FEDERAL GOVERNMENT
TRANSPORTATION
RESEARCH AND DEVELOPMENT

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A REVIEW
BY
DONALD WATSON

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This review was made by the author under a contact with the Ministry of State for Science and Technology. The opinions expressed and the recommendations put forward are solely those of the author.

CONTENTS

Introduction

1. This review was undertaken at the request of Treasury Board. It expressed concern that there should be the maximum possible coordination of federal government activities in transportation R&D and that any overlap that may exist or could develop among federal agencies be generally eliminated or avoided.

2. A Committee was established to act as a steering group for the study with the Secretary of the Ministry of State for Science and Technology as Chairman and membership of senior officials from the Privy Council Office, Treasury Board Secretariat and Transport Canada. A Study Director was appointed to carry out the review and to make recommendations to the Committee. The approved plan for the review appears as Appendix A. Subsequently the Committee requested that the plan also include an examination of the role originally intended for the Transportation Development Agency and its current role in relation to other parts of Transport Canada and to other federal government departments and agencies.

3. Transportation is a vast subject and hundreds of thousands of people are working full-time in the field. Transport Canada alone has over 20,000 employees and this number does not include those in Canadian National Railways or Air Canada. There must be

millions of man-years of work experience and wisdom in Canada. Transportation also touches every member of the public. In fact, transportation is almost entirely made up of myriads of small decisions by individuals. In many cases the choice is obvious. At the other extreme, careful analysis is made of all the influencing factors - the cost, comfort, time, probability of delay and so on. In between there are many decisions made by habit rather than logical choice.

4. As regards transportation research and development, there has first of all to be either a transportation problem that needs a solution or an opportunity for improvement, and of a type that an R&D project could help provide an answer. There is of course no justification for repeating work already done outside Canada and since many transportation problems are most acute in other countries there is obvious sense in concentrating on those problems that are peculiarly Canadian. Where the work is done should be decided by where the necessary skills are best available. There is a basic question of who should decide what R&D should be done.

5. A politically sensitive activity such as transportation does not stand still and it certainly does not wait for a review such as this one to be completed. Major changes have taken place in 1975. In June, a month before the first Interdepartmental Committee meeting was held, the Minister of Transport outlined a

new transportation policy. Shortly thereafter in a Cabinet shuffle, a new Minister of Transpcrt was appointed. A new Deputy Minister had earlier been appointed. He has made some basic crganizational changes. Cf particular significance is the creation of a new Planning and Development organization under a Senior ADM. Major interdepartmental reviews in transportation have alsc been actively pursued in parallel with this one - for example, the consideration of the need for a National Urban Transportation Develcpment Corpcration. Other significant influences have also come to a head, perhaps the most far reaching one being the cverall economic scene in Canada. There must now be a greater interest in seeing how R&D can lower investment expenditures rather than how R&D can provide new cpportunities fcr capital growth.

6. The next chapter describes a survey that was made of federal government R&D in transportation and the main conclusions to be drawn from it. After the survey data was collected, the Study Director had interviews with some sixty senior departmental officials. Besides answering specific questicns about individual R&D projects, private opinions and attitudes were expressed in confidence. These were very helpful in enabling the Study Directcr to reach a better understanding of the forces at play and what were the underlying causes of some of the prcblems. These views have perhaps influenced the judgements made in this

report more than have the bare bones of the data collected.

A Survey and Its Main Findings

7. No uniform records exist in federal government departments and agencies showing what R&D projects are underway, at what cost and with how many people. To find out what was being done in transportation R&D therefore necessitated an ad hoc survey. A questionnaire form and set of instructions were prepared and circulated to departments. These are given in Appendix B. Using standard Statistics Canada definitions, "feasibility studies" were added to "research and experimental development" in the natural sciences; and "economic and feasibility studies", and "operations and policy studies" were added to "research and experimental development" in the human sciences. Demonstration projects were included, data collection per se not.

8. The survey took place between mid-August and mid-September 1975. Altogether 575 completed inventory forms were received. Data on university grants and schclarships were obtained from NRC and DRB. All industrial grant projects were included, including DIP and PAIT as well as IRDIA and IRAP.

9. It should be remembered that the figures provided are for federal government expenditures in 1975-76. They do not include provincial, municipal or industrial expenditures. The data on man-years only includes those who are engaged in an R&D project in the current year. There has been no attempt to determine

cthers in departments who have had experience in transportation R&D, whether to a marginal or extensive extent. Not shown in the data summarized here are the expenditures that have been made for capital facilities. Except for the NRC wind tunnels and marine models, they have not been significant in a field of such magnitude.

10. Because of the number of forms received, a matrix was developed so that the forms could be sorted into reasonably sized bundles which could then be scrutinized separately. The division into modes of travel was straightforward (air, road, rail, etc.), although "urban" would have been an equally logical division that included part of "rail" and part of "road". The split by type of activity was not easy. Many projects dealt with forecasting, evaluation, planning, data collection, analysis, etc., and the words were used with different shades of meaning, often transposed. Descriptions of the modes and categories chosen are given in Appendix C. In Appendices D-1 to D-6 are tables showing the numbers of projects by category for each of the six modes.

11. The data for 1975-76 are summarized by department in Table 1. As the lead department, the Transport Canada (TRC) is subdivided into the major components of the Department and CTC. Other departments/agencies are not subdivided. The expenditures by modes are listed in Table 2.

Table 1

SUMMARY OF DATA BY DEPARTMENT

Department or Agency	No. of Projects	1975/76 MY	1975/76 $000's
Transport Headquarters	8	9	384
Canadian Air Transportation Administration	28	138	4,502
Canadian Surface Transportation Administration	69	17	2,917
Canadian Marine Transportation Administration	11	3	687
National Harbours Board	4	7	250
St. Lawrence Seaway Authority	3	11	250
Transportation Development Agency	154	47	15,364
Canadian Transport Commission	49	68	1,892
	326	300	26,246
Industry, Trade & Commerce	36	30	41,716
National Research Council	60	285	13,256
Environment Canada	34	122	3,643
National Defence	25	60	2,631
Urban Affairs	31	23	2,398
National Capital Commission	2	3	75
Energy, Mines & Resources	31	85	2,022
Regional Economic Expansion	5		871
Indian Affairs and Northern Development	13	13	283
Agriculture	3	7	237
Public Works	6	4	206
Post Office	3	4	68
TOTAL	575	936	93,652

1975/76 EXPENDITURES BY MODES

$'000

DEPT.	TOTAL	GENERAL	AIR	ROAD	RAIL	MARINE	OTHER
T.HQ	384	328	29	-	-	27	-
AIR	4,502	-	4,502	-	-	-	-
SURFACE	2,917	-	-	2,867	-	50	-
MARINE	687	-	-	-	-	687	-
NHB	250	-	-	-	-	250	-
SLS	250	-	-	-	-	250	-
TDA	15,364	2,055	4,934	2,078	4,143	1,344	810
CTC	1,892	1,326	148	42	236	140	-
IT&C	41,716	2,063	32,049	4,284	596	628	2,096
NRC	13,256	3,026	5,640	720	1,630	2,040	200
EC	3,643	184	1,158	620	-	1,520	161
DND	2,631	468	809	80	-	1,003	271
UA	2,398	197	-	95	2,000	-	106
NCC	75	50	-	25	-	-	-
EM&R	2,022	866	-	108	60	-	988
REE	871	-	-	-	-	-	871
IA&ND	283	3	-	260	-	-	20
AGRIC	237	237	-	-	-	-	-
PW	206	26	-	-	-	180	-
PO	68	-	-	68	-	-	-
	93,652	10,829	49,269	11,247	8,665	8,119	5,523

12. The first observation on this body of data is that the federal effort as a whole is quite large - 936 man-years and nearly $95 million in 1975-76. Certainly enough to monitor and control with interest. The total expenditures are much larger than those previously given in federal government publications on R&D expenditures. The reason for this appears to be that elsewhere federal expenditures in industry have been lumped together under a heading "Manufacturing Industry", with no attempt to allocate the transportation component in industry to the separate heading of "Transportation".

13. In view of current capital expenditures of several billion dollars per annum for transportation plant and equipment, an overall federal R&D total of about $100 million i.e. a few per cent, would seem to be in the right ballpark, but an examination as well of provincial and industrial R&D expenditures in relation to total transportation expenditures (infrastructure and equipment, capital and operation), would have to be made before giving a better answer.

14. The second observation is perhaps equally surprising. Transport Canada and the agencies reporting to the Minister of Transport are in charge of only 28% of the effort. The Deputy Minister, Transport Canada is in charge of a quarter of the man-years and the expenditures. The breakdown by federal objectives

is:

45%	$41.7M	IT&C	Support of Industry
28%	$26.2M	MOT	Support of Transportation
14%	$13.3M	NRC	Support of Science
13%	$12.5M	Other	Support of Environment, National Defence, Urban Affairs, etc.

15. It is usually assumed that a lead department is the primary influence and that other departments with related interests fit in along side. Here the tables are reversed. Admittedly in the 1975-76 fiscal year, IT&C's support of the Dash-7 airplane heavily tips the scales. IT&C's outlays in transportation under its Trade-Industrial Program are:

$24.3M	Support of Dash-7
$ 7.5M	DIP
6.1M	PAIT
1.0M	IRDIA
1.0M	Other

On the other hand, while this total is a large part of the federal government's R&D expenditures in transportation, the $38.9M provided by grants to industry is a quarter of IT&C's total $155.9M budget allocation for this purpose and this does not seem to be totally cut of proportion considering the size of the transportation industry relative to industry as a whole.

16. Table 2 shows that the expenditures in the Air mode are over half of the total. Even if the $24.3 million for support of the

Dash-7 airplane was deleted, Air would still take $25 million; over twice that spent in any of the other modes. The physical sciences R&D projects predominate in the Air, Marine and Rail modes while the human sciences R&D projects predominate in the Road, General and Other modes.

17. The allocations for transportation research from total budgets for scholarships and grants are:

NRC	$0.546M out of	$82.9M
DRB	0.306M	2.3M
IDA	0.875M	0.875M

Only IDA is consciously selecting support for university work in transportation: NRC and DRB are selecting the highest qualified science regardless of the field of activity. The very low percentages going to transportation shows that most of the best university faculty members and graduate students are not clamouring to do transportation R&D.

18. Members of the Committee have been provided with a binder listing by department all the project titles and the resources allocated to each project for 1975-76. The completed questionnaire forms are with the Program Review and Assessment Division of MOSST in two large volumes, one for the Transport Canada projects and the other for those of the other departments

and agencies.

Observations on the Survey

19. An examination was made to see how the R&D projects of a department related to the department's mandate. Here it was first necessary to decide how to determine what the "mandate" is. After a brief study of federal statutes the conclusion reached was that invariably a case could be made that a project of a department was within the scope of its legislative authority. This was because the relevant legislative clauses are broad. A scrutiny of legislation was also not enlightening as to which responsibilities of a department should have more effort devoted to them than others. The conclusion reached was that the most appropriate measure of "departmental mandate" was the allocation of resources in man-years and budget to the department under the Program and Activity descriptions in Estimates. On this basis, a table was prepared listing the programs and activities of the departments, with the man-years and budget allocations for 1975-76 and adding the R&D effort recorded by the survey. This is given in Appendix E. All the R&D projects in the survey met the criterion of being within a department's mandate.

20. Whether there is a proper distribution of R&D effort within a department to support major policy initiatives could not be

assessed. One reason for this is that the relative importance of new initiatives is not usually measured against earlier initiatives. The new policies are clearly of current importance and if they amend earlier policies that is known too. Often however earlier initiatives are unaffected and it is not self evident whether their priorities are changed or not. It would seem important to find a mechanism by which the relative priorities of government decisions on policies and programs that affect R&D projects are maintained and made known down to those at the working level. If the individual "worker" knows the official order of priorities, better concordance of projects with policy initiatives will come about naturally.

21. The vast majority of the R&D projects recorded in the survey are unique - there is no other similar R&D project in another department. This is particularly true of the physical sciences R&D projects. However, the CTC, IDA and Surface Administration are doing studies of the Canadian trucking industry. Urban Affairs, CTC and TRC are working on railway relocation studies. Environment Canada, Indian Affairs and Northern Development, and Energy, Mines and Resources are evaluating the impact of the Mackenzie Highway on the environment. NRC, Surface Administration, EM&R and Environment Canada are all involved in improving the efficiency of the use of fuels for automobiles.

