELLE POUR LA DÉFENSE
-  PROGRAM FOR THE ADVANCEMENT OF INDUSTRIAL TECHNOLOGY  
PROGRAMME POUR L'AVANCEMENT DE LA TECHNOLOGIE INDUSTRIELLE

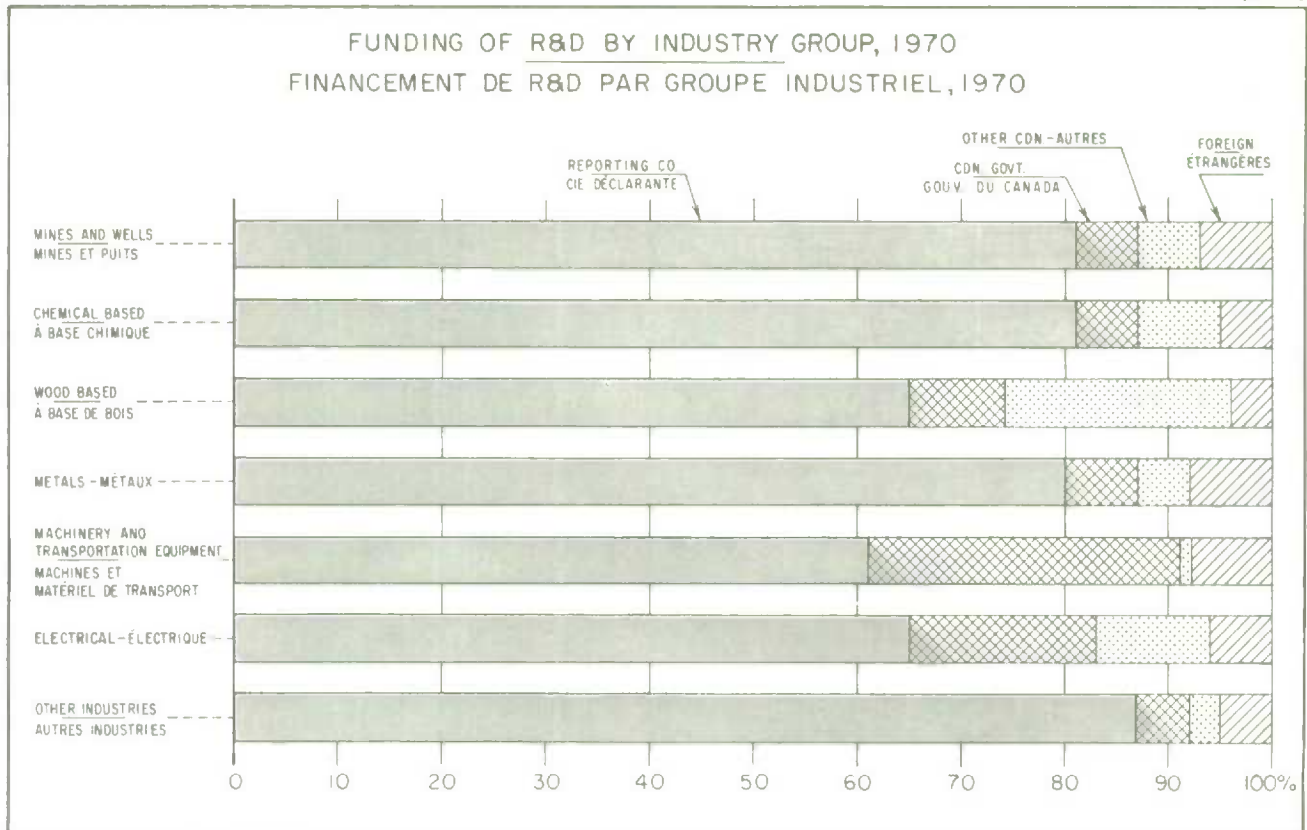
\$23,000,000



INDUSTRIAL RESEARCH OF  
 DEVELOPMENT INCENTIVES ACT  
 LOI STIMULANT LA RECHERCHE  
 ET LE DÉVELOPPEMENT SCIENTIFIQUES

CHART-5

GRAPHIQUE-5



another survey.<sup>1</sup> The year 1969 - 70 is the fiscal year ending on March 31, 1970 - it is, therefore, a period which does not completely correspond to the calendar year 1970 (the latest reference year for the data on source of funds).

Firms in four industry groups rely almost entirely on their own resources for the funding of their R & D. In one group, wood-based industries, a significant portion of the group's R & D is financed by other companies in the group. The Pulp and Paper Research Institute of Canada accounts for part of this funding pattern but there are important flows between affiliated companies within the group. However, two groups rely heavily on Federal Government funding. Companies in the machinery and transportation equipment, and the electrical groups receive over 75% of direct government assistance. These federal funds represented 30% and 18% respectively of their total intramural expenditures in 1970. In all other industry groups, more money is received as IRDIA grants than under all other programs. These grants represented between 11% (metals) and 5% (wood based) of the 1970 R & D not financed by the other Federal Government or foreign sources.

participant à une autre enquête<sup>1</sup>. L'année 1969 - 70 représente l'année financière prenant fin le 31 mars 1970; il s'agit donc d'une période qui ne correspond pas exactement à l'année civile 1970 (année de référence la plus récente pour les données sur les sources de fonds).

