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A COMPARATIVE COST STUDY OF THE
NORTH WESTERN GEORGIAN BAY
HYDROGRAPHIC SURVEY OF 1972

P. BRAITHWAITE

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SOCIAL SCIENCES RESEARCH

1972-73

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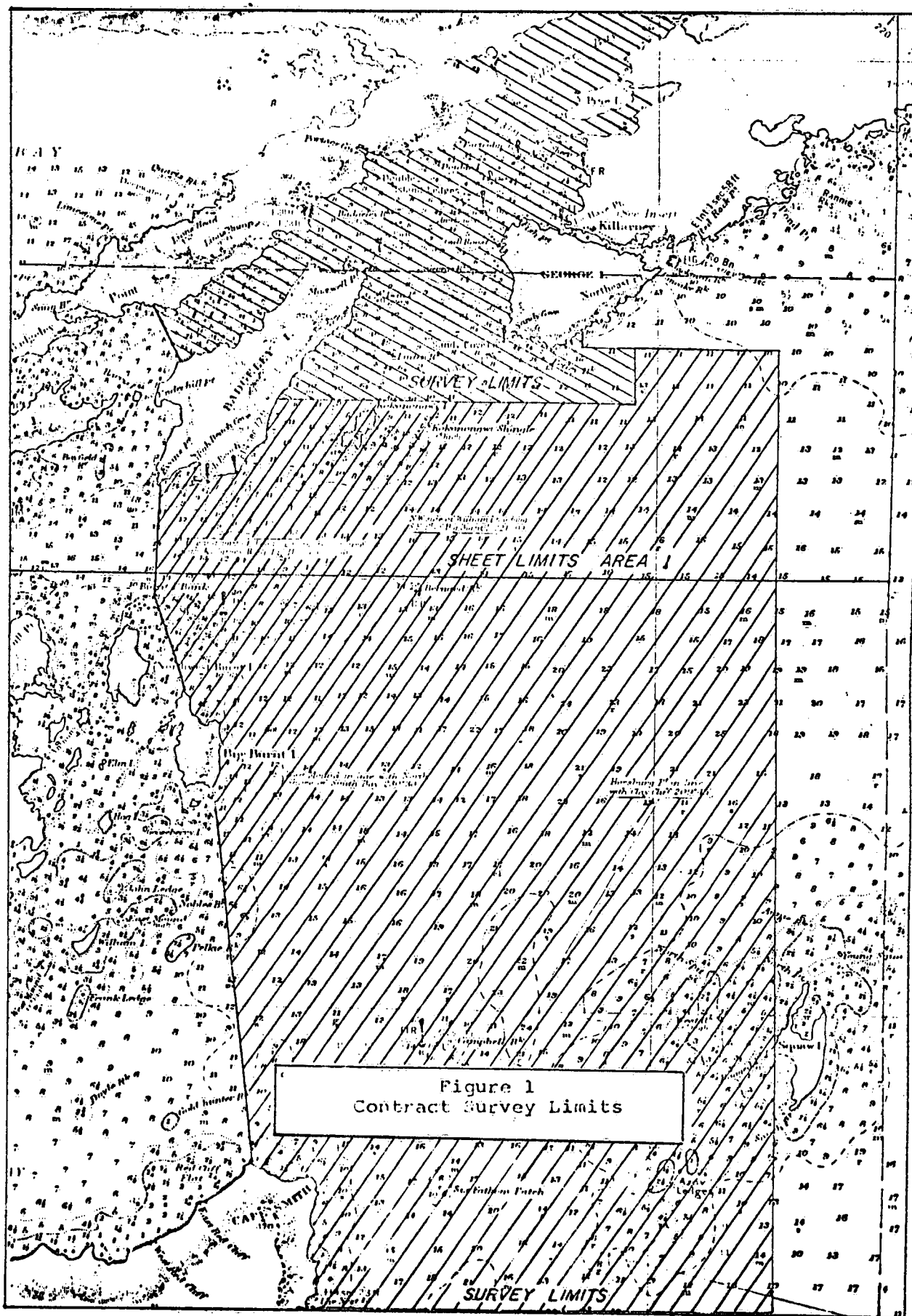
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A COMPARATIVE COST STUDY OF THE
NORTH WESTERN GEORGIAN BAY
HYDROGRAPHIC SURVEY OF 1972

INTRODUCTION

In the summer of 1972, the first hydrographic survey to be contracted out by the Marine Science Directorate was undertaken in North Western Georgian Bay by COM DEV Marine. The area surveyed covered approximately 60 square miles, from Killarney Bay in the north to an east-west line approximately 1-1/2 miles south of Cape Smith in the south, and was to be surveyed at a natural scale of 1:20,000 on a Universal Transverse Mercator projection. This study determines the total cost of that survey and then analyzes the cost of doing the same survey in-house. The total costs of both approaches are examined within the structure of the whole hydrographic service.

In form, the study is comprised of three parts. The first part discusses the cost of the COM DEV Marine survey; the second, which is by far the largest, is on accounting of the costs involved in an in-house survey; the third examines cost differences between the two approaches. The cost analysis is being done under the assumption that a majority of the surveys are done on contract and that contract work of this magnitude will be continued.



