



Chief Review Services

Program Evaluation of Research
and Development in the
Department of National Defence
and the Canadian Forces

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Team Leader:
Deputy Team Leader:

Norm Black
Harry Hubley



SYNOPSIS

This report presents the results of a program evaluation conducted by the Chief Review Services Branch. This study was conducted as a formative evaluation to report on the Departmental and Canadian Forces (CF) scientific research and development program as it undergoes restructuring as a Level One organization within the Department of National Defence under the governance structure of a Departmental and Special Operating Agency. This evaluation does not present summative evaluation findings of the results or outcomes of specific research and development activities or projects which are the purview of ongoing scientific peer review and client oversight activities.

Over the past decade, there has been a strong impetus for change in the management, organization and structure of research and development organizations in general and government-sponsored R&D capabilities in particular. This evaluation indicates that DND and the CF have responded to these trends in a logical and rationale manner by instituting significant and fundamental changes to its defence research and development organization. Accompanying these changes has been the development and implementation of management and administrative initiatives to accommodate DND's new R&D governance structure and the requirement to have in place research and development programs that provide an R&D capability which supports the strategic direction of the Department and the CF.

While the objectives and achievements of DRDC are identified and well-reported in their Annual Business Plans and Annual Reports, this evaluation sets the stage for assessing future impacts of the defence R&D program as initiatives implemented by the new Agency mature.

Considerable changes and progress have taken place in the provision of the defence R&D capability since the completion of the investigative phase of this evaluation and the issuance of the draft report. Implementation of the Defence Science Advisory Board Revitalization Plan, program oversight activities and human resource management initiatives have begun to positively influence the development and continuous improvement of many aspects of the delivery of the R&D capability to DND and the CF. Responses to the draft report from program stakeholders have resulted in many suggestions for additional issues that impact the effectiveness and efficiency of the R&D program and its contribution to the achievement of the objectives of the Department and the CF. These further areas of evaluation will be addressed in future CRS Branch planning activities.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	i
PART I – INTRODUCTION	1
BACKGROUND	1
AIM	1
SCOPE	2
METHODOLOGY	3
REPORT STRUCTURE.....	3
ACKNOWLEDGEMENTS.....	3
PART II – RESEARCH AND DEVELOPMENT PROGRAM CONTEXT.....	4
INTRODUCTION	4
SCIENCE AND TECHNOLOGY/RESEARCH AND DEVELOPMENT IN THE GOVERNMENT CONTEXT	4
EVOLUTION OF THE S&T FUNCTION WITHIN THE FEDERAL AND NATIONAL CONTEXT	5
BENCHMARKING DRDC WITH OTHER DEFENCE S&T ORGANIZATIONS.....	9
OVERVIEW OF DRDC PROGRAM PROFILE	24
PART III – DISCUSSION OF EVALUATION ISSUES	26
INTRODUCTION	26
GOVERNANCE OF THE RESEARCH AND DEVELOPMENT FUNCTION	26
PROGRAM DELIVERY	36
CLIENT SATISFACTION.....	55
REVENUE GENERATION.....	60
HUMAN RESOURCE MANAGEMENT.....	68
COMMUNICATION.....	82
RESEARCH AND DEVELOPMENT PERFORMANCE MEASUREMENT.....	92
RISK MANAGEMENT AND RESEARCH AND DEVELOPMENT.....	101
PART IV – SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS	107
SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS ON RESEARCH AND DEVELOPMENT ISSUES	107

TABLES:

Table 1 - Defence R&D Canada - Historical Expense Analysis.....12
 Table 2 - Benchmarking DRDC with other Defence S&T Organizations15
 Table 3 - DRDC Expenditures by Business Line and Client Group.....23
 Table 4 - Defence Research Establishments - Location and Primary
 Areas of Focus37
 Table 5 - DRDC Revenue Generation Targets.....62
 Table 6 - DRDC Age Profile69
 Table 7 - Years on Strength at DRDC70
 Table 8 - Major DRDC Communication Accomplishments Since 1 April 200090
 Table 9 - Generic Performance Measures Applicable to R&D/S&T
 Organizations99

FIGURES:

Figure 1 - The Tactical and Strategic R&D Program56
 Figure 2 - DRDC Civilian Salary Wage Envelope.....60

ANNEX:

ANNEX A - Notification of Review.....A-1

EXECUTIVE SUMMARY

INTRODUCTION

1. The Chief Review Services has been tasked to conduct a program evaluation of the defence research and development capability to addresses issues impacting the effectiveness and efficiency of the program and its contribution to the achievement of the objectives of the Department and the Canadian Forces (CF). There has been a strong impetus for change over the last decade in the management, organization and structure of R&D organizations in general and government-sponsored R&D capabilities in particular. Responding to these influences, Defence Research and Development Canada (DRDC) has undergone significant and fundamental changes by becoming a Departmental and Special Operating Agency. Accompanying these changes has been the requirement to develop and implement management and administrative initiatives to accommodate the new status and the requirement to have in place research and development programs that would continue to provide a R&D capability to support the strategic direction of the Department and the CF. In addition, DRDC has had to address the R&D requirements and expectations of an increasingly knowledgeable client while functioning in a political and fiscal environment that is faced with rapidly changing technological trends.

2. The objectives and achievements of DRDC have been identified and well reported in their Annual Business Plans and Annual Reports. The purpose of this evaluation is to validate those accomplishments through analysis of the management systems and practices that are in place to achieve the desired program objectives and to sustain a viable R&D capability.

EVALUATION FINDINGS AND CONCLUSIONS

3. The evaluation team has developed a significant number of conclusions and recommendations in fourteen issue areas that impact the delivery of the research and development program to DND and the CF. These conclusions and recommendations are summarized at Part IV to this report. Many of the R&D management and program initiatives reviewed by the evaluation team are relatively new activities that have been introduced to address long-standing R&D program weaknesses. Much of the activity introducing these programs was carried out concurrent to preparing for its status as a Departmental and Special Operating Agency. Accordingly, many of the team's recommendations reflect the need to adjust or fine-tune a range of relatively new and well-conceived initiatives that are intended to shape and redirect a defence R&D program that has been in place for more than fifty years. Taking consideration of the considerable work done by the DRDC organization to renew itself through new approaches and a new generation of management and staff, the evaluation team feels this study should be viewed as providing 'formative' advice in support of a logical and effective organizational response to the many change factors impacting the R&D environment.

4. The following major findings and conclusions regarding the Defence research and development program are:

- a. In many areas where the evaluation team determined that there were weaknesses or deficiencies in the DND/CF R&D program, DRDC has already made similar assessments and initiated, to a greater or lesser extent, appropriate corrective action. This proactive approach is reflective of the innovative and results-oriented style of the current management team that has benefited from the history of the Defence Research Board (DRB) and Chief Research and Development organization (CRAD), yet is looking well beyond the way business has been done in the past. The current management team is regularly assessing and reassessing what needs to be done now and in the future to position DRDC appropriately to provide strong R&D support to DND and the CF which closely aligns with the objectives of Strategy 2020.
- b. In the past ten years, public sector R&D organizations in all departments have experienced significant pressure to restructure and realign their management frameworks with the strategic direction of their departments. Benchmarking DRDC with other R&D organizations has indicated that the ‘factors of success’ and ‘The Attributes of a Well Managed R&D Organization’ as identified by the National Advisory Board on Science and Technology and the Office of the Auditor General, have been reasonably and actively addressed in the establishment of the Agency and have taken into account the unique features of DND and the CF.
- c. Governance structures have been adopted by DRDC to maximize involvement and interaction at the operational levels with its clients and stakeholders. Many mechanisms have been established and are in place to ensure input from its military client and provide client overview of the program (i.e., Thrust Advisor Groups, Technology Demonstration Programs and development of the R&D Plan). However, the success and effectiveness of these mechanisms are highly dependent on client interest and knowledge of the existence, potential and opportunity to participate in these venues in order to influence the program. R&D stakeholders must be sufficiently knowledgeable and informed about the requirements and the potential of technology in order to exploit the departmental capability. As the current governance framework for defence R&D matures and stakeholders gain greater exposure to it, the mechanisms that are in place will become more effective.
- d. The Technology Investment Strategy (TIS) is a well-reasoned and structured mechanism to ensure that the investment in R&D activities is linked to objectives defined in Defence Strategy 2020. However, to ensure its effectiveness as a means of assisting DRDC to focus its attention on relevant technologies, the TIS must become a familiar working document at all levels within the Agency’s organization structure.

- e. DRDC has demonstrated a level of commitment to the activity of Technology Watch as a critical means of keeping abreast of emerging technologies in areas of interest to the CF. In order to maximize return on its investment, Technology Watch must be supported by a knowledge management capability within the Agency, a focus on ensuring appropriate data mining and other skills are in place and the ongoing conduct of basic scientific research.
- f. In order to succeed at research and technological development, DRDC requires an organizational culture that not only encourages innovation, but also encourages an extensive exchange of information. As the organization grows in size and complexity, the sharing of knowledge becomes more important to ensure a net organizational efficiency by avoiding duplication or overlap of effort and making information available to the broadest segments of the R&D community. The need for migration of ideas increases with the need to innovate.
- g. Client satisfaction with the Departmental R&D capability was gauged to be positive. The senior management team of DRDC is highly regarded by senior client stakeholders in the Department and the CF who recognize the potential contributions to be derived from new program initiatives and the move to Agency status.
- h. DRDC is viewed as a successful example of reengineering, organizational change and management renewal. While the reengineering of the S&T function in DND occurred after the surge in this activity in the mid-1990's, DRDC management has been seen to have learned from the experiences of others and successfully managed the transition activities. As a result, the defence R&D community has been more receptive to implementing new approaches to doing business which enhances their potential for success.
- i. When benchmarked against other R&D organizations, DRDC is faced with similar human resource management problems, such as an aging population, recruitment and retention issues and salary disparities with some external scientific specialties. DRDC is actively engaged with its research community in putting strategies in place to address these issues.
- j. DRDC has made positive strides in implementing a 'best practices' approach to performance measurement in light of the state of evolution of performance measurement in the Department. Through the establishment of the Program Oversight Directorate, DRDC has laid the groundwork for its performance measurement framework and performance reporting mechanisms. Agreement on input measures, output and outcome measures remains an area in need of discussion and refinement.
- k. DRDC has demonstrated its capability to both manage risks inherent in its own program and its ability to contribute to the containment of risk on behalf of the Department and the CF.

PART I – INTRODUCTION

BACKGROUND

1.1 The Department of National Defence (DND) and the Canadian Forces (CF) are preparing for the defence environment of the 21st Century. In order to build an effective operational force, the CF must be prepared to meet and respond to an increasingly diverse set of challenges, which include the unprecedented pace of technological change and an acceleration in the development, acquisition and sharing of knowledge. The Defence Research and Development program provides a critical capability to DND and the CF in addressing the defence objectives which are set out for the Department in Defence Strategy 2020.

1.2 The Chief Review Services has been tasked to conduct a program evaluation of scientific research and development in DND and the CF which would address issues relating to the contribution of the research and development program to achieve the strategic objectives of the Department. While specific issues affecting research and development have been audited in recent years, a comprehensive program evaluation of the R&D program and its operations has not been done.

1.3 In the process of establishing the Research and Development Agency (DRDC, 1 April 2000), the function of defence research and development has undergone considerable scrutiny, including ASD analysis, preparation of a business case and development of a management framework. Formulation of the strategic plan for the CF¹ has also placed increased emphasis on the contribution and expectations of research and development and the integration of new technology and concepts into the long term direction for the Department and the CF. This CRS review is being undertaken in the context of the Department's increased expectations for science and technology to play a pivotal role in enabling the CF to meet and exploit the significant challenges and opportunities that it will face in the future. These expectations will be fulfilled only if astute choices on resource allocation and the focus of the science and technology program are made early and sustained as the organization progresses towards 2020.

AIM

1.4 The aim of this review has been to provide senior departmental managers and research and development program management with findings, analysis and recommendations regarding R&D issues which contribute to the effectiveness and efficiency of the program and contribute to the achievement of the strategic objectives of the Department. Specific evaluation issues examined during the course of this review include, but have not been limited to:

- a. benchmarking of DRDC management practices with other S&T organizations;
- b. assessing client satisfaction with the research and development program from the perspective of senior departmental stakeholders;

¹ Shaping the Future of Canadian Defence: A Strategy for 2020. June 1999.

- c. assessing the effectiveness of the management framework, internal management and support systems of DRDC to achieve the mandate and mission of the Agency;
- d. assessing human resource management issues and strategies which impact the delivery of the S&T program; and
- e. assessing issues which are related to the transition to Agency status.

SCOPE

1.5 The scope of this review has been limited to an assessment of the management issues and practices that impact the provision of science and technology to DND and the CF. The intent of this evaluation has not been to review the quality of the science or the research and development performed by DRDC, or to suggest technologies or R&D activities which should be pursued by the Department. These topics are the purview of the management and planning framework that is integral to the research and development process, DRDC planning documents² and specifically commissioned reviews such as those issued by the Defence Science Advisory Board³.