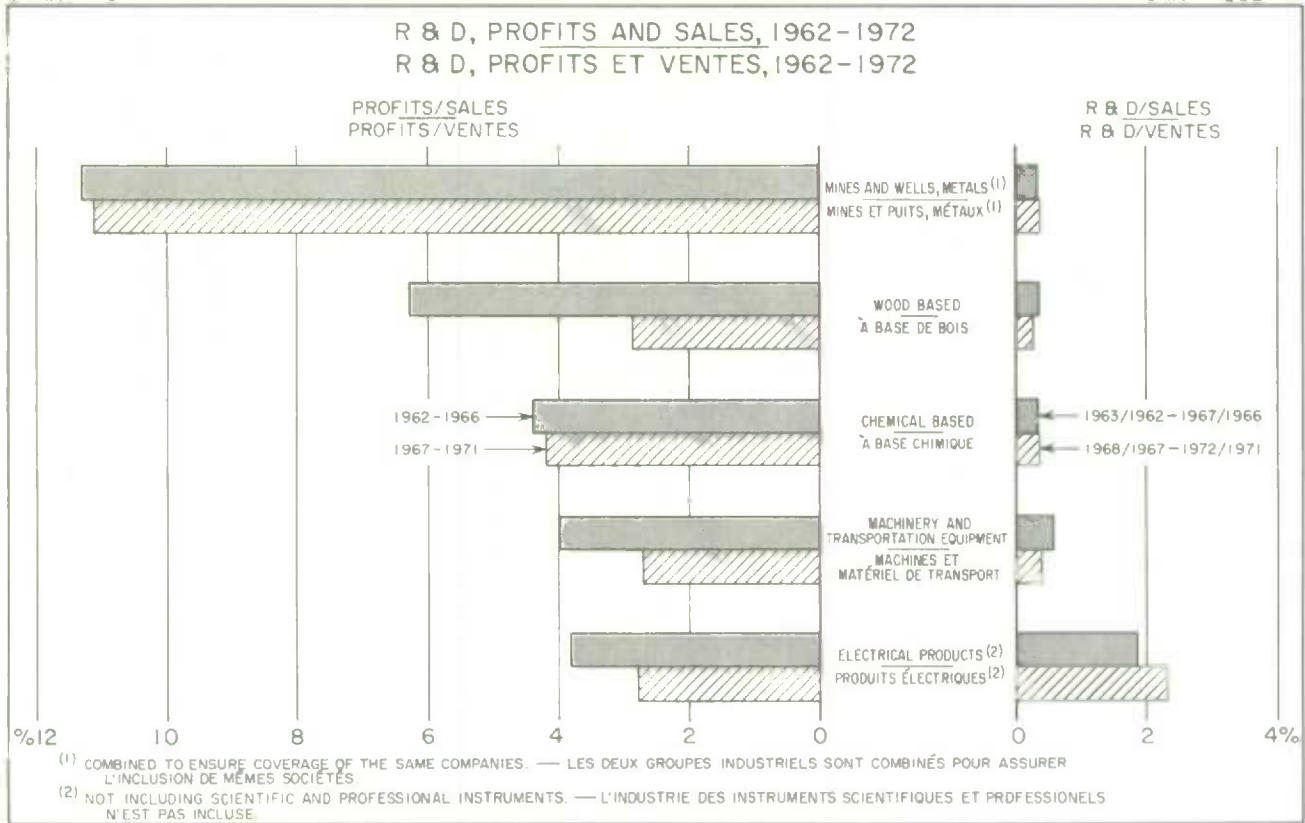
Les sociétés de quatre groupes industriels défraient elles-mêmes la plupart de leurs travaux de R & D. Dans le groupe du bois, une grande portion de la R & D des sociétés est subventionnée par d'autres sociétés du groupe. Ceci est dû, en partie, à l'Institut canadien de recherches sur les pâtes et papiers, mais il y a également des flux importants entre les filiales de ce groupe. Deux groupes font appel largement aux fonds de l'administration fédérale. Les sociétés dans le groupe des machines et du matériel du transport et le groupe électrique reçoivent plus de 75 % de l'aide gouvernementale. En 1970, ces fonds représentaient respectivement 30 % et 18 % de leurs dépenses intra-muros totales. Pour tous les autres groupes industriels, plus d'argent est reçu en vertu de la Loi stimulant la recherche et le développement scientifique qu'en vertu de tout autres programmes. Ces subventions ont couvert en 1970 entre 11 % (métaux) et 5 % (bois) de travaux de R & D financés par l'industrie canadienne.

<sup>1</sup> See *Federal Government Expenditures on Science*, Catalogue 13-202.