PART 1

COST OF SURVEY: COM DEV MARINE

The basic cost of contracting is the amount agreed upon through the acceptance of the tender, in this case \$89,500. Additional costs arise as a result of extra governmental services required to process the contract and supervise the contractor. Also, a certain amount might be subtracted from the tender as a result of money returning to the government through the taxation of profits. This item, of course, is not present in the cost calculations of the in-house survey. A breakdown of the total cost of the COM DEV Marine survey is found in the following table. It should be noted, in examining the table, that no amount has been attributed to the item "tax return from profits". Normally, a standard rate of profit, equivalent to several percentage points above some standard borrowing rate, would be used. However, discussions with the contract supervisor revealed that any profits generated would be too small to affect the overall cost comparison, and the resultant income tax was taken to be zero.

Information about the non-tender costs was obtained from the actual contract supervisor (scientific) for the COM DEV Marine contract, and from a memo describing the Department of Supply and Services' proposed 1973-74 contract administration rate structure under the Department's Revenue Dependency Plan. The proposed rate is used as a proxy for the actual cost, and will be applied to future contracts.

TABLE I

COM DEV MARINE COST OF CONTRACTING

<u>COST SOURCE</u>	<u>COST</u>
Tender	\$ 89,500.
Contract Supervision, Scientific	18,000.
1 Scientist	
1 Secretary	
Office Costs	
1 Driver of Boat	
1 Seaman	
1 Boat	
Field Expenses	
Contract Development and Financial Control	4,475.
TOTAL:	<hr/> 111,975.
Subtract	
Tax Return from Profits	<hr/> -0-
FINAL TOTAL:	<hr/> \$111,975.

PART 2

COST OF SURVEY: MARINE SCIENCE DIRECTORATE - IN-HOUSE

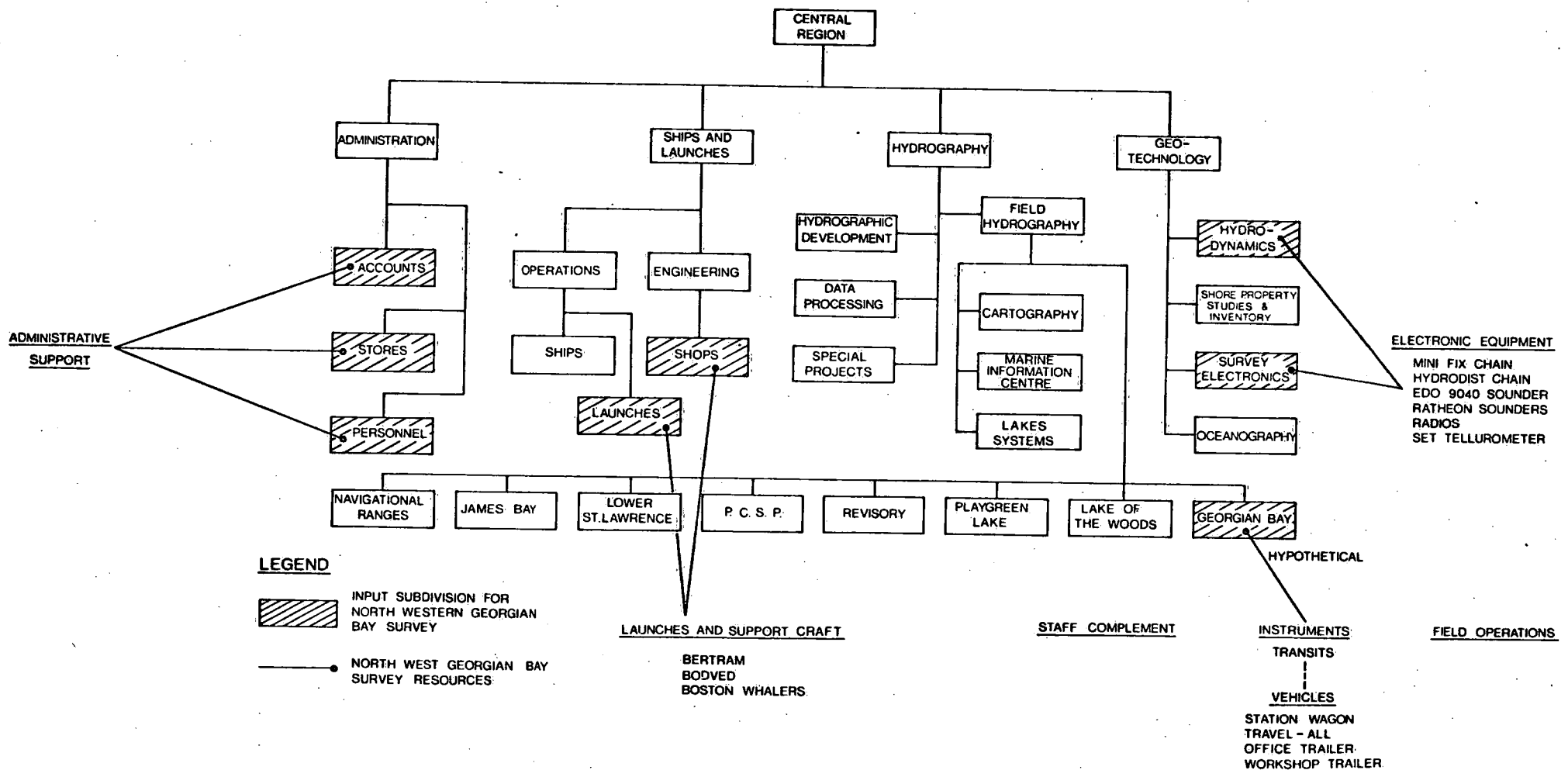
A. METHODOLOGY AND DEFINITIONS

The Marine Science Directorate is organized into four divisions (cost centres) -- Administration, Ships and Launches, Hydrography, and Geo-Technology, all of which are further subdivided in turn. For the purposes of this study, Ships and Launches, Hydrography, and Geo-Technology will be referred to as Operations divisions. Chart I shows the structure of the Directorate and indicates the relevant costing subdivisions.