22. A study of the information provided on the questionnaire forms showed that much time would have to be spent in attempting to prepare any meaningful complete list of the overlaps. For each project involved, an assessment would have to be made of how much, if any, overlapping there is and whether or not it is intentional. How much does a study of a situation in one city overlap a somewhat similar study in another city? There could in fact be considerable overlap in the preparatory work of projects with quite different goals.

23. The Study Director came to the conclusion that his time would better be spent determining why there was apparent overlap and what might be arranged to ensure adequate coordination in the future. The survey had provided a snapshot and another survey at a different time might show different overlaps. A detailed analysis of the survey made could in any case be made later by departmental officials if this was desired.

24. In some of the areas of overlap there are formal coordinating committees and in many of the others there are informal ones. In almost every case, officials of one department know that officials of another department are working in the same general area of study. Close coordination occurs naturally when officials need or value the assistance of others. It does not happen naturally when the judgment is made that the value of the help received will be less than that of the time lost in

ccordinating. If in addition there is a difference cf opinion as to which department should have the lead role in the area in question, the maximum coordination and cooperation is not likely tc occur.

25. In the field of transportaticn per se, the federal government is engaged in regulaticn, policy, operaticns, research and development, and carrier operations - those of Air Canada, CN Rail, East Coast Ferries and Northern Transportation Limited. In parallel to the objective of providing suppcrt to transportation, the federal government has cther objectives such as those in defence/sovereignty, the environment, urban affairs, agriculture, energy, industry, regional affairs and the arctic. For example, in the suppcrt of industry there are programs for the purchase of vehicles and other materiel, R&D incentives (PAIT, DIP, PEP, IDAP, IRAP, IRDIA), export market incentives and other support programs such as GAAP. In the suppcrt of Regicns, there are DREE programs; railway, ferry and seaway subsidies; the capital assistance program fcr urban transportation; Western Highways program and fiscal transfer arrangements.

26. In shcrt, there are two distinct influences on transportation policy - those that are solely to dc with transportation and those that are directed at something else but affect transportation either directly or indirectly. In the first category are the policies that are aimed at improving

transportation per se. In the second category are the policies that use transportation in order to reach other political ends. Invariably this means distorting the transportation picture and introducing incentives or subsidies.

27. What is important for the better coordination of transportation R&D is that in the areas of overlap of federal objectives, the primary objective and the secondary objectives be decided upon and the interfaces between them be defined and be made known in as many cases as possible. Each borderline would become easier to define should it be accepted that the department with the primary objective bears the cost of any program that follows the R&D projects pursuant to the principle of "beneficiary - pay". Once the priorities of the objectives in these areas of overlap have been established, the relative priorities of the work of the departments in these areas and of the supporting R&D projects follow suit. It would then be known which department has the lead responsibility for the R&D in this field. It is recommended that the lead department be responsible for the appropriate coordination with other departments. By having clear responsibility on one department for taking the lead role in a specific R&D field and by having it recognized that the responsibility for coordination with other departments is part of the lead role, better departmental cooperation and coordination would be achieved. Put the other way around, if agreement cannot be reached as to the primary objective and which is the lead

department, coordination of supporting R&D projects cannot be assured. Interdepartmental Committees are useful coordinating mechanisms when all departments can agree on the objective, how to reach it and who should do what work. They do not operate satisfactorily when there is not agreement. For this reason, it is recommended that wherever possible, one department is put in charge. It would be prudent for it to seek the best available advice and assistance through a committee or any other suitable mechanism.

28. It is recommended that PCO be responsible for arranging that the various interfaces are defined and the lead departments determined. The interfaces need to be widely available in an unclassified document so that all departmental officials working in the field know of the relationships.

Transport Canada

29. A new organizational structure was established in 1970 for the Ministry of Transport. Of relevance to this Review, there were created three Administrations (Air, Marine and Surface), an Arctic Transportation Agency, a Policy, Planning and Special Projects group, and a Transportation Development Agency, all reporting to the Deputy Minister. The three Administrations were subsequently grouped under a Senior ADM and a second Senior ADM

was created for the Transportation Task Force. In the fall of 1975 this latter organization was changed to Planning and Development which includes TDA, along with Strategic Planning, Current Policy and Liaison, and Program Planning and Evaluation.

30. The Air Administration is responsible for air regulations and safety, air navigational services, and for the provision of most of the airfields throughout the country. It has its own sizeable fleet of aircraft, but is not a commercial carrier. As will be seen from the survey data, Air Administration has a relatively large R&D program mainly dealing with navigational aids. It is applied R&D to meet known requirements or desired improvements. An internal R&D Committee has recently been set up to review the projects underway.

31. Marine Administration has few recorded R&D projects. Partly this seems to be the nature of the maritime world. However, Marine Administration is clearly master of its own house. It is not being challenged in its marine activities or in its surveillance field from any of the provinces. It puts into its ships the best technology that is available.

32. The Arctic Transportation Agency is a small group working on the development of policy and programming. It was set up to be responsive to the needs of the North. The implementation of the programs decided upon is carried out by the appropriate

Administration. One would hope that before long the Administrations would become equally responsive - in which case the Arctic Transportation Agency will have done its work.

33. Surface Administration is different from the other Administrations in two fundamental ways. The first is that it has competing modes of travel (road, rail and ferry) under its jurisdiction instead of a single mode and therefore has to be engaged in intermodal comparisons. The second is that it has no public operations to run. What this means is that Surface Administration has a greater chance of conflict with the Planning and Development organization of TRC than have the other Administrations, unless clear interfaces are drawn.

34. The Marine and Ferry Branch is the closest Surface Administration has to a commercial operation and there is much that is attractive in its arrangement. The Branch can plan the system as a whole - the harbours and the vessels. Based on its studies, it can set the requirements, define the specifications, request proposals and, subject to approval, go ahead and get the system built. For the location of harbours, the Branch has valued the assistance of NRC and its marine model testing facilities.

35. The Grains Transportation Branch is unique in that it deals with a single commodity, not a single mode of transportation. It

perhaps deals with the most sensitive political subject in transportation. Also active in this field at the present time is the Grains Handling and Transportation Commission (Hall Commission) dealing with branch line rationalization, the Snavely Commission dealing with costing, the Grains Group, the Department of Agriculture, DREE, the Wheat Board and the railways.

36. Another branch in Surface Administration of special interest to this Review is the Planning and Urban Application Branch. Here the overlapping of federal objectives comes clearly in view. Is urban transportation, the urban part of transportation or is it the transportation part of the urban process?

37. Throughout the Administrations there is a strong interest in safety and much of the work in engineering and in the development of regulations arises from safety considerations. To have rail safety the responsibility of the Canadian Transport Commission and to have the safety of the other modes the responsibilities of the respective Administrations, as is the case now, is not consistent.

38. Before turning to the Planning and Development side of TRC, some brief reference should be made to the CTC. In the new transportation policy announced in mid-1975, specific mention was made of the relationships between Transport Canada and the Canadian Transport Commission for policy advice to the Minister

cf Transport. The National Transpcrtation Act of 1967 had given this responsibility to the CTC alcng with a broad research and development mandate. CTC built up a strong R&D team. It had the advantage of having statutory access to certain basic transportation data (such as 1% of all waybills), and it tried to anticipate future problems and to understand basic issues as part of helping its colleagues in the development of regulations and orders which was their immediate purpose.

39. Because of the recent government announcement that the responsibility for policy advice to the Minister should be transferred from the CTC to the Department, the Study Director did not concentrate on looking at the interface between them. A committee cf individuals directly involved was established to do that. Whatever the words chosen to define the interface, there will inevitably be some straying in the future frcm both sides of the line since there can never be a total separation between the anticipatory research needed by CTC and the fcrmulation of policy advice tc the Minister required of the Department.

40. In the Planning and Development organization of TRC, Strategic Planning is to develop the broad policy concepts and then pass these over tc the Administrations tc develop the detailed pclicies and to implement the subsequent programs. New management is in charge and little can be said beyond the obvious that the rcle is a key one. Current Policy and Liaison, and

Program Planning and Evaluation are also new organizational units under new ADM's.

41. As regards the Transportation Development Agency, its past role has been uncertain and its future role has yet to be firmly settled. There is no doubt that the strategic planners need technical support and equally that transportation R&D needs to be done to meet the present and possible future needs of the Administrations. The question is where can it best be done.

42. The Transportation Development Agency was established pursuant to one of the recommendations of the "Task Force on the Objectives and Structure for the Portfolio of the Ministry of Transport". This Task Force proposed that the Administrations and Crown Corporations should undertake the modally-oriented development that would apply new technology to their own operations and that a new organization, TDA, should initiate the larger, more basic development projects that appeared to be promising. TDA would not necessarily perform the work it initiated - it would arrange and support demonstration projects with the Administrations and Crown Corporations and with other bodies, particularly the National Research Council. Close lisison would be maintained between TDA and the Administrations in the shared R&D objective.

43. The reasoning behind the proposal was that the MOT Administrations (Air and Marine at that time) and the Crown Corporations (CN Rail and Air Canada) were experienced operators. They had large infrastructures and operations, and they tended to be overwhelmed by day-to-day problems. No-one was looking ahead for the unexpected. Industry could get PAIT or other government support for the development of a new vehicle or equipment, provided a case could be made that it was economically viable. The Administrations and Crown Corporations could place R&D contracts for things they knew they wanted. In between there was a gap - the concept or the development that looked promising but which would not be federally supported since it could not be shown to be needed.

44. It should be remembered that at the end of the 1960's, the promise of new technology held considerable sway. There were STOL, high-speed passenger trains, commuter and urban transit, slurry pipelines, air-cushioned vehicles. Major development programs on these and other technologies would help usher in the solutions to many transportation problems and to many non-transportation problems too. But the important thing was to try out the new concepts to see if they were or were not promising. If the development showed there was no future in the program, it would be written off to experience: if the development proved promising, others would take it over and bring a fully developed

vehicle or system into Canadian use and into the marketplace.

45. Those who proposed the creation of TDA had in mind a powerful though small organization that would help to ensure Canada had the best possible and most up-to-date transportation system it could afford. Five years later, in the fall of 1975, TDA submitted 154 projects to the transportation R&D survey. Of these, 49 were listed as "current" and 105 as "planned" even though they were identified with 1975-76 expenditures. The distribution of the "current" projects by mode gives:

Air	2 projects
Marine	2
Road	13
Rail	19
General & Other	13
	49 projects

and of the "General" and "Other" modes, 7 of the 13 are ground and the remaining 6 concern air cushion vehicles and slurry pipelines. One of the ACV projects is marine, so that the totals become 2 for Air, 3 for Marine and 44 for Surface.

46. The two Air projects are the support of STOL and a $35,000 contract for sonic boom phenomenon research. The three Marine projects are a $50,000 contract to study ice loads on ship propellers, a $69,000 contract to study the measurement of ice thickness, and a $292,000 ACV cargo demonstration. The "planned"

projects of TDA show much greater emphasis in the air and the marine modes. This new trend continues in the planned Program Forecast for 1977-78.

47. It is clear that TDA correctly saw urban transportation as a gap in which it could make an impact. This direction was one of the thrusts foreseen by the proposers of TDA. However, as has been mentioned, a Planning and Urban Applications Branch has been created in Surface Administration. So that there are two groups in Transport Canada active in the field besides the interest of the Ministry of State for Urban Affairs.

48. TDA has not concentrated on the major projects that the Administrations might not have been able to handle. In five years it has only been involved in two such projects, STOI and the LRC train. In neither case has it taken full charge; partly by choice, partly by circumstances. It has not introduced or promoted any major project of its own. Most of its effort is being spent on a large number of small projects.

49. Why has there been a displacement of goal? It seems safe to say because the original one was largely a mirage. There will not be several giant steps into a new world, mainly tiny steps one by one. This is what TDA is currently working on; this is where over the long term much of the progress will be made. The Advisory Board set up to review TDA's programs and to set

priorities found itself not grasping with major and critical issues but with the minute. Not surprisingly the senior executives from cther organizations became disillusicned and showed disinterest in attending meetings.

50. Although TDA is not doing what its founders had in mind for it, the basic questicn now is whether its present role is the best possible or whether changes could usefully be made.