<sup>1</sup> Voir *Dépenses de l'administration fédérale en science* (Catalogue 13-202).

CHART - 6

GRAPHIQUE - 6



The net amount spent on R & D in any year directly reduces that year's profit. However, this R & D may be essential to the sales and profits of future years. In Chart 6 the profits and sales of one year are compared to the R & D expenditures of the following year. Two averages were compiled for each series: one for the five years 1962 - 1966 (profits/sales) or 1963 - 1967 (R & D/sales) and one for the next five years. The R & D expenditures used are current intramural expenditures less estimated government and foreign direct financing. The sales and profits<sup>2</sup> are those of all firms in the industry groups (i.e. including firms not involved in R & D).

From the chart one can see that profits, as a proportion of sales, have declined for all industry groups during the past 10 years. During this time, R & D expenditures, as a proportion of sales, have increased for three groups. This might be simply explained by the direct relationship between R & D expenditures and profits in the same year. However, if R & D expenditures and profits are added together, the

Le profit d'une année est directement réduit par les dépenses nettes de R & D de la même année. Cependant, cette R & D peut être essentielle aux ventes et profits de l'avenir. Dans le Graphique 6, les profits et ventes d'une année sont comparés aux dépenses de R & D de l'année suivante. Pour chaque série, deux moyennes ont été préparées: une pour la période de cinq ans 1962 - 1966 (profits/ventes) ou 1963 - 1967 (R & D/ventes) et l'autre pour les cinq prochaines années. Les dépenses de R & D utilisées pour le graphique correspondent aux dépenses courantes intra-muros, moins l'aide financière directe provenant de l'administration fédérale ou de l'étranger. Les ventes et profits<sup>2</sup> sont pour toutes les sociétés dans un groupe industriel (i.e. y compris les firmes qui ne font pas de R & D).

Il ressort clairement de ce graphique que les profits, par rapport aux ventes, ont diminué pour tous les groupes industriels pendant les dix dernières années. Pour cette période toutefois, les dépenses de R & D, par rapport aux ventes, se sont accrues pour trois groupes. La relation directe entre dépenses de R & D et profits pour une année est une explication possible. Cependant, si l'on additionne profits et dépenses de R & D, on obtient une

<sup>2</sup> *Industrial Corporations*, (Catalogue 61-003) and *Corporation Financial Statistics*, (Catalogue 61-207).

<sup>2</sup> *Sociétés industrielles-statistique financière trimestrielle* (Catalogue 61-003) et *Statistique financière des sociétés* (Catalogue 61-207).

resulting comparison with sales is almost identical with the profit/sales ratios. The two groups which had a relative decrease in R & D expenditures also had the greatest decline in profits. In general, it seems that Canadian industry has tended to increase its involvement in R & D during a time of declining profits.<sup>3</sup>

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<sup>3</sup> There are various patterns of activity within industry groups as well as between groups. For example, in 1969 the ratio of R & D expenditures to profits in the Chemical based group ranges from 31.2% (chemicals) to 2.9% (food and beverages): for the entire group it was 9.7%.

comparaison avec les ventes qui ne diffère pas sensiblement des rapports profits/ventes déjà établis. Les deux groupes qui ont connu des diminutions relatives de leurs dépenses de R & D sont également ceux qui ont subi les plus importantes diminutions de leurs profits. En général, il semble que l'industrie canadienne a augmenté ses activités de R & D, même en période de déclin des profits<sup>3</sup>.

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<sup>3</sup> Les activités s'organisent selon des schémas différents non seulement entre les groupes mais également à l'intérieur d'un même groupe. Par exemple, en 1969, le rapport de dépenses de R & D sur les profits pour le groupe chimique était de 31.2 % (chimique) à 2.9 % (aliments et boissons): Le rapport pour l'ensemble du groupe était de 9.7 %.

STATISTICAL TABLES

(100 Companies only)



TABLEAUX STATISTIQUES

(100 enquêtés seulement)

TABLE 1. Number of Firms, by Industry and Ownership Group, 1970

TABLEAU 1. Nombre de sociétés, par groupe industriel et par groupe d'appartenance, 1970

Industry group – Groupe industriel	Ownership group — Groupe d'appartenance				Total
	1	2	3	4	
A. Mines and wells – Mines et puits .....	1	2	1	3	7
B. Chemical based – A base chimique .....	1	20	4	3	28
C. Wood based – A base de bois .....	1	4	—	4	9
D. Metals – Métaux .....	—	1	—	8	9
E. Machinery and transportation equipment – Machines et matériel de transport .....	—	9	4	4	17
F. Electrical – Électrique .....	—	11	4	6	21
G. Other industries – Autres industries .....	3	2	2	2	9
<b>Total</b> .....	<b>6</b>	<b>49</b>	<b>15</b>	<b>30</b>	<b>100</b>

TABLE 2. Current Intramural R & D Expenditures, by Industry Group, 1965-1972

TABLEAU 2. Dépenses courantes intra-muros de R & D, par groupe industriel, 1965-1972