1.6 On 1 April 2000, the Defence Research and Development Branch (DRDB) became a Departmental Agency and a Level One organization represented by an Assistant Deputy Minister (ADM(S&T)). In July 2000, the organization was approved as a Special Operating Agency by the Treasury Board. While Agency status is intended to provide the organization opportunities to address the R&D needs of DND and the CF in a rapidly changing environment, insufficient time has passed to allow changes in core competencies, development of technologies and partnerships or the introduction of new efficiencies to take effect. Similarly, the annual reporting process⁴ is a critical element in the accountability framework for the organization that specifically reports what achievements have been accomplished relative to targets set out in Business Plans and Service Level Agreements. This existing reporting of both quantitative and qualitative information will not be repeated in this program evaluation. However, in order to be recognized as a 'world class' R&D organization by others who are conducting similar work or who are the clients of this organization, DRDC must have in place management practices and processes that are sound, efficient, well-managed, forward-thinking and rigorous in their application of science. The CRS team feels that the evaluation of management issues, processes and procedures will contribute to the performance management assessment of research and development within DND and the CF.

² Looking Forward - Staying Ahead...Into the Next Century, DRDC 1999; Technology Investment Strategy...For the Next Two Decades, DRDC; Defence Research and Development Canada Outline of Program, June 2000; ADM(S&T) Business Plan FY 2001/02, DRDC 1 November 2000.

³ DSAB Report 99/1 on Technology Opportunities for the Canadian Forces in the 2010 - 2020 Time Frame, Defence Science Advisory Board, July 2000.

⁴ Defence Research and Development - Annual Report 1999/00.

METHODOLOGY

1.7 This evaluation was conducted in accordance with DND standard practices and procedures for program evaluation following the general guidelines issued by the Treasury Board Secretariat. The evaluation included a comprehensive interview program with DRDC management and staff across the network of Defence Research Establishments, senior Environmental staff, R&D clients and Departmental stakeholders.

1.8 The review team also consulted research and development and science and technology personnel in the Canadian National Research Council, the US Department of Defence, as well as the Ministries of Defence for the United Kingdom, Australia, New Zealand, Germany, Denmark and Norway. This benchmarking information enabled the team to benefit from knowledge of areas of similarity and difference when analyzing the DND/CF situation.

REPORT STRUCTURE

1.9 The remainder of this report consists of three parts. Part II describes the context of the defence research and development program including current driving factors that have influenced its direction. Part III is a discussion and analysis of the specific issues that were examined during the course of the evaluation. Part IV is a summary of concluding material including recommendations and solutions which would contribute to the ongoing effectiveness of the program.

ACKNOWLEDGEMENTS

1.10 The review Team gratefully acknowledges the cooperation and assistance that was received from all personnel consulted within DND and the CF, as well as those organizations which submitted research and documentation contributing to the benchmarking of defence research and development.

PART II – RESEARCH AND DEVELOPMENT PROGRAM CONTEXT

INTRODUCTION

2.1 Many countries are grappling with the challenges and opportunities presented by the emergence of a knowledge-based society that stresses the importance of sound scientific and technological advice as a key input to policy formulation, strategy development and the fulfillment of assigned mandates. In turn, issues facing government departments and defence organizations are becoming increasingly complex, demanding decisions that involve risk assessments and an ability to capitalize on opportunities that are afforded by advancements in science and technology.⁵

2.2 As we enter the 21st Century, strategic decision-making is taking place in an increasingly dynamic environment. This places greater pressure on S&T organizations within government to respond to developments in increasingly complex fields of knowledge while resources remain static or are shrinking and within timeframes that must be continually compressed. Working and managing in such an environment places a premium on making choices where to concentrate efforts and resources to achieve the maximum effectiveness and value from an S&T investment. This inevitably leads to the importance of assessing quality in the performance of S&T activities, the S&T management environment and the S&T organization's contribution to the strategic interests of its clients and stakeholders.

SCIENCE AND TECHNOLOGY/RESEARCH AND DEVELOPMENT IN THE GOVERNMENT CONTEXT

2.3 The federal government is the largest individual sponsor of fundamental or basic research in Canada. Statistics Canada has estimated that federal departments combined have spent approximately \$6.3 B on S&T activities in FY 1999/00, of which \$4B was on research and development activities and the remainder on related scientific activities. Of these amounts, approximately 40 per cent of the research is conducted by federal government research establishments and the balance by industry, universities and other non-government establishments.⁶ In light of these expenditures, Canadians expect to benefit from having access to the best available scientific knowledge and to be assured that it is being applied to government activities and decisions that are being made on their behalf.

⁵ Throughout the conduct of this review, there has been ongoing discussion, confusion and overlap amongst individuals throughout the department and CF when using the terms science and technology (S&T) and research and development (R&D). For the purposes of this report, the term S&T is defined more broadly than R&D to include related scientific activities such as testing, scientific data collection, provision of S&T information services and other like activities which allows the Assistant Deputy Minister Science and Technology ADM(S&T) to carryout his primary function of providing Level One Managers in the Department with the scientific and technological advice, products and services they require to effectively carry out their missions and tasks. Research and development is more restrictively defined as creative work which is undertaken on a systematic basis to increase the stock of knowledge and the use of that knowledge to devise new applications.

⁶ Council of Science and Technology Advisor's Report, Building Excellence in Science and Technology. 1999.

2.4 In the past ten years, public sector science and technology organizations in all departments have experienced significant pressures to restructure and realign their management frameworks with the strategic direction of their departments. The requirement for greater financial accountability, flexibility to respond to rapid technological change and the widespread re-examination of organizations' strategic goals are some of the factors that have contributed to research organizations' striving to link their programs more closely with strategic corporate goals, increase research performance and productivity, and adopt the most appropriate organizational structure.

EVOLUTION OF THE S&T FUNCTION WITHIN THE FEDERAL AND NATIONAL CONTEXT

2.5 There have been two primary drivers behind the federal government's efforts to enhance the contribution they receive from their in-house science and technology capability. The first has been a recognition that an effective science advisory process will result in better government decisions and will enhance an organization's ability to capitalize on available opportunities. This recognition resulted in a series of government sponsored reports and studies (including those by the Auditor General) that were first initiated a decade ago. The purpose of these reports has been to identify essential changes required in S&T management to institute a viable and sustainable S&T/R&D capability within the federal government. The second principal force behind the ongoing evolution of S&T has been the alignment and integration of this function to organizations' strategic and business planning processes. It is recognized that a close linkage between S&T activity and strategic planning is essential to the achievement of long term strategic goals.

2.6 DND and the CF have not been immune to these influences and challenges. The Defence Research and Development Canada (DRDC) organization is unique amongst federal government S&T organizations in that it is the only S&T organization that focuses on and serves the defence environment. As well, DRDC, as a departmental Agency within DND, is the only S&T organization that is part of a government department that does not have S&T as its principal mandate. However, the evolution of the DRDC organization within DND reflects the same driving forces that have influenced the provision of S&T across the federal government. In order to place current management practices, benchmarking comments and evaluation observations and recommendations in context, the following summary of the influences on the S&T function within the federal and national context is provided.

Summary of Studies and Reports Influencing S&T in the Federal Context

2.7 In 1990, the Lortie Report⁷ examined and made recommendations on the "effectiveness of intramural R&D activities, taking account of the differences inherent in the federal system (from external R&D organizations)". The report identified intramural S&T as a major national asset which contributed to achieving national objectives through informed decision-making, supporting policy development and establishing a public technical and scientific knowledge

⁷ Revitalizing Science and Technology in the Government of Canadian - The Report of the Committee on Federal Science and Technology Expenditures, National Advisory Board on Science and Technology, 2 November 1990.

infrastructure. The report concluded that government practices, policies and regulations contributed to a scientific management culture in which science and technology could not flourish. The Lortie Report also noted that most federal S&T organizations had poorly defined missions and mandates, making it difficult to hold them accountable. These conclusions led to the recommendation that federal departments transfer their S&T functions to a separate organizational entity (which became known as a 'Lortie Institute') with delegated authorities which would allow for a distinct S&T culture to flourish in a more autonomous environment. While the Lortie recommendations were not immediately implemented across the government, Canada's federal Communications Research Centre was designated as the first pilot organization. It was given 'Institute' (equivalent to an Agency) status in 1992. Since that time, a number of additional recommendations, such as revenue retention and management of intellectual property, have been introduced on a case by case basis. The Lortie Report is considered to be the first impetus for changes that have occurred in the federal S&T community, although the prime recommendation to separate S&T functions from Departmental and Ministerial direction was not initially supported.

2.8 The next major influence on federal S&T occurred with the publication of several chapters of the 1994 Auditor General's Report which focused on overall management of federal S&T activities, its management within departments and of S&T personnel. The report identified the need to measure performance and evaluate results and the difficulties inherent in doing so. It was also pointed out that there was a need to develop an S&T framework to link policy and program initiatives with expenditures, planned results and actual outcomes and that there was no comprehensive reporting being done on federal S&T activities. There was also the need for increased business development efforts, identification of potential partners and collaborators and improvement of links to stakeholders. A major finding was the deficiency in research management skills and the need for structured training and development programs within federal S&T agencies.

2.9 In 1996, the government responded by releasing a strategic report entitled *Science and Technology for the New Century* which identified government priorities for S&T and identified operating principles for the design, implementation and management of departmental S&T activities. Improved governance and accountability for the S&T function were identified as priorities both within departments and at the national level.

2.10 The 1996 OAG Report commented that real progress was occurring in the overall management of federal S&T as a result of the 1996 strategy paper, and noted that a more management-oriented culture was appearing in the S&T environment. However, leadership and management commitment to S&T was still wanting as was meaningful performance measurement and reporting. The 1998 OAG Report commented on the stove-pipe nature of S&T within the departmental structures and that large gaps remained in achieving the 1996 Government strategy.

2.11 In 1999, the OAG produced a Chapter entitled “Attributes of a Well-Managed Research Organization” which focused on the four themes of:

- having the right mix of skills in a supporting environment;
- leadership, attention to relevance and the strategic management of resources;
- managing research to ensure excellence and results, leveraging of resources and learning; and
- organizational recognition of the S&T function and instituting performance measurement using quality and relevance criteria.

This report provided examples of specific practices used by selected Canadian and international organizations that were intended to help operationalize previously stated themes. Recommended examples of performance measurement included client surveys and external expert opinion, with the results to be shared with research staff and research advisory boards to encourage continuous improvement.

2.12 In addition to these reports, there have been several reports from the external advisory committee to government⁸ on science and technology. These reports built on the previous work of Lortie and the Auditor General and examined the international experience with respect to making effective use of S&T advice and bringing improvements to S&T management in the federal government. While these documents present universal advice to the management of the S&T function within the Federal context, there was little recognition of the role specifically played by S&T in the areas of defence or security.

Impact of a Decade of Review

2.13 While S&T within the federal government has been under scrutiny for many decades even preceding the Lortie Report, the direction and expectations set by some of the more recent reports have affected how departments and central agencies perceived the strategic and operational aspects of their S&T capability. The net result of the influences of the past decade are reflected in DND’s R&D organization and are linked to the observations and recommendations made in those reports. They are summarized below.

2.14 ***Improved Business and Management Practices:*** Research and Development organizations are now adopting and emphasizing business and management practices such as formal project management systems, performance measurement and reporting, business development offices, advisory boards, mission statements, client satisfaction surveys and revenue generation targets. R&D organizations are expected to operate in a more “business like manner” than ever before.

⁸ Council of Science and Technology Advisors (CSTA) which have produced two reports: Science Advice for Government Effectiveness and Building Excellence in Science and Technology.

2.15 ***Expanded Partnerships and Client Base:*** Due to reduced A-base budgets, R&D organizations are increasing their partnerships and collaborations with other R&D performers in the university, private and not-for-profit sectors in order to share costs and level of investment. Reduced budgets and the impact of the requirement to achieve revenue generation targets have led to increased revenue-producing contract work. To date, this work has tended to be short term and ‘applied’ in nature.

2.16 ***Reduced Scope and Selectivity:*** Again, largely because of budget cuts, but also due to the need to identify priorities more clearly, S&T organizations have cut whole programs that were deemed to be outside their mandate or non-essential - often because of changing conditions and government priorities. In other cases, programs continued but with reduced scope. Most recently, as budget constraints have been relaxed, some research programs have been reconstituted but are suffering the effects of lost expertise and are incurring rejuvenation costs which exceed the savings made during the intervening years.

2.17 ***Reduced Depth of Capability:*** Personnel and budget cuts have led to the retirement or loss of many experienced R&D employees across the government. This loss of expertise and corporate memory has led to significantly reduced capabilities in some areas. Personnel policies remain a concern in all government R&D organizations that are experiencing aging scientific populations, the need for retraining, the challenge of retaining professional staff and other problems associated with organizational renewal. In general, facilities and equipment have also suffered. Deferred capital reinvestment has seriously affected the long term viability of the capital infrastructure. In 1998-1999, capital spending for R&D was \$105 million in the federal government, compared with \$206.5 million in 1994-1995 which was considered insufficient even before program review.

