COMMUNICATIONS CANADA

- ONTARIO REGION -

(2)

SPECTRUM MANAGEMENT "IN THE FIELD" &
- A NEW CONCEPT -

(1)
R.R.B. Hoodspith
Regional Director (Ontario)

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C O N T E N T S

CONTENTS (continued) ---

INTRODUCTION

One aspect of the Department of Communications' mandate is the Management of the Radio Spectrum.

Spectrum Management in the broadest sense involves many activities such as, international negotiations, development of national policies, the establishment of procedures and standards for the licensing of stations and finally, implementation of all of these activities in the field.

Spectrum Management "IN THE FIELD" is accomplished primarily through three control functions:

- Enforcement - This includes the inspection of licensed stations and the investigation of interference;
- Authorization - This activity includes examinations application processing, recording cancellations, reviewing amendments and certificates;
- Monitoring - In this area, which has a constant workload and includes special assignments, compilation of infringement reports and electronic measurements.

However, the degree to which each of these functions should contribute to proper management has not been agreed to by all concerned. For this reason then, at the present time it is not possible to determine if, at the field level, the Spectrum is being properly managed and if the correct degree of control is being exercised, nor is it possible to set Regional, District or Personnel workload objectives against which performance and proficiency can be measured.

Objective

To establish the degree of control required for proper Spectrum Management IN THE FIELD and against which workload objectives can be established and management efficiently assessed.

REQUIREMENT FOR SPECTRUM MANAGEMENT IN THE FIELD

The Radio Spectrum is a national resource and therefore, to ensure maximum use by the public, must be properly managed. The right to use the Radio Spectrum is given to those who accept the standards and procedures established by the Department.

A continual increase in the demand for frequencies in an already congested situation is a constant problem necessitating good management of the Spectrum through the efficient and economical use of assigned frequencies and by taking every advantage of technological developments which will increase the number of frequencies that can be made available across the spectrum. This continuing problem can be exemplified by the following:

1962 - VHF Land Mobile - Split channelling to provide an increased number of frequencies.

1966 - H/F Single Sideband - Introduced to increase the number of channels available.

1968 - UHF Bands - Opened to Private operators as a result of over-crowding in the frequency spectrum allocated at that time.

1971 - H/F Marine Operations - Introduction of Single Sideband to increase the number of frequencies available.

1971 - VHF Marine Mobile - Split channelling introduced to increase the number of frequencies available.

Aeronautical - It is likely that some form of split channelling will be employed in the not too distant future due to increased requirements.

Land Mobile - Consideration is being given to the possible use of TV Channels 14 and 20 due to over-crowding in the existing band.

SHF - The feasibility of using these frequencies above 10 GHz is being investigated to increase spectrum occupancy.

Although processing applications, monitoring the Frequency Spectrum and investigating interference complaints assist in determining whether efficient utilization of frequency resources and the correct standards and procedures are being employed by licensed stations, at the present time, the only method of ensuring that all standards are being adhered to - is by carrying out a physical inspection of a station while it is in operation. In doing this, 10 points (discrepancies) which are representative, are sampled. (Refer page 10.)

It is in this manner that the Department manages the spectrum, protecting licensees who are operating stations properly, as well as restraining those who are not.

PRESENT SITUATION

Enforcement

- Inspections: As previously stated, although inspection procedures have been laid down, no completely acceptable standard has been established as to the frequency of inspections required to ensure proper control. Primarily, this appears to be due to the fact that the present requirements for inspections are not based on a statistical analysis which factually quantifies the number of inspections required to ensure control. Thus it will be seen that it is not possible to accurately forecast an inspection workload.

- Interference: This is a "demand" workload as each complaint must be investigated. Historical data is available and can be used to forecast yearly workloads.

Monitoring

This is an "Inhouse" support to inspection and interference activities which is carried out at District Offices and Monitoring Stations. Surveillance of the spectrum is programmed on an "as required" and "yearly" basis. Thus this is a constant workload.

Authorization

Authorization varies with population growth and the introduction of new services, i.e., CATV - MATV, etc. Basically this is an "Inhouse" administrative activity with a fairly consistent and determinable growth pattern.

not necessarily only licensed stations

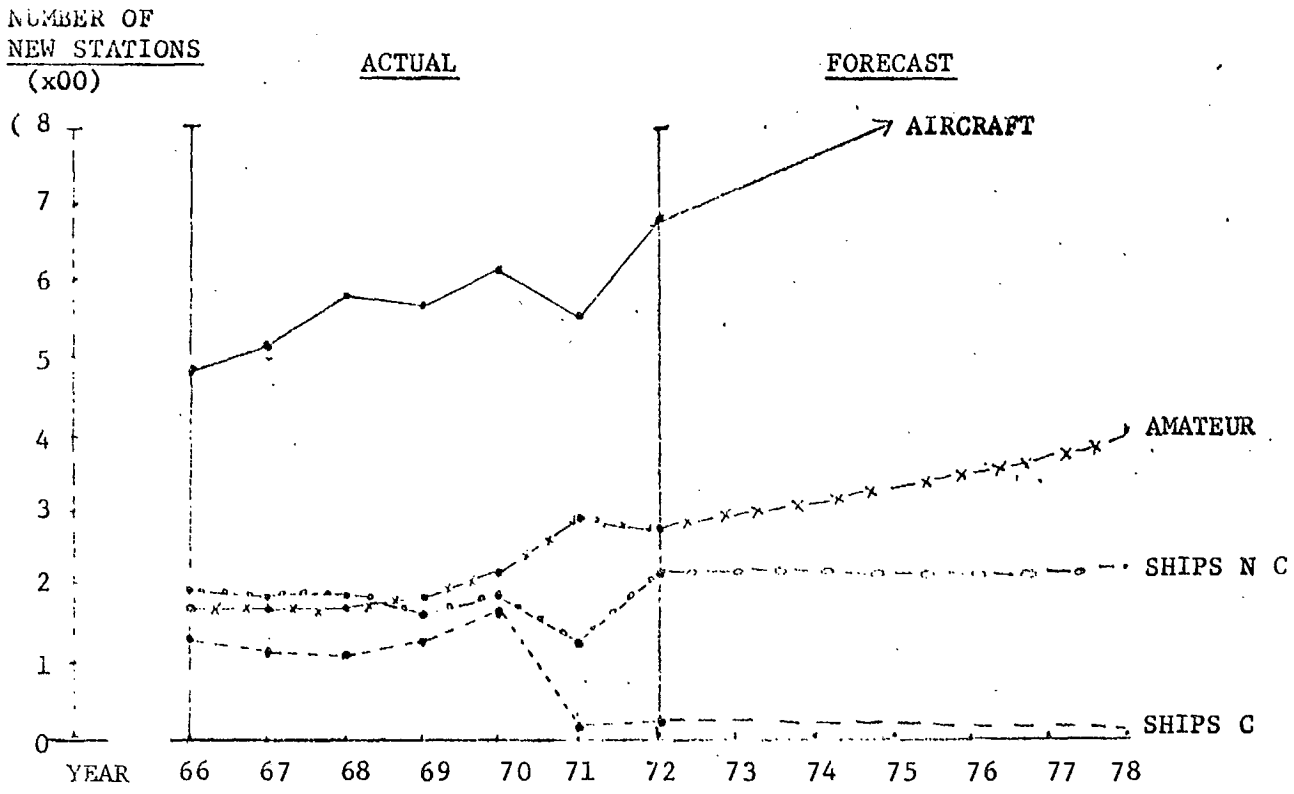
function / relation not known - may be 1, 2, ½

FUTURE TRENDS

As inspection and interference workloads are directly related to the licensed station population in the Region and the various Districts - any increase in the population will automatically increase the workload.