Industry group – Groupe industriel	1965	1966	1967	1968	1969	1970	1971	1972
	millions of dollars – millions de dollars							
A. ....	6.9	8.1	10.2	10.2	9.9	11.4	11.1	10.0
B. ....	41.7	50.4	55.5	58.7	61.9	57.0	53.3	55.9
C. ....	12.0	15.5	14.8	14.9	14.7	15.4	13.2	13.2
D. ....	14.5	15.0	17.7	16.1	22.2	29.0	28.8	35.2
E. ....	61.4	56.0	48.4	50.5	59.6	48.1	42.5	45.3
F. ....	58.5	69.0	82.9	82.2	89.7	92.5	98.1	92.0
G. ....	4.9	6.0	7.6	11.1	11.2	12.9	15.4	18.1
<b>Total</b> .....	<b>199.9</b>	<b>220.0</b>	<b>237.1</b>	<b>243.7</b>	<b>269.4</b>	<b>266.4</b>	<b>262.4</b>	<b>269.9</b>
Annual change – Changement annuel .....		10	8	3	10	- 1	- 1	3

Note: The letters A to G represent the industry groups in this and subsequent tables. – Nota: A partir de ce tableau, les lettres A à G remplacent les noms des groupes industriels.

TABLE 3. Capital Expenditures on R & D Facilities, by Industry Group, 1965-1972

TABLEAU 3. Dépenses en installations de R & D, par groupe industriel, 1965-1972

Industry group – Groupe industriel	1965	1966	1967	1968	1969	1970	1971	1972
	millions of dollars – millions de dollars							
A. ....	0.6	0.5	0.8	1.2	0.4	0.7	0.5	1.5
B. ....	19.9	15.7	10.2	8.3	9.0	6.9	5.2	4.1
C. ....	11.3	8.1	6.5	2.7	2.4	1.3	1.1	1.1
D. ....	4.9	8.1	5.7	3.6	3.5	3.5	3.8	6.8
E. ....	0.4	0.6	1.8	3.8	3.4	1.3	1.3	1.6
F. ....	7.2	8.6	10.9	4.4	8.6	7.6	7.1	6.3
G. ....	0.9	2.7	1.6	2.6	8.1	13.0	19.7	23.6
<b>Total</b> .....	<b>45.2</b>	<b>44.3</b>	<b>37.5</b>	<b>26.6</b>	<b>35.2</b>	<b>34.3</b>	<b>38.6</b>	<b>45.0</b>

**TABLE 4. Sources of Funds for Intramural R & D, by Industry Group, 1970**  
**TABLEAU 4. Sources des fonds pour la R & D intra-muros, par groupe industriel, 1970**

Industry group — Groupe industriel	Sources of funds — Sources des fonds					Total
	Canadian — Canadiennes				Foreign — Étrangères	
	Reporting company — Cie déclarante	Canadian government <sup>1</sup> — Gouvernement du Canada <sup>1</sup>	Other — Autres	Total Canada		
millions of dollars — millions de dollars						
A. ....	10.5	0.1	0.7	11.3	0.8	12.1
B. ....	56.4	1.9	0.6	58.9	5.0	63.9
C. ....	11.9	1.1	3.0	16.0	0.7	16.7
D. ....	27.7	1.1	1.0	29.8	2.7	32.5
E. ....	29.0	16.1	0.2	45.3	4.1	49.4
F. ....	66.0	16.8	11.7	94.5	5.6	100.1
G. ....	24.3	0.3	0.2	24.7	1.2	25.9
<b>Total</b> .....	<b>225.8</b>	<b>37.4</b>	<b>17.3</b>	<b>280.5</b>	<b>20.1</b>	<b>300.7</b>
Percentage — Pourcentage .....	75	12	6	93	7	100

<sup>1</sup> Does not include IRDIA grants nor nuclear power prototypes. — Ne comprends pas les subventions reçus en vertu de la L.S.R.D.S. ni les dépenses pour centrales nucléaires prototypes.

**TABLE 5. Assistance from the Government of Canada under the Industrial Research and Development Incentives Act, by Industry Group, 1968 - 1970**

**TABLEAU 5. Assistance du gouvernement du Canada en vertu de la Loi stimulant la recherche et le développement scientifiques, par groupe industriel, 1968 - 1970**

Industry group — Groupe industriel	1968		1969		1970	
	Claimed <sup>1</sup> — Réclamée <sup>1</sup>	Received — Reçue	Claimed <sup>1</sup> — Réclamée <sup>1</sup>	Received — Reçue	Claimed <sup>1</sup> — Réclamée <sup>1</sup>	Received — Reçue
	millions of dollars — millions de dollars					
A. ....	0.2	0.4	0.1	0.3	0.9	—
B. ....	0.8	5.7	0.3	2.9	2.7	1.9
C. ....	—	1.2	—	1.0	0.5	0.3
D. ....	—	1.9	0.4	1.5	3.2	—
E. ....	—	3.7	0.1	3.7	1.1	0.9
F. ....	0.7	4.8	1.0	4.8	2.7	2.2
G. ....	—	2.1	—	1.6	0.3	1.4
<b>Total</b> .....	<b>1.8</b>	<b>19.9</b>	<b>2.0</b>	<b>15.8</b>	<b>11.4</b>	<b>6.7</b>

<sup>1</sup> Unsettled claims only. — Réclamations en suspens.