51. The Deputy Minister TRC is the person to decide what and how much R&D shculd be carried out in each of his organizational units. There has to be coordinaticn within TRC and between TRC and outside organizaticns and the preferred sclution is the one in which the coordinaticn is kept to the minimum necessary.

52. An applied R&D organization should have most of its projects directed at targets that are agreed. It must be allcwed to have a smaller prcportion of resources entirely at its own disposal to do with what it thinks important but that others are not supporting. To have 25% for itself is not unreasonable; the other 75% should be spent on what the customer wants or agrees to. In TRC, the "custcmer" should be one of the Administrations or the parts of Planning and Development other than TDA, even if the work will primarily benefit an cutside organization. For evoluticnary type R&D (as distinct from the major breakthrough), having the R&D done in the Administrations minimises the effort

to achieve adequate cocrdination since the performer of the R&D and the "customer" are in the same organizaticn. The only internal cocrdination needed is the periodic across-the-board review which can conveniently be done at the time of preparing budgetary estimates.

53. Since Air and Marine Administrations have been traditionally independent and TDA has gained experience by working until recently almost exclusively working on "surface" projects, it is recommended that TDA be transferred organizationally to Surface Administraticn to become its R&D Centre. It would remain in Montreal. The minority of staff whc could better support Strategic Planning than Surface Administration could be transferred to Ottawa. The R&D Centre of Surface Administration would limit its activities to those of Surface Administration and the present air and marine activities of TDA would be transferred tc Air Administration and Marine Administration. Each Administration would then be fully responsible for the R&D support of its on-gcing operaticns.

54. This arrangement would abandcn the ccncept of an R&D organization separate from the Administrations to initiate the major, basic development programs. With the benefit of hindsight, it is not clear that a separate organization is needed or desirable. Ideas for potential breakthroughs can come from many quarters (e.g. industry, NRC, abroad) and advocates in

Canada should not have to convince any special organization before any R&D work is performed. One would expect Strategic Planning to want to have the value of new technological concepts assessed and it should be able to obtain viewpoints not only from a supporting technical arm but from the Administrations and from outside organizations as well, particularly NRC and IT&C. Should the ideas seem promising, and extensive development appear justified, a case would have to be fully aired at least at Treasury Board level. Should Treasury Board agree that a demonstration project be launched, it should be managed by whatever is the most suitable existing organization at that time. Often it would be the appropriate Administration.

55. It would be understandable if the Deputy Minister TRC would prefer not to consider making such a basic organizational change without first waiting to see how well the present TDA can operate with the much improved liaison between it and the other parts of TRC that has recently been introduced. Organizational changes, however good, made in rapid succession can upset more than they help. Establishing the new procedure of requiring the coordination of and the agreement with all the R&D projects to be carried out by both the Administrations and TDA was a desirable move: a committee structure however is likely to involve more people than is the minimum necessary to accomplish this coordination. Those members who are expert in one mode will not continue to willingly sit through discussions of another mode.

If they are excused, the "committee" meetings will really be a series of TDA/Administration meetings.

56. In its proposed five-year prcgram 1974-75 to 1978-79, TDA requested a rapid increase in the level of its activity from $7.2M in 1974-75 to $37.7M in 1978-79. Their Main Estimates for 1975-76 were $14.9M, and in 1976-77 Estimates, TDA has been inccrpcrated into the Planning, Research and Development activity of TRC's Headquarters' Program.

57. An essential first step before meaningful comments can be made either cn the proposed five-year program referred to above or on the planned Program Forecast for 1977-78 has to be an internal TRC decision between the Administrations and Planning and Development regarding what R&D projects in the different modes can be justified by TRC at the present time and the relative level of funding needed. The Administrations have to be as committed to the program as TDA. Until this analysis is completed any consideration of additional funding for R&D projects would be premature. Once the Administrations and Planning and Development give evidence that they are prepared strongly to support a proposed R&D project of TRC, it is recommended that this should be given sympathetic consideration since it is impcrtant to get TRC as a whole more invclved in transportation R&D.

Other Departments and Agencies involved in Transportation

58. In the case of urban transportation, an interface has been agreed between the Ministry of State for Urban Affairs and Transport Canada. MSUA is responsible for policy and urban development planning and TRC is responsible for urban transportation planning and the implementation of demonstration or other projects within the framework outlined by MSUA. In brief, MSUA sets the stage and TRC manages the program.

59. This working relationship is helped by MSUA not having a large transportation group and not desiring to build one up. Political sensitivities are very acute in urban affairs and there will be times when federal intentions will be viewed with suspicion. Having sensitive antennae and feeling through such situations is what MSUA is all about. The joint undertaking of a research study in transportation in a municipality with some or all of the expenses paid for by TRC is of course likely to be welcomed. Care has to be taken that the federal government gets recognition for its contribution.

60. A basic policy decision is whether, after an urban policy has been firmed up, the subsequent implementation programs are to be carried out by provinces and municipalities with some financing support from the federal government, or whether the federal government will get involved directly in the

implementation. How many TRC specialists are needed depends on the decision.

61. The initiative for the proposed National Urban Transportation Development Corporation from the federal end came from IT&C. They correctly foresaw that the market for urban transit and commuter vehicles and systems was fragmented in Canada and similarly that the potential manufacturers were not coordinated. They essentially proposed that the Canadian market be aggregated and that the supply capability be consolidated. Besides serving domestic needs, this would best prepare the industry for export opportunities.

62. An interdepartmental committee is currently looking at all the implications of this proposal and will perhaps be reporting before this report is finished. With the current change in Canada's economic climate, it is certain that the expected production in the coming years of any new urban vehicle will now be smaller than it was estimated to be a couple of years ago. A federal-provincial corporation does seem to be an elaborate and ponderous mechanism to get decisions made. It would seem to be much more effective for the federal government to pay for the design and development of any new vehicle that is needed by several municipalities and provinces and then to discuss its manufacture with the provinces and municipalities interested.

63. Agriculture is a major "industry" critically dependent on transportation. One might move a factory to ameliorate or reduce its dependency on transportation, but the fields cannot be moved. It is very understandable that those in transportation feel that it is their job to provide the best service they can with the resources available. Equally, the farmers will never be satisfied unless they believe their interests have been put foremost. On the assumption that the federal government will continue to pay subsidies, then although its agriculturical organizations (the Department of Agriculture, the Grains Group, the Wheat Board) and its transportation organizations (Transport Canada, CN Rail) both have major contributions to make, it would be logical to give the lead role to Agriculture. As the beneficiary department, it should be charged the cost of the subsidies, not Transport Canada.

64. The relationship between the Department of Indian Affairs and Northern Development and TRC in the north seem to parallel those between MSUA and TRC in urban centres, but an agreed interface is needed.

65. The Department of Energy, Mines and Resources has the prime responsibility of ensuring that energy supplies reach where they are wanted in Canada. There are competing funds and competing modes of transportation. Transport Canada has also to be very

much involved. The panel on Energy R&D has been quite successful in ccordinating the transportation R&D projects.

66. The R&D prcjects of the Department of National Defence have been chosen to be uniquely military in nature and the potential areas of overlap are in the advanced technologies that could have military and civilian applications. Examples are air-cushioned vehicles, ice-capable vessels, navigational aids. Undesirable duplication is less likely to take place in times of restricted budgets in technological R&D than in human sciences R&D since the former projects cost relatively much more and take relatively much longer to ccmplete.

67. The Department of Regional and Economic Expansion is another department involved in transportaticn but in a rather different way from the others. It is not dealing in grain or oil or even the North- it covers everything in all provinces. It is because of the broad uncertainty of what DREE might currently be interested in that its rcle in transportation is frequently looked upon with misgivings by cther departments. It is self-evident that the Department of Agriculture is interested in the transportation of agricultural products wherever they may be; it is not self-evident what DREE is currently involved in or even if it is considering anything at all in the field of transportation. DREE's decentralization into Regicns, while undoubtedly smoothing

its working relations with the provinces, does not help in forewarning the other departments that might well be concerned.

68. Nevertheless, the role of DREE in transportation is an important one. If the federal government wishes to support a regional activity that cannot afford to pay true economic transportation costs to maintain its viability, then rather than pressuring or wooing a carrier to provide lower-cost transportation against his better judgement, it would be better for the correct transportation costs to be paid and a rebate given to lower the expense to the shipper. Such a rebate should properly be the business of DREE. In today's world of computers this should not be too difficult to handle.

69. Environment Canada is also involved in transportation, but again in a different manner from other departments. They essentially have a veto to prevent another organization doing something that they judge will unacceptably affect the environment. They have to decide on the standards to be adopted and how to make measurements to see whether or not the standards are being complied with. What fraction of their R&D projects is related to transportation is a question that has no simple answer but transportation certainly affects the quality of the waters and of the air. It would seem that other departments are only going to do work in an area of interest to Environment Canada in

order to ensure meeting their standards or to help in the establishing of the standards.

70. The Department of Industry, Trade and Commerce, the National Research Council and the Department of Supply and Services deal in the hardware of transportation. The Transportation Industries Branch of IT&C has close ties with individual industrial firms and knows their strengths and weaknesses. Its function is to assist industry and it is primarily responsive to industry initiatives. The IT&C Office of Science and Technology is much involved too: its General Director is the Chairman of the PAIT Committee.

71. The National Research Council has a multi-facetted mandate that includes the technological support of industry, research on long-term problems of national concern and the operation of certain national facilities. It has wind tunnels, harbour and waterway models, and a railway car behaviour test rig is now under construction to add to its other railway test facilities.

72. NRC has nine Associate Committees in the transportation field, made up of first class technical experts who assess the technical worth of R&D projects and judge the progress of the work being done.

73. After reviewing NRC's transpcrtation R&D projects, one gets the feeling that NRC's capabilities are not being exploited to the fullest extent. It has been suggested that one reason for this is that the transpcrtation industry is mcre interested in receiving funding from NRC than its technical advice. Neither the transportation industry nor NFC can successfully go it alone. The transportation industry cannot continue tc be up-to-date without NRC's technical support: NRC will lose if its ties with the transportation industry are weakened.

74. The Department of Supply and Services is also active in the transportation field. Two of its responsibilities are described as follows:

"Requirements Definition - Assistance to customers in defining material and service requirements including item identification, cataloguing, quality determination, development of specifications and standards, engineering design and consulting and specialized procurement planning.

Acquisitions - The acquisition or leasing of scientific research and development, technically complex engineering products and services, and goods and services of a general commercial nature, including acquisition planning, sourcing, tendering contract negotiatien, contracting, contract administration, project management and contract close out and audit."

DSS also has its program of Unsolicited Proposals fcr Research and Development. While it is in charge of the program, it only provides funds for agreed contracts until the sponsoring departments have arranged to undertake responsibility for

funding. It therefore does not retain any R&D projects of its own. It issues a useful monthly listing of the R&D contracts it places on behalf of government departments and agencies.

75. No attempt was made to review the work of the Central Agencies (the Privy Council Office and the Treasury Board Secretariat) or of the Department of Finance in the field of transportation R&D. The Ministers of these Agencies play a key role in the Cabinet decision process and they need the support of their senior officials. These officials cannot be put in a position whereby they have no alternative but to accept the recommendations of other departments - they must be able to get their own analysis done if they have any doubts.

Some General Comments

76. Since all levels of government are very much involved in transportation, the largest areas of needed ccordination are between the varicus governments. The present review was limited to federal activities and any observations made here would therefore be equally limited and cne-sided. They would reflect different degrees of individual optimism as much as anything else. The extent of ccoperation or conflict is clearly dependent on the respective political views of the governments concerned regarding the objective of the R&D. This report concentrates on how the federal house can be put in better order.

77. To enable federal departments and agencies to be informed of the R&D projects of other departments it is recommended that the R&D project titles obtained in the survey be listed by department and circulated to all departments and agencies concerned.

78. A case is made in some quarters for a national roads research laboratory - a single place to which the less strong provinces and municipalities and even federal agencies could turn for technical information and advice. With the cooperation of the strcnger provinces it could make unnecessary the duplication of provincial R&D projects. The parallel of NRC's Division of Building Research is given - an activity that at first sight seems largely outside federal jurisdiction, but which has had a

very great and welcome impact throughout the country. Others argue that such a national laboratory is not needed and furthermore it would be resented by the major provinces.