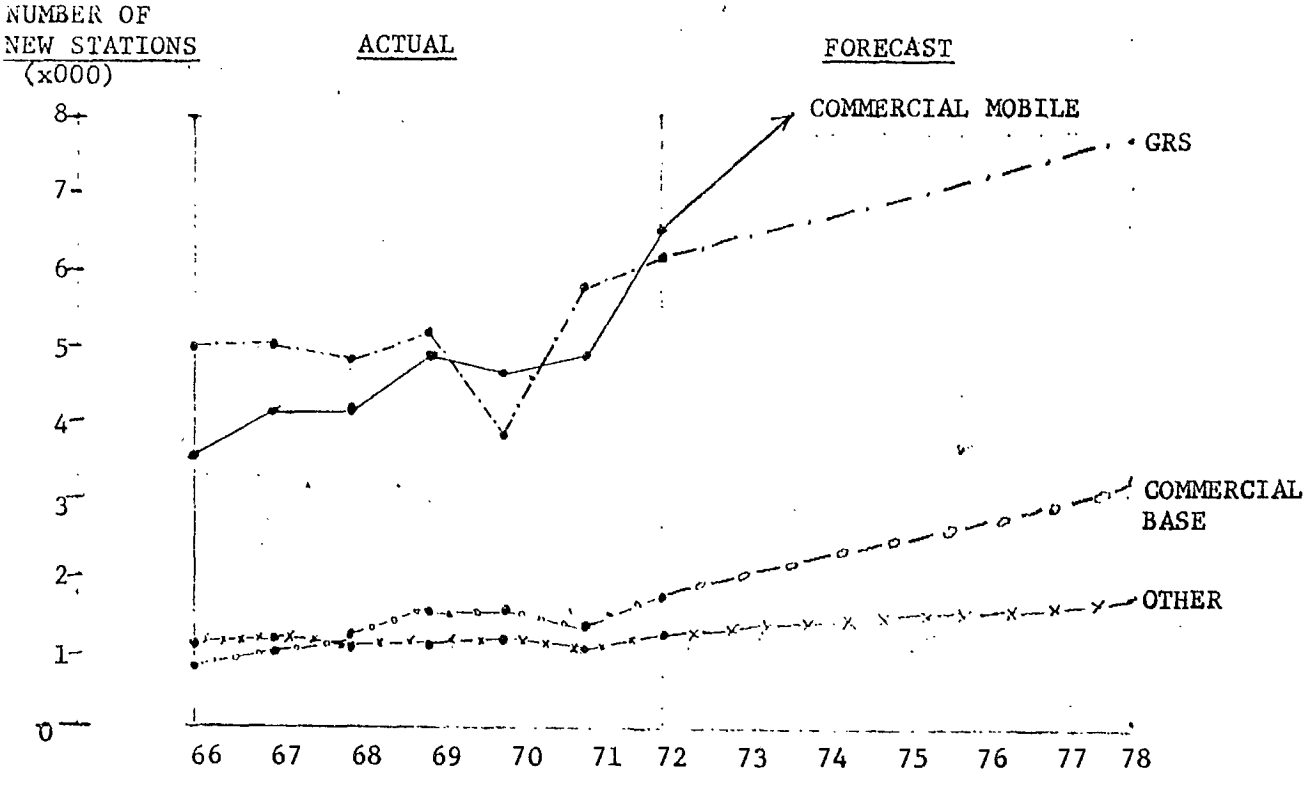
An analysis based on the number of applications for licensed stations over the past five years has been projected for a future five-year period which, in turn, indicates that a yearly increase of 7.75% - equals 8%, can be expected.

CHART NO.1 - STATION GROWTH -



Average Yearly Increase 7.75
Average 7 Year Increase 7.21 %

CHART NO.2 - STATION GROWTH -



SOURCE - REGIONAL STATISTICS - (Refer Appendices "D" and "E")

FUTURE TRENDS continued ...

Interference

In regard to interference, of which approximately 50% can be attributed to Hydro sources, based on forecasted kilowatt hours and combined with the number of interference complaints not investigated at the end of the year - a yearly increase of 25% can be expected.

Licensing of New Systems

An additional inspection workload will also be generated as a result of the introduction of departmental standards being established and implemented for the operation of new systems such as, CATV, MATV, as well as the likelihood of interconnect standards for terminal equipment and facilities being introduced in the not too distant future.

CONCLUSION

From the foregoing it will be seen that continual pressure is being exerted to accommodate the increased requirements within both the public and private sectors for radio frequency channels. This then demands extremely sound management of the spectrum not only to ensure high utilization of existing frequencies and investigation into new methods and techniques available for increasing channel availability, but also in ensuring that the ever increasing number of users are operating in accordance with spectrum management standards and procedures developed for the use of this national resource

In view of the conclusion a new concept for Spectrum Management which will provide the effective utilization of the resource and the proper degree of control is proposed. Furthermore, through application of this concept it will be possible to establish realistic workload objectives and assess the efficiency of the management activity.

SPECTRUM MANAGEMENT IN THE FIELD

- A NEW CONCEPT -

What is Spectrum Management "In the Field"?

Spectrum Management "In the Field" is concerned with ensuring that licensees operating stations are doing so in accordance with departmental standards. This is achieved through:

- Monitoring the spectrum to ensure that maximum utilization is achieved.
- Conducting inspections at regular intervals for licensed stations in the COMPULSORY category for purposes of assuring that they are properly operated.
- Conducting inspections of NON-COMPULSORY stations on a basis that will ensure that operating and technical standards are being maintained.
- Investigating sources of interference.
- Acceptance of applications for and the issuing of licences.

How Can the Spectrum be Managed?

In analysing Regional activity as applicable to spectrum management proper management requires the following identifiable activities to be performed:

- Enforcement - Includes inspection of licensed stations and the investigation of interference;
- Authorization - This activity includes examinations, processing of applications, cancellations, reviewing amendments and issuing certificates;
- Monitoring - This area includes special assignments, compilation of infringement reports and electronic measurements.

What Degree of Management is Required?

Enforcement - To ensure proper control in the area of Enforcement the inspector call workload can be placed into two categories:

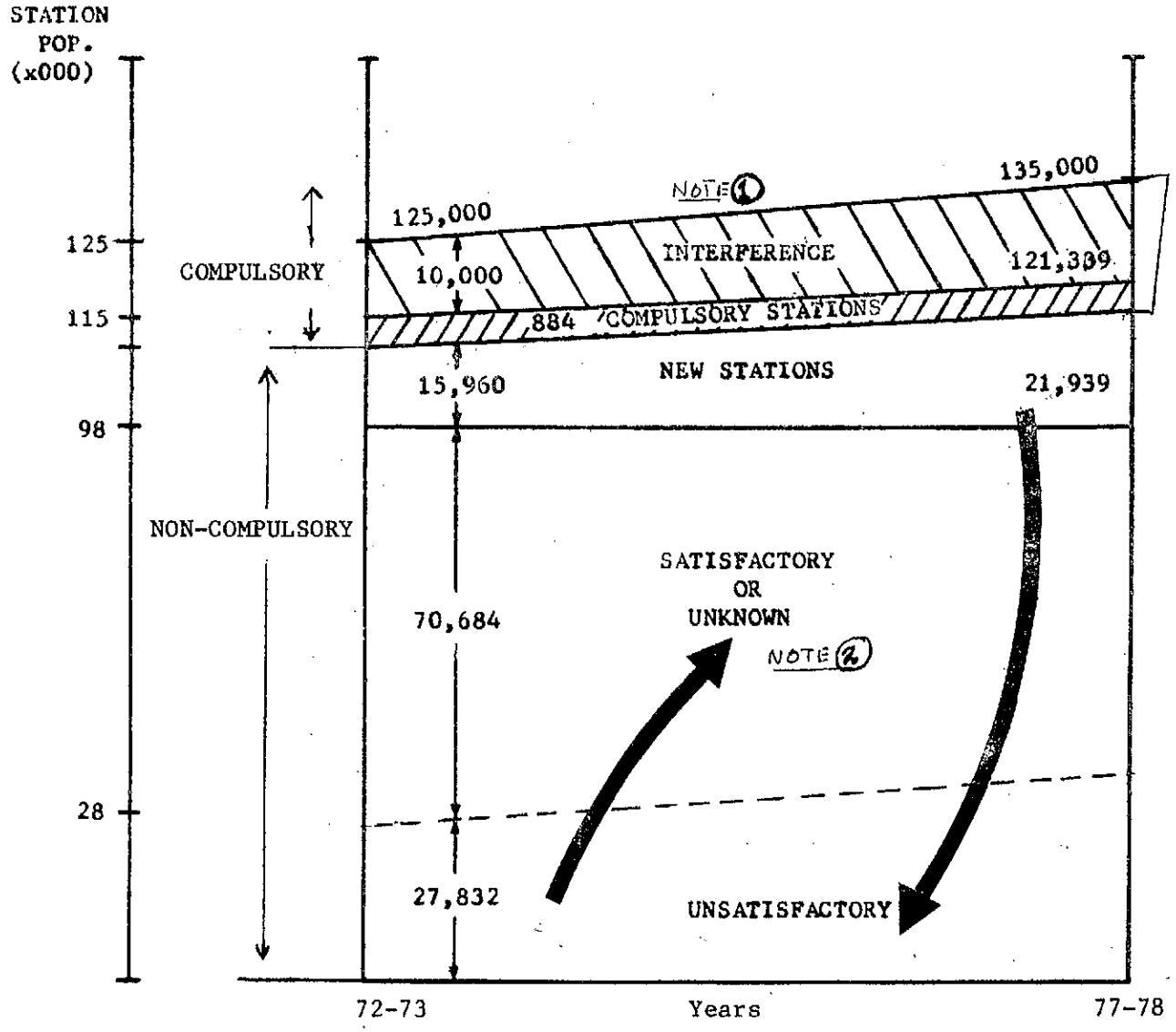
(a) COMPULSORY Inspections and Interference investigations - Demand Workload.

(b) NON-COMPULSORY Inspections - Sampling Workload.

SPECTRUM MANAGEMENT - ENFORCEMENT

CHART - 2

Licensed Stations & Interference Categories



NOTE - 1 - COMPULSORY & INTERFERENCE IS A DEMAND WORKLOAD.

NOTE - 2 - SOME MOVEMENT BETWEEN NEW STATIONS TO UNSATISFACTORY & UNSATISFACTORY STATIONS TO SATISFACTORY.

COMPULSORY Inspections

By legislation and international agreement a certain percentage of licensed station population must be inspected at agreed to intervals. These inspections are classified as COMPUSORY and include such stations as TV, AM, FM, CATV, AERONAUTICAL GROUND and SHIPS' stations.*

Management of the Spectrum occupied by these stations can be considered to be in a "controlled condition" when all inspections are completed, i.e., on a yearly basis.