As for the actual costing, all resources, equipment, and services which were inputs into the survey were grouped into, and costed within, the divisions and subdivisions. That is, the launches and support craft were costed within the Ships and Launches division; and instruments, vehicles, labour, and field operation costs were costed within the Regional Hydrography division (see Chart I). This detailed procedure of costing within the appropriate budgetary structure allows for a more complete and accurate assessment of the costs involved, in that each division's general costs are recognized, together with the overall Administrative division's overhead costs. The costing of a radio may be taken as an example of the costing

CHART I

THE ORGANIZATION OF THE MARINE SCIENCE DIRECTORATE CENTRAL REGION



of equipment. Within the Survey Electronics subdivision of the Geo-Technology cost centre (see Chart II), this incorporates the costs of space, maintenance machines, telephones, and other general costs within Geo-Technology as part of the cost of using the radio. The costs of the Administrative division must be borne by Geo-Technology to a certain extent, and logically, this cost may be added to the maintenance costs of the radio. In the end result, the cost of the radio is much more than its purchase price.

B. ADMINISTRATION: SOURCES AND APPORTIONMENT RULES

(a) Administration: Cost Sources (See Table II)

i) Salaries

Salary bill as per ledger.

The salary bill includes the following people: the personnel officer, one full-time and one part-time assistant, the accountant and two clerks, the stores administrator, two assistants and a secretary. This list does not include all those who are paid through the administration budget. The administrative officer and his secretary have not been added to the bill because of uncertainty as to what similar responsibilities would exist if all surveys were contracted. There is the possibility

that some sort of overall administrative direction would have to come from someone in this type of position. The secretary to the chief hydrographer has not been placed in this section because her duties are confined to the Regional Hydrography Division, as are the duties of another secretary who is also paid through administration. The latter secretary was placed in the Regional Hydrography Costing Section, while the secretary to the regional hydrographer, along with the regional hydrographer, has been excluded from all cost calculations for the same reason that the administrative officer and his secretary were excluded.

However, the labour bill does include monies paid through Ottawa for administration and the benefit of the employees. This includes \$500. per man year for Superannuation and Canada Pension Plan contributions provided in the Treasury Board Secretariat budget.

ii) Office Supplies

A total figure for the whole central region of MSD was obtained from accounts and this amount was apportioned among the divisions by the number of permanent employees in each unit.

iii) Space

\$6.00 per square foot per year for office space.

\$2.75 per square foot per year for stores space.

iv) Telephone

Cost obtained from a sampling and averaging of Bell Telephone bills.

v) Capital

A total figure was obtained from accounts for Administration. This amount was apportioned among the sections in relation to salary costs.

(b) Apportionment Rules: Allocation of Administration
Costs to Administration
Subdivisions

As all administrative cost sources were direct inputs into the subdivisions, these cost sources (once computed) were allocated without rules.

(c) Apportionment Rules: Allocation of Administrative
Subdivision Costs to
Operations Divisions
(See Table III)

In this section, the apportionment rules are listed, along with an explanation of the structure of the Divisions upon which the allocation of the costs of Accounts and Stores was based.

The organizational structure upon which this study is based has just come into effect for 1973-74. For budget purposes, in 1972-73, there are only three divisions -

Administration, Ships and Launches, and Regional Hydrography. The Geo-Technology Division had to be constructed from parts of Regional Hydrography. This was done as follows:

The Shore Property Studies and Inventory Field Party budget was placed in the Geo-Technology division and subtracted from the Regional Hydrography budget. Because no separate figure was available for Survey Electronics, its estimated 1973-74 operating and maintenance, and capital budget were subtracted from Regional Hydrography and added to Geo-Technology. There was also no specific budget for Hydrodynamics within Regional Hydrography. A sum, estimated by a member of that section, was subtracted from the Regional Hydrography Division's budget. This budget was estimated for the 1972-73 year, but it should be noted that this figure is expected to be more than double in 1973-74, and to some extent, to reduce the shares of stores costs carried by the other sections. Besides the reduction of the original Regional Hydrography budget by the construction of the Geo-Technology Division, a second division's budget, that of Ships and Launches, was also reduced. In all the following rules, reference to