79. NRC has national transportation facilities in air, marine and rail. It is noted that Surface Administration of TRC is building a national facility for road vehicles and that a survey is being made, under a TDA contract, of the need for a Canadian Guided Ground Transport Test Centre. There would appear to be a need for a national facility for testing vessel models in ice covered waters.

80. An argument is presented in Annex 1 that physical sciences R&D projects have to be planned on long time scales and that the choices of the direction of these projects often cannot wait for the objectives and requirements determined by strategic policy and planning. They cannot also be expected to follow radical short term policy changes.

81. In Annex 2 a case is made that new vehicles (and new systems if the new vehicles need them) have a major impact on technological R&D and also a powerful focussing influence on the R&D in materials and equipment. It is pointed out that once the federal government has decided to maintain an industry in Canada to build a class of public transportation vehicle, it is important to continue the development of this type of vehicle in

Canada and to ensure that the prccess for selecting the vehicles to be developed is the best one pcssible. This is not to say that procurement of the vehicles developed would be mandatory, only that if the choices for development are prudent then the vehicles shculd be very strong contenders in the anticipated procurement stage.

82. It is argued in Annex 3 that choosing between what manufacturers offer in the marketplace is nct good enough when selecting public transportation vehicles that are used in systems that are either permanently subsidized or automatically subsidized when there are losses. Manufacturers cannot have available all the knowledge and data that is the daily business cf officials in government departments. The operator also has a major contribution to make.

83. It is suggested that the time has come when it should be recognized that the development of a new public transportation vehicle in Canada has to be decided upon, be designed, developed and built by a triumvirate - government, industry and the operator. Neither party can go it alone. It is just as foolish fcr government to try to do the job itself as it is for industry or the carrier to work alone. It is essential for the knowledge and viewpoints of the operator tc be factored in. Almost anything can be made to work badly if it is disliked. What the gcvernment can do is handle the timing, the best situations to

demonstrate success, the financial support, the awareness of the availability of relevant R&D knowledge. Industry knows best how to use the R&D knowledge in its own manufacturing facilities and the tricks of the trade. What is needed is committed involvement.

84. To illustrate the triumviate concept, the following is an outline of a possible arrangement although the detailed arrangement for public transportation vehicles could best be developed by Transport Canada. This same general concept was adopted when launching Canadian nuclear power program.

(a) A triumvirate made up of a representative each from the federal government, industry and an operator would be established to be in charge of the consideration and any subsequent federal involvement in the research, design, development and testing of each new public transportation vehicle. (If, say, two different railway locomotives were under consideration there would be a triumvirate for each of them). If a vehicle required a new system, the word "vehicle" should be read to include the whole system.

(b) The federal government would pay for the R&D costs of designing, developing and testing an agreed public transportation vehicle except for the contributions made by the selected

manufacturer and operator. Federal funds now provided for the support of industry through programs such as PAIT would be correspondingly reduced. There seems to be little merit in requiring a manufacturer to contribute some fixed percentage of the costs of an R&D project agreed to by a triumvirate. In any case, the expectation would be that he would recover his costs from supplying vehicles to one or more Canadian public transportation companies. A licence agreement would provide for the payment of fees on export sales.

(c) In-house federal government expenditures would be made from departmental appropriations i.e. a department would pay for the work it did itself and neither charge another department for its services nor be provided with funds from another department. Continuity of funding has to be assured to maintain the best researchers. Any lack of cooperation can be made known and this is an adequate guard.

(d) The R&D work done by industry would be paid for through a DSS contract in the normal way and charged to TRC since it is the beneficiary department. Budget submissions would be sent to Treasury Board by TRC.

(e) A new, small federal government organizational group would be established with responsibility for federal support of the research and development for public transportation vehicles

(R&D/PTV). The chairmen of the triumvirates would be selected from its senior staff.

(f) When R&D/PTV deemed it desirable or was requested to consider the development of a new public transportation vehicle, it would first invite expressions of views from all interested parties. If then the prospects still seemed promising, the next stage would be an invitation by R&D/PTV to manufacturers and to operators tc participate in a joint project. The selection of a manufacturer and an operator would be based on the attractiveness cf its propcsal to participate. The manufacturer chosen would nct have exclusive rights in Canada of any vehicle developed but it would gain practical experience with it over its competitors. The operatcr chosen would have the privilege of having the first vehicles developed and manufactured in its system. In the case cf urban vehicles, the federal approach for the selection of the operator wculd be addressed to the provinces, not to municipalities or regions.

(g) A triumvirate would be responsible for deciding upon the operational requirements and the detailed performance specificaticns. It would be more than a Requirements Board. It would be in charge of the whole R&D program. It would decide what, if any, R&D projects needed dcing and who should do them. It would study what expected technical improvements to the operation, performance, maintenance and public acceptability of

the proposed vehicle were likely to be made by future dates and decide on which ones to wait for and which not. It would decide between alternative competing designs of components. Besides dealing with the design of the vehicle under consideration, the triumvirate would be in the best position to specify what technical sclutions would be desirable in future vehicles of the same general type. In this way there would be guidance given to the longer range R&D programs thus providing a better chance of having more things usefully on the shelf when a future triumvirate is studying a future vehicle.

(h) The chairman of a triumvirate would be responsible for coordinating its activities and for proposing the initiation of the longer range R&D projects. Internal liaison would be needed between the various chairmen and the head of the organization would be responsible for this liaison and for the coordination and liaison with other federal departments and agencies, particularly with TRC, NRC, IT&C and DSS. To have sufficient influence both within and outside the federal government and in view of the magnitude of the R&D program, the head would have to be at the ADM/Vice President level.

(i) A triumvirate would not automatically be involved in any subsequent procurement phase but it would be in a good position to offer supporting assistance if desired.

85. This proposed arrangement for close industry-government cooperation in transportation vehicle R&D is not a guarantee for success - but it would have much greater chances of success because of the better coordination. There are four departments/agencies that are potential candidates for this proposed new organizational unit - TRC, NRC, IT&C and DSS. The creation of a new unit with senior technologically experienced staff would be needed in any case. Is the development of public transportation vehicles "transportation", "research", "industry", or "procurement"? It is of course all of these. However since its impact is greatest upon transportation it would be preferable to have the unit located in Transport Canada.

86. It will not be easy to build up a strong team, and a weak one would be a disservice. It is recommended that Transport Canada prepares itself for this assignment.

Conclusions and Recommendations

87. A survey has shown that the federal government R&D effort in transportation is quite large - in 1975-76, totalling some 950 man-years and nearly $95 million. IT&C is spending 45% of the total funds, MOT 28%, NRC 14% and other departments the remaining 13%. Transport Canada is not the lead agency in the expenditure of these R&D funds.

88. All the R&D projects in the Survey made are within departmental mandates, but these mandates often overlap. In the vast majority of cases however, there is no overlapping of R&D projects. In some of the projects that do overlap, there was coordination through formal committees, in others little coordination at all. When there is a difference of opinion between officials as to which department should have the lead role, the maximum cooperation is not likely to occur. Clearly the department that is responsible for policies to meet an objective should be the one that decides what R&D is needed to support that objective. For example, Transport Canada as the agency responsible for policies for good transportation services should also be responsible for deciding what R&D is needed to that end. However there are areas of overlap between the federal support of transportation and other objectives such as the support of industry, science, defence, etc. For the better coordination of transportation R&D, it is recommended that in the areas of overlap of federal objectives, the primary objective and the secondary objectives be made known in as many cases as possible and that PCO be responsible for arranging for the various interfaces to be defined and for determining which department has the lead role. The relative priorities of the work of the departments in these areas and of the supporting R&D projects follow suit. It is further recommended that the lead department be responsible for the appropriate coordination with other departments. By having clear responsibility on one

department for taking the lead role in a specific R&D field and by having it recognized that the responsibility for coordination with other departments is part of the lead role, better departmental cooperation and coordination would be achieved. Put the other way around, if agreement cannot be reached as to the primary objective and which is the lead department, coordination of supporting R&D projects cannot be assured. Interdepartmental Committees are useful coordinating mechanisms when all departments can agree on the objective, how to reach it and who should do what work. They do not operate satisfactorily when there is not agreement. For this reason, it is recommended that wherever possible, one department is put in charge. It would be prudent for it to seek the best available advice and assistance through a committee or any other suitable mechanism.

89. Whether the R&D effort is being properly distributed within a department in relation to the departmental mandates and the policy initiatives affecting it, could not be assessed since the relative priorities of the policies and programs are not known. It is recommended that a mechanism be established by which the relative priorities of government decisions made over the years on those policies and programs that affect transportation R&D projects, are maintained and made known down to those at the working level.

90. The initial concept of the Transportation Development Agency was that it should choose and initiate the larger, more basic development projects that looked promising but for which success could not be assured. It would fill the gap between the applied R&D done by the Administrations to meet their known requirements or desired improvements and the R&D done by industry to anticipate the preferences of the marketplace. Five years later, TDA is primarily engaged in a large number of R&D projects of an evolutionary nature, as distinct from the major breakthroughs. TDA's experience has been mainly in the surface mode. A variety of circumstances militated against the achievement of the original concept.

91. An applied R&D organization should have most of its projects directed at targets that are agreed to by its "customers". In the case of TDA, the "customer" should be one of the Administrations or another part of Planning and Development, even if the work will primarily benefit an outside organization.

92. Surface Administration in Transport Canada is different from Air Administration and Marine Administration in two fundamental ways - it has competing modes of travel under its jurisdiction, and it has no public transportation facilities to operate. Since it necessarily concentrates on policy and planning there is an inherent greater conflict with the Planning and Development organization of the Department unless clear interfaces are drawn.

93. It is the responsibility of the Deputy Minister, Transport Canada to decide what and how much R&D should be carried out in each of his organizational units. However, since almost all of TDA's experience relates to surface rather than air or marine, it is recommended for his consideration that TDA be organizationally transferred at a suitable date to Surface Administration and become its R&D centre. The minority of staff more appropriately qualified to support Strategic Planning in Planning and Development be transferred to Ottawa. The R&D Centre of Surface Administration would limit its activities to those of Surface Administration. The present air and marine activities of TDA would be transferred to Air Administration and Marine Administration. Each Administration would then be fully responsible for the R&D support of its on-going operations.

94. The proposed projects of the Surface Administration R&D Centre, which might be named the Surface Transportation Development Agency, should be routinely concurred in by the appropriate Surface Administration branch, it being accepted that 25% of the effort (by fundings) of the Centre can be spent on projects of its own choosing.

95. As regards the proposed five-year program 1974-75 to 1978-79 of TDA and its planned Program Forecast for 1977-78, an essential first step has to be an internal TRC decision between the Administrations and Planning and Development regarding what R&D

projects in the different modes can be justified by Transport Canada at the present time and the relative level of funding needed. The Administrations have to be as committed to the program as IDA. Until this analysis is completed any consideration of additional funding for R&D projects would be premature. It is recommended that no additional funding for TRC R&D projects be approved pending an examination of the current and planned projects by the appropriate Administration and Planning and Development. However it is further recommended that should an Administration and Planning and Development give evidence that they are prepared strongly to support a current or planned R&D project, it should be given sympathetic consideration since it is important to get TRC as a whole more involved in transportation R&D.

96. Physical sciences R&D projects have to be planned on long time scales and the choices of the direction of these projects often cannot wait for decisions on the objectives and requirements determined by strategic policy and planning. They also cannot be expected to follow radical short term policy changes.

97. The selection and development of public transportation vehicles is of critical importance in technological R&D and it has a powerful focussing influence. It is recommended that a triumvirate of a representative of each of federal government,

industry and operator be established to be in charge of the consideration and any subsequent federal involvement in the research, design, development and testing of each new public transportation vehicle. Manufacturers and operators would bid for the opportunity of participating. An outline of a possible arrangement is given in paragraph 84. In addition to the R&D needed for a specific vehicle, longer range R&D projects would be identified and arrangements made for having it carried out by contract in industry or by agreement with a federal research organization such as NRC. Federal funds now provided for the support of industry through programs such as PAIT would be reduced by the contracts that are placed on industry.

98. A new, small organizational unit with senior technical staff is needed to be responsible for federal government support of the R&D for public transportation vehicles and it is recommended that Transport Canada prepares itself for this assignment. It will not be easy to set up a capability of this sort, but it is the way by which Transport Canada can become the lead department in transportation R&D.