Interference Investigation

As Interference complaints must be investigated as soon as they are received, this is a demand workload which, using historical data can be accurately determined. As it is a demand workload this activity can be considered similar to COMPULSORY inspections.*

NON-COMPULSORY Inspections

By far the largest number of licensed stations are in the Non-compulsory category. In theory, to ensure that each station is operating properly it should be inspected. To exercise Spectrum Management on this basis would require an extremely large work force. However, it is possible to categorize the licensed stations within the Non-compulsory group as follows:

- Satisfactory licensees
- Unsatisfactory licensees
- Unknown licensees
- New licensees

Furthermore, through the use of probability mathematics to develop sampling procedures and by analysing the discrepancy occurrence in each of the licensed station categories the number of inspections can be greatly reduced and yet a 99% control can be established. From this base then, a call workload necessary for properly managing the spectrum can be accurately projected. (Refer Methodology, Appendix "F".)

SATISFACTORY Licensees

Certain licensees are known to be conscientious and law-abiding, maintaining their equipment, reporting any changes and operating correctly,

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* NOTE: A call is completed when an inspector carries out a physical inspection of a radio station or conducts an on site interference investigation. (Refer page 10.)

as a result, this category of SATISFACTORY licensees requires infrequent inspection.

UNSATISFACTORY Licensees

Certain other licensees are known to consistently disregard regulations, allowing their equipment to deteriorate, failing to report changes in equipment, and not operating their equipment correctly to Departmental standards. Therefore, these UNSATISFACTORY licensees require frequent inspection to ensure that proper control over infractions is maintained. These infractions include ten items; each of which is classed as a discrepancy. (Refer Appendix "F".)

UNKNOWN Licensees (Included in Satisfactory)

In addition to SATISFACTORY and UNSATISFACTORY licensees, research indicates that there is a percentage of licensees whose performance because they have not been inspected - is UNKNOWN.

NEW Licensees

Probably the most productive area in which to exercise the required degree of control is NEW licensees where, if proper control is exercised at the outset, it can be assured that these stations will be classed as SATISFACTORY.

Additional benefits in the inspection of new stations are:

- As the location of new stations is known - search and find time is minimal.
- As licences are issued inspections can be carried out on a predetermined schedule - efficient use of manpower.
- These inspections are "before the fact" and therefore this activity is a preventive measure - saves time in searching at a later date.
- A psychological benefit arises in the fact that as new licensees will know that they will be inspected they are less likely to operate a station that does not meet DOC standards.

From the foregoing then, it will be seen that based on the number of licensed stations with discrepancies (UNSATISFACTORY) and on the number of new licensees (not categorized), plus a sampling of the UNKNOWN, it is possible to forecast the number of inspections that are required for proper control of NON-COMPULSORY licensed stations.

NEW CONCEPT - MANPOWER FORMULA

COMPULSORY Workload - (Calls)*- It is demonstrated that the COMPULSORY and INTERFERENCE demand workload can be readily established on a 1:1 ratio based on COMPULSORY station population and the number of interference complaints received.

NON-COMPULSORY Workload - (Calls)*- This workload can be determined as follows:-

(a) Sample each type of licensed station and total the number of offenders. An offender is a station that breaches any of the following -

1 - Off frequency
2 - Overmodulation/Excessive FM deviation
3 - Power in excess of authorization
4 - Unauthorized installation
5 - Unauthorized change of location
6 - Spurious radiation
7 - Inadequate type approval
8 - Unsafe installation of transmitting equipment
9 - Antenna structures not in accordance with authorization
10 - Station not equipped as required under Radio Regulations

Confidence limits for the actual proportion of offenders to the population size can be calculated with 99% confidence by limiting the error of sampling to three standard deviations. (Refer Appendix "F")

(b) The proportion of offenders to population size is multiplied by the population size excluding compulsory cancellations, new and amended stations to give the number of offenders.

TOTAL WORKLOAD (Enforcement and Authorization)

(a) To the above number of offenders, add the compulsory inspections since they ought to be done for reasons previously stated.

(b) The number of inspectors needed to accomplish the established workload is calculated by using the 1971-72 inspector performance (yearly inspections/inspector, Appendix "C")

(c) To the number of additional inspectors, additional support staff is added based on the 1971-72 ratio of support staff to inspectors of 1:5.

(d) Travel expenses are increased for the additional number of inspectors required and is based on 1971-72 experience.

(e) Similarly 101 additional vehicles are required for the additional inspectors, based on the ratio of 1 car for 1.5 inspectors.

WORK UNITS 1971/72

The following details work units within the main identifiable activities performed by the five regions during 1971-72.

	Atlantic	Quebec	Ontario	Central	Pacific	Total
A. Enforcement						
1. Inspections	1340	4563	8348	5167	4050	23468
2. Interference visits	2660	2714	11256	6923	2230	25783
	4000	7277	19604	12090	6280	49251
B. Authorization						
1. Examinations	944	513	1960	460	848	4725
2. Applications processed	6000	11250	15690	12716	7119	52775
3. Cancellations	300	5200	5334	4092	3224	18150
4. Amendments	3000	4925	1346	4620	-	13891
5. Certifications	944	494	1976	423	928	4765
C. Monitoring						
1. Assignments	696	594	1125	1306	387	4108
2. Infringement Reports	1196	717	942	4068	848	7771
3. Measurements	22600	8585	26698	38593	23450	119926

The above activities account for 66% of total operating expenditures in 1971-72. The remainder, 34%, was for the other activities namely, Directorate Administration and Engineering where no sound statistics are available at this time.

PRESENT COSTS 1971/72

	Atlantic	Quebec	Ontario	Central	Pacific	Total
			$(000's)			
Man-Years	57	100	111	96	58	422
O & M						
Salaries	$466	$704	$954	$1020	$476	$3620
Travel	22	33	36	47	14	152
Others	32	158	63	72	33	358
	$520	$895	$1053	$1139	$523	$4130
Capital	74	83	111	77	125	470
Total Expenditures	$594	$978	$1164	$1216	$648	$4600

/ combined West/Cent Reg. budget we don't have this much money in 72/73

Based on the New Concept Manpower Formula as outlined on page 11, the following indicates the proposed Workload by Region for 1973-74

PROPOSED WORKLOAD

1973-74

The following summarizes the main identifiable activities to be performed by the five regions during 1973-74.

	Atlantic	Quebec	Ontario	Central	Pacific	Total
A. Enforcement						
1. Inspections	11668	29119	47993	31663	21473	144576
2. Interference visits	2660	2714	11256	6923	2230	25783
B. Authorization						
1. Examinations	1010	549	2097	492	907	5055
2. Applications processed	6420	12036	16788	13606	7617	56467
3. Cancellations	321	5564	5707	4378	3450	19420
4. Amendments	3210	5270	1440	4943	-	14863
5. Certifications	1010	529	2114	453	993	5099
C. Monitoring						
1. Assignments	696	594	1125	1306	387	4108
2. Infringements Reports	1196	717	942	4068	848	7771
3. Measurements	22600	8585	26698	38593	23450	119926

When compared to page 12 the above table will show the increase in work units proposed for 1973-74 over 1971-72.

The number of inspections proposed are based on the premise that all compulsory stations have to be inspected and a minimum portion in the non-compulsory category must be inspected annually since there are that many offenders in that category.

The number of interference visits remains at the 1971-72 level since interference calls should not increase with an increase in inspections.

In the authorization activities, 1971-72 volumes were increased by 7%, the average growth in station population size.

Monitoring remains the same as 1971-72.

1973-74 MAN-YEAR RESOURCES

The methodology for determining the Manpower Resources for 1973-74 is according to the formula shown on page 11.

Field Inspections	Atlantic	Quebec	Ontario	Central	Pacific	Total
P-3 p	.169	.181	.255	.116	.164	.184
Station Population	27585	46213	79071	58262	56176	267307
Non-Compulsory inspections	4662	8365	20163	16758	9213	49161
Compulsory Inspections						
-AM, TV, CATV, AERO	1006	2040	884	646	1043	5619
-New and Amended Stations	6000	16000	15690	17336	8987	64013
Total Inspections	11668	26405	36737	24740	19243	118793
Interference visits	2660	2714	11256	6923	2230	39783
Total Inspections 1973-74	14328	29119	47993	31663	21473	144576
Inspections/Inspector 1971-72	364	485	603	604	598	541
15% increased productivity	417	558	693	695	688	623
Inspectors required 1973-74	34	52	61	46	31	232
Less: Inspectors on staff	11	15	33	20	11	90
Additional inspectors 1973-74	23	37	36	26	20	142
Support Staff						
1971-72 ratio of 1:5	5	7	7	5	4	28
Total Man-Years	28	44	43	31	24	170
Less: Decentralization	2	3	3	2	2	12
Net Man-Years required	26	41	40	29	22	158

Proposed Additional Costs

	Atlantic	Quebec	Ontario	Central	Pacific	Total
Man-Years	26	41	40	29	22	153
O & M		$(000's)				
Salaries	252	328	360	293	194	1427
Travel	59	97	55	76	35	322
Total O & M	311	425	415	369	229	1749
Capital						
Vehicles	90	147	141	102	77	557
Other Equipment	150	150	150	150	150	750
Total Capital	240	297	291	252	227	1307
Total Additional Costs	551	722	706	621	456	3056