CHART II
THE STRUCTURE OF COST;
RADIO EXAMPLE

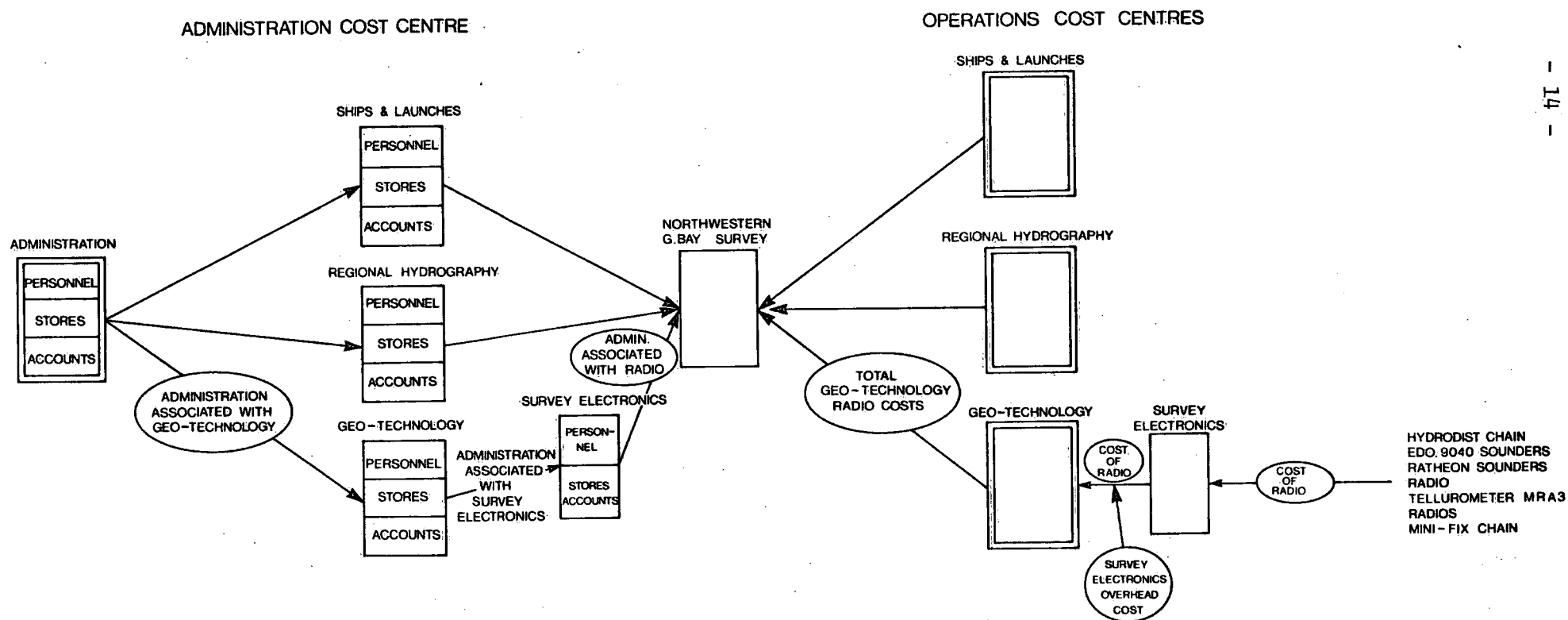


TABLE II

ADMINISTRATION: COST SOURCES

<u>COST SOURCE</u>	<u>ACCOUNTS</u>	<u>SUBDIVISION COSTS (\$)</u>	<u>PERSONNEL</u>
<i>Salaries</i>			
Labour	26,690	37,495	26,940
Office Supplies	34	45	34
Space	1,980	4,605	2,160
Telephone	560	560	600
Capital	<u>1,173</u>	<u>1,653</u>	<u>1,173</u>
Total Section Costs	30,437	44,358	30,907

TABLE III

ADMINISTRATION: ALLOCATION OF ADMINISTRATIVE
SUBDIVISION COSTS TO
OPERATIONS DIVISIONS

(\$)

<u>COST SOURCE</u>	<u>OPERATIONS DIVISIONS</u>		
	<u>SHIPS & LAUNCHES</u>	<u>REGIONAL HYDROGRAPHY</u>	<u>GEO-TECHNOLOGY</u>
Accounts	9,124	12,743	2,506
Stores	13,307	18,631	3,648
Personnel	<u>3,895</u>	<u>21,859</u>	<u>2,397</u>
Total	26,326	53,233	8,551

the Ships and Launches budget relates to only 60% of the actual budget since the workload is divided approximately 60-40 between the support of MSD activities and the field scientific work undertaken at the Canada Centre for Inland Waters.

i) Accounts

The costs of accounts in the Administrative Division have been allocated in proportion to the size of the budgets of the three operations cost centres.

ii) Stores

This Administrative cost has also been allocated to the three operations cost centres in proportion to the size of their budgets. The Geo-Technology budget is composed of the Hydrodynamics, the Shore Property Studies, and Inventory subdivisions' budgets.

iii) Personnel

Personnel costs have been allocated by two rules derived from discussions with the personnel officer. Approximately 30% of the personnel section's time was spent in general administrative duties and a proportionate sum was allocated to each division, in relation to the total number of man years in each. The remaining cost was generated in

activities directly benefiting recognizable cost centres. This cost was compiled on the basis that the expense of doing the paper work for a temporary employee over his term of employment is three times that of a permanent employee for one year. Only 60% of Ships and Launches personnel costs were included as costs because of the 60-40 workload division between MSD support work and scientific support for CCIW.

- (d) Apportionment Rules: Allocation of Administrative Subdivision Costs of Operations Divisions to the North Western Georgian Bay Survey [The Cost of Administration to the North Western Georgian Bay Survey]

i) Personnel

The personnel costs allocated to the launches used in the hydrographic survey were distributed by taking an average of the following ratios: -- cost of launches used / total cost of ships and launches owned by MSD Central and length of launches used / total length of all ships and launches, and multiplying it by the total personnel administrative costs allocated to Ships and Launches.

The personnel costs allocated to the Regional Hydrography input into the hydrographic survey were allocated on the basis of the number of permanent and temporary employees needed to undertake such a survey. The

TABLE IV

ADMINISTRATION: ALLOCATION OF ADMINISTRATIVE
SUBDIVISION COSTS OF OPERATIONS
COST CENTRES TO THE NORTH
WESTERN GEORGIAN BAY SURVEY

<u>COST SOURCE</u>	(\$)		
	<u>OPERATIONS CENTRES</u>		
	<u>SHIPS & LAUNCHES</u>	<u>REGIONAL HYDROGRAPHY</u>	<u>GEO-TECHNOLOGY</u>
Personnel	50	1,804	141
Stores, Accounts	<u>305</u>	<u>2,257</u>	<u>685</u>
Total Cost to North Western Georgian Bay Survey of Administration	355	4,061	826

methodology used in the primary allocation of personnel costs among the cost centres was also used to allocate costs to the subdivisions within Regional Hydrography.