Summary of Recommendations

99. It is recommended that:

(a) in the areas of overlap of federal objectives, the primary objective and the secondary objectives be made known in as many cases as possible and that PCO be responsible for arranging for the various interfaces to be defined and for determining which department has the lead role.

(paras. 28 and 88)

(b) the lead department be responsible for the appropriate coordination with other departments.

(paras. 27 and 88)

(c) a mechanism be established by which the relative priorities of government decisions made over the years on those policies and programs that affect transportation R&D projects, are maintained and made known down to those at the working level.

(paras. 20 and 89)

(d) TDA be organizationally transferred at a suitable date to Surface Administration in Transport Canada and become its R&D Centre.

(paras. 53 and 93)

(e) no additicnal funding for Transport Canada R&D projects be approved pending an examination of the current and planned projects by the appropriate Administration and Planning and Development. However it is further recommended that should an Administration and Planning and Development give evidence that they are prepared strongly to support a current or planned R&D project, it should be given sympathetic consideration since it is important to get Transport Canada as a whole more involved in transportation R&D.

(paras. 57 and 95)

(f) a triumvirate cf a representative of each of federal government, industry and operator be established to be in charge of the consideration and any subsequent federal involvement in the research, design, development and testing of each new public transportation vehicle.

(paras. 83 and 97)

(g) Transpcrt Canada prepares itself so that it can take on the responsibility for federal government support of the R&D for public transportation vehicles.

(paras. 86 and 98)

PART II - APPENDICES AND ANNEXES

CONTENTS

Approved Plan

for

Review of Federal Government Transportation R&D

Introduction

Treasury Board, in considering a proposal from the Transportation Development Agency (TDA) for a five-year transportation R&D program, expressed concern that there should be the maximum possible co-ordination of federal government activities in this field, and that any overlap that may exist or could develop among agencies be generally eliminated or avoided. A review of federal government transportation R&D will be carried out to achieve these purposes.

Terms of Reference

An interdepartmental committee will examine the nature of federal activities and the division of responsibilities in transportation R&D with a view to improving their planning and co-ordination, to eliminating any existing and avoiding future undesirable overlaps or fragmentation of effort. Specifically, recommendations are to be made concerning the following:

(a) the proposed five-year program of the TDA in relation to the current and planned programs of federal government departments and agencies,

(b) appropriate content of these programs in relation to departmental mandates,

(c) the need for and nature of mechanisms to achieve concordance of programs with policy initiatives (such as the developing transport and energy policies); priority planning and improved program co-ordination, and

(d) the need for initiatives concerning the allocation of responsibilities for R&D between and within the various organizations.

Plan

Les travaux s'effectueront en trois étapes:

I Le directeur de l'étude préparera un plan d'étude précis, y compris les délais fixés et le budget, qu'il soumettra à l'approbation du Comité le 2 juillet 1975.

II Un rapport intérimaire sur les éléments a) et b) des descriptions du mandat sera préparé conformément au plan d'étude et aux délais fixés définis à l'étape I.

III Un rapport final sur les éléments c) et d) des descriptions du mandat et résumant l'ensemble des travaux sera rédigé conformément au plan d'étude et devra être prêt au plus tard le 1er avril 1976.

Direction de la revue
et de l'évaluation des programmes

Study Program

The study will be structured to include:

1. Identification and description of current and planned programs of departments and agencies, and the extent of the relationships between the various organizations.

2. Levels of funding, manpower, and capital facilities utilized by each department and agency for each program identified.

3. Identification of the underlying authorities for such programs.

4. Identification of and effectiveness of existing mechanisms for co-ordinating R&D activities, and preventing unnecessary duplication and fragmentation.

5. Identification of and effectiveness of existing planning/priority mechanisms.

6. Analysis of concordance of programs with existing and planned policy initiatives.

Organization

The Interdepartmental Committee, chaired by the Secretary of MOSST, will consist of senior officials from PCO, TBS, MOT and MOSST. It will oversee the work of a task force supervised by a Study Director, who will be advised and assisted as required by ad hoc working groups constituted from staff of interested departments and agencies. The Study Director will be responsible to the Chairman of the Committee for the preparation of the Committee's report.

Schedule

The work will proceed as follows:

I A detailed study plan including the schedule and budget will be prepared by the Study Director by July 2, 1975, for the approval of the Committee.

Programme d'étude

L'étude portera sur:

1. L'identification et la description des programmes actuels et proposés des ministères et organismes, ainsi que les relations qui existent entre les divers organismes.

2. Le type de financement, la main-d'oeuvre et les installations utilisées pour chacun des ministères et organismes aux fins de chaque programme identifié.

3. L'identification des autorisations sous-jacentes à ces programmes.

4. L'identification et l'efficacité des mécanismes actuels de coordination des activités de R-D, et les mesures à prendre pour empêcher le chevauchement inutile et le morcellement des forces.

5. L'identification et l'efficacité des mécanismes actuels de planification en fonction des priorités.

6. L'analyse de la conformité des programmes aux politiques actuelles et projetées.

Organisation

Le Comité interministériel, présidé par le Secrétaire du M.E.S.T., se composera de hauts fonctionnaires du Bureau du Conseil privé, du Secrétariat du Conseil du Trésor, du ministère de Transports et du M.E.S.T. Il supervisera le travail d'un groupe d'étude, qui sera sous la responsabilité d'un directeur d'étude, lequel sera conseillé et aidé, au besoin, par des groupes de travail spéciaux formés de membres du personnel des ministères et organismes intéressés. Le directeur de l'étude sera responsable devant le Président du Comité de la rédaction du rapport du Comité.

II An interim report covering items (a) and (b) of the terms of reference will be prepared in accordance with the study plan and schedule set out in phase I.

III A final report covering items (c) and (d) of the terms of reference and summarizing the work as a whole will be prepared in accordance with the study plan, not later than April 1, 1976.

Program Review &
Assessment Branch

Plan approuvé

pour

La revue des programmes fédéraux de R-D en matière de transports

Introduction

Prenant en considération une proposition formulée par le Centre de développement des transports concernant un programme quinquennal de R-D dans le domaine des transports, le Conseil du Trésor s'est dit d'avis que les activités du gouvernement fédéral dans ce domaine devraient être coordonnées le plus possible et que tout chevauchement qui existe ou qui pourrait se manifester entre les organismes devrait être éliminé. Une étude des programmes fédéraux de R-D en matière de transports sera effectuée à cette fin.

Description du mandat

Un comité interministériel étudiera la nature des activités du gouvernement fédéral ainsi que la répartition des tâches dans le domaine du R-D en matière de transports dans le but d'améliorer leur planification et leur coordination, et d'éliminer, maintenant et à l'avenir, tout chevauchement ou morcellement indésirable des efforts. Plus particulièrement, des recommandations seront formulées en ce qui a trait aux sujets suivants:

a) le programme de cinq ans proposé par le Centre de développement des transports par rapport aux programmes actuels et futurs des ministères et organismes fédéraux,

b) le contenu approprié de ces programmes par rapport au mandat des ministères,

c) la nécessité et la définition de mécanismes permettant d'atteindre la conformité du programme avec les initiatives des politiques (telles que les politiques des transports et de l'énergie); l'établissement des priorités et l'amélioration de la coordination dans la réalisation du programme lui-même, et

d) le besoin de mécanismes de répartition des tâches en matière de R-D au sein des divers organismes ainsi qu'entre ceux-ci.

Ministry of State Science and Technology | Ministère d'État Sciences et Technologie

CONFIDENTIAL (WHEN COMPLETED)
CONFIDENTIEL (LORSQUE REMPLI)

Appendix B-1

INVENTORY OF FEDERAL GOVERNMENT SCIENTIFIC ACTIVITIES IN TRANSPORTATION, 1975

INVENTAIRE DES ACTIVITÉS SCIENTIFIQUES DU GOUVERNEMENT FÉDÉRAL DANS LE DOMAINE DES TRANSPORTS, 1975

1. DEPARTMENT / AGENCY:
MINISTÈRE OU ORGANISME:

2. BRANCH / DIVISION:
DIRECTION OU DIVISION:

3. PROGRAM:
PROGRAMME:

4. ACTIVITY:
ACTIVITÉ:

5. TITLE OF PROJECT:
TITRE DU PROJET:

6. OBJECTIVES OF PROJECT:
OBJECTIFS DU PROJET:

7. DESCRIPTION OF PROJECT:
DESCRIPTION DU PROJET:

8. COLLABORATION WITH:
EN COLLABORATION AVEC:

9. CO-ORDINATION WITH:
COORDINATION:

10. START DATE:
DATE DE MISE EN CHANTIER:

11. COMPLETION DATE:
DATE D'ACHÈVEMENT:

12. CURRENT STATUS:
ÉTAT ACTUEL:

(further questions on the back)
(verso)

13. RESOURCE UTILIZATION *UTILISATION DES RESSOURCES*	1974-75	1975-76	1976-77	1977-78	1978-79	TOTAL
OPERATING $'000 *FONCTIONNEMENT (EN MILLIERS DE DOLLARS)*						
MAN-YEARS *ANNÉES-HOMMES*						
CAPITAL $'000 *CAPITAL (EN MILLIERS DE DOLLARS)*						

14. DEPARTMENTAL / AGENCY CONTACT:
PERSONNE-RESSOURCE AU SEIN DU MINISTÈRE OU DE L'ORGANISME:

15. DATE FORM COMPLETED *DATE*
DAY *JOUR*
MONTH *MOIS*

complete if applicable
remplir si nécessaire

16. CAPITAL FACILITIES UTILIZED; DESCRIPTION, APPROX. COST & YEAR INSTALLED:
INSTALLATIONS UTILISÉES; DESCRIPTION, COÛT APPROXIMATIF ET ANNÉE DE MONTAGE:

17. CONTRACTOR'S NAME & ADDRESS:
NOM ET ADRESSE DE L'ENTREPRENEUR:

18. CONTRACT AUTHORITY
AUTORISATION DU CONTRAT:

☐ TREASURY BOARD — MINUTE NUMBER:
CONSEIL DU TRÉSOR — NUMÉRO DE DÉLIBÉRATION:

APPROVAL DATE:
DATE D'APPROBATION:

☐ DEPARTMENTAL / AGENCY
MINISTÈRE OU ORGANISME

19. CONTRACT NUMBER:
NUMÉRO DU CONTRAT:

INVENTORY OF FEDERAL GOVERNMENT SCIENTIFIC ACTIVITIES IN TRANSPORTATION, 1975

Treasury Board has asked for a review to be made of research and experimental development (R&D) and certain other scientific activities in the field of transportation. This inventory is the first part of the review.

Instructions for completing the form:

Compress the information into the space available; do not add supplementary sheets.

Use a separate sheet for each project.

The scientific activities to be reported are those listed below: their Statistics Canada definitions are added for convenience. Demonstration projects are included.

Report all such activities involving transportation even if the primary area of application is something else, such as arctic development or industrial assistance.

The definition of transportation for the purposes of this inventory is given below.

Item	Explanation
3. & 4.	List the Program and Activity used for program budgeting.
5.	A name that identifies the work. Preferably the subdivision should not be smaller than the work done by 3-5 people unless (a) special mention of a unique situation is desired or (b) the work cannot be logically grouped under a broader title. Example: lighting for highway safety.
6.	Example: to improve highway safety. Broader than No. 5 but more precise than Nos. 3 and 4.
7.	Describe the nature of the work, the origin and purpose of the proposal and how the project differs from previous work. If funded, give funding information.

exercée par des unités affectées à l'analyse et au contrôle permanents de phénomènes extérieurs (par ex., les statistiques économiques) ainsi qu'en des études destinées à fournir une base de données aux fins de l'élaboration de politiques, telles que les études menées par les ministères d'Etat. Ces études comprennent les travaux des commissions royales d'enquête et des groupes de travail de l'administration fédérale, sauf lorsque les projets de R-D peuvent être identifiés et lorsque leur coût peut être établi.

Définition de "transports"

Tout déplacement de personnes ou d'articles à des fins sociales ou économiques nécessitant l'emploi de machines ou d'équipement. Sont exclus le transport dans l'usine, le transport intra-muros ou le transport sur le chantier de personnes ou d'articles (par ex., les courroies mécaniques, les dispositifs d'élimination des déchets, la cueillette des fruits, l'enlèvement de la terre). Les pipe-lines pour le transport de matières premières sont compris dans cette définition. Sont exclus en outre, les communications et la transmission de l'électricité.