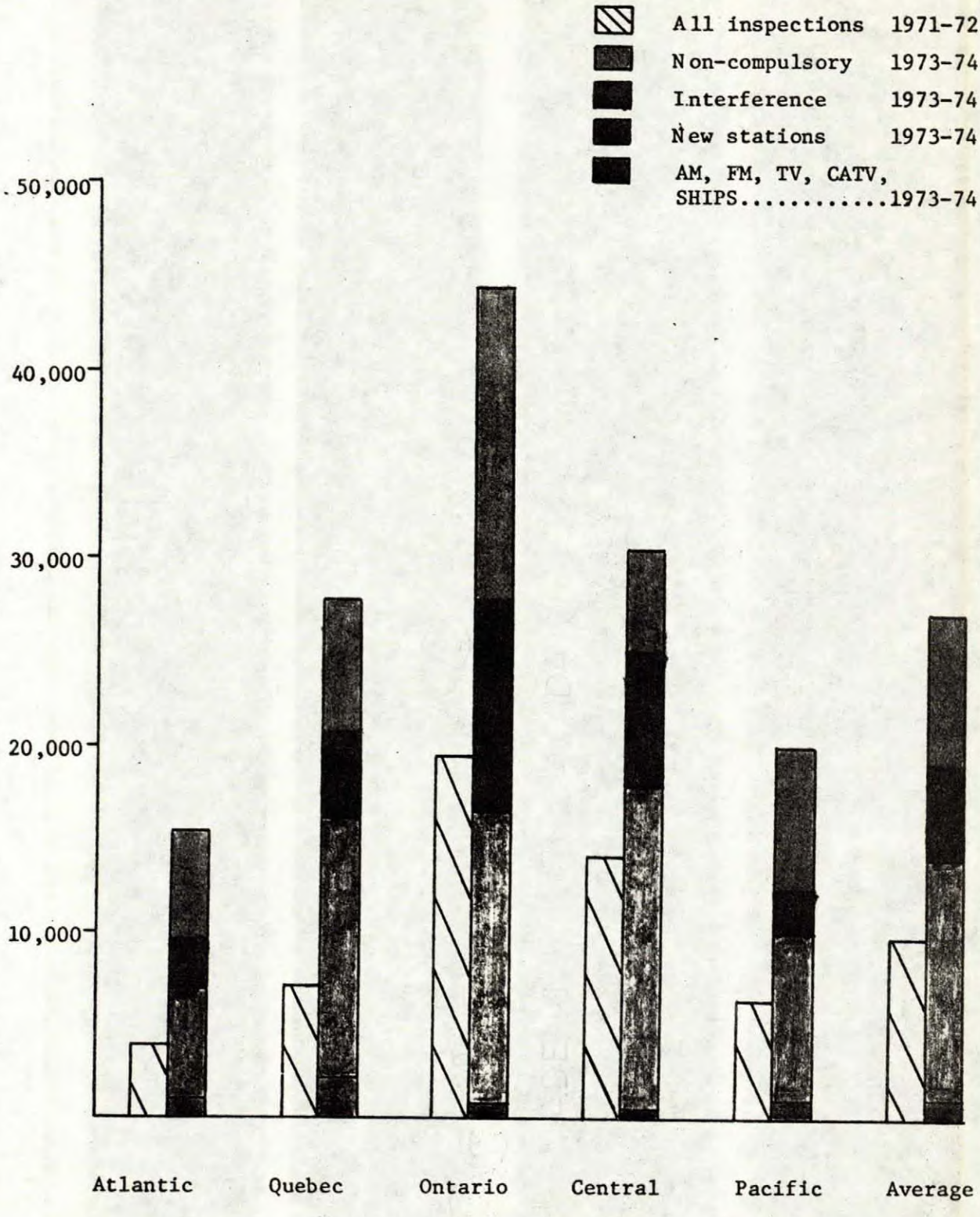
WORKLOAD BAR CHART

The following bar chart visually compares inspection workload units for 1971-72 with the proposed workload units for 1973-74.

The proposed volumes for the NY is broken down in four (4) groups in order of priority. The first three (3) groups, i.e. AM, FM, TV, CATV, aeronautical; new and amended stations, and interference calls are considered as compulsory. The fourth grouping is the non-compulsory portion which is equivalent to the minimum number of offending stations in the population.

It can readily be seen that current levels of inspections are far from covering an adequate portion of the station population. This in turn reflects adversely on the management of Radio Frequency Spectrum.

INSPECTION WORK UNITS



CAPITAL EQUIPMENT - COST EFFECTIVENESS

Capital equipment requirements for field operations have, in the past, been allocated on departmental priorities limited by a constant inadequacy of funds. As a result, purchases of equipment essential to the efficiency and cost effectiveness of the legislated workload has tended to be "in-fed" over an extended period of time. This in turn means that the regions have never had sufficient equipment to enable them to fulfil their objectives. The effectiveness in the regions could be increased with additional capital equipment.

The lack of essential equipment greatly increases costs by preventing productivity that could be achieved if equipment were available.

Examples of the excessive cost generating activities are:

a) Travel - lack of two-way communications for despatching greatly increases travel time (double trips).

b) Analysis - lack of two-way radio communications prevents District Officers performing analysis in support of vehicle activity.

c) Portable Equipment - lack of sufficient portable equipment at District Offices restricts the number of calls that can be made in a day.

d) Fixed Equipment - lack of fixed equipment at District Offices precludes the ability to conduct off-air inspections and provide analytical support to mobile operations.

While we recognize that these are general observations and do not apply in all Regional or District Offices, it is felt that productivity could be increased an estimated 15% across Canada by properly equipping the field and regional offices.

Basically, increased efficiency and cost effectiveness in field operations results from better productivity (more calls per inspector) and better utilization of equipment (the use of centralized fixed, and portable equipment rather than installing certain types of equipment in all vehicles).

The 15% increase in performance would therefore have a direct impact on man-year requirements, and with an immediate investment of $750,000 in capital equipment would reduce additional man-year requirements by 33 as described on page 15.

The above $750,000 capital investment does not include the vehicle costs needed for the additional inspectors.

IMPLEMENTATION - OBJECTIVE SETTING AND MANAGEMENT CONTROL

Objective Setting

It has been stated that work units (calls) sufficient to ensure management of the spectrum can be accurately forecasted on a yearly basis. It follows, therefore, that because of this each District Office and each Field Inspector's work unit objectives can be established on a daily, weekly and monthly basis. In doing this performance objectives can be made at each level. Regional objectives and performance can also be established and measured in a similar manner. Once objectives are set then all that is needed to measure performance is a method of reporting work unit activity on a monthly basis, itemized as to number and type of work units performed, and time taken to complete same.

Reporting Control

For purposes of determining performance against objectives and for analysing work unit activity throughout the Region three reports have been designed to provide the pertinent information.

- Inspectors' Call Report/self-explanatory; used for each call.
- Weekly Roll-up/Individual inspectors
  Weekly totals of call activity are maintained for each inspector. This facilitates a rapid roll-up at the month end.
- Monthly Performance Report/This report embraces all activity and includes such work units as calls, administration, interference, etc. It replaces four reports previously used. The Monthly Performance report is reviewed by the Region and Districts for verification of performance against objectives as well as analysing trends and substantiating operating standards such as time and cost to complete work units.

Computerized MIS

Use of the above reports provides a Management Information System which at the present time is manual. However the system is designed in such a manner as to readily be adaptable to a computerized operation.

T.F.O-C A L L-R E P O R T

A COMPANY/ORGANIZATION	REQUEST FOR ASSISTANCE BY:			
	B	ACTIVITY	C	TYPE OF CALL
NAME		INSPECTION		XXXXXXXXXX
ADDRESS		INTERFERENCE		PLANNED
CONTACT		OTHER		DISPATCHED

D IF INSPECTION TYPE:	SHIPS	ACFT	P.C.BASE	MOB.	B.C.	TV.	FM.	CATV	AMT.	GRS.	OTHER

E PROBLEMS/DISCREPANCY OR INTERFERENCE: CURED: YES? NO?

INSPECTION				INTERFERENCE FROM:	REMARKS TO:
1		9		POWER LINE	
2		10		INTER-MOD	T.V.
3		11		CROSS-MOD	RDO.
4		12		HOUSEHOLD	P/C
5				INDUSTRIAL	OTHER (Specify)
6	This should			SCIENTIFIC	
7	relate to			MEDICAL	
8	Discrep.Code			OTHER	

F ACTION TAKEN AND RESULTS:

G MONITORING FACILITIES USED- DIST.OFFICE [ ] MONITORING STATION [ ] VEHICLE [ ]

H ARRIVAL

DEPARTED AT

TOTAL TIME

XXXXXXXXXXXXXXXXXXXXXXXX

OTHER EXPENSES

SIGNATURE DATE

NAME: ______________________ OFFICE: ______________________ FROM: ____________ TO: ____________

		POWER LINE						HOUSEHOLD																								R.R.O.	
		TELEVISION			RADIO			TELEVISION			RADIO			NOT ON/HOME			OTHER			I.S.M.			INTER/X/MOD			CATV			MATV			EXAMINATIONS	
PLANNED	DISPATCHED	V	C	HRS.	V	C	HRS	V	C	HRS.	V	C	HRS	V	C	HRS.	V	C	HRS	V	C	HRS	V	C	HRS	V	C	HRS	V	C	HRS	GEN.	A.A.A.

