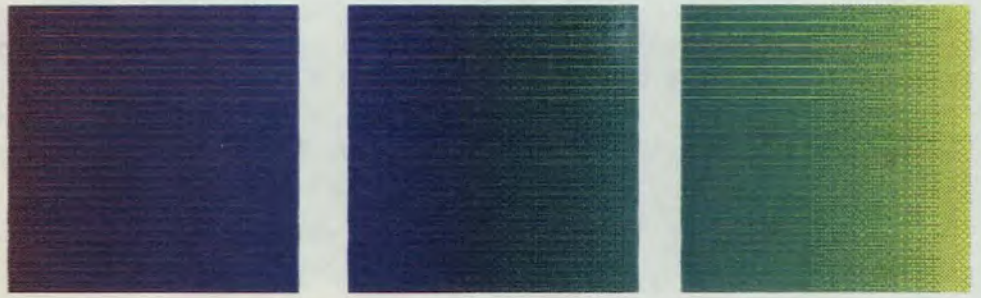

Spectrum Control

Annual Report 1989-90

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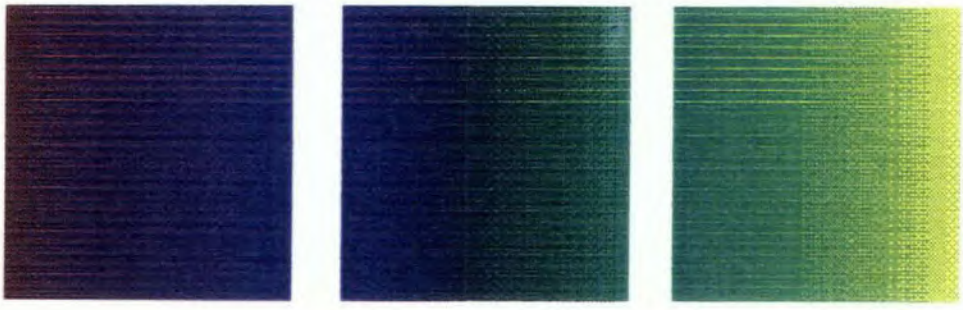

Spectrum Control

Annual Report 1989-90

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FOREWORD

This document, compiled by DOSP-C, provides an analysis of spectrum control activities for the period 1989/90. Our intention is to share our ideas with those involved in spectrum management. We hope the report will give rise to discussions that will help to clarify and resolve the issues we have identified.

The author's viewpoint is that of National Headquarters and as a result the document analyses spectrum management activities from a national rather than a regional perspective.

Although the Department's structure has changed since 1989 the recommendations in this report continue to be applicable since they are designed to improve the quality of spectrum management and, as such, transcend organization and structure.

For all those involved in spectrum management

1989 was a year that demonstrated how flexible program operations must be in an environment where procedures and priorities are constantly monitored and revised. Spectrum control officers throughout the country managed to adapt their program delivery to cope with resource reductions due to priority realignment and the short term impact occasioned by the introduction of enhanced automated processes at the district office level. With a focus on automation, we are now poised to address Spectrum Control issues through activities that are not only efficiently conducted but also well coordinated with other Departmental initiatives.

We have produced a report that, in the context of the feedback mechanisms reflected in the Spectrum Control Model, shares with you the information we consider relevant together with our observations. We would like to stress that our comments are intended primarily to stimulate the discussion of issues relating to Spectrum Control activities.

Feedback is an essential and fundamental part of any dynamic organization. The Spectrum Control Model includes a series of quality-control activities designed to provide the information needed to make decisions. This report focuses on this concept and our continued efforts in this direction.

As we look into the future, we see a spectrum management team in transition. Advancing communications technologies and increasing program pressures have already changed the traditional role of the Departmental radio inspector. If our Department is to effectively manage this change and retain control of frequency spectrum management in the 90's, we will be required to implement the management systems and technological ingenuity of the 21st century.

Mission, mandate and structure

Spectrum Management and Regional Operations (ADMSR) has two major responsibilities: spectrum management of the radio frequency spectrum and the delivery of regional programs and services.

Spectrum Management and Regional Operations is achieved through four major activities:

- The planning, technical services and client interface result area is carried out in order to meet Canada's current and future needs;
- The authorization result area is carried out in order to guarantee public access to the radio spectrum;
- The spectrum control result area is carried out in order to maintain the quality of the radio spectrum; and
- Non-spectrum operations involving other Department activities such as the formulation of standards and policies, the testing of interconnection equipment for telecommunications networks, emergency telecommunications planning, the development of telecommunications technology, cultural development, public affairs and government telephone regional operations.

At headquarters, the Sector is divided into three Branches and one Division:

- Radio Regulatory Branch (DGRR)
- Broadcasting Regulations (DGBR)
- Engineering Programs (DGEP)
- Sector Policy, Planning and Assessment (DAP)