Item	Explanation
8.	List any other departments/agencies working on the project.
9.	Give the name of any interdepartmental or outside committee or organization to which the work is reported.
10. & 11.	Approximate month and year is sufficient.
12.	What milestone has been reached or is approaching.
13.	Use the 'Total' column unless the work has no foreseeable termination date. The capital expenditures are those acquired or to be acquired for the project.
16.	Capital facilities acquired for many projects, e.g. wind tunnel. List only those facilities paid for by the federal government. Indicate the extent of usage, such as approximate percentage of floor area of a testing laboratory or approximate percentage of time a facility is used.
17. - 19.	For outside contracts only.

Scientific activities to be covered by this inventory

A. Natural Sciences

(a) Research and experimental development

Research and experimental development (R&D) is defined as creative work undertaken on a systematic basis to increase the stock of scientific and technical knowledge and to use this knowledge in new applications. The central characteristic of R&D is an appreciable element of novelty - new knowledge (new information integrated into existing hypotheses; new hypotheses derived from new facts; the re-evaluation of known data) or new products of processes are sought.

...3

à des hypothèses exitantes; nouvelles hypothèses découlant de nouvelles données; réévaluation de données connues) ou produits ou procédes nouveaux.

(b) Etudes de faisabilité

Ce sont des études techniques que l'on fait sur des projets de génie innovateurs envisagés afin d'obtenir les renseignements supplémentaires nécessaires avant que la décision de les réaliser ne soit prise. N'incluez pas les travaux courants tels que les études aux fins de la sélection des terrains et des matérieux pour la construction de routes et de ponts, à moins que certaines conditions spéciales (barrières de permagel ou de montagnes) n'exigent des solutions innovatrices.

B. Sciences humaines

(a) Recherche et développement expérimental

La recherche et le développement expérimental (R-D) sont considérés comme un travail systématique de création visant à l'acquisition de nouvelles connaissances sur l'homme, sur ses actes et ses institutions, et à de nouvelles applications de ces connaissances. L'acquisition de connaissances nouvelles englobe l'intégration de renseignements nouveaux à des hypothèses existantes, la formulation et la mise à l'essai de nouvelles hypothèses ou la réévaluation d'observations existantes.

(b) Etudes économiques et de faisabilité

Les études économiques et de faisabilité consistent en des études sur les caractéristiques et les répercussions socio-économiques de situations spécifiques (par exemple, l'étude de la viabilité d'un port en eau profonde à Gaspé, ou une étude coût-avantages du service proposé de train rapide dans le corridor (Québec-Windsor). Ces études se limitent habituellement à des problèmes spécifiques et exigent l'application de techniques et de méthodes établies en sciences humaines.

(c) Etudes d'opérations et de politiques

Les études d'opérations et de politiques consistent en l'analyse et en l'évaluation de programmes, politiques et opérations ministériels, en l'activité

(b) Feasibility studies

Technical investigations of proposed innovative engineering projects to provide necessary additional information for decisions on implementation. Exclude such routine work as studies for selection of road routes, materials and bridge sites, unless there are conditions, such as permafrost or mountain barriers, which impose innovative solutions.

B. Human Sciences

(a) Research and experimental development

Research and experimental development (R&D) is creative work undertaken on a systematic basis towards the acquisition of new knowledge about man, his actions and his institutions, and the application of this knowledge in new ways. New knowledge involves the integration of newly acquired information into existing hypotheses, the formulation and testing of new hypotheses or the re-evaluation of existing observations.

(b) Economic and Feasibility Studies

Economic and feasibility studies are investigations of the socio-economic characteristics and implications of specific situations (e.g. study of the viability of a deep water harbour in the Gaspe; or a cost-benefit study of the proposed high speed rail service in the Quebec-Windsor corridor). Such studies are generally limited to a specific problem and involve the application of established human science techniques and methodologies.

(c) Operations and Policy Studies

Operations and policy studies involve the analysis and assessment of departmental programs, policies and operations; the activities of units concerned with the continuing analysis and monitoring of external phenomena (e.g. economic statistics); as well as studies to provide an information base for policy development, such as conducted by Ministries of State. This includes the work of government royal commissions and task forces, except when R&D projects can be identified and costed.

...4

Poste	Explication
7.	Décrire la nature des travaux, la source et l'objet de la proposition et ce en quoi le programme diffère de travaux précédents. S'il s'agit d'un programme subventionné, donner des précisions quant au financement.
8.	Enumérer tout autre ministère ou organisme participant à l'excécution du programme.
9.	Donner le nom de tout comité ou organisme interministériel ou autre auquel on fait état des travaux.
10.&11.	Le mois approximatif et l'année suffisent.
12.	L'étape qui a été atteinte ou qui doit l'être prochainement.
13.	Utiliser la colonne "Total" sauf si l'on ne peut prévoir la date d'achèvement précise des travaux. Les dépenses en capital sont celles qui ont été engagées ou qui doivent l'être au titre du projet.
16.	Les installations nécessaires à la réalisation de divers projets, par exemple un tunnel aérodynamique. Enumérer seulement les installations qui ont été acquises par le gouvernement fédéral. Indiquer le degré d'utilité, par exemple le pourcentage approximatif de la superficie d'un laboratoire d'essai ou le pourcentage de temps approximatif qu'une installation est utilisée.
17-19.	Pour les contrats passés avec l'extérieur seulement.

Activités scientifiques qui doivent faire l'objet de cet inventaire

A. Sciences naturelles

(a) Recherche et développement expérimental

La recherche et le développement expérimental (R-D) sont définis comme un travail systématique de création qui a pour objet d'accroître les connaissances scientifiques et techniques et de leur trouver de nouvelles applications. La principale caractéristique de toute R-D est un élément appréciable de nouveauté - nouvelles connaissances (nouvelles données relatives à des

Definition of Transportation

All movement of people or things for social or economic purposes which involves the use of machines or equipment. In-plant, in-house or on-site transportation of people or things are excluded (e.g. conveyor systems, waste disposal, fruit picking, earth removal). Pipelines for primary products are included. Communications and the transmission of electricity are excluded.

INVENTAIRE DES ACTIVITES SCIENTIFIQUES DU GOUVERNEMENT FEDERAL DANS LE DOMAINE DES TRANSPORTS, 1975

Le Conseil du Trésor a demandé qu'une étude soit effectuée sur la recherche et le développement expérimental (R-D) et sur certaines autres activités scientifiques dans le domaine des transports. Cet inventaire constitue la première partie de cette étude.

Instructions pour remplir la formule:

Donner tous les renseignements nécessaires dans l'espace réservé à cette fin; ne pas ajouter des feuilles supplémentaires.

Utiliser une formule pour chaque projet.

Les activités scientifiques qui doivent être énumérées sont celles décrites ci-dessous, leur définition, établie par Statistique Canada, est donnée pour votre gouverne. Les projets de démonstration doivent aussi faire partie de cet inventaire.

Enumérer toutes les activités touchant les transports même si le domaine primaire d'application est autre chose, par exemple le développement arctique ou l'aide industrielle.

La définition de transports aux fins de cet inventaire est donnée ci-après.

Poste	Explication
3. & 4.	Enumérer le programme et l'activité utilisés aux fins de la budgétisation du programme.
5.	Un nom qui caractérise le travail en question. Il est préférable que la subdivision ne soit pas plus petite que le travail effectué par un groupe de trois à cinq personnes sauf si (a) on doit faire mention d'une situation unique ou si (b) les travaux ne peuvent pas être regroupés logiquement sous un titre moins restrictif. Exemple: le balisage sécuritaire d'une autoroute.
6.	Exemple: Pour améliorer la sécurité sur les autoroutes. Ce poste doit être plus étendu que le numéro cinq et plus précis que les numéros trois et quatre.

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DESCRIPTION OF TRANSPORTATION MODES USED

A	GENERAL	Not related to a specific mode - usually of wide applicability.
B	AIR	Excludes air cushion vehicles (ACV's).
C	ROAD	Automobiles, buses, trucks.
D	RAIL	All guided ground transportation.
E	MARINE	Inland and ocean.
F	OTHER	Off-road, intermodal and pipeline

DESCRIPTION OF TRANSPORTATION CATEGORIES USED

1 VEHICLE
From applied research to service test.

2 POWER, PROPULSION
Power generation, transmission and converters.

3 GUIDANCE, NAVIGATION, CONTROL
Includes fixed and moving equipment.

4 WAY, FIXED EQUIPMENT, TERMINALS
From applied research to service test.

5 SAFETY
Protection from personal danger, material damage, etc.

6 ENVIRONMENT
Effect of systems on the environment and vice versa.

7 HUMAN FACTORS
The human being as an element of the transport system.

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8 PLANNING, POLICY

Elaboration and selection of future transportation systems or long-term changes to present systems, formulation and evaluation of transport policy.

(8A Supporting Economic and Financial Studies)

9 PERFORMANCE IMPROVEMENT

Operations research, cost/benefit analysis and other systems analysis intended to improve the performance of an existing system.

(9A Supporting Data Collection)

10 REGULATORY, LEGAL

Studies concerning regulations affecting the transport industry.

NUMBERS OF PROJECTS BY CATEGORY — GENERAL mode

	1 - 5	6	7	8	8A	9	9A	10	
AGRIC						3			3
DND			1						1
EM&R		17						2	19
EC		3							3
GG			1						1
IA&ND							1		1
IT&C				1					1
NCC				1					1
NRC	12	4	1						17
PO									
PW	1								1
REE									
UA			1	10	2	5			18
DOT/TTF				2	1				3
DOT/Arctic						1			1
DOT/Air									
DOT/Marine									
DOT/Surface						1			1
DOT/TDA	3		3	4	11	9	4		34
CTC			1	2	2	7	7	6	30
NHB									
SLS									
	16	24	8	25	16	26	12	8	135

Appendix D-1
GENERAL mode

NUMBERS OF PROJECT BY CATEGORY — AIR mode

CATEGORY	1	2	3	4	5	6	7	8	9	10	
AGRIC											
DND	6	1			1						8
EM&R											
EC				4	2	1					7
GG											
IA&ND											
IT&C	7	5			2						14
NCC											
NRC	10	5	1	1	2	2	2	1			24
PO											
PW											
REE									4		4
UA											
DOT/TTF											
DOT/Arctic								1	1		2
DOT/Air			13	9			1	4		2	29
DOT./Marine											
DOT/Surface											
DOT/TDA	2	1		1	1		1	2	1	4	13
CTC								7	2		9
NHB											
SLS											
	25	12	14	15	8	3	4	15	B	6	110

Appendix D-2
AIR mode

NUMBERS OF PROJECT BY CATEGORY — ROAD mode

CATEGORY	1	2	3	4	5	6	7	8	9	10	
Agric											
DND					1						1
EM&R		1		1		2					4
EC						11					11
GG											
IA&ND				2		7					9
IT&C	4	2						1		1	8
NCC									1		1
NRC	1			1	2						4
PO	1								2		3
PW											
REE											
UA						1	1	1	1		4
DOT/TTF											
DOT/Arctic											
DOT/Air											
DOT/Marine											
DOT/Surface				1	23	6	19	4	8	4	65
DOT/TDA	4	1	5		2			4	11	2	29
CTC										1	1
NHB											
SLS											
	10	4	5	5	28	27	20	10	23	8	140

Appendix D-3
ROAD mode

NUMBERS OF PROJECT BY CATEGORY — RAIL mode

CATEGORY	1	2	3	4	5	6	7	8	9	10	
Agric.											
DND											
EM&R				1							1
EC											
GG								1			1
IA&ND											
IT&C	1	3									4
NCC											
NRC	2	1		2			1				6
PO											
PW											
REE								1			1
UA								2			2
DOT/TTF											
DOT/Arctic											
DOT/Air											
DOT/Marine											
DOT/Surface	1			1							2
DOT/TDA	13	5	6	6			1	6	5		42
CTC								1	2		3
NHB											
SLS											
	17	9	6	10	-		2	11	7	-	62