2.18 ***Changed Time Horizons:*** The move to partnerships, contract work, achieving revenue generation targets and the need to demonstrate short term relevance, has led to generally reduced time horizons and expectations for government R&D. There has also been a trend towards allocating fewer resources for longer term foresight work anticipating emerging trends and policy needs.

2.19 ***Focus on Economic Impacts:*** Perhaps due to business practices being employed and greater political direction, there has been a growing trend to engage in economically relevant work and focus on industry transitions, partnerships and revenue generation. This focus has detracted from an essential role of government R&D which is to support achievement of government and departmental mandates that cannot be achieved by external partners.

2.20 ***More Formal Planning, Reporting and Performance Measurement:*** The new central agency-imposed cycle of Reporting on Plans and Priorities (or presentation of the annual business plan and the Departmental Performance Report), has had a large influence on R&D management. Together with the continued reference to accountability, evaluation, and performance measurement in virtually every report since 1990, R&D organizations are being challenged to develop management frameworks to measure, manage and report on their objectives, activities to accomplish them, resultant outputs and the outcomes and impacts being

achieved. While reporting formally to government is one requirement, R&D organizations are also communicating to their clients and stakeholders more intentionally to inform them of opportunities and to demonstrate accountability.

2.21 The material presented in Part III of this report will discuss the progress and the appropriateness of the activities undertaken by DRDC as an active participant in progressing the overall thrusts being pursued by R&D organizations within the federal government.

Alignment with Strategic Direction

2.22 The second of the two principal forces behind the burgeoning interest and importance of science and technology (para 2.5) is the recognition of S&T as being integral to an organization's strategic and business planning process, particularly within DND and the CF. Visibility for research and development and science and technology has never been higher within the Department - partly attributable to the development of Defence Strategy 2020⁹ and the acceptance of the Revolution in Military Affairs (RMA) as having a significant impact on the character and conduct of military operations.

2.23 Defence Strategy 2020 has been developed within DND to serve as the cornerstone for defence planning into the next century. This Strategy maps out a direction for the CF to deliver the kinds of military capabilities, people, equipment and training that the Government believes Canada requires. Science and technology is recognized as playing a vital role in meeting the challenges of delivering these capabilities. The departmental strategic direction is based on an organization that is no longer 'people-rich', but which must leverage its technology decisions to achieve the vision set out by Strategy 2020. The role of the S&T program in this environment is to provide the CF with the necessary and affordable technology which will support their missions and deliver their desired capabilities. Strategy 2020 recognizes that to be successful, it must foster a research environment that develops new ideas and innovations. These ground-breaking achievements in S&T will contribute to our ability to deploy military forces, improve combat effectiveness, address capability gaps and ensure technological compatibility with others with whom we must be able to operate.

BENCHMARKING DRDC WITH OTHER DEFENCE S&T ORGANIZATIONS

2.24 Benchmarking, by definition, is "a systematic and continuous process of measuring and comparing an organization's business processes against leaders and practitioners anywhere in the world to gain information which will help drive continuous improvement."¹⁰ In order to conduct this evaluation of DRDC in accordance with the review objectives, it has been useful to compare the factors driving changes in R&D to the management of other defence R&D organizations and their responses to those factors. Considerable benchmarking has already been done by DRDC as it conducted its Alternative Service Delivery analysis and prepared its business case for Agency status. As a result, the evaluation team did not conduct an extensive and detailed investigation or

⁹ Shaping the Future of Canadian Defence: A Strategy for 2020. A strategic framework for defence planning and decision-making to help guide DND and the CF into the next century.

¹⁰ Sharp, C.A. (1994) Industry Best Practice Benchmarking in the Evaluation Context. Evaluation News and Comment.

comparative analysis with a large number of countries. However, a generic comparison was carried out with six military R&D organizations to determine their imperatives for change and some of the specific aspects of how they conduct their functions on behalf of their defence organizations. In addition to the discussion in this section of the report, benchmark findings are referenced as they apply to specific issues discussed throughout this report. For ease of reference, benchmarking findings for four comparable foreign defence organizations and DRDC have been consolidated at Table 2 (following para 2.37).

2.25 ***Imperatives for Change:*** All S&T organizations, working either within the context of defence or as a national capability, report that the most significant influences on their S&T organizations fell into the following categories:

- Government S&T organizations are responding to the demands of fiscal restraint and public accountability and as a result are being pressured to spend less but more wisely while providing a clear indication of benefits.
- The innovation process of R&D is becoming more global due to the development of niche expertise, the internet, collaborative arrangements and communication.
- The rate of technological change is increasing while time horizons are shortening as clients have demands and expectations to be met in the near term. The private sector is also increasingly relying on the public sector to provide basic research and long term R&D.
- The intellectual capital of R&D is a critical factor. The scientific workforce is generally aging and the compensation disparities are becoming more evident between the public and private sectors. It is becoming increasingly difficult to retain professional S&T staff as they are attracted to the private sector or other countries.
- There is a critical role for governments to retain an S&T capacity. As defence spending is generally decreasing worldwide, there is a declining industrial interest and capacity to support this specialized type of R&D. Governments have recognized the need, as a minimum, to maintain a capability to understand S&T issues, advise on the policy and strategic impact of S&T and remain as a ‘smart buyer’ of technology.

2.26 In light of these imperatives for change, all defence R&D organizations found that adjustments were required to meet the new demands and expectations of an R&D capability while continuing to be able to provide basic and applied research services. All organizations benchmarked have increased their focus on client involvement in their research program, increased its internal visibility and ensured that their principal client is satisfied with a relevant R&D output. DRDC in Canada and the Defence Evaluation and Research Agency (DERA) in the UK, have undertaken more fundamental changes to their strategic approach to providing defence R&D through adopting agency status (as is the case for DRDC) and pursuing privatization options in the case of DERA.

2.27 Ensuring relevance and responsiveness to the operational and strategic needs of their military clients has become a significant consideration of all defence R&D organizations, particularly in an environment of scarce and competing resources. While client involvement in the planning and reporting process of R&D activities has become integral to most R&D organizations, this has been formalized in DRDC through both its planning and approval processes. Discussions with larger defence R&D organizations have indicated a degree of envy with the approach implemented by DRDC which has been made possible by the relatively more manageable size of DRDC's client base, ready access of scientific staff to all client levels in the organization and a heightened level of visibility of S&T issues in the planning and decision-making activities of the Department and CF.

2.28 **Resourcing of Defence R&D Activities:** All defence R&D organizations benchmarked have experienced downsizing pressures to some degree within the last decade. This has resulted in staff reductions, targeting of research activities and greater reliance on information sharing and collaboration on an international level to leverage complementary activity and optimize in-house expertise. R&D organizations have commonly responded to budget reductions by reducing support overhead and redistributing this workload in order to preserve professional and scientific expertise which cannot be recovered easily. By way of example, Australia's Defence Science and Technology Organization (DSTO) reduced their establishment by over 1500 positions between 1990 and 1998 while increasing their scientific/professional staff by 193. Similar trends were followed by DRDC during the mid-1990's. A common sentiment expressed by all defence R&D organizations is that it is essential to sustain a critical mass in defence R&D technologies and that any further contraction of funding support would seriously jeopardize the ability to provide a viable S&T capability. In general, the depth of scientific and technical expertise in defence R&D organizations such as Australia, New Zealand and Canada is thin (often one deep) and any further reduction of personnel would result in lost capability and expertise.

2.29 DRDC's R&D budget, at approximately 1.7 per cent of the total defence budget, is comparable in percentage terms to that of the UK's (1.9 per cent) and falls between Australia's (2.5 per cent) and New Zealand's Defence Operational Technology Support Establishment budget (0.33 per cent). The US DoD budgets approximately \$8B annually for basic, applied and development defence R&D activities¹¹, accounting for 3.5 per cent of its defence budget. The United States as a country is acknowledged as the world leader in R&D activities, spending 43 per cent of what the industrial world spends on R&D. In 1999, the United States spent more on research and development than Germany, Japan, France, Britain, Canada, Italy and Russia combined. Of the total R&D funded by the U.S. government, 55.3 per cent goes to defence activities.¹²

¹¹ Vote 6.1, 6.2 and Vote 6.3 funds publicly accounted for.

¹² Sources include: U.S. National Science Foundation, OECD, Council of Competitiveness, Computer Industry Almanac, and U.S. Department of Commerce.

2.30 When comparing DRDC's annual budget of approximately \$210M¹³ with that of the 50 Top R&D Companies in Canada¹⁴, DRDC would rank 3rd in total expenditures behind Nortel Networks at \$2.9B and Newbridge Networks (Alcatel) at \$264M. However, DRDC would rank in the lower third of Canadian industries based on a percentage of total company revenue. When compared against other Federal Government Departments according to their 1999-2000 expenditures on science and technology and research and development, DRDC would rank ninth behind such departments and agencies as the National Research Council, Industry Canada, the National Science and Engineering Research Council of Canada, Environment Canada and Natural Resources Canada.¹⁵

2.31 The following table shows the trend and history of the Defence R&D expenditures in Canada over the past four years¹⁶.

Table 1

Defence R&D Canada - Historical Expense Analysis				
Fund	1996-1997	1997-1998	1998-1999	1999-2000
(SWE)				
Salary Wage Envelope	\$54.6M	\$53.75M	\$54.5M	\$59.04
Research and Development Activity	\$96.5M	\$88.2M	\$86.1M	\$89.5M
Operations and Maintenance	\$17.8M	\$17.7M	\$19.35M	\$20.6M
Capital	\$9.1M	\$12.8M	\$17.4M	\$39.4M (Note 1)
Miscellaneous Requirements	\$1.1M	\$0.97M	\$0.24M	\$3.2M (Note 2)
Total	\$179.1M	\$173.4M	\$177.2M	\$211.8M

Notes 1 and 2: These figures include a one-time special increment of \$25M and \$8M respectively that is not part of the annual DRDC budget allocation.

2.32 **Technology Watch and Collaboration Activities:** All Defence R&D organizations acknowledge that individually, they can only conduct a small percentage of the defence R&D that is being undertaken worldwide and have only limited resources to pursue basic research. As a result, technology watch, which looks for emerging technologies and assesses their potential relevance to defence, is becoming a strategic and 'cost-effective' R&D activity for most organizations. DRDC has incorporated this function as a formal Thrust initiative within its Business Line 2 (provision of S&T policy and advice), and has assumed a leadership role within The Technical Cooperation Program (TTCP) for this activity. Other organizations such as Australia and New Zealand are also very active in this initiative within TTCP and are following the leadership of DRDC. DERA has also formally incorporated a technology watch component

¹³ See Notes 1 and 2 at Table 1 following para 2.31.

¹⁴ Globe and Mail, July 2000 Report on Business Magazine, 50 Top R&D Companies.

¹⁵ Statistics Canada - Cat. No. 88-204-X1B.

¹⁶ Figures provided by DGRDBA.

within each research project, while other countries have identified a point of contact within their organization to coordinate the technology watch function. Further discussion on this topic is at para 3.50.

2.33 Complementary to the technology watch function is collaboration on an international level with other defence R&D organizations. As shown in the chart at Table 2, collaboration can be a significant portion of the research program, ranging from 10 per cent as reported by DSTO in Australia to 30 per cent as reported by the Danish Defence Research Establishment (DDRE). DRDC also collaborates extensively with other nations through an extensive network of multi-lateral and bi-lateral arrangements which provide the CF and DND with global access to defence technology, information and scientific expertise. A focus of this international network is to facilitate interoperability with our allies. Participation in The Technical Cooperation Program and the NATO Research and Technology Organization receive a high priority from DRDC. Table 2 also indicates that these forums rate highly with the benchmarked organizations.

2.34 **Revenue Generation:** A revenue generation objective has been adopted by DRDC since it has assumed agency status. The Agency has the authority to retain and spend revenues that are generated through the conduct of its operations with the intention of supplementing baseline funding provided by the Department. While the targets set for this activity are not large (the goal is 10 per cent of the personnel budget by 2004), adopting this formal objective has influenced the scientific community's reaction to the strategic changes that have taken place. Components of the U.S. DoD research program also have revenue generation objectives, such as the Army, Navy, and Air Force Research Labs, as does DERA in the U.K. However, other countries such as Australia, New Zealand, Denmark and Germany do not have revenue generation as an objective or activity of their defence research organization.

2.35 **Human Resource Management in R&D:** All defence R&D organizations benchmarked appear to be facing similar human resource management issues: the aging demographic profile of the scientific community, retention and recruitment concerns (particularly in the areas of communications and information systems specialists), salary discrepancies with private industry, and cultural adjustments (particularly in the case of Agency status for DRDC and privatization issues for DERA in the UK). However, similar factors such as freedom and flexibility to pursue research interests and the ability to network internationally on a professional level, are considered by all organizations as attractive features of working in government-sponsored defence research organizations.

2.36 **Performance Measurement:** The role and importance of performance measurement in the management of defence research organizations is increasingly being recognized. Steps to implement formal performance measurement frameworks vary between organizations, with DRDC, Australia and the US DoD taking more formal steps to implement performance measurement planning and reporting activities following government-wide initiatives and legislated requirements in their respective countries. DRDC's governance structure under an Assistant Deputy Minister makes them responsible for issuing an annual business plan and to report on their performance, as well as communicating their activities to their clients and stakeholders informing them of R&D opportunities and to demonstrate accountability. Selection

of appropriate metrics for R&D activities and implementation of a formal system is still in the early stages in most organizations. However, the establishment of an R&D Program Oversight Directorate within DRDC demonstrates organizational commitment to this activity.