**TABLE 6. Extramural Payments for R & D, by Industry Group, 1965 - 1972**

**TABLEAU 6. Dépenses extra-muros de R & D, par groupe industriel, 1965 - 1972**

Industry group — Groupe industriel	1965	1966	1967	1968	1969	1970	1971	1972
millions of dollars — millions de dollars								
A. ....	0.6	0.6	0.8	0.7	0.5	0.7	1.1	1.2
B. ....	5.8	6.2	6.1	5.9	6.2	5.3	5.6	6.4
C. ....	2.1	2.1	2.1	2.0	2.0	2.1	1.9	1.5
D. ....	7.2	7.1	6.9	7.7	7.6	8.6	9.0	8.5
E. ....	2.4	2.7	1.7	2.0	2.6	2.3	2.0	2.4
F. ....	3.2	2.4	3.1	3.3	6.1	6.6	5.2	4.5
G. ....	4.0	4.5	7.3	5.3	11.4	9.0	18.8	27.4
<b>Total</b> .....	<b>25.3</b>	<b>25.6</b>	<b>28.0</b>	<b>26.9</b>	<b>36.7</b>	<b>34.8</b>	<b>43.6</b>	<b>51.9</b>
Annual change — Changement annuel .....		1	9	- 4	36	- 5	25	19

TABLE 7. Current Intramural R & D Expenditures, by Ownership Group, 1967 - 1972

TABLEAU 7. Dépenses courantes intra-muros de R & D, par groupe d'appartenance, 1967 - 1972

Ownership group - Groupe d'appartenance	1967	1968	1969	1970	1971	1972
	percentages - pourcentages					
1. ....	4	4	5	6	7	8
2. ....	45	47	48	43	41	39
3. ....	18	16	13	10	10	10
4. ....	33	32	34	41	42	43
<b>Total</b> .....	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

Note: The ownership groups are identified in the Technical Notes on page 11. - Nota: Les groupes d'appartenance sont décrits dans les Notes techniques à la page 11.

TABLE 8. Sources of Funds for Intramural R & D, by Ownership Group, 1970

TABLEAU 8. Sources de fonds pour la R & D intra-muros, par groupe d'appartenance, 1970

Ownership group - Groupe d'appartenance	Source of funds - Sources des fonds					Total
	Canadian - Canadiennes				Foreign - Étrangères	
	Reporting company - Cie déclarante	Canadian government - Gouvernement du Canada	Other - Autres	Total Canada		
	millions of dollars - millions de dollars					
1. ....	25.9	0.1	3.2	29.2	-	29.2
2. ....	85.0	23.4	1.6	110.0	13.0	123.1
3. ....	19.3	6.5	--	25.8	3.1	28.9
4. ....	95.6	7.4	12.5	115.5	4.1	119.5
<b>Total</b> .....	<b>225.8</b>	<b>37.4</b>	<b>17.3</b>	<b>280.5</b>	<b>20.1</b>	<b>300.7</b>

Note: The ownership groups are identified in the Technical Notes on page 11. - Nota: Les groupes d'appartenance sont décrits dans les Notes techniques à la page 11.

TABLE 9. Personnel Engaged in R & D, by Industry Group, 1970

TABLEAU 9. Personnel affecté à la R & D, par groupe industriel, 1970

Industry group - Groupe industriel	Professionals - Professionnels	Technicians - Techniciens	Other - Autres	Total
	full-time equivalent - équivalent à plein temps			
A. ....	183	177	125	485
B. ....	1,435	1,143	553	3,131
C. ....	362	370	217	949
D. ....	584	622	342	1,548
E. ....	730	688	866	2,284
F. ....	1,838	1,621	1,425	4,884
G. ....	298	244	107	649
<b>Total</b> .....	<b>5,430</b>	<b>4,865</b>	<b>3,635</b>	<b>13,930</b>

TABLE 10. Level of Education of Professional Personnel Engaged in R & D, by Industry Group, 1970

TABLEAU 10. Niveau d'éducation des cadres professionnels affectés à la R & D, par groupe industriel, 1970

Industry group - Groupe industriel	Scientists and engineers - Cadres scientifiques et techniques				Adminis- trators - Adminis- trateurs	Total
	Bachelors - Bacheliers	Masters - Maîtres	Doctors - Docteurs	Total		
	full-time equivalent - équivalent à plein temps					
A. ....	118	25	19	162	21	183
B. ....	802	170	322	1,294	141	1,435
C. ....	191	35	90	316	46	362
D. ....	340	72	128	540	44	584
E. ....	574	88	13	675	55	730
F. ....	1,209	243	76	1,528	310	1,838
G. ....	173	43	59	275	23	298
<b>Total</b> .....	<b>3,407</b>	<b>676</b>	<b>707</b>	<b>4,790</b>	<b>640</b>	<b>5,430</b>