INSPECTIONS
TYPE NO. HRS

AM
FM
TV
CATV
RAD
RPTR
TV
REPR
ACFT.S
ACFT.M
GRD.
PUB FX
PUB M.
PCB
PCM
GOVT FX
AMT.
XPRTv
GRS.

MARINE
C.G.
RT
W.T.
N.C.

DISCREPANCY CODE
1
2
3
4
5
6
7
8
9
10
11
12

ADDENDUM

Revenue

Under a controlled situation it is possible to generate additional revenue as a larger number of inspections should expose a greater number of unlicensed stations or stations whose licence is not current.

An estimate is now being made to determine a reasonable forecast.

Other sources of revenue might be explored and in this connection it seems unfair for the general public to bear the expense involved in inspecting stations that are not operating according to Departmental standards, nor the cost of locating interference.

For Example: If a licensed station is causing interference and several hours or days are required to determine and rectify the situation - why should this cost not be charged against the offender? The same would apply to Hydro interference.

A rough estimate of revenue, based on a loaded hourly rate of 20.00 for an average call of 2 hours and 30 minutes = $50.00 per call is -

Licensed stations operating incorrectly ..... = 15,000 x 50.00 = $ 750,000

Interference Calls ..... = 11,256 x 50.00 = 562,800

Total additional revenue per annum (estimated) = $1,313,000.

This revenue could be added to existing revenue to defray Operating and Capital costs. (Refer Ontario Region Paper - Possible Sources of Revenue.)

APPENDIX "A"

DETERMINING RATIO UNSATISFACTORY STATION TO SATISFACTORY

DISCREPENCIES BY CATEGORY

In order to determine the number of stations to be inspected in each category, a discrepancy table is maintained by each district office. Monthly summaries of the number of stations inspected, the number of each type of discrepancy found, and the number of unsatisfactory stations found will provide statistics indicating the areas for concentration.

The following is an example using annual statistics from Hamilton and Kitchener district offices.

	2												1	1÷2
	# Insp	A	B	C	D	E	F	G	H	I	J	Total	# Unsat. Stations	Ratio
Ships NC	62				3	2					1	6	7	.12
Aircraft	386	6			7	19			10	4		46	46	.12
PCF	511	26	3	10	20	13	27	31		14	22	166	160	.31
PCM	1800	80	8	18	154	36	3	66		2	23	390	380	.21
GRS	133	16	2		9		1					28	26	.20
AMA	134						1				7	8	8	.06
EXP														
PAGING														
RCCMRS														
PUB CF														
MAR C/STN														
TOTAL	3026	128	13	28	193	70	32	97	10	20	53	644	627	.21

Assuming that Experimental, Paging, RCCMRS, Public Commercial, Mobile and Marine Coast Stations are all 20%, one can determine the number of stations to be inspected in each category as follows:

TYPE	1 POP	2 RATIO	1 x 2 NO. INSP.
Ships NC	1,345	.12	161
Aircraft	3,226	.12	387
PCF	10,787	.31	3,344
PCM	54,539	.21	11,453
GRS	21,827	.20	4,369
AMA	5,884	.06	353
Exp.	259	.20	52
Paging	56	.20	11
RCCMRS	93	.20	19
Pub. CF	471	.20	94
Mar C/Stn.	29	.20	6
	98,516	.21	20,245

The above actual figures are used as an example only to describe the methodology.

ONTARIO REGION--"Unsatisfactory" Licensed Stations

DATA: (SOURCE: Hamilton, Kitchener, and Toronto District Offices)

	Unsats Discovered	Stations Inspected	%
HAMILTON	822	214	26
KITCHENER	1013	309	31
TORONTO	239	68	28
	2074	591	28

$p = \frac{591}{2074} = .28$

n = 2074 which is greater than 80

CALCULATIONS: CONFIDENCE LIMITS

$$\pi = \frac{1}{1 + \frac{9}{2074}} \left(.28 + \frac{9}{2(2074)} \pm 3\sqrt{\frac{(.28)(.72)}{2074} + \frac{9}{4(2074)^2}} \right)$$

π max = .310
π avg = .280
π min = .251

One can be 99% confident that the true proportion of unsatisfactory licensees to population size is between .310 and .251.

NO. OF INSPECTIONS

$$O_{\text{mifi}}^{\text{avg}}{}^{\text{max}} = \pi_{\text{min}}^{\text{max}} \times N$$

Omax = .310 x 99,400 = 30,814
Oavg = .280 x 99,400 = 27,832
Omin = .251 x 99,400 = 24,949

NO. OF INSPECTORS

	MAX	AVG	MIN
NO. OF INSPECTIONS	30,814	27,832	24,949
NO. OF CALLS/INSPECTOR	603	603	603
NO. OF INSPECTORS	51	46	41

APPENDIX "C"

INSPECTOR WORKLOAD CALCULATION

A] METHOD

Total calls, each district ÷ No. Field Inspectors available in each district = No. calls per Inspector each district

Regional Total Calls ÷ Total Inspectors = Regional average No. calls per Inspector

B]	TOR	HAM	LON	KIT	KING	OTT.	N.BAY	SSM	T.BAY	KENORA	TOTAL
No. Inspections 1971/72	566	2186	1570	1196	436	750	339	598	228	479	8348
No. Interfer. 1971/72	3083	2333	1342	920	311	829	533	492	1288	125	11256
No. Calls 1971/72	3649	4519	2912	2116	747	1579	872	1090	1516	604	19604
No. Inspectors 1971/72	5.5	5.5	4.5	3.5	2.0	4.0	2.5	1.5	2.0	1.5	32.5
Average No.Calls/ Inspector	663	822	647	605	374	395	349	727	758	403	603

does consistency applications only
ignore cancellations
or inactive stations

APPENDIX "D"

NEW YEAR APPLICATIONS--7 YEAR ACTUALS

	65/66	66/67	67/68	68/69	69/70	70/71	71/72
Ships C	42	11	17	13	16	5	8
Ships NC	194	189	188	162	195	140	213
Aircraft	472	511	571	559	605	554	685
Commercial Base	843	1046	1308	1528	1505	1377	1647
Broadcast TV	5	3	2	1	--	5	--
Amateur	176	179	173	180	219	281	266
Commercial Mobiles	3494	4273	4276	4912	4829	4885	6575
CATV	58	85	106	6	1	--	2
Remote Control	122	112	115	127	162	1	9
Experimental	24	23	22	38	25	15	18
Aeronautical Ground	2	5	3	6	3	3	8
PC Rcvrs	23	5	33	32	3	8	88
Duplicate Certificates	5	4	3	--	--	--	--
GRS	4963	5074	4786	5149	3851	4734	6171
	10,423	11,520	11,603	12,713	11,414	12,008	15,690

APPENDIX "E"

NEW APPLICATIONS--5 YEAR FORECAST

YEAR	ESTIMATES @ 7%	ACTUAL	NO. INSPECTORS @ 7%↑	actual
65/66	10,423	10,423	17	17
66/67	11,153	11,520	18	19
67/68	11,933	11,603	20	19
68/69	12,769	12,713	21	21
69/70	13,662	11,414	23	19
70/71	14,619	12,008	24	20
71/72	15,642	15,690	26	26
72/73	16,737		28	
73/74	17,909		30	
74/75	19,162		32	
75/76	20,504		34	
76/77	21,939		36	

METHODOLOGY

Determining the number of Inspections of Non-Compulsory Stations to Ensure a Controlled Condition

A] An unsatisfactory licensee is one who breaches any of the following discrepancies:

1) Off frequency
2) Overmodulation/Excessive FM deviation
3) Power in excess of authorization (including increase in ERP caused from transmission line or antenna changes)
4) Unauthorized installation
5) Unauthorized change of location
6) Spurious radiation
7) Inadequate type approval or model number identification plates
8) Unsafe installation of transmitting equipment, including antennae
9) Antenna structures not in accordance with authorization, e.g. height, markings
10) Station not equipped as required under the Radio Regulations

B] Sample each type of Non-Compulsory licensed station and total the number of "Unsatisfactories".

C] Confidence limits for the actual proportion of unsatisfactory licensees to population size can be calculated with 99% confidence by limiting the error of sampling to 3 standard deviations:

$$|\pi - p| < 3\sqrt{\frac{\pi\,(1-\pi)}{n}}$$

π: true proportion; p: sample Proportion; $\sqrt{\frac{\pi\,(1-\pi)}{n}}$: standard deviation; n: sample size

where π is the actual number of unsatisfactory licensees divided by the population size, p is the discovered number of unsatisfactory licensees divided by the sample size, and n is the sample size.