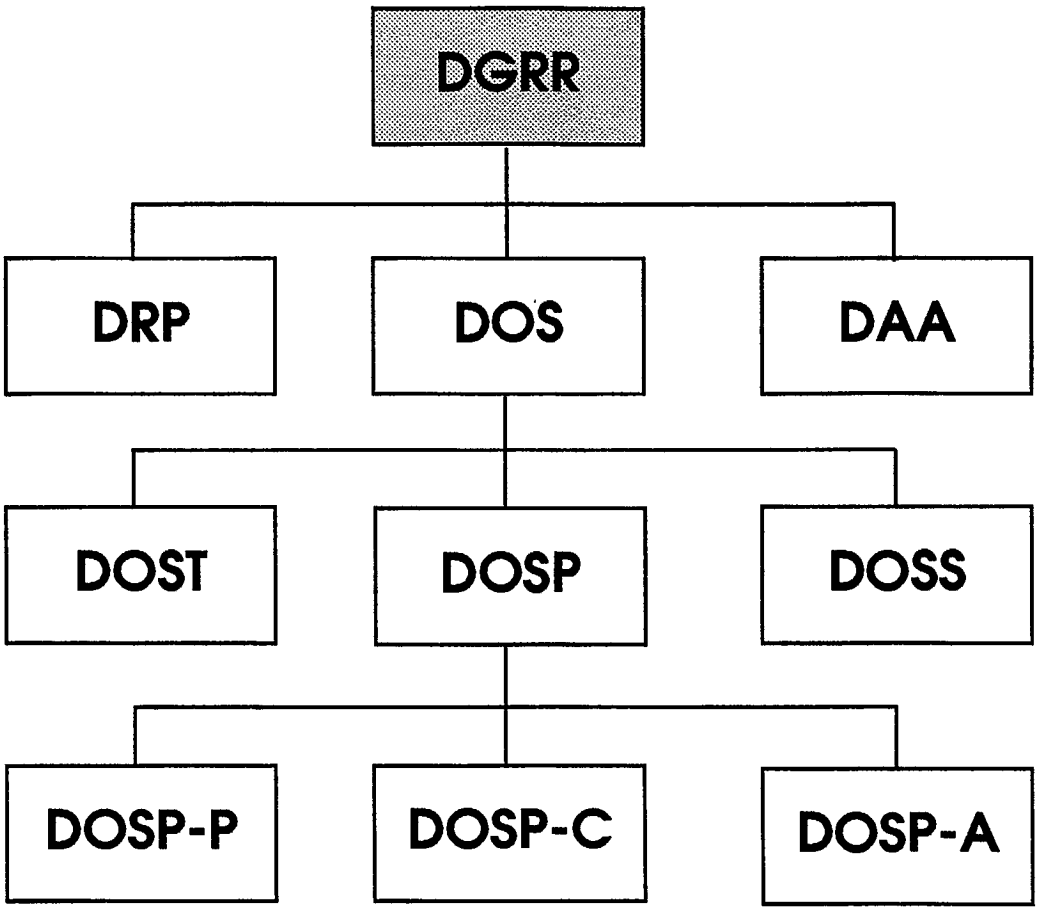
The mandate of the Radio Regulatory Branch is to develop regulatory and operational policies for orderly spectrum utilization, taking into account technological developments and the changing requirements of Canadians.

Within this framework, DOSP is in charge of directing spectrum control and authorization activities, coordinating the formulation and publication of all operational policies and procedures, and providing an advisory service to operational groups.

DOSP is divided into three groups:

- Spectrum Control
- Authorization
- Publications (operational policies and procedures)

Organisational Chart[1]



[1] As it appeared in 1989

Spectrum Services

These identify services provided to users of the radio frequency spectrum on a request basis and for which the costs are often recovered. This cost recovery can be direct billing as is the case for ship inspections or indirect as is the situation for general public investigations, where the cost of these services is recovered through the broadcast station licence fee levied by the Canadian Radio Television and Telecommunications Commission. For the period 1989/90, the cost of these services was $9,161,219.

The following activities fall into this category:

- Ministerial Inquiries
- Spectrum Measurement Services
- Radiocommunications Investigations
- General Public Investigations
- Ship Inspections
- Broadcast Inspections

In spite of the fact that we have made significant gains given the total yearly expenditure, one of our goals must be to improve our cost effectiveness in all these areas. Although some of our clients supply revenue for these activities, as is the case with ship inspections, clients are rarely in a position to provide person years and tend not to consider this factor when outlining their requirements.

Figure 1 reflects a small overall 1.3% increase in expenditures distributed among the service activities. In current dollars this means the cost has effectively decreased. *Figure 2* shows person-year resources over a six-year period.

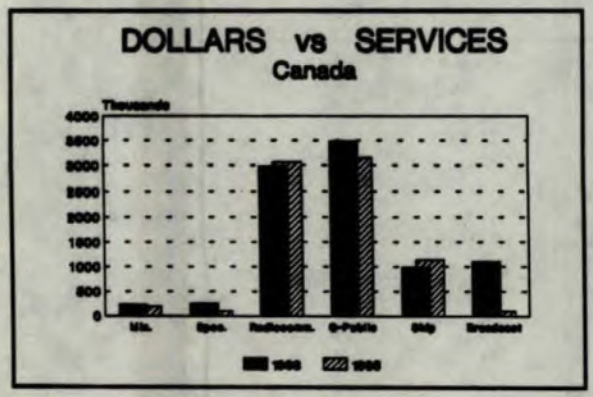


Figure 1

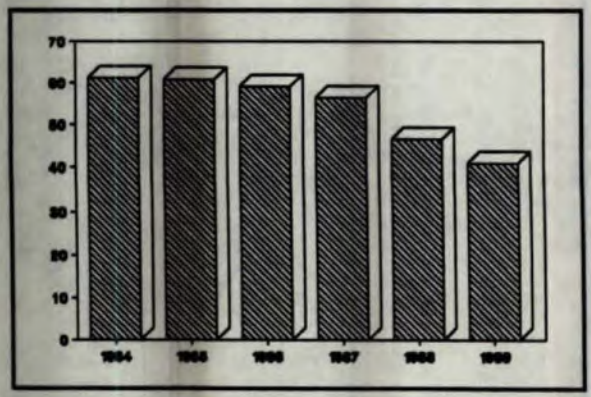


Figure 2

To perform the same service tasks for basically the same clients, the number of PYs required went from 61.23 in 1984 to 40.91 in 1989, despite the fact that the overall workload only slightly decreased. This represents an obvious and significant increase in productivity.