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Le Royaume-Uni

Department of Education and Science and the Ministry of Technology, *Statistics of Science and Technology.*

Les États-Unis

National Science Foundation, *Research and Development in Industry.*

Science Statistics Section  
OTTAWA, ONTARIO

**RESEARCH AND DEVELOPMENT IN CANADIAN INDUSTRY  
1970**

Please correct any mistakes in name or address

**Note:** Your report is CONFIDENTIAL and will be seen only by employees of Statistics Canada (formerly the Dominion Bureau of Statistics). It will be used to compile statistics in which no identifiable data will appear. The report of the last survey, *Industrial Research and Development Expenditures in Canada 1969*, is now available from Information Canada.

**GENERAL INSTRUCTIONS**

1. This survey has been carried out every two years since 1955; you may have file copies of your returns for earlier years (e.g. 1967 or 1969) which will help you now. Research and development are defined on page 3.
2. Do NOT include any capital depreciation costs or capital consumption allowances in any answer of this questionnaire.
3. Please enter all financial information in thousands of dollars.
4. Please answer all questions. Your best estimates are satisfactory when precise figures are not available. Your estimates will be better than ours.
5. Mr. Michel Trudelle of the Science Statistics Section will be pleased to answer any enquiries or supply you with more forms on request. His phone number is (613) 994-5287.
6. Mail one completed copy of this schedule before November 15, 1971.

SCIENCE STATISTICS SECTION  
EDUCATION DIVISION  
STATISTICS CANADA  
OTTAWA, ONTARIO.

An addressed return envelope is enclosed.

Name and address of person completing this return.

Name		Official Position	
Business address		Telephone number	
Date	Period covered		
From		to	

	Wages and salaries		Other current costs		Total current costs
	14-20	\$'000	21-26	\$'000	\$'000
<b>1. Current costs of R &amp; D done within the reporting company:</b>					
(a) in 1969 .....	27-33		34-39		
in 1970 .....	40-46		47-52		
in 1971 (estimate) .....	53-59		60-65		
in 1972 (approximate forecast) .....					

Current costs are:

**Wages and salaries**, which include all costs of R & D personnel (wages and salaries, fringe benefits and related costs e.g. costs of education paid for by employers). The costs of persons engaged only part-time in R & D should be pro-rated according to this time.

**Other current costs**, which are the costs of:

- (a) materials and supplies used, including the costs of purchasing, receiving, inspection, storage and transportation,
- (b) literature purchased to provide background information necessary for research operations, and
- (c) overhead, which is an estimated share of the costs of the functions supporting R & D activity.

	Land		Buildings		Equipment		Total
	14-18	\$'000	19-23	\$'000	24-29	\$'000	\$'000
<b>2. Capital expenditures on new or extended facilities for use in R &amp; D activities:</b>							
(a) in 1969 .....	30-34		35-39		40-45		
(b) in 1970 .....	46-50		51-55		56-61		
(c) in 1971 (estimate) .....	62-66		67-71		72-77		
(d) in 1972 (approximate forecast) .....							

	Canadian sources		Non-Canadian sources	
	14-19	\$'000	51-56	\$'000
<b>3. Sources of all funds expended in 1970 for R &amp; D within the company:</b>				
(a) Reporting company .....	20-24		57-61	
(b) Parent, affiliated and subsidiary companies .....	25-29			
(c) Canadian Federal Government through:				
(i) R & D prime contracts .....	30-34			
(ii) R & D portion of procurement contracts .....	35-40			
(iii) grants in aid of research or development .....	41-45		62-66	
(d) Contract work for other companies .....	46-50		67-71	
(e) Others .....				
<b>Total (equal to the 1970 expenditures of Questions 1 and 2) .....</b>				

**Note:** These are funds such as those provided by the company itself, grants, contractual payments or regular assessments of affiliates which are used to support the current R & D programme of the reporting company. Grants received under I.R.A.P., P.A.I.T., D.I.P. (development portion) or D.I.R. are to be reported in Question 3(c) (iii). Funds received for past R & D are to be reported in Question 4 (I.R.D.I.A.).

	Claimed but not yet received		Received	
	14-18	\$'000	19-23	\$'000
<b>4. Net grants or credits against tax liabilities claimed or received from the Federal Government under the Industrial Research and Development Incentives Act (I.R.D.I.A.):</b>				
(a) Company fiscal year 1968 .....	24-28		29-33	
(b) Company fiscal year 1969 .....	34-38		39-43	
(c) Company fiscal year 1970 .....				
<b>Note:</b> Funds received under IRDIA are NOT reported as part of Federal Government support in question 3 above.				