Conclusions Related to Benchmarking DRDC with Other Defence S&T Organizations

2.37 The Review Team has concluded that:

- a. All government-sponsored defence R&D organizations have had to realign their governance structures, management processes and research focus in response to similar 'driving forces for change'. These forces include fiscal restraint, public accountability, globalization of research and development, the rate of technological change and management of their intellectual capital (HR issues).
- b. All sponsoring organizations recognize the need to retain a defence research and development/science and technology capability.
- c. DRDC has undertaken more fundamental changes than most defence R&D organizations.
- d. Maintaining relevance and responsiveness to their principal client is receiving increased priority amongst R&D organizations.
- e. Downsizing of defence R&D organizations benchmarked was generally achieved through reductions in support overhead and redistribution of the workload to preserve professional and scientific expertise.
- f. Technology watch and collaboration with partners and allies is becoming a strategic and cost-effective R&D activity for most organizations.
- g. All defence R&D organizations are facing similar HR management issues: aging demographic profile of their community, recruitment and retention concerns and salary disparity with industry in some areas of specialty.

TABLE 2

BENCHMARKING DRDC WITH OTHER DEFENCE S&T ORGANIZATIONS

Issues	Canada (DRDC)	Australia Defence Science and Technology Organization (DSTO)	New Zealand Defence Operational Technology Support Establishment (DOTSE)	United Kingdom Defence Evaluation and Research Agency (DERA)	Denmark Danish Defence Research Establishment (DDRE)
General Comments	<p>- On 1 April 2000, the Defence Research and Development Branch ceased reporting to the Assistant Deputy Minister (Materiel) to become a departmental Agency under an Assistant Deputy Minister Science and Technology who functions at its Chief Executive Officer. The defence research and development function is now known as Defence Research and Development Canada (DRDC).</p>			<p>- DERA is an agency of the MoD whose mission is to “harness science and technology to UK defence needs.” It employs approx. 12,000 staff with a budget of \$2.5B (Cdn). - Current proposal is to privatize 75 per cent of DERA and retain 25 per cent within MoD to provide impartial advice and guidance to the Government. - This proposal is in response to ‘exponential growth in the financing of research and enhances opportunities to exploit technology internal and external to DERA.</p>	<p>- Danish military R&D characterized by absence of a significant indigenous defence industry. - Main purpose of military R&D is to support acquisition and implementation phase of equipment and capabilities and to improve upon existing equipment and capabilities operationally and technically. Greater focus on application of existing technologies rather than basic research.</p>

Issues	Canada (DRDC)	Australia Defence Science and Technology Organization (DSTO)	New Zealand Defence Operational Technology Support Establishment (DOTSE)	United Kingdom Defence Evaluation and Research Agency (DERA)	Denmark Danish Defence Research Establishment (DDRE)
<p>Changes to Strategic Direction in Defence R&D</p>	<p>- ASD and business case analysis of R&D function through the 1990's resulted in Agency status for defence R&D. Resulted in a mission driven org focused on performance measurement and accountability with increased financial authority and admin flexibility. - Increased organization's visibility congruent with role in DND/CF fulfilling its long term strategic plan.</p>	<p>- Significant changes in last decade to increase client relevance and efficiency in performing its work by:</p> <ul style="list-style-type: none"> • Increasing visibility of entire program to clients and explaining why work being done, not just what and how. • Increasing formal client involvement in planning process at both senior mgmt and working levels. Increased emphasis on clients maintaining and updating their long term and annual S&T plans. • Reducing organizational complexity of number of labs and divisions. Support staff was reduced while increasing number of professional staff (scientists, engineers and officers). Between 1990 and 1998, staff was reduced by 1500 while professional staff increased by 193. Ratio of support to professional staff dropped from 2.73:1 to 0.52:1 	<p>- Budget constraints effected a reduction in S&T research effort. - Downsizing of staff resulted in reduction of admin support. Technical staff were replaced by scientific professional staff where possible. - Strict management practices imposed such as increased accountability, financial management (accrual accounting), charge-out policy and ABC costing. - Work effort redirected from long term research to short term problem-solving. Note: Swing too far in this direction noted and need for long term R&D recognized if DOTSE to continue to be an effective provider of S&T advice and assistance.</p>	<p>- In response to reduced defence R&D budgets, MOD Defence Research and Evaluation Agency made a radical proposal in 1998 to be privatized. Current proposal consists of ¼ of DERA to be retained in MOD to interface with the international defence community and ¾ to be privatized.</p>	<p>- DDRE states they have not adjusted their strategic approach to providing defence R&D, but greater attention is being placed on the value and application of R&D to enhance military capacity.</p>

Issues	Canada (DRDC)	Australia Defence Science and Technology Organization (DSTO)	New Zealand Defence Operational Technology Support Establishment (DOTSE)	United Kingdom Defence Evaluation and Research Agency (DERA)	Denmark Danish Defence Research Establishment (DDRE)
<p>Ensuring Relevance and Responsiveness to operational and strategic needs of military clients</p>	<ul style="list-style-type: none"> - Majority of R&D activities and resources allocated to delivering an R&D program to the CF and DND. Services are determined annually with the client through Service Level Agreements. - R&D program packaged in ‘Thrusts’ which are targeted to major client groups. - Thrust Advisory Groups and Working Groups are client lead. - S&T managers are scientific advisors to Environmental Commanders. - Chief of Defence Staff chairs the R&D Program Board to ensure it reflects CF priorities and requirements. 	<ul style="list-style-type: none"> - Clients are involved extensively in DSTO’s planning and reporting process. They are responsive to immediate and unexpected operational needs. - Research staff willing to be involved in operational theatres. 	<ul style="list-style-type: none"> - Individual S&T projects have a single service sponsor who provides oversight, liaises with DOTSE staff to ensure relevance and satisfactory progress. - Formal project reviews evaluate military relevance and intrinsic scientific quality. 	<ul style="list-style-type: none"> -Stakeholder process adopted where client defines requirements and tasks the technical experts to make proposals to meet objectives. -MOD defines research package to meet international programs and long term S&T thrusts. - Military clients define their requirements to address short/medium term capability gaps. - Program visibility is key to relevance. 	<ul style="list-style-type: none"> - DDRE has developed its own technology base which responds to military requests for R&D services. - Future plans intend to integrate a R&D strategy into a long term development plan for the Danish Defence which will identify and prioritize relevant technology areas for future R&D activities. -Analysis of military missions will identify trends in R&D activities which will become the basis of the program.

Issues	Canada (DRDC)	Australia Defence Science and Technology Organization (DSTO)	New Zealand Defence Operational Technology Support Establishment (DOTSE)	United Kingdom Defence Evaluation and Research Agency (DERA)	Denmark Danish Defence Research Establishment (DDRE)
<p>Priority Setting Mechanism for Defence R&D activities</p>	<p>- A defined process exists for program formulation that involves client group participation and approval. - Thrusts, or ‘work packages’ are formulated and prioritized for five client groups - Maritime, Land, Air, Command and Control Information Systems and Human Performance. - A hierarchy of client R&D Overview Groups, the R&D Executive Committee, the DRDC Advisory Board and senior departmental /CF involvement through the R&D Program Board and Senior Review Board establishes R&D program priorities.</p>	<p>- R&D program influenced by following factors: client priorities and emphasis within ADF strategic and financial guidance, need to staff and sustain critical areas of expertise. - R&D program developed in collaboration with clients. R&D program divided into five Force Research Areas (Maritime, Land, Air, Policy and Command). Work in each area is sponsored by that client group. - An R&D Review Committee represents each client group and establishes priorities - R&D workplan presented to stakeholders at DSTO’s Annual Planning Meeting where 90 per cent of R&D resources allocated to client groups. Key is presentation of info in layman terms using ‘generic technology descriptors’.</p>	<p>- Each service establishes a Science Steering Committee to determine S&T requirements in light of in-house R&D skills and capabilities. Each committee assigns priority to their list of proposals. The Defence Technology Committee interleaves all priorities for CDS approval and funding.</p>	<p>- Priorities for investment in R&D determined by the military Equipment Capability Staff under CDS (Equipment Capability) and Deputy Under Secretary (S&T).</p>	<p>- A Defence Research Coordination Committee meets twice annually to coordinate and prioritise R&D activities, capabilities and resources.</p>

Issues	Canada (DRDC)	Australia Defence Science and Technology Organization (DSTO)	New Zealand Defence Operational Technology Support Establishment (DOTSE)	United Kingdom Defence Evaluation and Research Agency (DERA)	Denmark Danish Defence Research Establishment (DDRE)
Establishment of R&D Resource levels	<p>- R&D budget approximately 1.9 per cent of defence budget.</p>	<p>-DSTO budget allocated by Australian Defence Force to be assigned internally by DSTO to best undertake annual program. There is no pre-determined split between salary and non-salary expenses. - R&D budget 2.5 per cent of defence budget.</p>	<p>- R&D budget capped at .33 per cent of defence budget since 1990. - Objective is to sustain critical mass in selected scientific areas. - Further contraction of budget seen to jeopardize ability to provide viable S&T to NZDF. Some technological capability will be lost if individual staff members attrit.</p>	<p>- R&D budget approx. 1.9 per cent of defence budget. - Recent government study recommended MOD adopt a formula funded defence S&T budget of 2-3 per cent. - Strong sentiment exists that current budget levels have fallen too low to maintain critical defence technologies at state-of-the-art levels.</p>	<p>- DDRE activities are funded to the following extent:</p> <ul style="list-style-type: none"> • pre-planned requested tasks from military commands - 40 per cent • internal R&D activities to develop knowledge base - 40 per cent • unforeseen requirements - 10 per cent • administration - 10 per cent <p>- Military clients pay the incremental costs of R&D other than salary. - additional funding sources are sales of R&D services to foreign militaries and orgs external to Danish Defence.</p>
Technology Watch	<p>- A structured approach to technology watch has been adopted through initiating a formal Technology Outlook Thrust - Assesses emerging technologies and threats for potential relevance to Cdn defence. - DRDC a leader in TTCP (The Technical Cooperation Program) heading such initiatives as <i>Winning Techniques in Science and Technology Management: A Compendium of Best Practices</i>.</p>	<p>- Consideration being given to establishing a formal Technology Watch function as an aid to strategic forecasting and S&T priority setting. - Interested in taking part in proposed TTCP technology watch study. - DSTO strives to maintain sufficient breadth of S&T functionality, but with limited capacity in several areas.</p>	<p>- Pre-1999, technology watch undertaken on ad hoc and informal basis through TTCP and exchanges with universities and industry. - Now a formal point of contact established for Technology Watch. - Technology Watch funded as a separate project within the S&T program.</p>	<p>- Technology watch has transitioned from receiving little attention to a top priority activity. Every project has a formal Tech Watch component. - DERA acknowledges that 99 per cent of defence R&D is done elsewhere, hence the high priority for technology watch. - Fifteen per cent of basic research activity dedicated to technology watch.</p>	<p>- Technology Watch is not identified as a separate R&D activity, but carried out through international cooperation activities, mainly NATO Research and Technology Organization. This is the most important factor in identifying emerging technologies.</p>

Issues	Canada (DRDC)	Australia Defence Science and Technology Organization (DSTO)	New Zealand Defence Operational Technology Support Establishment (DOTSE)	United Kingdom Defence Evaluation and Research Agency (DERA)	Denmark Danish Defence Research Establishment (DDRE)
International R&D Collaboration Activities	<ul style="list-style-type: none"> - Critical role is to bring defence technology into Canada from Allies through collaboration, partnering, info exchange, conferences and scientific papers. - DRDC's niche expertise provides significant leverage in obtaining work and research developed by others. - DRDC strives to have scientific standards of research, publishing and S&T products of highest levels to encourage exchange and be considered of value on quid-pro-quo basis. 	<ul style="list-style-type: none"> - The major international R&D collaboration activity is TTCP. Input received through synergistic insights from information exchanges is considered "cream on the cake" for DSTO. - DSTO states that without TTCP, the DSTO would have to double in size to deliver the same output to its clients. 	<ul style="list-style-type: none"> - Ten per cent of DOTSE R&D efforts dedicated to international R&D collaboration - mainly TTCP - International R&D contacts credited with providing military personnel with access to collaboration fora. 	<ul style="list-style-type: none"> - Approximately 15 per cent of research and technology resources are dedicated to international activities, but leveraged gains are estimated at a multiple of three. 	<ul style="list-style-type: none"> - It is estimated that 30 per cent of the research and development effort is attributable to international cooperative programs.