A suggestion

In order to have clients fully realize what our services cost, we should issue a fact sheet (statement) for some of the services we provide. The SCOMS program now in place in district offices could easily be adapted for this purpose since it holds all the necessary information. In our opinion, this practice would have a tremendous impact and might result in substantial savings. Some sectors of provincial governments already issue this type of "statement" in areas such as health care.

Ministerial Inquiries

Ministerial Inquiries are those requests for information, or complaints made to or received by the Minister or Deputy Minister. Investigations undertaken at the request of the Regional Directors General are also considered ministerial investigations if the initial request is made by an elected representative of a provincial or federal government.

The regions are closely involved in this activity, along with DGRR. The issues addressed under this activity range from requests for information or clarification on certain departmental policies and regulations to public appeals regarding departmental action or decisions with respect to specific regulatory actions.

Of the 2.56 PYs budgeted for the year, only 1.03 PYs were spent. Although we have no hard data to support our assumption, it appears that the introduction of client interface programs in the regions during the last few years has been successful in reducing our work in this area.

In the future the public's major areas of concern are expected to be the environment and the introduction of new radio regulations. Regions are to be congratulated on the manner in which they deal with what are, in many circumstances, politically sensitive situations. We have yet to receive a complaint concerning the professionalism of our employees while conducting these inquiries.

Comment

District inspectors should continue to be made aware of national policies and regulatory issues that could become the object of ministerial inquiries.

Regions should also continue to implement client interface activities that address specific areas of public concern.

Spectrum Measurement Services

Spectrum Measurement Services is a technical service offered to other departments, agencies or industry for studies both in the laboratory or in the field according to the conditions outlined in RSP 110. The costs of providing these services are normally recovered from the client.

Examples of the type of work performed under this activity are recordings on behalf of the Canadian Radio Television and Telecommunications Commission (CRTC), monitoring assignments requested by the International Telecommunication Union and requests from private industry. *Figure 3* below shows how the 0.44 PYs utilized in this activity is distributed among the regions and the Director General, Engineering Programs (DGEP).

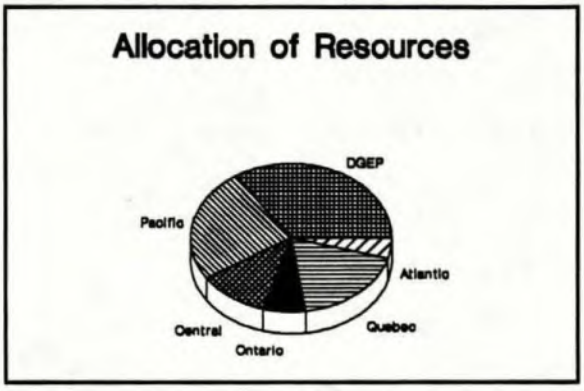


Figure 3

Volumes are very low (66) and unevenly distributed among the regions.

DGEP accounted for 0.15 PY. The regions used 0.29 PY mainly to make various recordings. 2.21 PYs had been budgeted for this activity, representing an anticipated expenditure of $369,853. The actual utilization was only 0.44 PY for an expenditure of $73,653.

Radiocommunications Investigations

Complaints received from licensees of radiocommunication systems. Virtually all the work is performed by the regions and districts and is done on a high priority basis in response to local demand.

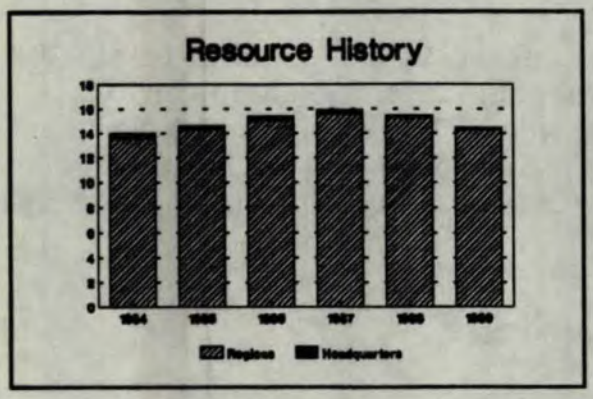


Figure 4

Of all the various spectrum control activities, Radiocommunications Investigations come second as far as PY expenditures are concerned. It uses almost as many resources as all the spectrum quality activities combined.

These investigations cost the Department over 3 million dollars. Since 4,909 investigations were conducted, this means that each cost in excess of $600. Efforts aimed at reducing the number of investigations by applying preventive measures could represent a cost effective approach to this activity.

Although the preventive approach is not new, it has not been applied consistently at the national level. Identifying the **true source** of the problem (not to be confused with the symptoms) and developing a coordinated approach to address these problems, is consistent with the spectrum control model and represents the orientation that we should promote.

Figure 5 clearly indicates the importance of using a precise coding system. Such a system would enable us to concentrate on specific targets (see *interference source codes* as indicated on page 14).