<b>5. Total payments made by the reporting company for R &amp; D performed by others:</b>				44-48	\$'000
(a) in 1969 .....				49-53	
(b) in 1970 .....				54-58	
(c) in 1971 (estimate) .....				59-63	
(d) in 1972 (approximate forecast) .....					

6. Number of personnel engaged in R&D done within the reporting company in 1970 (estimate full-time equivalent if some persons work part-time only in R&D):

	Bachelors	Masters	Doctors	Total
Scientists and engineers .....	14-17	18-21	22-25	26-29
Senior R & D administrators .....	30-32	33-35	36-38	39-42
<b>Total, professionals</b> .....	<b>43-46</b>	<b>47-50</b>	<b>51-54</b>	<b>55-58</b>
Technicians and technologists .....				59-62
Skilled and unskilled labour .....				63-66
Other (clerical and administrative) .....				67-70
<b>Total supporting staff</b> .....				<b>71-75</b>
<b>Total personnel</b> .....				<b>76-80</b>

**Note:** Senior R&D administrators and executives are often scientists and engineers who have moved to administration from R&D. They are normally university graduates. Professional staff without a university degree should be entered as "bachelors". Technologists and technicians are technically trained personnel who assist scientists and engineers in R&D (e.g. chemical technicians, draftsmen). They may be certified as technicians by either provincial educational authorities or by provincial or national scientific or engineering associations. Skilled and unskilled labour are skilled craftsmen or unskilled help who are directly engaged in the R&D programme (e.g. machinists and electricians building prototypes). Other includes such persons as clerks, typists, accountants and storemen engaged in the administration of R&D units or in the clerical support of other R&D personnel.

Please exclude company employees engaged only in building or assembling capital facilities for R&D, as well as persons employed in providing subsidiary services such as janitors, cafeteria workers and security guards.

7. Approximate 1970 sales of the reporting company (exclude sales of goods purchased for resale) .....	66-73	\$'000
8. Average 1970 employment of the reporting company .....	74-80	
<b>Note:</b> If this is a consolidated return, please aggregate the sales and employment of all companies included in the report.		

## DEFINITIONS

### Research and Development

(a) R&D is investigative work carried out:

- (1) to acquire new scientific and technological knowledge,
- (2) to devise and develop new products or processes, or
- (3) to apply newly acquired knowledge in making technically significant improvements to existing products or processes.

(b) For the purposes of this survey, R&D does NOT include:

- (1) market research and sales promotion,
- (2) research in the social sciences,
- (3) operations research, except when required during the development phase of a product or process,
- (4) quality control or routine testing of products and materials,
- (5) geological and geophysical surveys, mapping, exploration and similar activities not resulting in scientific or technological advance,
- (6) scientific and technical information except when conducted for the sole or primary purpose of R&D support,
- (7) all activities necessary for commercial production of the new or improved product or process after development is completed.

(c) Development is the use of knowledge derived from research in order to produce new materials, devices, products or to devise new processes, or to improve existing ones. Thus, the design, construction and testing of prototypes, models, pilot plants (so long as they are primarily used to acquire experience and gather information necessary to the start-up of production) are part of it. Moreover, development includes those activities required before the setting up of a process or production line and which embody the information gathered from development activities: for example, the preparation of drawings, reports and instructions.

Development ceases and pre-production begins when the work is no longer experimental. Hence, the costs of tooling (design and try out), the costs of construction drawings and manufacturing blueprints and the costs of production start-up are not included in development costs. Pilot plants may be included in development but only so long as the main purpose is to acquire experience and compile data. As soon as they begin operating as normal production units, their costs can no longer be attributed to R&D. Similarly, once the original prototype has been found satisfactory, the costs of other "prototypes" built to meet a special need or to fill a very small order are not to be considered as part of R&D. In other words, once the primary objective is no longer investigation but rather production or preparation for production, the activity can no longer be considered as part of R&D even though it could be regarded as an important part of the total innovative process.

(d) Research and development may be carried out either by a permanent R&D unit (e.g. R&D division) or by a unit generally engaged in any non-R&D activity such as engineering or production. In the first case, the R&D unit may spend part of its time on routine testing or trouble shooting or on some other activities which should not be included in R&D. In the second, consider only the R&D portion of such units' total activity.

### TECHNOLOGICAL INNOVATION

**Technological innovation** - the transformation of a scientifically developed product (process) into a new or improved marketable product (operational process) - is considered as one of the most significant industrial activities. It is an activity which enables a firm to widen its markets, enhance its productivity and increase its profits, thus allowing growth of the economy. However, until recently, innovation has been studied less closely than R & D. Research and development have benefited from several government assistance programmes. Now, one of them, the Program for the Advancement of Industrial Technology, has been extended to include some of the costs of innovation. At the same time, managers, planners and advisers in government, industry and the universities have become interested in obtaining data which are more relevant to industrial and economic growth. There is therefore an increasing need for statistical information on innovation - this section is intended to examine the feasibility of securing such data.