Within the Geo-Technology Division, costs were first allocated to the Survey Electronics section by the same rules used to allocate personnel costs to the cost centres. This cost was then allocated to the electronic equipment used in the survey by taking the ratio of the value of the equipment used to the value of all electronic survey equipment within MSD Central Region.

ii) Stores, Accounts

These administrative costs were allocated to the launches used in the Hydrographic survey in the same manner that personnel costs were allocated.

The Regional Hydrography share of the above administrative costs was allocated to the Regional Hydrography input into the hypothesized Georgian Bay Survey by multiplying the share by the percentage of the Regional Hydrographic budget comprised of field costs.

The Geo-Technology share of administrative costs, excluding those of the personnel section, was allocated to the electronics equipment to be used in the Georgian Bay Survey by determining the survey electronics section's

TABLE V

SHIPS AND LAUNCHES

<u>No.</u>	<u>Type</u>	<u>Purchase Price Each</u>	<u>Depreciation Cost - Total</u>	<u>Repair Costs Labour & Supplies</u>	<u>Repair Costs Space Equipment</u>	<u>Telephone</u>
- Launches -						
1	Bertram, deep "V" 25'	35,000	3,966	2,000		
1	Botved, deep "V" 21'	11,805	1,335	1,000		
2	Boston Whaler 17'	2,775	315	300		
- Trailers -						
1	Thorobred	2,895	328	75		
1	Gator	700	79	50		
Totals			6,023	3,425	732	146
Grand Total = Totals + Administrative Overhead + Ships and Launches Administrative Overhead						
Grand Total = \$10,353 +			\$355	+	\$310	
= \$11,018						

share. This was done in relation to the survey electronics budget's percentage of the Geo-Technology budget. The survey electronics share of these administrative costs was then allocated to the field party in the same ratio as the value of the electronics equipment used in the survey to the total value of the electronics equipment within MSD Central Region.

C. SHIPS AND LAUNCHES: COST SOURCES AND
APPORTIONMENT RULES

i) Purchase Price and Depreciation of Launches

Purchase price as per ledger.

Depreciation was assessed using the annuity method at a 7% interest rate over a ten year period.

Because extensive repair work is done on the ships and launches, and obsolescence is not a major depreciation factor, ten years is not considered an excessive time period. Information about the useful life of the launches was obtained from W. Corkum and K. Robertson.

ii) Repair Costs

An estimate of labour and supply repair costs for the launches was obtained from W. Corkum and a similar estimate for the boat trailers was obtained from T. O'Hagan.

The space used by the Ships and Luanches Division includes the launch repair area, the paint shop, the electrical shop, the battery storage - engine overhaul area, the second floor small stores area, and the drafting foreman's office. Area data were obtained from the architectural drawings and a rate of \$2.75 per square foot was applied. This rate for warehouse space was agreed upon by the Department of Supply and Services Building Administration Branch. The total repair cost allocated to the boats used in the survey was in proportion to the total value of space and labour required to repair the ships and launches in MSD Central Region. In addition, this figure was averaged in proportion with the mean cost per lineal foot of repairing MSD vessels. Total repair costs and lengths of ships and launches in the MSD Central Region was obtained from an MS Branch inventory.

Administrative office space was not included in this space costing section because it was included in Ships and Launches administrative costs. Yard space has not been included, resulting in an under-estimate of space costs.

Repair equipment purchase price was obtained from a Marine Science Branch inventory of paint shop and boat shop and yard equipment over a ten year period at 7%, while the cost apportioned to the launches in the survey was derived

by applying to the total equipment cost the ratio of value of launches used in survey to the total value of ships and launches in MSD Central Region.

iii) Telephone

This cost was obtained from a sampling and averaging of Bell Telephone bills.

iv) Grand Total

This total consists of the sum of the above costs, plus the general administrative overhead cost as determined in the administrative costing section, plus the cost of Ships and Launches administration apportionable to the launches used in the survey. Ships and Launches administration for this costing section is composed of the Launch Supervisor and the Engineering Superintendent for MSD Central Region. The cost of Ships and Launches administrative overhead includes the salary of the above administrators and the cost of their office space. The costs of a Marine Superintendent and his secretary have not been included because Ships and Launches administration would be required regardless of whether or not most field parties were contracted out and scientific work was done.

TABLE VI

FIELD HYDROGRAPHY: FIELD PARTY
SALARIES & WAGES

<u>EMPLOYEE</u>			<u>Period of Employment on Survey (months)</u>	<u>\$ Rate of Pay</u>	<u>\$ Basic Salary</u>	<u>\$ Overtime Pay</u>
Hydrographer-in charge	EG	8	9.5	13,000 yr.	10,290	6,430
Assistant Hydrographer	EG	6	9.5	10,000 yr.	7,920	5,080
Assistant Hydrographer	EG	10	9.5	9,100 yr.	7,200	4,710
Electronic Technician	EL	4	5	9,400 yr.	3,920	2,450
Student Assistant			3	2.45 hr.	1,200	790
Gasoline Engineer			4	590.00 mo.	2,360	1,475
Coxswain			4	523.00 mo.	2,090	1,310
Seaman			4	480.00 mo.	1,920	1,100