Issues	Canada (DRDC)	Australia Defence Science and Technology Organization (DSTO)	New Zealand Defence Operational Technology Support Establishment (DOTSE)	United Kingdom Defence Evaluation and Research Agency (DERA)	Denmark Danish Defence Research Establishment (DDRE)
Defence R&D links to Industry	<ul style="list-style-type: none"> - Defence Industrial Research Program utilized to solicit R&D proposals from industry with defence application - conducted on a 50/50 cost-shared basis. - Partnering and collaboration with industry promoted to facilitate transfer of technology and knowledge to industry to encourage a defence industrial base and share in delivery of the defence R&D program. 	<ul style="list-style-type: none"> - DSTO aim is to improve national capacity to develop and support new defence capabilities and to sustain existing capabilities. - Links to industry is through benefit/risk sharing arrangements, collaborative arrangements, sponsored tasks and licensing IP. - <i>Centres of Excellence</i> are arrangements with industry to do contract research in specific areas of technology to supplement DSTO's R&D activities. This is a long term partnering arrangement 	<ul style="list-style-type: none"> - DOTSE has no formal links to industry. - Defence industry in NZ is very small. - Director of DOTSE participates on NZ Government's Defence Industry Committee. 	<ul style="list-style-type: none"> - Prior to privatization initiative in DERA, 30 per cent of R&D funding was sub-contracted to industry. - MOD now funding 'Towers of Excellence' program with industry and Universities to build required 'towers'. - DERA now treated similar to any contractor who must win a contract with MOD. 	<ul style="list-style-type: none"> - Limited size of Danish defence industry restricts development of formal links. However, DDRE cooperates on a case-by-case basis with industry to assist development activities.
Revenue Generation	<ul style="list-style-type: none"> - As a Departmental Agency, DRDC has set a goal of generating \$10M in revenue annually by 2004 to supplement baseline funding for R&D activities. - Revenue will be earned from intellectual property rights, licensing and patents, service contracts and international and commercial contracts. 	<ul style="list-style-type: none"> - Revenue generation is not an objective of DSTO and there is no mandate to pursue dual use technologies or capabilities with industry which can be a by-product of revenue generation. 	<ul style="list-style-type: none"> - Not an objective of DOTSE. - NZDF clients are notionally invoiced for R&D services to permit oversight and visibility of individual projects. - Full costs are recovered for all work performed for non NZDF clients - Revenue earned is not retained by the R&D organization. However, it may be reallocated to cover unforeseen expenses. 	<ul style="list-style-type: none"> - DERA has strong revenue generation capabilities which supplement MOD funding of R&D. Income sources are other government departments, industry and international sources. - DERA retains all revenue earned. 	<ul style="list-style-type: none"> - Revenue generation has not been an objective of defence R&D function. However, budget reductions have revised this approach. In 2001, a modest income is planned from externally financed activities and will be retained and reinvested in DDRE activities.

Issues	Canada (DRDC)	Australia Defence Science and Technology Organization (DSTO)	New Zealand Defence Operational Technology Support Establishment (DOTSE)	United Kingdom Defence Evaluation and Research Agency (DERA)	Denmark Danish Defence Research Establishment (DDRE)
Human Resource Management in R&D	<ul style="list-style-type: none"> - Demographic profile reflects aging of the scientific community. - While scientist salaries lag private industry, flexibility, challenge and professional work environment provide some compensation. - A 'one-time' salary bonus for scientists instituted to reduce wage gap with private industry. - Recruiting and retention problems have been identified and are being actively addressed by corporate management and at the research establishments. - The change to Agency status with new objectives and accountability responsibilities has created the need for 'cultural adjustments' by the scientific community. 	<ul style="list-style-type: none"> - Salaries and conditions in DSTO comparable throughout public sector and better than academia. they are not comparable with private sector in new economy disciplines. - Professional recognition, award schemes, access to international travel and conferences are non-salary benefits - Recruitment and retention is improving and profile of scientists is getting younger. - HR strategy is to have targeted recruiting, marketing and selection. - Failed in recent bid to remove artificial barriers to career progression. Aim to have an open and simplified employment structure. - Employment practices are to enhance science, management and leadership skills of staff to facilitate career progression over long term. 	<ul style="list-style-type: none"> - Private sector R&D salaries are generally higher than R&D salaries in public sector. - Difficult to compete in electronics and software engineering areas. Recruiting difficult in these areas. - Salary adjustments seen as necessary to remain competitive employer in R&D. - A performance-based pay system exists with promotions, salary increases and bonuses related to individual's effectiveness. 	<ul style="list-style-type: none"> - Privatization issues impacting DERA have placed HR issues in a state of flux. - Salaries in range between academia and industry. - Difficult to compete with private sector in areas of communications and information systems. - Plans are to send large number of DERA staff who will not be privatized back to university at mid-career for skills upgrade. 	<ul style="list-style-type: none"> - Salaries are similar to all other government sector research institutions. - Private industry pays higher salaries, particularly in IT-business. - Scientists are attracted to the considerable amount of freedom in performing their job. - Significant overweighing of 50+ year old employees. This creates a challenge in recruiting and retaining expertise in certain areas. - DDRE sponsors Ph.d. education which assists recruiting of scientists.

Issues	Canada (DRDC)	Australia Defence Science and Technology Organization (DSTO)	New Zealand Defence Operational Technology Support Establishment (DOTSE)	United Kingdom Defence Evaluation and Research Agency (DERA)	Denmark Danish Defence Research Establishment (DDRE)
Performance Measurement in R&D	<p>- A DRDC R&D Program Oversight directorate was established in 1998 for measuring performance of the Agency in meeting program delivery and effectiveness.</p> <p>- A performance measurement framework has been established around the key objectives set for the org and its four business lines with emphasis on providing R&D for DND and the CF.</p> <p>- Metrics include success rates on major initiatives and milestones, resource expenditures, client satisfaction and peer review of each defence technology area.</p>	<p>Performance measured in following ways:</p> <ul style="list-style-type: none"> • Annual R&D task reviews with client to assess outputs and expenditures against plan. • Visibility of annual R&D plans and reports discussed at highest executive level. • Every three years, long term speculative work is peer-reviewed for relevance and scientific excellence. 		<p>-Performance measurement is emerging as a key issue to drive scientific and technical capabilities to higher levels to allow DERA to compete in the ‘Towers of Excellence’ initiative.</p> <p>- The Defence Science Advisory Council audits the skills and quality of the program run by DERA for MOD.</p> <p>- External peer reviewers from universities etc., are more commonly used.</p>	<p>- Only modest performance measurement is in place in DDRE.</p> <p>- Decision has been made to adapt the ‘Balanced Scorecard’ approach to PM.</p>

OVERVIEW OF DRDC PROGRAM PROFILE

2.38 As of 1 April 2000, the research and development program of DND and the CF has been the responsibility of the Defence Research and Development Canada (DRDC) Agency. The organization is under the direction of the Assistant Deputy Minister for Science and Technology (ADM(S&T)) who also serves as its Chief Executive Officer.

2.39 DRDC consists of a corporate headquarters located in Ottawa and five defence research establishments that are located across the country, each with specific areas of expertise.¹⁷ The organization is largely staffed by civilians (1,049), of which 379 are defence scientists. Sixty seven percent of the staff are scientists, technologists or other scientific professionals. There are also 35 military FTE's (full time equivalent positions) which provide essential liaison, project management and communication functions for the organization.

2.40 DRDC is the only Canadian federal S&T organization which operates in the defence environment. One of its significant roles is to bring defence technology to Canada from its allies through collaboration efforts, information exchanges and 'technology watch' with international partners and scientific colleagues. In its efforts to obtain the best quality and 'leading edge' technology from organizations with whom they collaborate, DRDC strives to offer comparable quality, productivity and scientific rigour.

2.41 The DRDC Agency delivers its services along four Business Lines:

- *Business Line 1* - research and development for the Canadian Forces and DND;
- *Business Line 2* - providing strategic science and technology policy and advice (including technology watch);
- *Business Line 3* - carrying out science and technology with National security partners; and
- *Business Line 4* - fulfilling corporate management functions.

2.42 The majority of the Agency's resources are directed to Business Line 1 where most of the R&D activities take place. Under this business line, the R&D program is divided into five client groups: Maritime, Land, Air, Command Control and Information Systems, and Human Performance. Each client group is divided into Thrusts, which address specific military capability requirements of that environment. The program for each client group is formulated in conjunction with an R&D Overview Group, chaired by a senior military client to ensure the relevance and applicability of the program to client requirements. A Director General from DRDC serves as the Scientific Advisor to each client group while also managing a Defence Research Establishment. A Director of Science and Technology for each client group is located within DRDC corporate management and is responsible for ongoing liaison between client

¹⁷ A description of each Defence Research Establishment, their areas of expertise and resource expenditures, can be found in the Defence Research and Development Canada Outline of Program 2000 and the DRDC Annual Report 1999 - 2000.

groups and the delivery agents of the R&D program. The R&D program itself is delivered through a combination of in-house activities at a Research Establishment, contracting with universities or industry, or through collaborative arrangements with other government R&D organizations or international partners.

2.43 The following Table shows the 1999 - 2000 DRDC expenditures by business line and between client groups.

Table 3

DRDC EXPENDITURES by BUSINESS LINE and CLIENT GROUP			
Business Line	Client Group	Expenditure 1999 - 2000	Total 1999 - 2000
<i>Business Line 1</i> - R&D for the CF and DND	Maritime Client Group	\$30.1M	\$124.5M
	Land Client Group	\$25.5M	
	Air Client Group	\$23.0M	
	Command and Control Information Systems	\$27.1M	
	Human Performance	\$18.8M	
<i>Business Line 2</i> - Strategic S&T Policy and Advice			\$1.98M
<i>Business Line 3</i> - S&T with National Security Partners			\$1.5M
<i>Business Line 4</i> - Corporate Management			\$50.4M
One-time Allocation for Special Projects			\$8.0M
One-Time Allocation Opportunity Funding			\$24.3M
Total			\$210.7M

PART III – DISCUSSION OF EVALUATION ISSUES

INTRODUCTION

3.1 Part III of this report provides a discussion and analysis of the evaluation issues and concerns regarding research and development that were identified during the preliminary phase of the study and presented in the CRS Notification of Review¹⁸. The major issues discussed in this section of the report include: governance of R&D, program content, client satisfaction with the R&D program, human resource management, communication, performance measurement and risk management. Findings and conclusions of the evaluation team are included in the discussion of each issue along with recommendations to address major deficiencies that were identified.

GOVERNANCE OF THE RESEARCH AND DEVELOPMENT FUNCTION

Introduction

3.2 Defence Research and Development Canada (DRDC) is the departmental organization mandated to provide a defence science and technology capability for the CF. As its Chief Executive Officer, ADM(S&T) is the steward of the departmental S&T resources and capabilities to provide national leadership and expertise in S&T and R&D as they apply to defence. In order to fulfill this role, the organization has adopted a governance framework that is intended to ensure that it can be relevant to its principal clients and stakeholders and enable it to achieve the goals and objectives that have been assigned to it through the defence planning process. The following discussion of governance of the R&D function is intended to assess the structure and management systems that support the R&D stewardship role, identify governance issues that impact that role and provide observations, conclusions and recommendations which can contribute to strengthening the function of DRDC.

Governance Framework for DRDC

3.3 A governance framework for any organization sets the rules and limitations on the authorities an organization may have to achieve its mission and the accountability structure for demonstrating their results to the next level. R&D organizations, like all others, must have a governance structure that is appropriate for achievement of their mission and facilitate accountability for results.

3.4 Since the Lortie Report of 1990, it has been recognized that the organization structure assumed by an R&D organization is a key element in the successful performance of its role. This observation was premised on the conclusion that the quality of research and relevance to clients is highly dependent on the existence of a distinct and visible organization that values and leverages its scientific culture and at the same time, provides an obvious link between the S&T establishment and other parts of the department. The organization structure is also key to

¹⁸ Notification of CRS Review - Program Evaluation of Research and Development in DND and the CF, 7053-41-4 (CRS), 23 May 2000

facilitating productive relationships with capabilities external to the parent department, such as universities, industry and other scientific groups. The 1996 federal government report, *S&T for the New Century* and subsequent Auditor General reports, also spoke of governance issues for R&D. These reports stressed that the governance structure must ensure that the R&D organization focuses programs and resources on achieving government and departmental objectives. The OAG reports stressed that within R&D organizations, there needs to be a means to ensure that delivery units of the program focus on both corporate-level objectives and output relevant to their clients. The discussion beginning at para 3.17 on organizational relevance addresses this issue.

3.5 Concurrent with a governance structure that confers authority to an organization to achieve its mandate, is the obligation of accountability. Discussion at para 3.7 will address this issue as it relates to DRDC.

DRDC Governance Structure

3.6 As of 1 April 2000, DRDC has become a special purpose departmental agency within the National Defence portfolio. In July 2000, DRDC received Treasury Board approval to be a Special Operating Agency (SOA), which allows it to continue to operate as a departmental organization, but with additional authorities and flexibilities to support its operations which are not normally available to a Level One manager of a department. As a SOA, DRDC operates under an Agency Charter or 'framework' which provides greater independence for the organization from department and government-wide administrative rules, in return for greater commitment and accountability for performance and results.