#### What Is Technological Innovation?

Technological innovation, as a corporate strategy, consists of the transformation of an idea based on an identified (actual or anticipated) need into a new product (or process) or the improvement of an existing product (or process). **For statistical purposes, we must link the concepts of technological innovation with those of research and development** (which have been surveyed now for 15 years). Hence, we will use a greatly simplified model and define technological innovation as the post R & D phase of the innovation process.

IDEA -----> PRODUCTION

Basic research	Applied research	Development	Technological innovation
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It is composed of final product engineering, tooling, industrial engineering and trial runs. Also included are two activities which do not necessarily take place after the R & D phase is completed but which are not included in R & D. These activities, which are often directly related to the decision to innovate, are new product marketing and patent work.

#### Definitions for Technological Innovation

Technological innovation covers the work necessary to carry a product or process from the end of the R & D phase to successful production and sales. It also includes a few activities which may have taken place during the R & D phase but which are directly related to the decision to innovate.

**New product marketing** is the set of activities necessary to the successful introduction of a new or improved product (process) into the market. Its costs comprise those of market research, the non-recurring costs of establishing distribution and sales channels, and advertising system, as well as the initial advertising expenditures.

**Final product or design engineering** is the further modification of a product (process) after the R & D phase is completed in recognition of market or manufacturing requirements. For instance it includes the costs of modifying part lists, materials, specifications and drawings.

**Tooling and industrial engineering** covers all changes in production machinery and tools, in procedures, methods and standards to be used in manufacturing the new product or using the new process.

**Manufacturing start-up** includes the costs of retraining personnel in the new techniques or in the use of new machinery, trial production runs and the costs of items damaged because of faulty equipment, procedures and operators' errors.

**Patent work** is the filing of patent applications and searches for prior patents in connection with the product or process being introduced or improved.

### ESTIMATES OF EXPENDITURES ON INNOVATION

On pages 2 and 3, you have provided estimates for R & D expenditures and manpower. Ultimately we would like to secure similar data for innovation. However, this experimental survey will be used primarily to assess the information which may be available. It is not expected that this information exists in a convenient form - **please do not hesitate to estimate.**

Innovation may be successful or unsuccessful (or uncertain during the process). It may be connected with a firm's own R & D or it may be related to a new product or process developed elsewhere. It may be "original" or it might perhaps even be imitative (or adopted). It is not the copying of any other product or process.

**Estimates for 1970 innovation**

Please consider only innovation related to the R & D of this firm carried out either currently or in the past. This will provide us with some comparative figures.

If only total "original" innovation (i.e. including that based on the R & D of others) can be estimated, please complete this section anyway but check the box following:

Estimates include innovation from non-company R&D

**1. Current intramural expenditures, 1970.**

Activity	Wages & salaries	Other	Total
		\$'000	
Market research .....			
Product engineering & design .....			
Patent work .....			
Tooling & industrial engineering .....			
Manufacturing start-up .....			
Other (specify) .....			
<b>Total innovation</b> .....			

**2. Expenditures on fixed assets, 1970.**

	\$'000
Buildings .....	
New production equipment .....	
Tools .....	
Other (specify) .....	
<b>Total innovation</b> .....	

**3. Personnel engaged in innovation, 1970.**

Activity	Professionals			Technologists & technicians	Other supporting staff	Total
	Scientists & engineers	Administrators	Other professionals			
			full-time equivalents			
Market research .....						
Product engineering & design .....						
Patent work .....						
Tooling & industrial engineering .....						
Manufacturing start-up .....						
Other (specify) .....						
<b>Total innovation</b> .....						

Note: "Other professionals" are essentially other university graduates such as lawyers or market researchers. "Other supporting staff" are skilled and unskilled labourers, clerical and administrative support staff.

Estimates for various kinds of innovation

4. Do you think you could identify the approximate costs of individual innovations either annually or at the end of the innovative process? (check one box)

- Always       Frequently       Occasionally       Never

5. If possible, please estimate the approximate total current intramural costs of innovation over the past five years (1966 + 1967 + 1968 + 1969 + 1970):

Dollars

(a) Innovation from own R & D:

Commercially successful .....  
Commercially unsuccessful .....  
Commercially unproven .....

(b) "Original" innovation based on products or processes developed by others:

Commercially successful .....  
Commercially unsuccessful .....  
Commercially unproven .....

(c) "Imitative" innovation or the introduction of products or processes new to the firm but not to the world or the industry .....

We understand that any data you have been able to supply are, at best, only estimates. We are sure that you appreciate the potential value of measures of innovation costs, both to industry and to government. Please suggest any improvements in either our concepts, definitions or format. If you consider the project impossible or of no value, we would be grateful for your noting this. Thank you again for your co-operation.

Name and address of person completing this section on innovation

Name

Official position

Business address

Telephone number

Date

Period covered in Questions 1 to 3:

From \_\_\_\_\_ to \_\_\_\_\_





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HS. — Hors série

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