			<u>\$ Other Costs¹</u>	<u>\$ Cost per Employee²</u>	<u>Number of Employees</u>	<u>\$ Total Direct Cost³</u>	<u>\$ Indirect Cost⁴</u>	<u>\$ Total⁵</u>
Hydrographer-in charge	EG	8	2,520	19,240	1	19,240	396	
Assistant Hydrographer	EG	6	1,981	14,981	1	14,981	396	
Assistant Hydrographer	EG	10	1,811	13,721	1	13,721	396	
Electronic Technician	EL	4	1,175	7,545	1	7,545	208	
Student Assistant			204	2,194	2	4,388	250	
Gasoline Engineer			607	4,442	2	8,884	333	
Coxswain			544	3,944	1	3,944	167	
Seaman			503	3,523	3	10,569	500	
						83,272	2,646	85,918

- FOOTNOTES:
1. This category includes Unemployment Insurance, Superannuation, Canada Pension Plan & Ontario Hospitalization.
 2. This is a summation of Basic Salary, Overtime Pay, and Other Costs.
 3. The cost per employee has been multiplied by the number of employees in each position.
 4. This is the Public Service Commission Cost of Job Processing - \$500. per man year.
 5. This figure is the total of Direct and Indirect Costs.

EXPLANATION OF TABLE VI

Column One	Employer Designation
Column Two	Period of Employment - In the case of the staff, this is longer than 4 months because the major project which they undertake during the year is the survey.
Column Three	Rate of Pay - This is an average of the high and low rates in each employment category.
Column Four	Normal Salary and Wages - $Y = \text{Period of Employment} \times \text{Rate of Pay}$
Column Five	Overtime is added to the normal salary and wage payment. Average 25 hr. week (15 hour real) $Y \times \frac{13}{8}$
Column Six	Superannuation and CPP contributions of the government are added. $114.5\% \times (Y \times \frac{13}{8})$ in the case of all but the students. $108\% \times Y \times \frac{13}{8}$ in the case of the students.
Column Seven	Unemployment insurance contribution of the employer.
Column Eight	No. of employees in each category.
Column Nine	Cumulative total.
Column Ten	Total number of man years involved.
Column Eleven	Total cost including personnel services provided by various government departments, \$500 per man year as specified in the Department of Environment booklet.

TABLE VII

REGIONAL HYDROGRAPHY: THE TOTAL COST

<u>FIELD HYDROGRAPHY COST SOURCE</u>				\$ <u>SUB-TOTALS</u>
LABOUR				
Personnel			84,742	
Field Expenses			<u>24,000</u>	108,742
TRANSPORTATION				
				500
FIELD MATERIALS				
Survey Materials			1,500	
Miscellaneous Stores			<u>1,900</u>	3,400
CAPITAL OPERATING COST				
Gasoline			1,200	
Lubricants			300	
Minor Repairs			<u>1,000</u>	2,500
SPACE				
CCIW			3,000	
Field Rental			<u>375</u>	3,375
TELEPHONE				
				460
OFFICE COSTS				
Supplies			34	
Secretarial Services			<u>942</u>	976
INSTRUMENTS				
<u>Type</u>	<u>No.</u>	<u>Depre- ciation</u>	<u>Repair</u>	<u>Deprec. + Repair</u>
Transit T2 Wild	2	718	80	798
Transit T1 Wild	1	1,156	15	1,171
Level NA2 Wild	1	116	15	131
Sextant	4	<u>268</u>	<u>125</u>	<u>393</u>
Totals		2,258	235	2,493
VEHICLES				
<u>Type</u>	<u>No.</u>	<u>Depre- ciation</u>	<u>Repair</u>	<u>Deprec. + Repair</u>
Station Wagon	1	854	200	1,054
Travell-all	1	975	250	1,225
Office Trailer	2	1,025	150	1,175
Workshop Trailer	1	<u>513</u>	<u>75</u>	<u>588</u>
Totals		3,367	675	4,042
TOTAL FIELD HYDROGRAPHY COST:				126,488
ADMINISTRATIVE OVERHEAD COST (TABLE IV):				<u>4,061</u>
TOTAL REGIONAL HYDROGRAPHY COST:				130,549

D. REGIONAL HYDROGRAPHY

- (a) Field Hydrography: Cost Sources and
Apportionment Rules
(See Table VII for Total
Cost Breakdown)

i) Labour (see Table VI for explanation)

For detailed labour costs including wages, salaries, unemployment insurance, and Ottawa personnel costs, see the table on personnel costs. Wages and salaries are per ledger. The field expense costs, which include room and board, were estimated by the senior hydrographer who prepared the list of required resources.

ii) Transportation

This cost figure includes the transport costs of materials and boats to and from the survey site as well as the travelling expenses of the staff and crew. The estimate was obtained from the contract supervisor (scientific) for the CD Marine contract.

iii) Field Materials

The cost of survey material was an estimate made by the senior hydrographer.

Costs relating to miscellaneous stores were estimated by considering a scaled down 1971 Lake of the Woods survey, since the North Western Georgian Bay field

party is about half the size of the Lake of the Woods survey. The cost estimate was also based on the fact that miscellaneous stores last on the average for about two years.

iv) Instruments

Transit prices were obtained from the Wild Co. of Canada Ltd.

Price of sextants was per ledger.

Depreciation was spread over 8 years at a 7% interest rate and the salvage value was considered to be 10% of the purchase price.