3.7 The Deputy Minister remains accountable for all activities of DRDC while the ADM(S&T), as the organization's Chief Executive Officer, is accountable for the performance of the Agency. Echoing a recommendation of the Lortie Report¹⁹, a Defence R&D Advisory Board has been established co-chaired by the DM and CDS, composed of representatives from DND, other government departments, industry and universities. This Board provides strategic advice and guidance to the Minister and to the Agency on Defence R&D matters. An R&D Program Board chaired by ADM(S&T) is composed of senior CF representatives from Client Groups and their Scientific Advisors, as well as R&D partners external to the Department. This board reviews the defence R&D program to ensure that it reflects the overall priorities and requirements of the Department and the CF. There are also five R&D Overview Groups which are chaired by senior client representatives and endorse the respective service level agreements (SLAs) and Thrusts which are carried out on behalf of the Client Groups. The R&D Executive Committee (RDEC) consists of the Directors General of the Agency and the senior military representative, chaired by the ADM(S&T). This committee oversees the management and conduct of the Agency including the R&D program.

¹⁹ Lortie Report 1990, "Each Institute have a Board of Directors...including a chair and two ex officio directors, namely the departmental deputy minister and the president of the institute, with the external directors selected from senior executives of technology intensive corporations and universities in Canada and abroad." Page 115.

3.8 In addition to the committee structure internal to DND/CF supporting the R&D function, an external Defence Science Advisory Board (DSAB) has existed since 1987. This organization has the mandate to provide the DM and CDS with independent, private sector advice from a broad scientific and technological perspective, on current problems or issues affecting defence, linking the nation's scientific and industrial community with the defence planning framework. The relevance of this board will be discussed in the following section.

Governance Issues

3.9 ***Role of Defence Science Advisory Board (DSAB)***: As discussed at para 3.8 above, DSAB is an organizational entity external to DND which reports directly to the DM and CDS providing advice and guidance through the conduct of topic-specific studies completed by ad hoc groups of experts. Studies range from being policy-oriented or strategic in nature to specific topics deemed important to the chairman. In order to provide an interface between DSAB and the Department for policy coordination purposes, a Defence Science Advisory Board Coordinating Committee has been established, chaired by the VCDS with representation from the Level One Advisors and military staffs. The DSAB function is funded by the Department at approximately \$200K annually.

3.10 Discussions held by the evaluation team with senior departmental and CF stakeholders at early stages in the review regarding client satisfaction with defence R&D, touched on the subject of the DSAB. A sentiment expressed during the course of this evaluation (March - November 2000) was that the value, contribution and relevance of this body was questionable, particularly as it related to the requirements of the three operational environments. Interviewees indicated that while the Board is comprised of senior and experienced representatives of government, industry and academia, there is insufficient exposure to leading-edge R&D thinking, new frontiers in science and technology, and innovative and creative consideration of S&T issues. Several interviewees recommended that representation on the Board be reviewed to include representatives from new and emerging technology areas, industries and academia to provide innovation and foresight to the advisory role of the Board.

3.11 Additional comments were made to the evaluation team that the reports, studies and papers produced by the Board did not receive sufficient visibility within the Department to stimulate thought and discussion on R&D or S&T issues. Although a recent DSAB report did receive wide circulation and stimulated discussion,²⁰ this was not considered a routine occurrence. While the DSAB provides a mechanism for bringing external advice and guidance to the R&D program, the DRDC Advisory Board also exists which includes industry, university, and senior S&T representation from other government departments and CF stakeholders which tends to overlap the external composition of the DSAB. In order to maximize the contribution of the DSAB through its reports and papers, a mechanism should exist to provide departmental stakeholders more ready access to the deliberations, analysis and advice provided by this body. A source of sound external S&T advice is essential to ensure the government and the Department has the ability to build on the

²⁰ DSAB Report 99/1, Technology Opportunities for the Canadian Forces in the 2010 - 2020 Time Frame. 16 August 2000.

S&T advice it receives and to bring sound scientific advice to its policy and strategic decisions. The Defence Science Advisory Board Revitalization Plan²¹ provides the opportunity to effect changes to improve the relevance of this Board.

3.12 **Committee Role:** The functioning of DRDC is dependent on the role of the various R&D committees and the appropriate involvement of the various stakeholder groups in their respective committees. In the 1999 Client Satisfaction Survey²², the role of the various committees that contribute to ensuring that the “right” or relevant research and development is being carried out, was questioned. At that time, opinion was divided on the value and impact of the various committees influencing the direction of the R&D program. In brief, the governance/committee structure includes the DRDC Advisory Board co-chaired by the DM and CDS, the R&D Program Board chaired by ADM(S&T), five R&D overview groups (representing each Client Group), Thrust Advisory Groups (TAGs) and their Working Groups and the R&D Executive Committee (RDEC) which is internal to DRDC.

3.13 During the course of this evaluation, varying sentiments were also expressed on the effectiveness of this committee framework. The essence of these sentiments are summarized below:

- The large number of R&D committees and the degree of client involvement that is demanded on the part of stakeholders to participate, was often viewed as excessive and time consuming. While clients have expectations for an R&D program that is relevant to their needs, the expansive demands of committee involvement were greater than clients believed they could afford in order to monitor the applicability of program content to their requirements.
- Despite the evidence of considerable committee work, clients expressed concern that there is duplication of scientific work between Defence Research Establishments that was being conducted on their behalf.
- The role of the R&D Executive Committee was questioned from within the DRDC community as not being one that was clearly defined and understood by its members. RDEC was viewed as a vehicle for communicating corporate policy and direction rather than providing the opportunity for its members to influence or participate in the corporate decision-making process. Similarly, decisions taken at RDEC were viewed as being subject to varying degrees of interpretation as they filter back down to the DREs. This has led to inconsistency in their application and implementation.

²¹ 1150-3 (DDA 3-3) 19 November 2000. Defence Science Advisory Board Revitalization Plan - Topic Sponsor Responsibilities.

²² Report on Client Satisfaction Survey Conducted on behalf of the Defence Research and Development Board by AeroVations Associates, 30 August 1999.

- While many clients commented that DRDC was “somewhat committee heavy” in the management of its R&D program, clients, program deliverers and stakeholders generally agreed on the necessity of such a structure. It was acknowledged that the complexity of the R&D program and its many project elements involve multiple client groups, inter-DRE cooperation and collaboration which requires coordination and management that can only be accomplished through these mechanisms.
- All parties concurred that the work of these committees does focus on the delivery of the R&D program and that the committees are essential to ensure the involvement of participants and deliverers of the program. As well, they provide a mechanism to obtain mutual agreement on the way ahead and the progress that is being made.

3.14 It is often difficult to convince the client that an appropriate balance has been achieved in the utilization of a committee structure. However, interviewees were generally agreed that a ‘managed approach’ is being achieved within the R&D program through the existing governance structure which provides for client/DRDC dialogue regarding this balance.

3.15 **Agency Status:** The establishment of DRDC as a Departmental and Special Operating Agency has been a major milestone for defence R&D. The basis for such a change was laid in the Lortie Report, which, among other conclusions, stated that “fundamental changes are required in the organization and design of department’s intramural S&T activities and that a management regime, one better suited to the unique nature of science and technology, needs to be established.” By assuming agency status, an organization is able to extricate itself from a departmental bureaucracy whose policies, regulations and administrative procedures do not specifically apply and may inhibit the conduct of its business. In becoming a departmental agency, DRDC no longer remained as an organizational entity of ADM(Mat) within DND, but assumed the status of a Level One organization within the Department. Its Chief Executive Officer is currently ADM(S&T), a Level One manager. An assessment of this organizational realignment is discussed below.

3.16 During the course of this review, the following views and comments were received on the R&D function acquiring agency status within the Department:

- The transition process from being an organizational entity in ADM(Mat) to attaining Level One status has imposed a significant workload on the Agency. This additional workload includes such initiatives as the Universal Classification System, developing human resource management strategies, dealing with retention, recruitment and cultural issues, and introducing revenue generation and systems and procedures to fulfill financial and personnel administration responsibilities associated with Agency status. In addition, fulfilling Level One planning and reporting responsibilities has added workload to an organization which must continue to deliver a research and development program which itself is in transition and facing increased expectations and demands.

- Agency status has removed a level of bureaucracy, thereby streamlining the organization's ability to deal with external organizations and industry. However, government contracting limits and procedures imposed by external departmental authorities continue to constrain DRDC activities.
- Providing DRDC with agency status has been viewed positively, both within the Defence S&T organization and by senior departmental managers. Internally, separation from an organization which has a distinctly different culture, focus and mandate (ADM(Mat)), has allowed DRDC increased latitude to direct its activities and resources to its own priorities for which it is uniquely suited without the constraints of policies, regulations or timelines of a larger and multi-focussed organization. External stakeholders to DRDC have viewed agency status positively, as the ADM(S&T) is now directly available to all Level One managers to contribute and participate in strategic decision-making and provide an S&T perspective on all DND and CF issues. DRDC is now viewed as a proactive participant in the strategic direction of the Department rather than merely a reactive provider of a R&D capability.
- At the program delivery level, many of the changes associated with obtaining agency status have remained transparent and as a result, has kept disruption of the R&D program to a minimum. However, transition planning and implementation has highlighted internal personnel and management issues that have existed in the organization and proved to be dissatisfiers in the past. Ownership of these issues and the responsibility to address them now rests within the Agency. While this provides a challenge and workload to the organization, it is viewed as an opportunity for positive change by the DRDC community.

3.17 **Organizational Relevance:** In order to provide for organizational relevance, it is essential to develop mechanisms which identify and reflect the needs of the client and stakeholder and to ensure that the organization's capabilities, programs, activities, outputs and results are aligned to meet those needs. It also includes being aware of the full range of scientific and technical knowledge that can be brought to bear on meeting client needs.

3.18 There are many factors that must be considered in implementing this general strategy. The first factor is the recognition of the various levels of clients whose needs must be met by the R&D program. In the case of DRDC, clients exist at the national level, the Department level, the Commands (and specific projects and initiatives within Commands), as well as international alliance and collaborative partners. In addition, various timeframes for satisfying these clients must be considered - from the immediate, intermediate and the long term.

3.19 Mechanisms needed to provide the R&D service will vary according to the nature of the work performed and the timeframes to be addressed. In order to meet immediate expectations of clients and stakeholders, direct interaction, involvement and communication in carrying out the research are the primary mechanisms. DRDC has accommodated this requirement through the use of the committee structure that requires commitment and involvement from its clients. Effective use of the R&D Program Board and the five Client R&D Overview Groups are critical

elements for ensuring ongoing client relevance. This mechanism, in turn, is supplemented by the Director Science and Technology positions (DST) which exist for each Client Group to manage the negotiated service level agreements (SLAs). In addition, to support DND and the CF as the corporate clients for strategic S&T policy advice, access and participation as a Level One manager (ADM(S&T)) provides the necessary mechanism.

3.20 It is important that staff of the R&D organization also understand that maintaining relevance includes more than providing scientific and technical competence. DRDC staff have a major role to play in ensuring relevant services are provided by paying careful attention to meeting client needs, demonstrating good project management skills and timely, client-friendly services.

3.21 For the intermediate and longer timeframe, mechanisms are required in addition to close communication with Client Groups as to their future needs. For the longer range timeframes, discussions with clients must be held at a different level, requiring a more strategic perspective from both the client and the Agency. Mechanisms such as the Technology Demonstration Program, the Technology Investment Fund (discussed at paras 3.44, 3.50 and 3.86) and the emerging Technology Outlook Thrust are in place to provide the opportunity to address intermediate-term relevance issues.

3.22 In most cases, for the longer term S&T services, the direct client is as yet unaware of the specifics of their future needs. In order to be prepared to address the problems that may present themselves in the future, the R&D community must begin to build the scientific and technical capability now. In proactively contributing to long term relevance of the S&T role, DRDC has carried out the following activities. They have worked closely with the strategic and operational planners of the Department to develop the Departmental Strategy 2020 and they have hosted symposia on future-focussed issues such as Modeling and Simulation, Concept Development and Experimentation, Joint Experimentation and many other topics.

3.23 The DRDC organization clearly has a desire to be recognized and distinguished as an 'innovative organization'. These types of organizations are typically characterized as receiving corporate support from the top of the organization, having a clear reward system for innovation, striving to be 'error correcting' rather than 'error free', willing to learn from the outside (benchmarking), and seeking input from all stakeholders in the planning and management processes of the organization.²³ DND has recognized these attributes, particularly as they relate to DRDC. The organizational status of the Agency and structures employed in the management of DRDC attest to the implementation of those factors that will support a meaningful contribution by DRDC to the achievement of the Department's strategic direction. However, the following organizational issues were presented to the evaluation team during the course of this review.

²³ Prof. Borins, University of Toronto. May 2000.