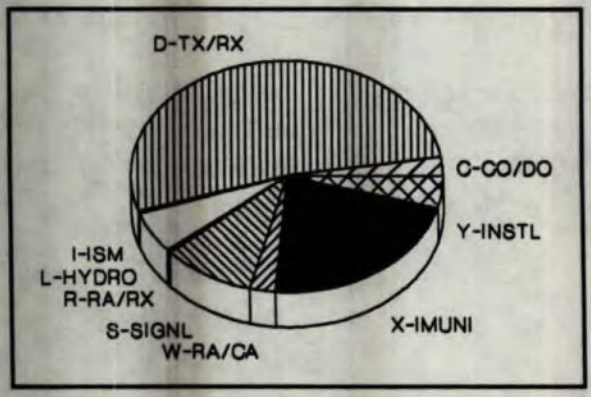


Figure 5

This year, over 60% of all reported cases of radiocommunication interference were due to breaches of regulations. The D-TX/RX portion of the pie chart can be further subdivided. *Figure 6* shows the occurrence of each discrepancy. (as per discrepancy codes indicated on page 12)

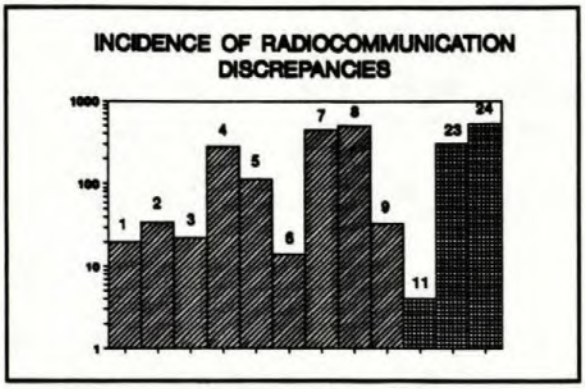


Figure 6

One current problem is that we cannot determine which of the 15 technical/operational discrepancies are the most costly in terms of the expenditure of district office resources.

At a more general level, for the second year in a row we note that in one case out of three operating procedures played a major role. Unfortunately, our coding method is not precise enough to enable us to pinpoint specific culprits. In response to this, we are currently attempting to correct this weakness and the elements needed in order to identify potential culprits will be inserted in an enhanced coding structure.

Figure 6 shows the relatively low incidence of discrepancies relating to radio station technical parameters. Although caution must be exercised before drawing conclusions, the graph does show we may need to question the competence of radio operators and licensees with regard to radio regulations.

The standard response time for this activity, according to the management manual, compared to the response time achieved is as follows:

Standard	Achieved
70% completed within 30 days	66%
85% completed within 60 days	84%
95% completed within 120 days	95%

Recommendations

1) DOSP-C should introduce as soon as possible an enhanced level of coding that will take into account identified faults and allow us to draw a link with the sources of the problem.

2) The production of client interface films or brochures targeted for specific radio users describing the responsibilities of radio equipment operators, should be encouraged.

3) In order to sensitize our clients to the cost of our services, we should issue a fact sheet showing the cost of the services we provide.

Radio Station Discrepancy Codes

1. Off frequency operation.
2. Excessive or insufficient modulation, excessive bandwidth.
3. Power higher than authorized.
4. Unauthorized frequency.
5. Unauthorized location (does not correspond to that specified in the licence).
6. Unauthorized antenna features or pattern.
7. Spurious coverage or excessive harmonic pattern.
8. Incorrect operating procedures, superfluous, unauthorized communications.
9. Incorrect or non-identification.
10. Dangerous installations.
11. Unlicensed mobiles (affiliated to a licenced base station).
12. Antenna structure does not meet approved specifications (height, lights, beacons).
13. Station facilities do not comply with regulations regarding documents, registers and maintenance of equipment and spare parts.
14. Irregularities in operators certificates.
23. Newly authorized stations.
24. Non-identified

General Public Investigations

General Public Investigations are conducted following a complaint from the general public. All complaints are dealt with at district offices. Over the last few years, the number of requests for investigations has declined substantially due to client interface programs and other departmental initiatives. Other factors have also contributed to this decrease, such as the penetration of cable TV into non-urban areas and the distribution of "self-help" interference brochures to radio equipment users. Over the last six years, our sustained efforts have been rewarded by a steady PY and resource reduction in this activity. As indicated in *Figure 7* in 1989 we used approximately half of the 28.69 PYs used in 1984.

It should be noted that the Quebec Region has entered into a formal agreement with Hydro Quebec. Under the terms of this agreement, the public report cases of interference directly to the utility who then determine if they are responsible for the source of the problem. If not, the cases are referred to the Department. This type of initiative, is in place in all the other regions who have similar agreements with their utilities on an informal basis. This practice accurately reflects the direction that DOSP believes should be pursued where feasible regarding activities related to spectrum services.

Figure 8 displays how the 14.82 PYs for this activity where distributed among the regions.