The repair cost of individual instruments was assumed to be in the same proportion as total MSD repair costs to the total value of MSD instruments.

v) Vehicles

Vehicle costs were an average from the ledger since the makes of vehicles that would be used are not known. The station wagon and travel-all were depreciated over 5 years at 7%, while the office trailers and the workshop trailer were depreciated over 10 years, also at 7%. T. O'Hagan aided in estimating the repair costs.

vi) Capital Operating Costs

The costs under this category were estimated by the senior hydrographer.

vii) Space

Field rental was estimated by the CD Marine contract supervisor (scientific), while CCIW space, composed of a hydrographer's office and field party drafting space, was costed at \$6.00 a square foot.

viii) Telephone

This estimate was based on Bell Telephone bills.

ix) Office Costs

MSD Central Region office supply costs were allocated to the field party by considering the number of permanent employees in the field party relative to the total number of permanent employees with MSD Central Region.

The services of one secretary were divided among the several field parties. The associated costs (salary, \$500 for Ottawa services, space) were allocated to the North Western Georgian Bay field party in proportion to the ratio of a field budget of a similar size survey to the total field budget for 1972-73.

TABLE VIII

GEO-TECHNOLOGYSurvey Electronics

(\$)

<u>No.</u>	<u>Item</u>	<u>Purchase Price Each</u>	<u>Depreciation Cost - Total</u>	<u>Repair Costs Labour & Supplies</u>	<u>Repair Costs Space</u>	<u>Equipment</u>	<u>Telephone</u>	<u>Office Supplies</u>
1	Mini Fix	165,000	19,968	3,500				
1	Hydrodist Chain	23,000	3,628	1,000				
3	Edo Sounder	12,000	1,892	(
				(
2	Ratheon Sounder	5,500	867	(2,000				
				(
3	Radios CH 25	5,000	788	(
				(
4	Radios PT 400	4,000	631	(
				(
1	Tellurometer MRA 3	12,500	1,971	200				
	Totals		29,745	6,700	1,400	960	90	27

Grand Total = Totals + Administrative Overhead

= 38,922 * + 826**

= 39,748

* Grand Total of Totals Listed Above.

** See Table IV

E. GEO-TECHNOLOGY

(a) Survey Electronics: Cost Sources and
Apportionment Rules
(See Table VIII)

i) Purchase Price and
Depreciation of Electronic Equipment

The Mini-Fix purchase price was obtained from a representative of Computer Devices of Canada, which supplied MSD with the Mini-Fix system.

The Tellurometer purchase price was obtained from a representative of Tellurometer of Canada Ltd., as was the price of the Hydrodist chain.

The purchase prices of the other pieces of equipment were estimated by the head of the Survey Electronics section.

Depreciation was over a 10 year period at 7% for the Mini-Fix system and over an 8 year period at 7% for the remainder of the equipment.

ii) Repair Costs

Labour and parts costs were estimated by the head of the Survey Electronics section.

Space in the Survey Electronics workshop was costed at \$7.00 per square foot and the resulting cost apportioned

to the equipment used in the survey in relation to the ratio of the equipment's value to the value of all electronic equipment repaired in the shop. Total cost of all equipment was estimated by E. Lewis, the Head of the section.

iii) Telephone and Office Supplies

These costs were obtained in the same way as they were for the Administration cost centre.

iv) Grand Total

This is the total of the above costs plus the administrative overhead as determined previously in this paper.

F. A BREAKDOWN OF TOTAL IN-HOUSE COSTS (see Table IX)

This section supplements the cost analysis by breaking down the total cost into various categories. This is done in Table IX which is described below.

i) Ships and Launches

Fixed costs include the depreciation cost, space, and equipment for repair work, while variable costs include those of labour, supply, repair, and telephone. Administration includes Ships and Launches administration.

TABLE IX
A BREAKDOWN OF COSTS

	COSTS (\$)		PERCENT OF TOTAL
<u>Ships and Launches</u>			
Variable	3,452		1.9
Fixed	<u>6,901</u>		3.8
Direct		10,353	5.7
Administration		<u>665</u>	0.4
TOTAL		11,018	6.1
<u>Regional Hydrography</u>			
Variable	118,633		65.1
Fixed	<u>9,000</u>		4.9
Direct		127,633	70.0
Administration		<u>4,061</u>	2.2
TOTAL		131,694	72.3
<u>Geo-Technology</u>			
Variable	6,455		3.5
Fixed	<u>32,267</u>		17.7
Direct		38,722	21.3
Administration		<u>826</u>	0.5
TOTAL		<u>39,548</u>	21.7
Total Variable Cost	128,540		70.5
Total Fixed Cost	<u>48,168</u>		26.4
Total Direct Cost		176,708	96.9
Total Administration Cost		<u>5,552</u>	3.1
GRAND TOTAL		<u>182,260</u>	100.0

ii) Regional Hydrography

Fixed costs include depreciation cost of instruments and vehicles and the cost of space, while variable costs include all other direct costs.

iii) Geo-Technology

Fixed costs are depreciation and the cost of space and equipment for repair work, while variable costs include the costs of labour and parts for repair work, telephone service, and office supplies.

G. THE ACCURACY OF COST DATA AND ESTIMATES

Given that the sum of money contained in the previous table is necessary to successfully undertake the North Western Georgian Bay survey with MSD resources, it is important that the accuracy of data sources and cost estimates be assessed. This section examines uncertainties stemming from the source of data and allocative rules, as well as the accuracy of the original estimate of required resources and depreciation parameters.

The accuracy of the cost data acquired will be dealt with for equipment costs, salaries and wages, space, and labour and supply repair costs, in that order.

i) Equipment Costs

All equipment costs, except those for the Survey Electronics repair equipment, have been taken from inventory records or obtained from company representatives. These costs account for 23% of the grand total cost and may be considered accurate.