- While governance structures have been adopted by DRDC to maximize involvement and interaction at the operational and strategic levels, departmental governance structures have not been adjusted to reflect the evolving emphasis on issues such as the Revolution in Military Affairs (RMA), technology and other S&T matters that may have significant program implications. The absence of science and technology expertise was noted at the level of Armed Forces Council where it would ensure that program decisions could take adequate account of evolving technologies and approaches to modern warfare.
- Some ambiguity exists regarding the role and command and control relationships of the Scientific Advisors (SA) and the Directors of Science and Technology (DSTs). Scientific Advisors to each environment are double-hatted as the Directors General of their respective defence research establishments and are responsible for the management of their facility while notionally responsible for the research program conducted on behalf of their Client Group. The SAs are dependent on the science and technology directors at DRDC HQ who report to the Director General R&D Programs who are responsible for administering the R&D service level agreements (SLAs) for each environment. However, the DSTs have no line authority to influence the research work that is carried out at the DREs on behalf of the client. This has resulted in positions at headquarters (DSTs) which have been assigned management responsibilities for SLAs that have been negotiated with each Client Group, but who have no line authority or budget influence on the research activity that is carried out on behalf of the client. Similarly, Scientific Advisors have dual roles that are sometimes in conflict with each other. While the Scientific Advisors have management and accountability responsibilities for the program delivered at their lab sites, they are also responsible to their Client Group for the research program that may be delivered from multiple defence research establishments which are under the direction of other DGs or Scientific Advisors. While the governance or committee structure within DRDC provides a mechanism to coordinate program delivery on behalf of client groups, potential conflict exists in prioritizing activities between operation of the DREs and conducting R&D activities in the best interests of the client.

3.24 ***Interface With Director General Operations Research:*** During the course of this review, many interviewees raised the issue of the linkage and interaction between DRDC and the operations research function within the Department. This issue had been broached in the 1999 DRDB Client Satisfaction Survey and remains a topic of interest within the Department and CF. Director General Operations Research (DGOR) is a separate organization from ADM(S&T) that reports to the DCDS. DGOR is composed of military personnel and civilians who are mainly classified as defence scientists who are career managed in a similar fashion to those employed in DRDC. In carrying out their function, DGOR personnel are generally integrated into client organizations throughout the Department and CF, tasked directly by their client to perform activities within short timeframes - usually measured in weeks or months. The 1999 survey reported that many clients viewed these two organizations as being complementary and should

be more closely connected than they appeared to be. While the views from the Client Satisfaction Survey continued to be expressed during this evaluation, there did not appear to be an appreciation of the factors that distinguished the two organizations.

3.25 Internal sentiment within DGOR and DRDC does not support a stronger, formal organizational relationship between the two functions. Rather, increased collaboration and utilization of complementary skills on client-specific projects was seen as beneficial. While DGOR personnel have been seconded to work in DRDC, there is minimal flow of personnel from DRDC working in DGOR. Considering the nature of operational research work and scientific research work done at the research establishments, this one-way flow of individuals is understandable. There is currently close co-ordination of work plans between the two organizations involving bi-weekly meetings between DGOR and DGRDP (Director General R&D Programs), but the work programs themselves remain distinct in content and planning horizons. The timeframe for responsiveness, output delivery and other milestones for DGOR resources remains significantly different from that of DRDC. Research and development activity conducted by DRDC generally has a longer term research horizon (usually measured in years) coupled with a distinct scientific culture of 'knowledge innovation and creation' which contrasts with the shorter term 'knowledge application' type of work performed by DGOR.

3.26 The client satisfaction report (1999) concluded that there was no impetus for organizational realignment of these activities, but advocated that "increased collaboration between DRDB and the OR Branch would be beneficial". This sentiment was reiterated during this evaluation by departmental clients, DGOR and DRDC staff. Clientele were appreciative of efforts to combine appropriate resources from the two organizations when there was mutual involvement on projects of common interest and skills. Combining efforts of DGOR and DRDC staff on specific projects has proved more beneficial than attempting to align or integrate the planning processes of the two organizations. The ongoing relationship between DGOR and DRDC has been evolving and strengthening as aspects of the DRDC program delivery system mature. DGOR teams have become involved in Technology Demonstration Projects (TDPs) that are being carried out by DRDC, and as this process continues to evolve, the opportunity exists for increased involvement of DGOR personnel.

3.27 Designation of the Directors General of the Defence Research Establishments as Scientific Advisors to Environmental Commanders has provided the opportunity for increased visibility and information exchange between DRDC and the CF, similar to that which has been enjoyed by DGOR and her staff on a regular basis. While geographical distribution of the SAs at DREs across the country hinders opportunities for contact with senior clients as regularly or frequently as that enjoyed by DGOR, the mechanism exists to be exploited to the extent practical.

Conclusions relating to governance issues:

3.28 The evaluation team has concluded that:

- a. DRDC has adopted a governance structure which includes Special Operating Agency status which supports the management principles espoused in the 1990 Lortie Report and subsequent advisory and OAG Reports.
- b. The value, contribution and relevance of the DSAB has been questioned , particularly as it relates to meeting the requirements of the operational environments.
- c. The large number of R&D committees and the degree of client involvement required is often viewed as excessive by departmental clients and stakeholders.
- d. Despite the coordinating efforts of the existing R&D committee structure, overlap and duplication of R&D programs and activities conducted on clients' behalf appear to be happening across Defence Research Establishments.
- e. There is not a clear or consistent understanding or acceptance of the role of RDEC within the research community. This has led to inconsistent interpretation and application of decisions taken by this committee.
- f. Despite the aforementioned comments, R&D stakeholders felt the committee structure remains essential to ensure stakeholder involvement in the R&D program.
- g. Special Operating Agency Status for DRDC has been received positively by internal and external stakeholders to the organization. DRDC is now better positioned as a pro-active contributor to the strategic direction of the Department as well as providing an R&D/S&T capability.
- h. The working relationship between DGOR and DRDC is evolving and strengthening through the coordination of efforts at the Directors General level.
- i. As program activities such as the TDP become more mature, identification of cooperation and collaboration opportunities between DGOR and DRDC should increase.

Recommendations regarding governance issues:

3.29 The evaluation team recommends that:

- a. support be provided to the DSAB Revitalization Plan to ensure a source of sound external science and technology advice is available to the Department and DRDC;
- b. mechanism be developed and supported, such as the Defence Science Advisory Board Revitalization Plan, to ensure that departmental stakeholders and interested parties are provided ready access to the deliberations, analysis and advice that is presented by external S&T advisory groups;
- c. the role and decision-making authority of the R&D Executive Committee be clarified and communicated across the R&D community;
- d. the R&D committee structure be cognizant of the potential conflicts of interest that may exist between prioritizing activities between DREs and conducting R&D projects on behalf of their client organizations; and
- e. mechanisms for sharing information between DGOR staff and DRDC at the working levels be developed and encouraged, as well as the early identification of R&D projects that would benefit from mutual involvement in projects sharing common interests and skills.

PROGRAM DELIVERY

Background

3.30 DRDC has the significant challenge of delivering a complex, multi-faceted defence R&D program to a CF client who is an active player on the stage of an uncertain world. ADM(S&T) has provided a vision for the organization which is captured in the following words: “As Canada’s lead defence science and technology organization, our vision is to provide science and technology leadership to the Department, the Canadian Forces and the Canadian defence industrial base.” This vision is supported by a clearly stated mission and set of values to guide the ADM(S&T) Group to deliver its defence R&D program on behalf of DND and the CF.

3.31 While leadership, direction, program formulation, program oversight and senior level client interface are all functions carried out by staff at National Defence Headquarters in Ottawa, the bench-level R&D work is accomplished largely at five sites across the country. The following table identifies the sites, geographical locations and primary areas of focus of each DRDC Defence Research Establishment:

Table 4

DRDC Defence Research Establishments Location and Primary Areas of Focus					
Sites	Defence Research Establishment Suffield	Defence & Civil Institute of Environmental Medicine	Defence Research Establishment Ottawa	Defence Research Establishment Valcartier	Defence Research Establishment Atlantic
Location	Suffield, Alberta	Downsview, Ontario	Ottawa, Ontario	Valcartier, PQ	Dartmouth Nova Scotia (laboratories in Halifax and CFB Esquimalt)
Primary Focus	Chemical and Biological Defence Military Engineering Tactical Vehicles	Human Performance Human System Integration Operational Medicine	Radar Communications Electronic Warfare Information Operations Space Systems	Electro-optics Weapons Systems Command & Control Information Systems	Undersea Warfare Acoustics Marine Vehicle Technology

3.32 While Table 4 presents an overview of R&D program delivery in DND/CF, it understates the complexity of the program. Although each defence research establishment (DRE) has its own primary areas of focus, there is considerable cross-DRE activity that at times, blurs these lines. Delivery of an R&D product to a client often touches on multiple aspects of science, drawing on the talents and infrastructure of more than one DRE. As well, DRDC does not deliver its full capability in isolation. Instead, it provides service to the client by way of a combination of in-house activities at the DREs, working in cooperation with the ADM(Mat) EPM organizations, contracting with universities and industry, or working collaboratively with R&D organizations in other government departments or with international colleagues.

3.33 In order to manage the complexities of delivering this program, DRDC has established nine major 'Thrust' areas that are further subdivided into 30 specific areas of focus across four Business Lines. A fuller description of the program is readily available in various DRDC documents and will not be repeated here²⁴.

3.34 During the fact gathering phase of this program evaluation, the CRS team probed into a number of the R&D program delivery mechanisms to determine if they were meeting stated objectives and whether there were opportunities for enhancement or improvement. This section of the report will discuss the results of the CRS analysis.

²⁴ One example such documents is DRDC's, Looking Forward Staying Ahead ...As a New Agency, Defence R&D 2000 (undated).

Technology Investment Strategy

3.35 DRDC has statements of *Vision*, *Mission* and *Values* that have been cast in the context of what DND/CF has stated it is striving to accomplish through Strategy 2020. Clearly, the departmental S&T capability's role in contributing to the accomplishment of Strategy 2020 is intended to be significant and hence, close alignment between DRDC's plans for future activity and the DND/CF strategy is essential.

3.36 Publication of comprehensive statements of vision, mission and organizational values alone does not ensure that they will influence the strategic direction of the organization. In order to be effective, corporate messages must be reflected in mechanisms that will assist staff to carryout their day-to-day work. The Technology Investment Strategy (TIS) is one of the bridges that DRDC has developed to create the linkage between the work people are doing and statements of mission, vision and values. The objective of the TIS "...is to ensure that the CF of the future remains technologically prepared and relevant...".²⁵ In order to do this, 21 specific scientific areas have been identified for the R&D function. It is DRDC's intent that the 21 areas, viewed as *technology investments* by the R&D community, align with Strategy 2020.

3.37 In their own words, DRDC describes the Technology Investment Strategy as follows: "A Technology Investment Strategy (TIS) has been developed by Defence R&D Canada in response to a projected set of new capabilities that the Canadian Forces and DND will need in 2010 and beyond. These are required Outcomes of the TIS. The TIS identifies technology opportunities that will enable the outcomes and sets out a series of R&D Activities that will harness Technology Opportunities through the Delivery Vehicles."²⁶

3.38 While providing a touch-stone document to which DRDC personnel can relate their day-to-day work, the TIS also provides DRDC senior leadership with a strategy to anticipate the needed R&D capacity and position the organization to meet future demands. The long term nature of research is such that these lead times are needed so that the S&T function is ready to respond to meet CF operational requirements when called upon.

3.39 The TIS also serves as a useful mechanism to bring closure to R&D effort being expended on old technology. Interviews with clients and other stakeholders indicated some sense of frustration in the past in observing work being done in areas that they felt had limited potential to yield beneficial results to DND/CF. These interviewees felt that a consequence of devoting resources to old technologies was that current priority work was being deferred due to lack of available resources. If it functions as intended, the TIS should help to overcome this problem, as scientists will be able to relate their work to one of the 21 research areas. If this link cannot be made, then either the activities require adjustment or the work should be terminated. The evaluation team observed that the TIS serves as an overarching framework that is

²⁵ DRDC, Technology Investment Strategy for the Next Two Decades, (undated) back of the cover page.

²⁶ Ibid page 2.

complemented by activities such as the Technology Investment Fund, Technology Watch and Knowledge Management, Migration of Ideas, R&D Thrusts and the Technology Demonstration Program. (Each of these topics will be discussed in detail later in this section of the report.)

3.40 *Extent to Which the Technology Investment Strategy is Used to Guide the DRDC*

Program: Just as is the case with many initiatives in DRDC, the TIS is still a relatively new concept in the Agency. The intention to implement the TIS was announced in September 1999²⁷ and the Strategy itself has been published subsequently.²⁸ Accordingly, it has only been in the domain of the DS community and clients for a very short time. Nonetheless, the evaluation team noted that it was frequently raised as one of the key strategic working documents for the Agency at the director general and director levels. As well, there was some awareness of the strategy further down in the organization in the various DREs.

3.41 As a result of its observations, the evaluation team concluded that the TIS is being used to guide work done in DRDC, but that its utility appears to be almost exclusive to senior level personnel. Many interviewees at the working level in the DREs were either unaware of the document or stated that they did not use it as input to assess whether or not the work they were doing continued to be relevant. While decisions related to whether or not programs should be continued or terminated would normally rest with management, it would be beneficial for the working level to be able to relate the work they are doing to the goals for the CF, their respective DREs and DRDC. Accordingly, there are opportunities to strengthen the use of the TIS as a working document.