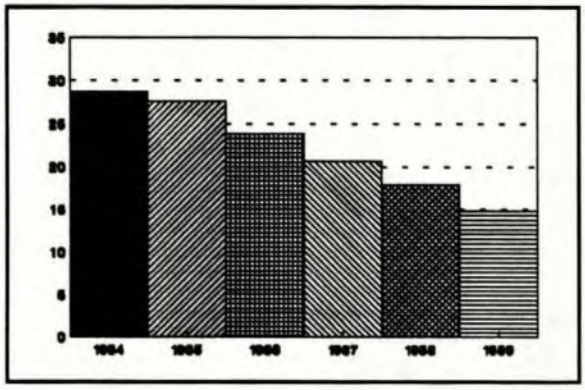


Figure 7

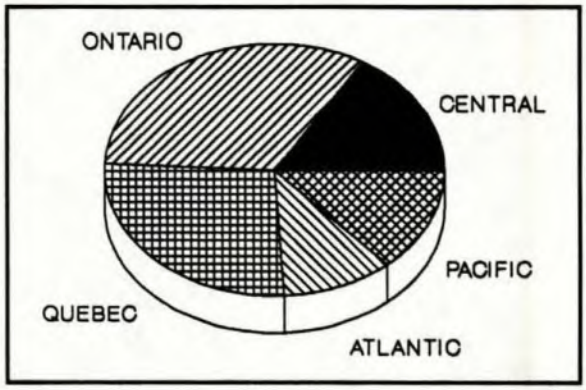


Figure 8

The cost of this activity to the Department was $3,151,773. This expenditure was slightly lower than last year and nearly $200,000 less than the budgeted amount. 8,197 investigations were conducted, for an average cost of $385.

As indicated by *Figure 9*, a major problem is the lack of immunity of electronic equipment to radio frequency emissions. As you recall, a few years ago we decided to de-emphasize the coding of equipment affected by interference. We might wish to reconsider this decision since the data obtained through this method informed manufacturers of the current situation, thus enabling them to correct it.

DOSP-C will shortly publish a circular informing the general public of manufacturer's policies with regard to the repair, replacement or refund of radio sensitive consumer equipment. We hope by this action to orient many complaints to the appropriate manufacturers/distributors thereby reducing our involvement in equipment immunity problems.

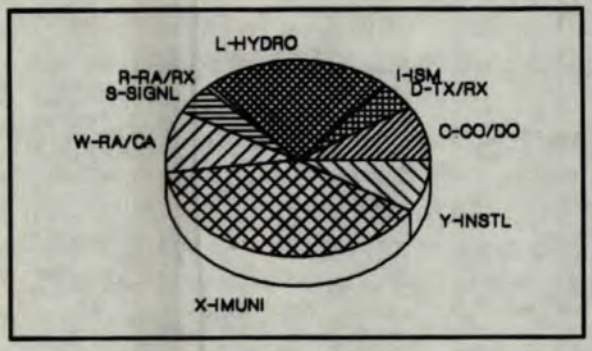


Figure 9

The standard response time for this activity, according to the management manual, compared to the response time achieved is as follows:

Standard	Achieved
70% completed within 30 days	65%
85% completed within 60 days	87%
95% completed within 120 days	96%

Recommendations

1) Interference brochures published by the Department should be readily available to the general public.

2) In order to sensitize our clients to the cost of our services, we should issue a fact sheet showing the cost of all services provided with regard to general public investigations.

INTERFERENCE SOURCES CODE

C Series
Commercial/Industrial/Household Equipment
D Series
Radiocommunication System Discrepancy
I Series
Industrial/Scientific/Medical Equipment
L Series
Electrical Power Supply
R Series
Interference Caused by Receiver Installation
S Series
Signal Problems
T Series
Internal Combustion Engines
W Series
Distribution System Reflection
X Series
Immunity/Swamping Problems
Y Series
Defective Equipment
Z Series
Others

Ship Inspections

Ship Inspections are conducted at the request of the Canadian Coast Guard (CCG) to meet Canada's domestic and international obligations with respect to the Canada Shipping Act and the International convention for the safety of life at sea. These inspections are conducted exclusively on those vessels that are compulsorily fitted with radio equipment. The incremental portion of inspection costs is recovered from the CCG.

For several years now, the contract we have with the CCG has remained virtually unchanged, as shown in *Figure 10*.

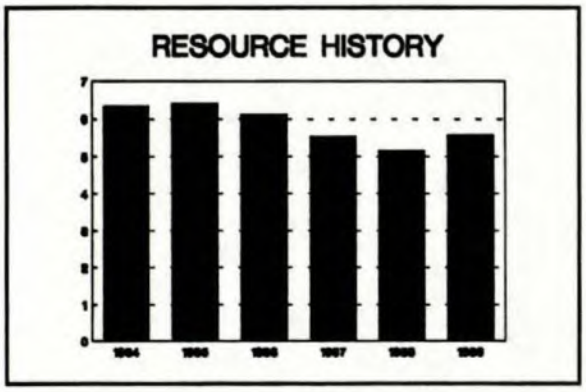


Figure 10

The regions perform the work and the workload has remained relatively stable. However, in the future the amount of work involved is expected to increase. The CCG is in the process of amending its regulations to include the mandatory inspection of smaller fishing vessels. If we participate in this program, this will affect regional resources as the number of ship inspections for each year will increase.

Figure 11 displays the PY distribution for ship inspections among the regions.

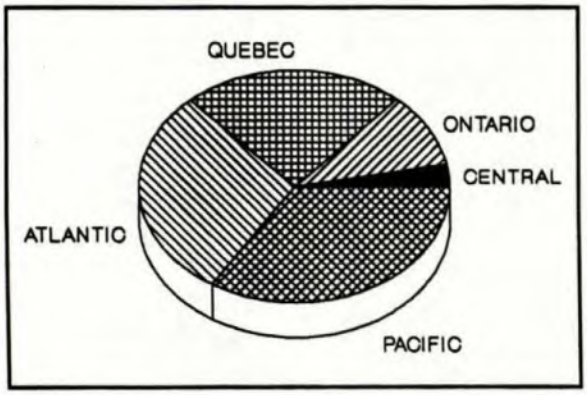


Figure 11

The increase in this activity is expected to affect primarily the Atlantic and Pacific Regions. The new inspections will be very short and consist of testing VHF equipment as well as verifying the operator is a holder of the appropriate certificate. In the fiscal year 89/90 the Department charged the CCG $641,00 which represents the incremental portion of the total cost ($1,140,466 and 5.6 PYs) of carrying out these inspections.