Appendix D-4
RAIL mode

NUMBERS OF PROJECT BY CATEGORY — MARINE mode

Category	1	2	3	4	5	6	7	8	9	10	
Agric.											
DND	5	2									7
EM&R	1										1
EC				5		4					9
IA&ND											
IT&C	1			1					1		3
NCC											
NRC		1		6							7
PO											
PW	1			2		2					5
REE											
UA								1			1
DOT/TTF											
DOT/Arctic				2							2
DOT/Air											
DOT/Marine	2		1	6		1			1		11
DOT/Surface								1			1
DOT/TDA	9	1		2				3	3		18
CTC								1	1	4	6
NHB				3					1		4
SLS	1								2		3
	20	4	1	27	-	7	-	6	9	4	78

Appendix D-5
MARINE mode

NUMBERS OF PROJECTS BY CATEGORY — OTHER mode

CATEGORY	1 - 5	6	7	3	8A	9	9A	10	
Agric.									
DND	1					2	1		4
EM&R		3					3		6
EC		2				1	1		4
GG									
IA&ND	1			2					3
IT&C	2	1		1					4
NCC									
NRC	1					1			2
po									
pw									
REE				4					4
UA				2					2
DOT/TTF									
DOT/Arctic									
DOT/Air									
DOT/Marine									
DOT/Surface									
DOT/TDA	4			3	1	6	4		18
CTC									
NHB									
SLS									
	9	6	-	12	1	10	9	-	47

Scientific Activities in Transportation Related to Total Resources
Estimated Expenditures in 1975-76 by Programs and Activities

	Total Resources					R & D	
	Man-Years	Operating	Capital	Grants	Total	Man-Years	$ 000's Total
		$ 000's					
1. INDUSTRY, TRADE & COMMERCE							
(a) Trade-Industrial Program							
Industry Development	904	22,629	39	155,863	178,531	19	39,651
International Trade Development	833	26,842	27	7,237	34,106	9	195
Administration	517	13,888	550		14,438		
Metric Conversion	86	3,406	13		3,419		
	2,340	66,765	629	163,100	230,494	28	39,846
(b) Tourism Program	376	21,823	35	2,150	24,008		
(c) Grains & Oilseeds Program	56	2,153	10	94,593	96,668	2	1,870
2. MINISTRY OF TRANSPORT							
(a) Department Headquarters Program							
Executive	71	1,722			1,722	6	320
Admin. & Common Services	808	19,958	8,600		28,558		
Arctic Transportation Agency	16	527			527	3	64
	895	22,207	8,600		30,807	9	384

...2

	Total Resources					R & D	
	Man-Years	Operating	Capital	Grants	Total	Man-Years	$ 000's Total
		$ 000's					
2. MINISTRY OF TRANSPORT							
(b) Marine Transportation Program							
Administration	538	9,627			9,627		
Terminal Facilities	45	1,047	3,800		4,847		
Way Facilities	4,591	122,589	44,509	2	167,100	3	687
Marine Safety	363	7,812	544	29	8,385		
	5,537	141,075	48,853	31	189,959	3	687
(c) Air Transportation Program							
Administration	875	17,043	747		17,790	1	67
Airports & Associated Ground Services	3,409	78,211	80,674	5,134	164,019	6	122
Air Navigational Services	6,432	147,031	46,649	580	194,260	131	4,314
Regulatory Services	982	23,601	606	61	24,268		
Construction Services	844	12,544	1,777		14,321		
	12,542	278,430	130,453	5,775	414,658	142	4,503
(d) Surface Transportation Program							
Administration	112	4,211	17	59,900	64,128	7	1,641
Ferry Services		100,000	26,740		126,740		
Road & Motor Vehicle Safety	101	5,360	6,103	140	7,011	10	1,276
	213	109,571	32,860	60,040	197,879	17	2,917

...3

	Total Resources					R & D	
	Man-Years	Operating	Capital	Grants	Total	Man-Years	$ 000's Total
			$ 000's				
2. MINISTRY OF TRANSPORT							
(e) Transportation Development Agency Program							
Administration	54	2,080	25		2,105	7	423
Transportation Systems R & D	44	8,124		875	8,999	30	10,174
Technology Development	17	4,260			4,260	10	4,767
	115	14,464	25	875	15,364	47	15,364
(f) Canadian Transport Commission							
Administrative & Support	231	4,178	43		4,221		
Regulatory & Control	434	7,986	57	246,906	254,949		
Railway Safety	108	2,791	6	25,000	27,797		
Research	111	3,396	22	10	3,428	68	1,892
International Relations	17	334	2		336		
	901	18,685	130	271,916	290,731	68	1,892
(g) National Harbours Board							
Harbours	2,300					7	250
Bridges & Autoroutes	45	750	3,450		4,200		
	2,345	750	3,450		4,200	7	250

...4

	Total Resources					R & D	
	Man-Years	Operating	Capital	Grants	Total	Man-Years	$ 000's Total
			$ 000's				
2. MINISTRY OF TRANSPORT							
(h) St. Lawrence Seaway Authority							
Deep Waterway Program							
Montreal - Lake Ontario Section	601						
Welland Canal Section	826	33,660			33,660	11	250
	1,427	33,660			33,660	11	250
3. NATIONAL RESEARCH COUNCIL							
(a) Engineering & Natural Sciences Research Program							
Basic and Exploratory Research in the Natural Sciences & Engineering	801	17,975	414		18,389		
Research on Long-term Problems of National Concern	518	11,898	1,677		13,575	285	12,300
Research in Direct Support of Industrial Innovation & Develop.	314	7,024	2,436	16,580	26,040		410

...5

	Total Resources					R & D	
	Man-Years	Operating	Capital	Grants	Total	Man-Years	$ 000's Total
			$ 000's				
3. NATIONAL RESEARCH COUNCIL							
Research to Provide Technological Support of Social Objectives	338	7,456	1,037		8,493		
National Facilities	211	7,406	562	5,968	13,936		
Research and Services Related to Standards	269	6,208	96		6,304		
Administration	364	8,327	318		8,645		
	2,815	66,294	6,540	22,548	95,382	285	12,710
(b) Scientific & Technical Information Program	271	8,143	126		8,269		
(c) Scholarships & Grants In Aid of Research Program	56	1,203	7	81,693	82,903		546
4. ENVIRONMENT CANADA							
(a) Environmental Services Program							
Environmental Protection	777	23,857	3,194		27,051	11	259
Atmospheric Environment	2,612	74,366	5,381	492	80,239	29	1,065
Environmental Management	3,268	81,106	10,695	10,570	102,371	82	2,319
	6,657	179,329	19,270	11,062	209,661	122	3,643

	Total Resources					R & D	
	Man-Years	Operating	Capital	Grants	Total	Man-Years	$ 000's Total
		$ 000's					
4. ENVIRONMENT CANADA							
(b) Fisheries & Marine Program							
Fisheries Management & Research	3,470	86,405	50,114	13,157	149,676		
Ocean & Aquatic Affairs	1,291	33,932	17,604	26	51,562		
	4,761	120,337	67,718	13,183	201,238		
(c) Administration Program	697	16,835	125	98	17,058		
5. NATIONAL DEFENCE							
(a) Defence Services Program							
Defence Scientific Services	1,937	41,500	8,500	4,000	54,000	60	2,631
Other Activities	113,885	2,204,300	337,629	22,277	2,564,206		
	115,822	2,245,800	346,129	26,277	2,618,206	60	2,631
6. URBAN AFFAIRS							
(a) Ministry							
Urban Policy & Research	165	7,599	200	800	8,599	5	335
Urban Coordination	67	3,152		6,132	9,284	18	2,063
General Administration	69	1,612	110		1,722		
	301	12,363	310	6,932	19,605	23	2,398

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	TOTAL RESOURCES					R & D	
	Man-Years	Operating	Capital	Grants	Total	Man-Years	$ 000's Total
		$ 000's					
6. URBAN AFFAIRS							
(b) National Capital Commission							
Policy Development				700	700		
Land Development	225	4,885		5,300	10,185		
Transportation	10			8,000	8,000	3	75
Services & Utilities				5,000	5,000		
Recreation & Culture	458	6,634		3,750	10,384		
Administration & Finance	301	8,249		500	8,749		
	994	19,768		23,250	43,018	3	75
7. ENERGY, MINES & RESOURCES							
(a) Administration Program	491	10,605	528		11,133		
(b) Mineral & Energy Resources Program							
Energy Development	203	5,152	80	757	5,989		
Office of Energy Conserv.	12	496	4		500		
Mineral Development	172	4,523	31	791	5,345		
Mining & Metallurgical Investigations	758	15,699	862	254	16,815	48	825
Geological Research & Surveys	693	19,797	1,092	560	21,449	3	99
	1,838	45,667	2,069	2,362	50,098	51	924

...8

	TOTAL RESOURCES					R & D	
	Man-Years	Operating	Capital	Grants	Total	Man-Years	$ 000's Total
		$ 000's					
7. ENERGY, MINES & RESOURCES							
(c) Earth Sciences Program							
Field & Air Survey, Mapping & Aeronautical Charting	1,123	23,715	1,067	154	24,936		
Geological Research & Surveys	96	2,653	73	91	2,817	34	1,098
Research in Geophysics	177	5,434	444	58	5,936		
Polar Continental Shelf Studies	32	3,126	235		3,361		
Canada Centre for Remote Sensing	94	5,202	2,555		7,757		
Administration	16	446	1		447		
	1,538	40,576	4,375	303	45,254	34	1,098
8. REGIONAL ECONOMIC EXPANSION							
Planning and Administration	1,249	36,649	496		37,145		871
Developmental Opportunity Incentives				186,070	186,070		
Industrial Incentives				92,424	92,424		
Other Programs	981	15,531	15,895	121,418	152,844		
	2,230	52,180	16,391	399,912	468,483		871

	TOTAL RESOURCES					R & D	
	Man-Years	Operating	Capital	Grants	Total	Man-Years	$ 000's Total
		$ 000's					
9. INDIAN AFFAIRS AND NORTHERN DEVELOPMENT							
(a) Administration Program							
Executive	56	1,343	3		1,346		
Advisory Services	655	10,279	48		10,327		
Engineering, Architectural & Technical Services	301	6,411	12		6,423		
Claims Negotiation	30	2,834	10		2,844		
	1,042	20,867	73		20,940		
(b) Indian & Eskimo Affairs Program	6,794	205,561	95,791	133,951	435,303		
(c) Northern Affairs Program							
Territorial & Social Development	211	6,807	370	149,678	156,855		
Northern Policy and Program Planning	78	2,661		220	2,881		
Northern Natural Resources and Environment	494	18,174	2,738	40	20,952		
Northern Roads & Airstrips	34	8,325	34,122		42,447	13	260
	817	35,967	37,230	149,938	223,135	13	260
(d) Parks Canada Program	4,564	75,166	68,655	83	143,904		23

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	TOTAL RESOURCES					R & D	
	Man-Years	Operating	Capital	Grants	Total	Man-Years	$ 000's Total
		$ 000's					
10. AGRICULTURE							
(a) Administration Program							
Departmental Admin.	662	12,488	114	52	12,654		
Economics	220	4,621	42		4,663	7	237
Canfarm	331	6,097	60		6,157		
Small Farm Development Adjustment	109	5,062	56		5,118		
Information	92	2,109	12	466	2,587		
	1,414	30,377	284	518	31,179	7	237
(b) Research Program	3,834	66,832	19,469		87,151		
(c) Production & Marketing Program	2,274	34,259			346,963		
(d) Health of Animals Program	2,509	44,194	3,020	3,814	51,028		
(e) Canadian Grain Commission Program	1,159	19,581	2,834	2	22,417		
11. PUBLIC WORKS							
(a) Administration Program	1,380	21,748	340		22,088		
(b) Professional and Technical Services Pro.	1,298	27,507	376	5	27,888	4	206
(c) Accommodation Program	5,455	260,018	306,000		566,018		
(d) Marine Program	540	11,834	9,205	245	21,284		

...11

	TOTAL RESOURCES					R & D	
	Man-Years	Operating	Capital	Grants	Total	Man-Years	$ 000's Total
		$ 000's					
11. PUBLIC WORKS							
(e) Transportation and Other Engineering Program	91	11,400	14,530		25,930		
(f) Land Management and Development Program	136	5,552	6,874		12,426		
12. POST OFFICE							
Marketing	6,529	116,630	2,060		118,690		
Mail Processing	25,450	331,151	48,228		379,379		
Mail Transportation	241	107,823	1,377		109,200	3	46
Mail Collection and Delivery	20,142	281,614	6,591		288,205	1	22
Technical Operations Support	2,153	35,535	1,854		37,389		
Administration	4,724	77,115	818	257	78,190		
	59,239	949,868	60,928	257	1,011,053	4	68

Research and Development - Some differences in type Annex 1

Although the same words "research and experimental development" and "feasibility studies" are used in both the natural sciences and the human sciences, there are differences in the nature of the work. For example, an aeronautical engineer would not feel qualified to develop a ferry vessel. A planner analysing how to get freight across the rockies feels equally at home in dealing with railways and highways.