Solving for π gives the confidence limits:

$$\pi = \frac{1}{1+9/n}\left(p + \frac{9}{2n} \pm 3\sqrt{p\frac{(1-p)}{n} + \frac{9}{4n^2}}\right)$$

D] One can be 99% certain that the true proportion of unsatisfactory licensees to population size is between these confidence limits based on sample data. The following minimum requirements must be maintained to obtain reliable results:

If p equals	n should be greater than
.5	30
.4 or .6	50
.3 or .7	80
.2 or .8	200
.1 or .9	600
.05 or .95	1400

E] The proportion of unsatisfactory licensees to population size is multiplied by the population size to give the number of unsatisfactory licensees (again including confidence limits).

$$\pi \times N = 0$$

where π^{max}_{min} are the confidence limits,
N is the population size,
and 0 is the number of unsatisfactory licensees.

F] Example:

DATA: (Source: Bell Northern Quality Control Report)
(Used for purposes of comparison unit Regional data)

$$p = \frac{\text{no. of offenders discovered}}{\text{no. of stations inspected}} = \frac{348}{1343} = .26$$

n = 1343 which is greater than 80

CALCULATIONS: CONFIDENCE LIMITS:

$$\pi = \left(\frac{1}{1 + 9/n}\right)\left(p + \frac{9}{2n} \pm 3\sqrt{\frac{p(1-p)}{n} + \frac{9}{4n^2}}\right)$$

$$= \frac{1}{1 + 9/1343}\left(.26 + \frac{9}{2(1343)} \pm 3\sqrt{\frac{(.26)(.74)}{1343} + \frac{9}{4(1343)^2}}\right)$$

π max = .297
π avg = .260
π min = .225

One can be 99% confident that the true proportion of unsatisfactory licensees to population size is between .297 and .225.

Ontario Region - Number of Inspections Required

$$\pi \begin{matrix} \text{max} \\ \text{avg} \\ \text{min} \end{matrix} \times N = 0 \begin{matrix} \text{max} \\ \text{avg} \\ \text{min} \end{matrix}$$

$$0 \text{ max} = .297 \times 99.400 = 29,522$$
$$0 \text{ avg} = .260 \times 99.400 = 25,844$$
$$0 \text{ min} = .225 \times 99.400 = 22,365$$

G] This number of unsatisfactory licensees is considered to be the minimum number of inspections which should be made in order to manage the spectrum. This, then, becomes the objective, statistical calculation of the number of inspections to be made in one year.

Determining Number of Inspectors Required

To obtain personnel requirements, the number of inspections is divided by the number of calls per inspection per annum:

Example - Number of Inspectors Required

	Max.	Avg.	Min.
No. Inspections	29,544	25,844	22,365
No. Calls/Inspector	603	603	603
No. Inspectors	49	43	37

COST PER WEIGHTED WORKLOAD UNIT

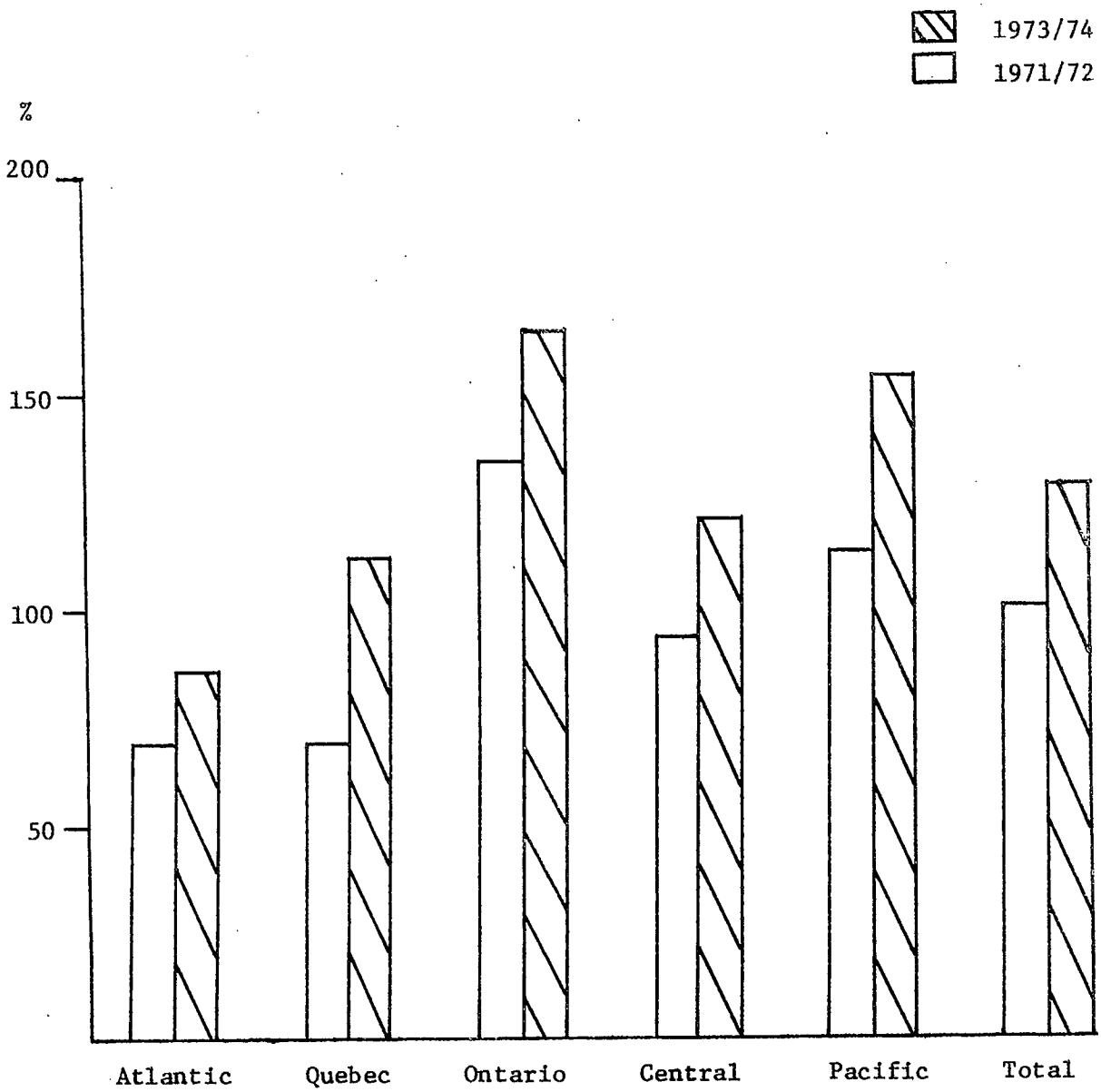
1971-72 vs. 1973-74

This section compares the weighted workload unit cost for each region using 1971-72 cost per unit as a base.

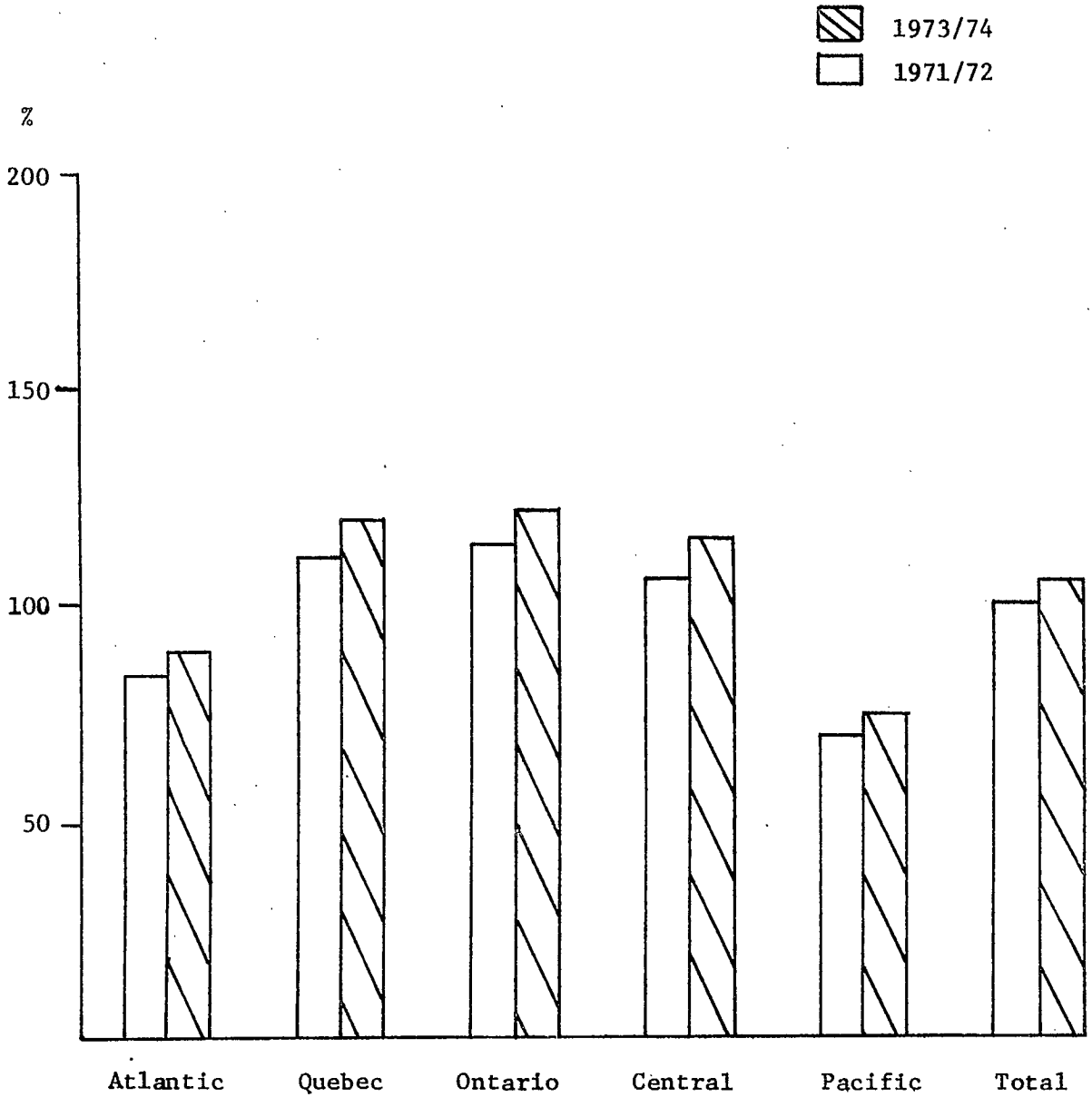
The 1973-74 proposal will reduce unit cost by an overall $17.44 from $62.02, representing a 39% improvement in cost performance.