Computerization of ship inspection duties. This work has been undertaken in collaboration with the CCG and DOC. The systems will shortly be in place to allow automatic transfer of ship inspection data to the CCG therefore eliminating the need for the preparation of a hard copy inspection report.

Broadcast Inspections

Inspections of broadcasting stations are conducted in accordance with their Technical Construction and Operating Certificate for the purpose of licence renewal.

These inspections are conducted at the request of the Director General, Broadcasting Regulation and are based on a inspection program directed by the regions in accordance with the current availability of resources. The work is distributed among the regions in accordance with the broadcast undertakings in their area, as indicated in *Figure 12*.

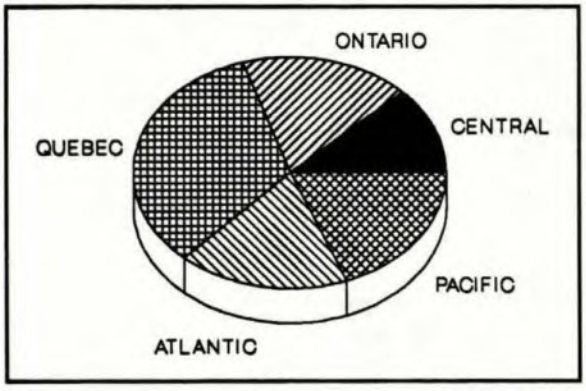


Figure 12

In 1989-90, $1,327,796 and 7.68 PYs were budgeted to carry out 1,307 inspections, for an average of $1,015 per inspection. The actual figures for the period are 4.6 PYs and 807 stations inspected which represents 61% of the inspections projected.

What the public complains about should also be analyzed; in other words, what are the major sources of the problems affecting viewers and listeners?

Equipment immunity problems are at the top of the list, followed by hydro-electric interference.

In the past instead of conducting inspections prior to TCOC renewals, the Department required broadcasters to file Proofs of Performance for their station. The philosophy then changed and the proofs were no longer requested. This required that district offices conduct more broadcast inspections. This new approach draws heavily on already scarce resources.

In a few years, the number of PYs used went from a low of 1.26 to the current 4.6, reaching a 5.66 PYs ceiling in the year 88/89.

Recommendations

1) The necessity of carrying out broadcast inspections due to CRTC licence renewal should be reviewed. A reactive approach to this program, implemented at the discretion of the District Director would initiate considerable savings without a serious negative impact on the radio environment. Interference brochures, published by the Department should also be made readily available to the general public.

   A good sampling program would also yield the information we require at a lower cost. The philosophy we successfully apply to the inspection of land fixed stations could also be extended to this activity.

   If we use the ARKIN statistical formula and take as our base value a 90% reliability rate, with a 5% error margin and a 3% probability of finding a discrepancy, then we would have to inspect a certain number of stations every year based on the following table:

Type	Population	Sample	Cost $
AM	652	97	97 000
FM	857	101	101 000
TV	1713	107	107 000
CATV	1877	108	108 000

   Applying last years estimate of $1015 per inspection, the total cost of this activity would be approximately $400 000 which is significantly lower than $1,327,796, the amount projected for 89/90.

   With this information, we would be able to get an overall picture of the situation across Canada and still reduce the drain on person-year resources.

2) In order to sensitize our clients to the cost of our services (ie: the broadcasting industry), we should issue a fact sheet showing the cost of the services provided for broadcast inspections.

Spectrum Quality

Spectrum Quality is composed of those activities intended for collecting information that serves to develop our various spectrum management programs.

It is made up of the following activities:

- Land Fixed Surveys
- Licence Compliance
- Directed Investigations
- Enforcement
- Spectrum Surveillance

The purpose of these various activities is to measure the state of the radio spectrum or take the necessary steps in order to be fully cognizant of developing trends and, when required, institute enforcement action where there is a flagrant disregard for the regulations.

This activity cost the department $4,662,244.00 and required 22.2 PYs for the year 1989/90. This is a significant reduction from the previous year when we expended almost 5.25 M$ and 28 PYs. This however does not necessarily reflect efficient resource utilization. It may be that these activities have experienced cuts simply because some resources were shifted to programs considered to be of a higher priority.

It is our preference to continue the spectrum quality activities, while attempting to reduce their demand on our resources. Spectrum Control has already made outstanding efforts in economizing resources in all areas. Future Spectrum Quality tasks must be planned and implemented in a manner that will allow us to receive the maximum benefit for the resources used. National agreement on the development and implementation of such activities will be required.

Land Fixed Surveys

This activity consists of the inspection of land fixed stations which are selected according to random sampling methods.

For a number of years now, we have observed a pronounced lack of involvement in this program which can most likely be ascribed to the drain on our resources. In 1988, we had already noted the trend and suggested measures in order to ensure that a minimum of work be performed under this program. *Figure 13* clearly shows the decrease in resources expended.