The outside competition is not the same. Systems experts and planners are under pressure tc meet the dates and goals set by political prcmises or influences. They do not have to worry about what their opposite numbers are doing in other countries: these people are concerned with their own problems. No-one outside Canada is thinking about railway relocation in Canadian cities or about railway abandonment on the prairies. The physical scientist or engineer should always remember that another scientist or engineer in ancther country might beat him to his disccvery or to his design.

It is, however, the time scale of a program or series of programs that has to be borne in mind in the present study. A new government with a new set of priorities can scon get the R&D projects in the human sciences focussed on its main interests. It is not possible tc turn from metallurgy to ceramics anything

like as quickly. Unless a type of physical R&D work is going to be continued for ten years, it is not usually worth starting. Physical R&D projects have therefore to be somewhat isolated from political cycles.

The two worlds have to be kept in contact with each other, otherwise both are the losers. The planners of Gander Airport did not know or paid no attention to the new generation of jet aircraft being built that would fly straight from Europe to Montreal or New York. The designers and developers of the Arrow aircraft lost sight of the fact that the circumstances around them had changed during the course of their work. The designers of equipment have to have a way of keeping in touch with political winds as well as with their competitors.

The social scientists need the advice of the best physical scientists with similar interests and visa-versa. There is much promotion of physical equipment that is straight advertising or wishful thinking: social scientists have to be helped to learn what is real and what is unreal in the expectation of new hardware or their planning will be based on sand. Likewise, the physical scientists should heed the thinking of the social scientists or they will find that they are out of step with everyone else.

The sequence of strategic policy, detailed planning, development of hardware and implementation cf program is too simplistic in determining the general direction of physical sciences R&D. At the time it is decided to acquire some new vehicles, it is necessary to determine their functional requirements and prepare technical specifications. The aim is to incorpcrate all the wisest, compatible choices from among the latest technologies then available. But these technologies will not have been developed and be ready for use unless the possible or likely requirements had been foreseen many years previously and R&D projects to those ends had been initiated.

There must be a strong overall plan. Research people, whether of the physical cr social disciplines, can happily keep themselves going in a tctal wilderness. They will go the way that looks most promising to them unless someone gives them a route map tc follow.

What should be designed in Canada? Annex 2

It is well accepted that there has to be careful selection of the R&D projects done in Canada particularly in the physical sciences. Equally it is accepted that the selection ought to be strongly influenced by the uniqueness of Canadian circumstances - the things that would give Canada an edge over others. It could be gecgraphic, climatic, historical, investment or other circumstances. Again nothing will be successful without the right people - people who are not only skilled but who cannot repress an inner urge to do something original and important.

It is sometimes argued that, in the physical sciences, if the Americans wanted to do something badly enough they could always beat anyone else. They would not just solve the problem, they would overwhelm it. This view is almost entirely correct, but the inference that is implied - namely that we should not bother doing anything - is quite wrong. The reality is that the Americans have many priorities to consider and just beating Canadians is not one of them. It does mean that no one should compete with any of the American's priority interests unless he is very sure of himself.

What sort of manufacturing plants do we want to have? We have grown up with branch plants and are now well experienced in putting together automobiles and refrigerators that parent

ccmpanies have designed and develcped. Is this prcduction of copies going tc be satisfying enough to the graduate scientists and engineers that are coming out of our universities? If their minds are nct gcing to be challenged in Canada, they will migrate abroad. Then we will ask why we spend money on the graduate schools. It is not difficult tc argue ourselves back tc chopping trees.

There is a similar line of reasoning that says Canadian industry cannot compete so why suppcrt it any more? More people are employed building shopping centres and other social infrastructures. Let industry decline. The other side of the coin is equally valid. We all need industrial products. Why dcn't we dc our best tc get Canadian plants making what we want rather than importing from abroad? Why pay fcr foreign R&D if we can do our own at about the same price?

Transpcrtation R&D in the physical sciences can be broadly subdivided into materials and equipment on one side and vehicles on the other. There are many bcrderline prcjects and of course the work on one side interacts with that on the other. Railway track can be improved upon as a continuing activity quite apart from the introduction of a new train. Electronic navigational aids can be imprcved and introduced into service without changing airplanes or relocating airfields. The new generation of jumbo jets however, required new or altered airfields, hangars,

passenger loading devices, and so on. The STCL aircraft wanted a new airfield in the sense that it could use a smaller one closer tc dcwntown, and a new total system made up of aircraft, navigational system and terminals.

What new vehicle is to be designed in Canada is of key importance to transportation R&D. To continue with airplanes. It is self evident that Canada has seen the end of designing fighter planes. It is clear that Canada cannct hcpe to compete with the Bceing 747 or the Lockheed L1011. At the other end of the scale, there are the very small aircraft like the Cessnas and Piper Cubs. There are some 1800 aircraft licensed in Canada, mcstly small cnes. Is a producticn line of several hundred planes a year big encugh to get into their manufacture? If the answer is "no", there are the planes a little bigger - the size of the Twin Otter and a little abcve.

It is in this narrcw band of sizes that Canada has concentrated and equally has had success. Into this band fits the Dash-7 STOL aircraft. The federal government has purchased the de Havilland Aircraft Company and has authorized the first production of the Dash-7 aircraft. But at this stage, the successor to this aircraft should have been decided upon and the R&D tc support it should be well underway. No selection has yet been made and it seems that another crisis in the aircraft

industry lies ahead.

In the rail mode there is the same set of questions. What is wanted? what is the competitiсn? what can be developed in Canada that has a place in the scheme of things? The non-expert would be surprised if Canada coould corner a market in the world of rail-passenger transportation. With Japan and many countries in Eurcpe with far greater need than Canada has, it would indeed be a triumph if a Canadian design could penetrate the export market. With the populations involved, the shorter distances, these countries have everything gcing for them in the rail passenger business. The factors are so different from those in Canada.

On the other hand, with an expanding world population, if anything is certain, it is that Canadian primary products (minerals, food, wood, etc.,) will be more and more needed abroad. This suggests greatly expanding rail freight that should cpen up majcr opportunities. At what stage has electrification of the railways to be introduced to get the freight across the Rockies? It has to be done while there is still time tc work on the track between one train and the next. When the track is saturated is too late. With the size of Canadian freight trains, does not this mean a much bigger electric lccomotive than is common in Europe? When is the time to start designing it and

planning the new infrastructure - or doing something more effective at less cost? The growth has to be there.

In the marine mode, an encouraging development is taking place along the same line of reascning. An Arctic Class Two Bulk Carrier is being designed and built to meet the ice conditions in the North and elsewhere. This is a requirement of special importance to Canada, different from those of most other ccuntries.

It is not the purpcse of this review to propose what vehicles should be chosen for development, only that some vehicles shculd be. The selection itself has a mcst powerful focussing influence on the R&D in materials and equipment. It continually helps to restore the needed sense cf urgency should it be slipping. If a part of a design has to be frozen by a certain date in order to meet the overall schedule, the design can only include the latest R&D that has been firmly established by then. After that date has passed, anything new will have to wait for the next generation of machines to be designed. The R&D has a real purpose. Even if it is finally decided that the vehicle designed cannot go into production owing to financial or other limitations, the discipline of the whole R&D process will have produced better value for the money spent. An immediately announced revised target for another vehicle gets the teamwork

going again.

This reasoning still holds even if it is found that a complete vehicle is too big for Canada to tackle. If we cannot make a place for ourselves for a whole airplane, we should settle for something less - such as airplane under-carriages. After all Canada would be good at this. NASA used a Canadian product in landing on the moon. Snowmobiles are a type of motorized under-carriage.

In transportation, where modes compete, it is important to allow the physical scientists and engineers to compete. The rules have to be established and then the scientists and engineers have to be left to do the best they can. The value of money for the purpose of the competition has to be given. This is needed by the researcher so that he can work out the best compromise between capital cost and operating cost of his vehicle. No side should be arbitrarily told that it cannot win and therefore cannot be supported. If it really believes it can win it should be given a chance. The protection is a lean budget and a number of important jobs to do that forces decisions to be made on priorities that otherwise would be put off.

Who should decide what should be designed? Annex 3

Who is in the best position to know what vehicles or systems are wanted? Until recently the standard answer was "the manufacturer because of the decisions of the marketplace". Until a few months agc no-one would have suggested that the government should tell the automobile industry what types of automobiles to build for the public to buy. The conventional wisdom was that industry had to have a keen eye since it will go under if it fails to offer the public what it wants at the price it is willing to pay. Now because of energy considerations, the government has moved in and the whole industry is being totally changed.

In the narrower field of public transportation vehicles, the systems in which they operate are either permanently subsidized or automatically subsidized when there are losses. Should not the government who has to pay have a major say in what type of vehicle it is offered as distinct from only having a choice between the vehicles the manufacturers offer? The basic question is who has the data and knowledge upon which the best decisions can be made?

Traditionally, railways have purchased vehicles from the manufacturers. Perhaps Canadians can be excused for believing that the diesel railway engine was introduced into Canada in the

early 1950's owing to the promise of the Leduc oil discovery in 1947. The transformation to diesel in fact came about because General Motors decided to build diesel locomotives and to phase out its coal-burning line of engines. The manufacturer was king. CN Rail has recently had a hard time in getting General Motors to instal an anti-slip device on the axles of its engines as is standard practice in Europe. The device detects the liability to slip of the driving wheels and provides automatic throttling back to permit the maximum thrust without slippage. It enables a locomotive of 20% less horsepower to do the same job.

United Aircraft decided to diversify and develop a Turbotrain. The promise of a completely new technology and a contract that protected it from any risks, persuaded CN Rail to let the train run in its system. Between the outskirts of Montreal and Toronto it is the third or fourth fastest train in the world. But it has earned for itself wider publicity in Canada by freezing up in winter, catching fire and hitting road vehicles.

Quite separately a Montreal consortium designed and built the LRC (light, rapid, comfortable) train. Heavier than the Turbotrain it is an extension or evolution of conventional rail technology rather than being radically different. The development was supported by IT&C under the PAIT program and subsequently by Transport Canada to pay for its testing,

operational trials and subsequent modifications. IT&C satisfied itself that there was the potential for an export market for the train and reasoned that if the consortium was prepared to put up its money on faith then PAIT funds should likewise be made available.

It can be argued whether passenger train service can be profitable or desirable, but there is no argument that rail freight trains will be needed as far ahead as one can see. Rolling steel wheels on a steel rail is an ideal system for moving heavy freight long distances with few stops. After the train has got going, the engine has only to overcome rolling friction unless grade ascents are involved.

It is inescapable that hundreds of millions of dollars will be spent annually on new and replacement railway engines, car, track, and other infrastructure. Technical improvements through R&D should be able to lower the capital and operating outlays. The CN Technical Research Centre in suburban Montreal is a good beginning but it is very small in relation to the job to be done.

The Dash-7 airplane was decided upon by de Havilland. Its market studies helped define the seating capacity, the range and the other characteristics. IT&C carefully reviewed the scene and satisfied itself that the plane was worth giving federal support. Transport Canada has been heavily engaged in subsidizing a major

demonstration project of STOL with Twin Otters and no doubt will be with the Dash-7 planes when they come off the production line.

Was the Dash-7 the right airplane at the right time? Those concerned with the arctic say that its range is somewhat limited for use there. DND says that if some changes had been made during design they would probably have a place for it. Can any private manufacturer (even if bought by the government) have available to it all the knowledge and data that is the daily business of officials in government departments?

The time has come when it must be recognized that a new transportation vehicle in Canada has to be considered, designed, developed and built by a triumvirate of government, industry and operator/carrier. Each has his essential contribution to make.