It is intended to implement this basis of reporting in our Monthly Management Report within the next few months up until the Performance Indicator study is finalized and implemented.

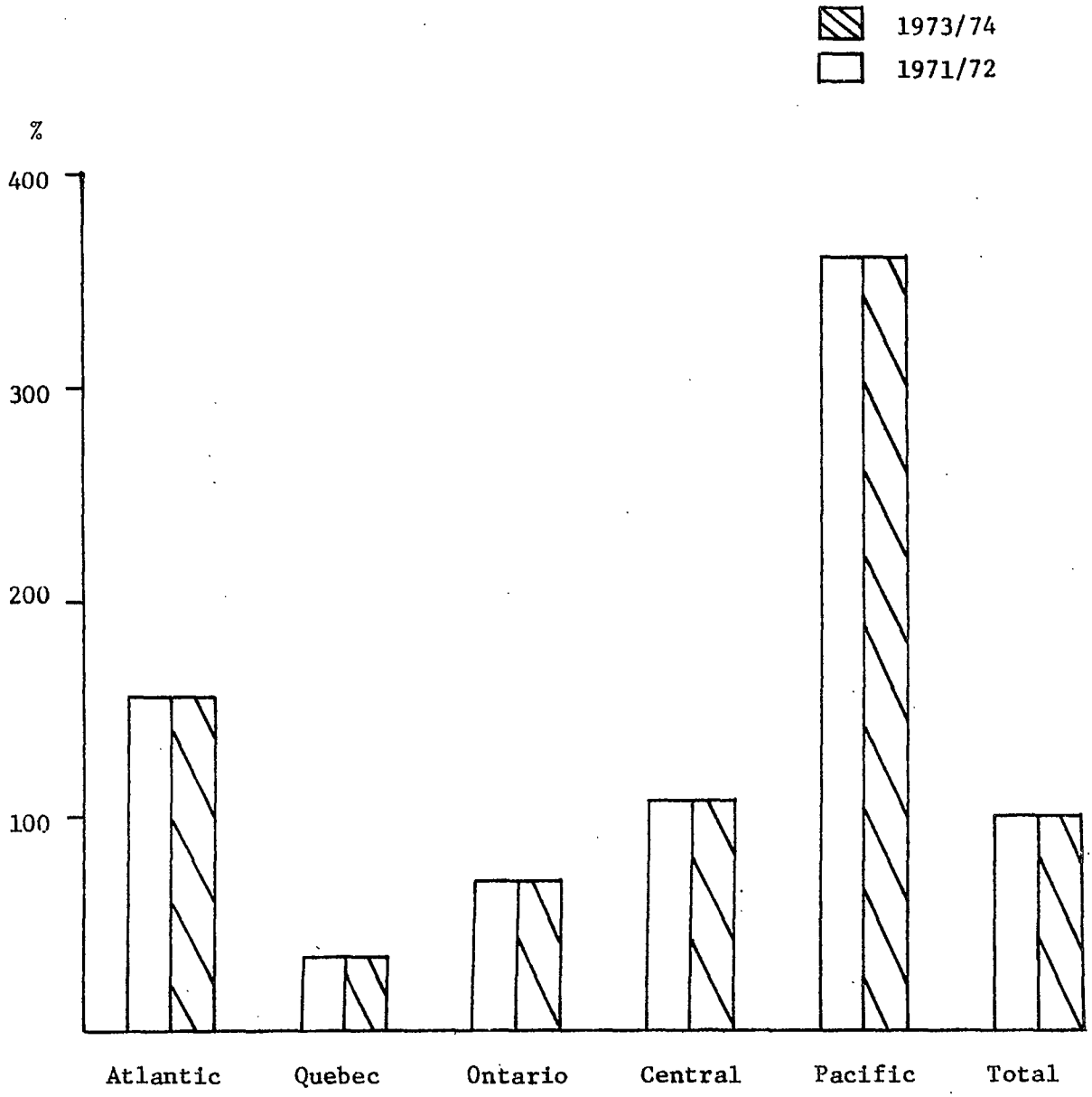
Cost Performance-Enforcement



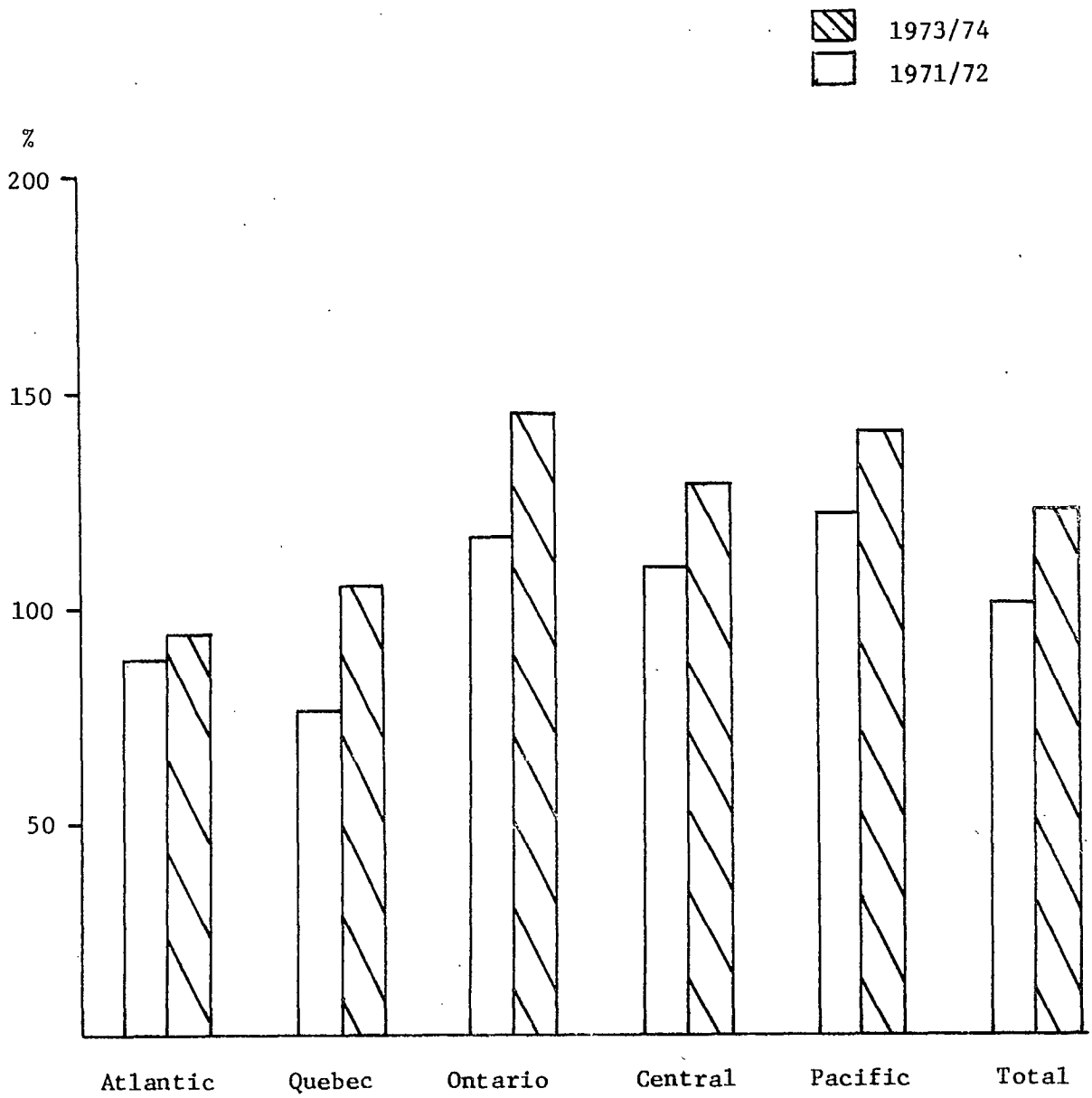
Cost Performance-Authorization



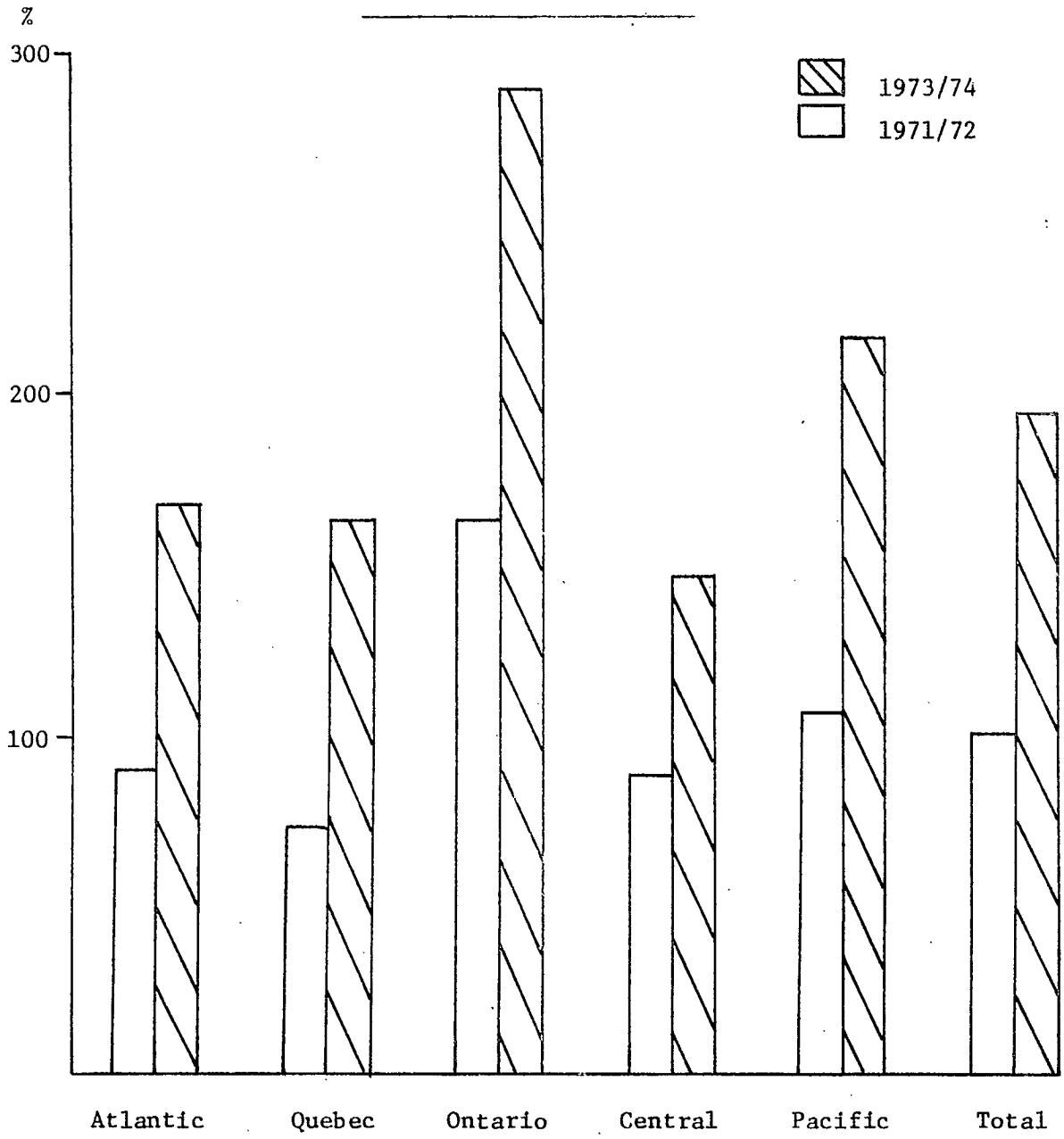
Cost Performance-Monitoring



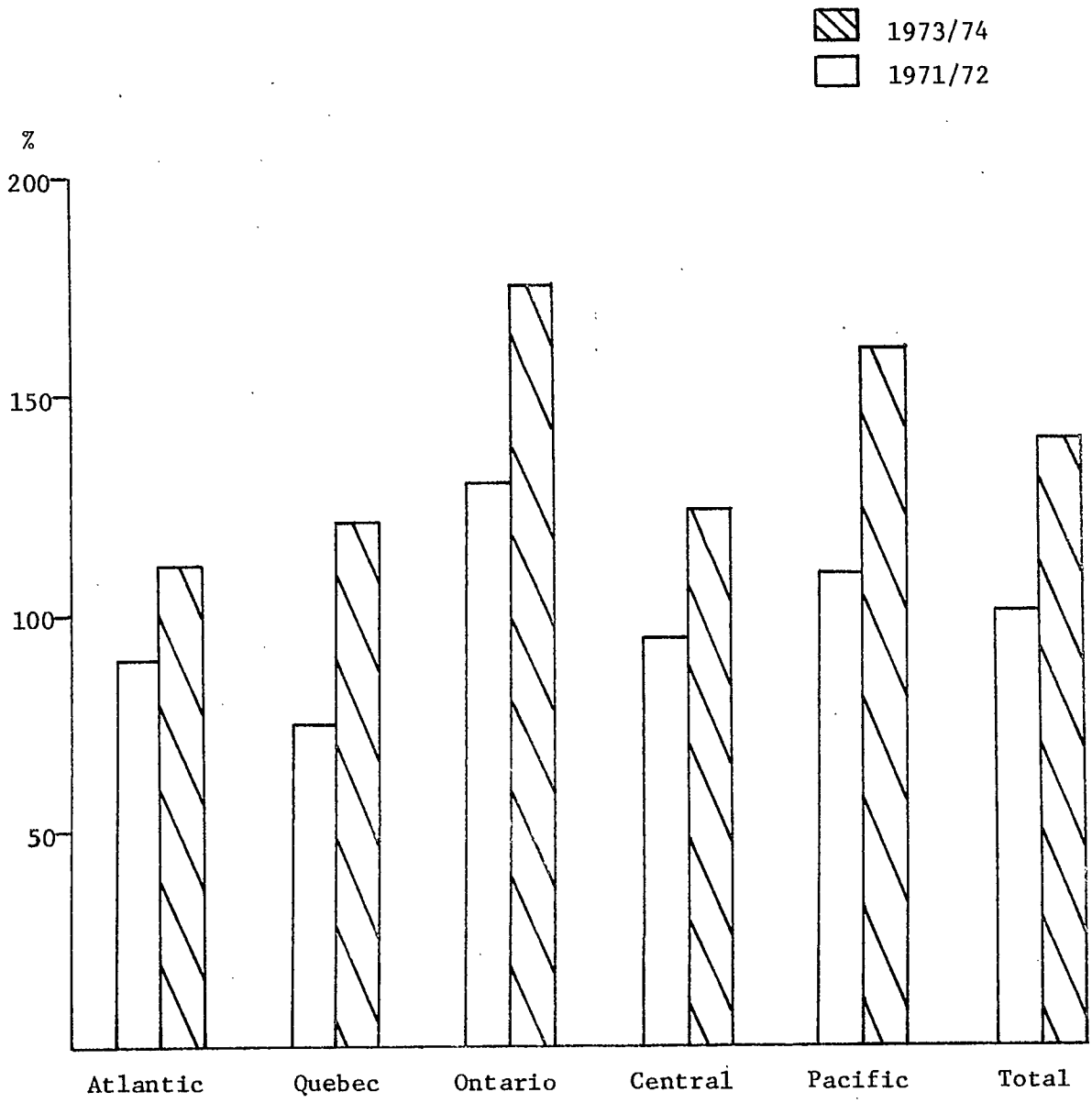
Cost Performance-Total Operations



Cost Performance-Others



Cost Performance-Total Telecomm Regs.



MANAGEMENT INFORMATION SYSTEM
PERFORMANCE INDICATORS

The Department is presently undertaking the development of Performance Indicators to provide more detailed information and statistical data for management to:

- support budgetary submissions
- measure the efficiency of operations
- measure the cost of the systems employed in the Department

It is hoped that the project will achieve the following results:

a) the identification of outputs by program activity and responsibility centre

b) the identification of those operations represented by outputs

c) the identification of non-quantifiable operations

d) the determination of inputs, resource requirements, and input/output ratios

e) the identification of quality indicators

A proposed reporting system would have each employee of the activity submit a report of his personal activity or time utilization each day. This report would include codes for Responsibility Centre, Activity and Operation.

These report cards would be used as the input to a computer program which would do the necessary aggregation and cost allocations to the outputs of each sub-sub-activity. The results of the program should provide the department with a series of financial reports. This type of financial report meets the requirements of providing data by Responsibility Centre, and Activity as prescribed by the Program Planning and Budgeting System (PPBS).

The individual report card could also provide the base for operational measures of efficiency. After reports have been processed for several months, an acceptable standard time should emerge. If wide variations in performance exist between offices or regions, the work measurement staff would determine why and set a standard where necessary.

The overall result will be a close monitoring of volumes, efficiency and performance of all offices to ensure the optimum use of resources in fulfilling our objectives.