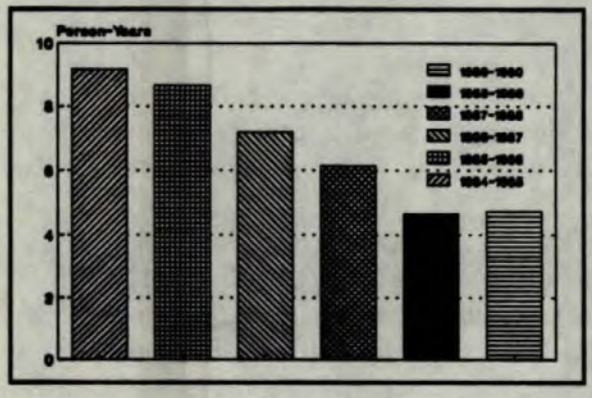


Figure 13

This loss in PYs is not necessarily the result of improved work procedures; it simply means that the work was not performed due to other more pressing priorities.

Up until now, the spectrum control model was prone to distortion whenever a region did not participate in the sampling program. *Figure 14* pictorially displays regional participation.

In 1989, for the first time in five years, a major modification of the sampling program produced agreement from all spectrum control managers to allocate the necessary resources to adequately carry out Plan A (a plan containing the minimum requirements for a national report), which was submitted and outlined at the 1989 SMCC/SMOC meetings. Thanks to this commitment, we will have enough data at the end of 1990 to test the new model's validity and produce our first reports.

The results of this year's land fixed sampling program should be compared to the graph on page 11 which indicates the incidence of discrepancies relating to radiocommunications investigations. It may then be possible to see a link between the discrepancies provided through our sampling program and the impact these

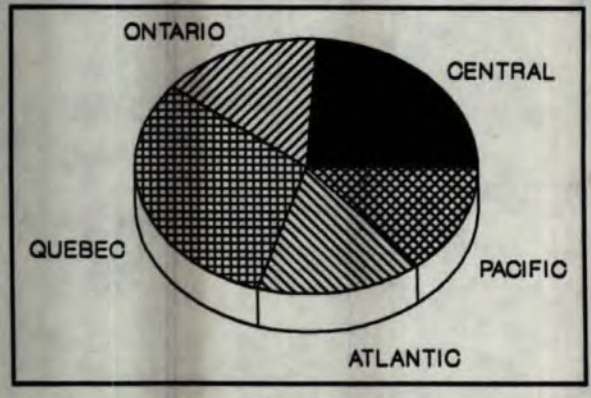


Figure 14

have on radiocommunication investigations. However, in order to effectively draw the proposed link between these two activities, we feel an enhanced level of coding for radiocommunication investigations needs to be implemented, as proposed.

It will be possible to do even more through a reorganization of resources and activities. You are invited to read carefully DOSP-C's analysis, "*The ABC of Sampling*", which deals mainly with the sampling program, assessing its strengths, weaknesses and potential.

Recommendations

1) Work in this area should continue and Plan A, introduced in the presentation entitled "The ABC of Sampling" and described in IPC 3.21.1, should be implemented.

   Regions should study Plan "0" (zero), as proposed in DOSP-C's statistical analysis, and this should become a new national minimum.

2) Activities land fixed and surveillance sampling should be combined, as proposed in DOSP-C's statistical analysis.

   The regions should use the old Plan A as their minimum and the districts Plan B or C.

   Alarm thresholds should be revised, as suggested in DOSP-C's statistical study.

3) The sample findings from our land fixed survey program should be used in our client interface or directed investigation activities. If specific problem areas emerge, we would have sufficient information to target these areas.

Licence Compliance

This activity samples users (i.e. taxis, aircrafts, etc.) and is designed to measure the ratio of licence to unlicensed stations.

We have finished the year with an expenditure of $201,494.00 and 1 PY.

Despite our efforts, we still have no clear idea of the amount of revenue lost to the Department due to unlicensed operation. According to various sources it is estimated anywhere between 2 and 9 million dollars.

In the event that the Treasury Board grants the request for resources to be allocated to this activity, a standard work procedure on the national scale will be devised for 1990-91 so that we are able to submit our findings to Treasury Board at the end of the fiscal year.

To date we do not have a circular specifically describing the procedure to follow; however we expect that through consultation with regional managers the implementation of a somewhat flexible licence compliance procedure acceptable to the regions will result.

Recommendation

An agreed method should be applied nation-wide in order to give us a national picture for licence compliance in various service categories. The method used must be statistically sound and yield results that can be rolled up in a national report. This method should also be constructed as a stepping stone from which we will be able to further evolve and perfect national procedures for future use.

Directed Investigation

This activity is used to collect technical or operational data when required or to supplement the information obtained from inspection, investigation or surveillance activities.

This is one of the most flexible activities at our disposal. Of all spectrum control activities, it has the biggest budget: in 1989-90, $2,814,693 and 16.40 PYs were forecast. In actuality, we spent $2,371,735 and 11.29 PYs. *Figure 15* shows the number of person years used in the last six years. On the average, an investigation costs approximately $400.

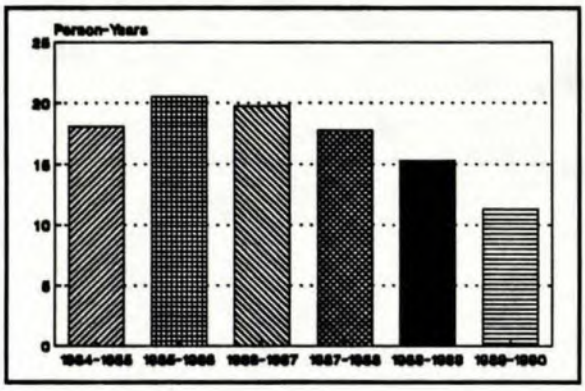


Figure 15

Currently, we have no reporting mechanism to allow for the national analysis of the tasks being performed. Thus we are unable to determine national trends or areas of current concern for spectrum control managers.