A further 46% of the grand total may be considered totally accurate since the figures come from the ledger. This latter percentage excludes from the total wage bill all wages paid for repair work.

The costs of space, labour and supplies for repair work, and other cost factors have not been taken from the ledger completely, but have involved some estimates. The total price allocated to space must be considered a minimum since the application of a warehouse area cost rate to the areas involving ship repair is, if anything, underestimated, while the cost of yard space has not been included anywhere in the calculations. Labour and supply repair costs, for both the launches and the electronics equipment, have been estimated by those persons responsible for them. It is difficult to determine the degree of accuracy of estimates, especially in Ships and Launches, since no repair records are kept for any individual ship and no type of systematic upkeep is practised. This cost

source, and that of space, account for only 9% of costs, leaving 22% to be accounted for by other minor sources, such as telephone costs and office supplies, which are less certain costs.

The significant point about the above percentages is that 69% (46% - wages + 23% equipment) of costs have been taken from precise records and can be considered accurate. If it is assumed that the other 31% is within 50% of the correct figure, and this is most likely, then with respect to the criteria of data accuracy, the total MS Central Region cost of the survey should fall within approximately 85% and 114% of \$182,460.

Allocative rules present a second source of error. However, allocative rules did not affect costs in the field, or equipment and launch costs, excluding their maintenance costs. Costs in the field, and equipment and launch costs totalled 76% of the \$182,460 grand total, a large enough portion of total costs to exceed the COM DEV Marine Contract cost. Unfortunately, the cost of equipment which is included in the total cost is subject to error, as well as debate, as to just how it should be measured. Therefore, an explanation of the method used is in order. In calculating the cost of equipment for a single survey undertaken in-house, there are two basic approaches.

The first involves the original purchase price of the equipment. This can lead to a high estimate of survey costs if an expensive piece of equipment which will be used for several years is purchased for the survey. A low estimate of survey cost may be arrived at if no major and little minor equipment is necessary. The adopted approach involves costing the usage of the equipment by spreading the purchase price over its useful life. Depreciation was used, as opposed to a rental rate, because it reflects the equipment usage and rental administration would result in an over-estimate. The depreciation method adopted is based on the premise that the purchase price of equipment is equal to the present value of a stream of equal nominal income payments over the life of the equipment and that these annual payments are the amount by which the equipment must be depreciated each year. This method reflects the fact that the present value of a piece of equipment is based partially on its capacity to generate income in the future, while the use of the nominal interest rate reflects, to some extent, the influence of future inflation. This is subject to error in both the discount rate applied and the choice of the time period over which the equipment is discounted. However, the 7% interest rate appears reasonable and the depreciation periods have been determined after consultation with persons both buying and using the equipment. The

formula used is.

$$\text{Annual Depreciation} = \frac{Pi (1+i)^n}{(1+i)^n - 1}$$

where P = present value

i = interest rate per period

n = useful life of the equipment

The accuracy of the original estimate of required resources has been touched upon earlier, at which point, it was stated that a senior hydrographer had drawn up the requirements and that a second hydrographer, with experience in the area, had verified them. Given the accuracy of 1972-73 field party estimates, there should be no concern over serious inaccuracies in this estimate.

If the Regional Hydrography survey actually costs the same as the COM DEV Marine Survey (\$111,975), the above errors would have to total 39% of the \$182,460 and 63% of the \$111,975 cost. Given the methodology used in the study and the above accuracy factors, even a 30% error on the \$182,460 is extremely unlikely. Using this 30% figure as the maximum amount of error, the survey would cost, at the minimum, \$127,722, if undertaken by Regional Hydrography.

The total cost figure for the COM DEV survey has been assumed accurate throughout this section, as only 15%

of the figure was arrived at by estimate. Furthermore, the estimate was determined by the scientific contract supervisor, and hence may be assumed to be reasonably thorough.

PART 3

COM DEV MARINE AND MSD COST DIFFERENCES

In this section, a few brief comments on cost differences will be made. If costs are examined under three operational cost centres of MSD Central Region, it will be noted that the cost of launches to the Regional Hydrography survey is 12% of the COM DEV Marine tender, the cost of Regional Hydrography budgeted resources 105% of the COM DEV Marine tender, and the cost of electronic equipment 45% of the COM DEV Marine tender. It is obvious that costs differ with respect to both field costs and electronic equipment costs. Labour costs, as one field cost, must differ because, at \$85,887 for wages and fringe benefits, they were 96% of the COM DEV Marine tender, while field expenses were an additional 27% of the tender. Overtime, at approximately \$31,000 was a significant part of the labour bill. The cost of the Mini-Fix system, as part of electronic equipment costs also must differ because COM DEV is the supplier of that piece of expensive equipment. Whether other MSD costs are higher is not obvious, and not nearly as significant, in light of the fact that the sizeable total cost difference which exists can be traced to several sources. It is important to note that, of these sources, the variable cost portion of the Regional Hydrography total accounts for a

full 65% of the total MSD cost of the survey.

One final reason that might be sensibly argued is that the quality of the MSD product might be better. It is generally acknowledged that, while the outside contractor will meet contract standards, the MSD survey will most likely be above these standards. However, work done which is over and above contract requirements may have little utility. If the extra quality is necessary, it should be specified in the contract. Therefore, insofar as the contract requirements are surpassed, MSD costs may be reduced. Whether or not this is the case, the variable cost component of the Regional Hydrography subdivision (especially labour) should be carefully examined, as well as the fixed costs of Geo-Technology.

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