What do directed investigations contribute to the decision-making process? Could these activities give us...at SMCC/SMOC...a better picture of the radio environment?

Recommendation

Although directed investigations are well documented at the district office level we have no method to report the results on a national basis. Therefore the establishment of a reporting mechanism should be examined (type codes could be extracted, ... etc.) that would allow a national snapshot for these activities. This could be very important in the identification of future spectrum control trends and thus allow the development of programs to address key areas of concern.

Enforcement

This activity consists of all the tasks associated with the suspension and revocation of licences or legal prosecutions.

2.1 PYs and $370,363 were allocated for this activity, however we spent less than one PY.

The regions enjoy much autonomy in deciding who will be prosecuted. At the end of 1988 the decision to prosecute was delegated to the regional Directors General.

Over the last few years, we have significantly reduced our expenditures in this area. This is due to two factors: 1) diminishing resources at the regional level for spectrum quality activities and 2) the work has been entirely transferred to the regions therefore eliminating any duplication of effort by headquarters.

Which cases went before the courts and what were the charges and penalties?

1) George Loveless
   Radio Act 4(1)
   Found guilty and fined $150.00 or 7 days in prison. His radio equipment was forfeit to the crown.

2) Dr. John A. Scholten
   Radio Act 4(1)
   Found guilty and fined $600.00

3) W.W.Smith
   Radio Act 4(1)
   Found guilty on 2 counts and fined $200.00 each for a total of $400.00

4) Adrian Brooks
   Radio Act 4(1)
   Found guilty on 2 counts, fined $100.00 each for a total of $200.00

5) Mr. E. Eles
   Radio Act 4(1)
   * Found guilty and sentenced to 3 months prison

* operating in VHF aeronautic band and giving false instructions to pilots.

Recommendations

1) The Regions should continue to initiate enforcement action as they determine necessary. DOSP-C should provide, to the extent practicable, national guidelines to assist the regions in the application of enforcement measures.

2) DOSP-C in conjunction with DRP, should investigate new processes that could be implemented under the auspices of the Radiocommunication Act to aid the Regions in enforcement actions.

Spectrum Surveillance

Spectrum Surveillance consists of the measurement and analysis of the operational and technical characteristics of radio stations, including occupancy of authorized Canadian stations. Activities of ionospheric stations are also included here.

The total PY increase from 1987 was due to work related to ionospheric sounding being redirected from spectrum measurement services to this activity. Therefore, regional resource expenditure have continued to decrease in this area.

In view of the trend observed it is apparent that regional needs have changed, therefore this program should be adapted in order to meet regional needs and the results reported in a national framework.

Recommendations

1) Surveillance sampling should be used to complement the survey (on site) sampling.

2) Automated technologies should be developed and integrated into spectrum surveillance programs.

3) The internal procedures circular should be revised accordingly, in order to reflect program changes.

Highlights

	1989	1988	1987
	(Resources are in person years)		
Development of policies, regulations, procedures and standards	**31.47**	35.05	36.94
Client interface	**30.57**	30.99	30.10
Operating procedures and standards	**35.86**	39.16	41.83
Licensing			
Land fixed	**46.77**	45.22	49.12
Land mobile	**20.58**	21.11	21.18
Ship, aircraft, amateur and GRS	**9.27**	9.79	7.27
Radio equipment approval	**3.47**	3.92	3.88
Cable TV licence application	**5.79**	7.56	3.86
AM/FM/TV licence application	**13.08**	12.65	4.83
Proof of performance - Broadcasting	**0.82**	0.47	0.48
Professional and amateur radio operator examinations	**5.22**	6.29	5.00
Ministerial inquiries	**1.03**	1.28	1.59
Spectrum measurement services	**0.44**	1.20	5.05
Radiocommunications investigations	**14.45**	15. 40	15.89
General public investigations	**14.82**	17.89	20.64
Ship inspections	**5.57**	5.15	5.53
Broadcast inspections	**4.60**	5.66	5.32
Sampling - Land fixed surveys	**4.74**	4.67	6.14
Licence compliance	**0.99**	1.42	3.57
Directed investigations	**11.29**	15.29	17.79
Enforcement	**0.81**	0.87	1.45
Spectrum surveillance	**3.96**	5.23	1.78

Highlights

	1989	1988	1987
	(The volumes are given in units)		
Development of policies, regulations, procedures and standards			
Client interface			
Operating procedures and standards			
Land fixed (licences)	**115 251**	109 503	
Land mobile (licences)	**641 406**	603 062	
Ship, aircraft, amateur and GRS (licences)	**91 265**	86 853	
Radio equipment approval			
Cable TV licence applications	**1 533**	1 073	
AM/FM/TV licence applications	**156**	401	
Proof of performance - Broadcasting	**47**	21	
Professional and amateur radio operator examinations	**22 936**	19 365	16 427
Ministerial inquiries	**85**	108	97
Spectrum measurement services	**66**	72	85
Radiocommunications investigations	**4 909**	5 000	5 354
General public investigations	**8 197**	9 053	10 407
Ship inspections	**1 720**	1 390	1 930
Broadcast inspections	**807**	877	805
Sampling - Land fixed surveys	**3 210**	2 775	4 225
Licence compliance			
Directed investigations	**6 448**	6 668	13 820
Enforcement	**12**	20	17
Spectrum surveillance	**890**	1 056	2 293