Conclusions Related to the Technology Investment Strategy

3.42 The evaluation team concluded that:

- a. the Technology Investment Strategy (TIS) is a well-reasoned and structured mechanism to ensure that investment in research and development activities is linked to the objectives defined in Defence Strategy 2020;
- b. when used as intended, the TIS should serve as an effective means of assisting DRDC in bringing closure to R&D work on older technologies that are no longer relevant; and
- c. the TIS has become a familiar working document for DRDC senior leaders and managers, but is less so further down the Agency's organizational structure.

²⁷ Department of National Defence, Chief Research and Development, Looking Forward Staying Ahead...Into the Next Century. September 1999, Page i.

²⁸ The Technology Investment Strategy is undated.

Recommendations Related to the Technology Investment Strategy

3.43 The evaluation team recommends that:

- a. efforts be made to increase awareness and understanding of the TIS at levels below senior management and that its use as a working document and tool be encouraged and promoted; and
- b. section heads and group leaders actively use the TIS as a mechanism to assess and validate the on-going relevance of R&D work.

Technology Investment Fund

3.44 The Technology Investment Fund (TIF) was established by the Research and Development Executive Committee (RDEC) in 1996 in order to encourage staff and external collaborators to put forward new ideas and explore new research areas.²⁹ The TIF is intended to make resources available to either DRDC staff or external collaborators to encourage research in areas considered to be high risk but offering high pay-off potential.

3.45 Approximately \$6M is set aside annually to fund the TIF which normally has 20 to 30 projects underway at any point in time. Typically, in the order of 10 projects per year start and a similar number wrap-up annually. Most projects have a three year time horizon, with annual budgets in the order of \$100K per year. Project proposals seeking TIF support are subject to peer review by academia, industry and members of the scientific community in other countries. As well, the TIF is an enabler to accomplishment of the TIS.

3.46 ***Processes in Support of the TIF:*** From an evaluative perspective, the CRS team examined processes associated with the TIF in order to determine if mechanisms were in place to promote optimization of the value for money obtained from TIF-sponsored activities. An annual report is prepared by the Technology Assessment Working Group (TAWG) highlighting current and new TIF projects, notable accomplishments, program changes and project resource information. In particular, the February 2000 report resulted in the development of six recommendations that were reflective of a critical internal examination of the program.

3.47 Due to the scope of this review, the CRS team did not examine individual TIF projects. The evaluation team did note however, that the application of an extensive peer review screening process, coupled with action-oriented TAWG-generated program-level recommendations directed at program deficiencies, combine to provide significant assurance that the TIF is receiving a reasonable amount of management oversight. Accordingly, the evaluation team is satisfied that there are processes and mechanisms in place to provide the necessary management oversight of this program.

²⁹ DRDC, Technology Assessment Working Group, Technology Investment Fund Annual Report February 2000.

Conclusions Related to the Technology Investment Fund

3.48 The evaluation team concluded that:

- a. the Technology Investment Fund is a reasonable means for researchers in DRDC and organizations with which it collaborates, to obtain short term funding to pursue high risk and reward research activities; and
- b. while it is early to make meaningful assessments on the overall effectiveness of the TIF program, DRDC has put mechanisms in place to manage and monitor this activity.

Recommendation Related to the Technology Investment Fund

3.49 The evaluation team recommends that implementation of the recommendations resulting from the February 2000 Annual Report on the Technology Investment Fund take place in a timely way.

Technology Watch and Knowledge Management

3.50 DRDC's senior leadership and that of DND and the CF are keenly aware of the critical role technology will play in the future. As captured in the words of the Department's corporate vision for 2020 "...We will exploit leading-edge doctrine and technologies to accomplish our domestic and international roles in the battle space of the 21st century and be recognized both at home and abroad, as an innovative, relevant, knowledge-based organization..."³⁰ This notion is front and center on the DRDC stage and is reinforced in its program documents³¹.

3.51 One way to facilitate DRDC staying abreast of emerging technologies in areas of interest to the CF is through Technology Watch. We emphasize that this is only one means of staying abreast of new technologies. In response to an observation made in a recent report by the Defence Science Advisory Board, ADM(S&T) opined "...Technology Watch can be a useful way of monitoring technology trends and opportunities, but it is not a substitute for science and technology knowledge or expertise that is required to assess and exploit the technology. This knowledge and expertise comes from performing research and development..."³² This sentiment aligns with the views expressed by the DRDC and client communities in the field. Interviewees indicated to the evaluation team that having first hand involvement with the science is essential to enable informed judgements to be made on the applicability or appropriateness of certain technologies in a Canadian military context.

³⁰ Department of National Defence, *Shaping the Future of Canadian Defence: A Strategy for 2020*, June 1999.

³¹ Department of National Defence, *Looking Forward Staying Ahead ...As a New Agency*, Defence R&D 2000, Page 8 (undated).

³² DND ADM(S&T), Memorandum 'Defence Science Advisory Report 99/1 "Technology Opportunities for the Canadian Forces in the 2010-2020 Timeframe"' 1150-110/D114 (DST Pol 7), page 1/2, 17 November 2000.

3.52 As one highly respected interviewee from a US defence organization pointed out “...\$500 billion to \$800 billion a year is being spent world-wide on S&T. A small country (like Canada) can leverage its investment in R&D if it strategically includes a formal technology watch program. For small budgeted countries with significant R&D needs, technology watch is particularly important...”³³.

3.53 Consultation with S&T officials domestically and internationally pointed out other relevant notions related to technology watch. Firstly, technology watch is a discrete function that should be integral to one’s day-to-day work across the S&T organization. The majority of personnel in the DRDC organization has technology watch responsibilities by virtue of their knowledge, position, contacts and nature of their work. Secondly, a certain minimum amount of structure is required around any scientific technology watch activity. An effective structure needs to have simple mechanisms for ease of two-way transmittal of information. There needs to be coordination of the technology watch information so that clients and scientists can access what is available in a particular technology area or even to be able to determine if no information has been gathered on certain technologies. As well, while database controls and gate-keeping of input are necessary, these mechanisms should not be labour intensive or overly bureaucratic and should encourage input from within and external to the DRDC community.

3.54 ***DRDC Involvement in Technology Watch:*** DRDC has shown leadership on the technology watch front, particularly in the international R&D community. ADM(S&T) staff has played a prominent role in The Technical Cooperation Program production of *Winning Techniques in Science and Technology Management: A Compendium of Best Practices*. The evaluation team was also advised that nationally, both inter and intra departmentally, DRDC staff has been working with other organizations to gather and codify Canadian technology and expertise.

3.55 ADM(S&T) has demonstrated a level of commitment to technology watch, in part, by establishing a new Thrust entitled ‘Technology Outlook’ which was put in place as part of Business Line 2 - S&T Policy and Advice. A level of effort equivalent to eleven full-time civilians is being applied to this area with expected expenditures to be in the order of \$650k. The primary objective for the Technology Outlook Thrust is “...to look out for emerging technologies and assess their potential relevance to Canadian defence...”³⁴. Focussing on technology watch within the Thrust structure, setting objectives and attaching resources to the effort, provide evidence of DRDC’s intent to continue to grow and develop this activity within their management framework.

3.56 ***Perspectives from the R&D Community on Technology Watch:*** A concern frequently raised with the CRS team was that researchers are often not involved early enough in DND/CF projects with technology implications. This lack of early involvement has technology watch implications from at least two perspectives. Firstly, the scientists cannot bring to the table technologies that they might be aware of, or might be able to conduct research in, in order to

³³ Kostoff, Dr. Ronald N., CRS Interview at the Office of Naval Research, Arlington Virginia, 28 September 2000.

³⁴ Department of National Defence, Draft DRDC Annual Report - 1999 - 2000, page54 (undated).

minimize the risk of the project heading down blind or unfruitful alleys. Secondly, if the research community is not aware of departmental projects that are being undertaken, they may not conduct focussed technology watch activities.

3.57 Concerns were expressed by senior departmental stakeholders and members of the CF that, in spite of DRDC's strong connections with other Canadian S&T departments and national and international collaborative partners, S&T information with potential military application may not be consistently shared with military colleagues. In fact, a perception exists that much of this information is retained within the S&T community. Some interviewees perceived that information that might be useful to operators, planners or managers is not easily transferred from the research to the user community to assist them in their day to day operations. Interviewees felt that information of a scientific nature is at times valued as a building block of S&T intelligence rather than for its wider application for the benefit of the military client. Again, early involvement of the defence scientists in military projects should contribute to mitigating these concerns.

3.58 ***Training for Technology Watch Activities:*** Many interviewees relayed the sentiment that there is no formal training process related to doing good technology watch. Many of the activities related to technology watch are done by rote or intuitively in the normal course of being a good scientist. Attending conferences, trade shows, and science-based symposia present opportunities to do technology watch. Additionally, peer reviewing papers, reading scientific journals, participating on scientific committees and participating in other collaborative activities are all part of the normal course of scientific personnel doing their jobs. The evaluation team was advised by acknowledged experts in the area of technology watch, that in order to fully exploit this activity, special skills were required in addition to normal research methodologies. As DRDC is placing increasing emphasis on this activity and formalizing it as a R&D thrust, attention should be given to specialized training in the areas of data mining, search protocols and information retrieval and storage.

3.59 ***Bridging the Gap Between Technology Watch and Knowledge Management:*** In order to fully exploit and leverage the benefits obtained from its technology watch activities, DRDC is making inroads into implementing a knowledge management strategy within its organization. One definition of knowledge management extracted from the literature is "...Knowledge Management is the practice of identifying, capturing, evaluating, systemizing and applying information and insights for the business of driving strategic business performance..."³⁵. The ADM(S&T) Group recognizes that knowledge management is a burgeoning area in research with the potential to provide structure, process and accountability to the activity of gathering information through technology watch. The Directorate of Science and Technology Policy has been assigned responsibility to advance the knowledge management capacity of DRDC. It has begun this process by doing research into how knowledge is generated and is probing into the development of tools to address issues of data accessibility. They are also active in fostering links in the international forum through activities such as the International Technology Watch Partnership (ITWP) of the TTCP.

³⁵ Friedman, Mark H., <http://www.intelligentkm.com>, "Barrier Bashing - Successful knowledge management initiatives rely heavily on linkages between people and technology, page 7, October 2000.

3.60 Once ADM(S&T) has established a corporate vision for knowledge management in DRDC, a strategy will need to follow which will address the scope of the activity in the Group and where it will be placed more permanently in the organization. Development of a knowledge management capacity through a structured capability within the Agency should facilitate the harnessing of knowledge. In the absence of a knowledge management strategy, there is a risk of information being lost, overlooked, or being isolated in pockets rather than being utilized for the benefit of all defence S&T stakeholders.

Conclusions Related to Technology Watch and Knowledge Management

3.61 The evaluation team concluded that:

- a. the importance of Technology Watch as a strategic tool to prepare the CF to deliver a combat capable force for 2020 is recognized departmentally and by the ADM(S&T) Group;
- b. Technology Watch is not a substitute for the conduct of scientific research, but is an important component of that activity;
- c. ADM(S&T)'s appreciation of the importance of Technology Watch is demonstrated by the establishment of a specific program Thrust (Technology Outlook - in Business Line 2) to address this issue and support assignment of resources;
- d. Technology Watch offers significant potential to leverage DRDC resources and capabilities to provide a comprehensive R&D program in support of the objectives of Defence Strategy 2020;
- e. optimum return on the DND/CF investment in Technology Watch will only be achieved if adequate structures are put in place to support the activity;
- f. DRDC has made significant contributions in advancing Technology Watch as a discrete activity in the defence scientific community;
- g. insufficient involvement of DRDC researchers in the early stages of departmental projects limits the potential benefits that could be derived from knowledge gained through Technology Watch;
- h. some of the benefits to be derived from Technology Watch will be lost if DRDC fails to hone and maintain a certain level of data mining skill sets within the departmental S&T community; and
- i. while knowledge management is still in its infancy in DRDC, the defence S&T community recognizes the corporate value of having a knowledge management capability and has assigned responsibility and invested resources to progress this activity.

Recommendations Related to Technology Watch and Knowledge Management

3.62 The evaluation team recommends that:

- a. Technology Watch be promoted within the DRDC organization and the Department as a tool which is complementary to the conduct of scientific research and development;
- b. DRDC support the Technology Outlook Thrust with formal structures such as technology watch data bases, mechanisms for sharing and disseminating information, and training in data mining to optimize investment in this activity;
- c. DRDC strongly promote the early involvement of the S&T community in departmental projects that may have new technology implications; and
- d. DRDC assess its specialized skill sets related to accomplishing Technology Watch to make sure that maximum benefit is derived from time invested in this activity.

Migration of Ideas - A Concept for Improving the Conduct and Management of Research and Development

3.63 This element of the Program Delivery section of the report examines the notion of 'migration of ideas' and how it applies to defence research and development. Migration of ideas is the concept of taking creative or innovative ideas, concepts or initiatives and determining how they can be shared or communicated with all relevant stakeholders. While technology watch has been acknowledged as a significant contributor to leveraging and exploiting the results of externally sponsored R&D, the sharing and dissemination of this information to potential users within the organization is an area where further improvements can be made. Technology watch, data mining and scientific literature searches are themselves disciplines for obtaining and extracting information for research purposes which are all based on the latest information technology concepts. However, a substantial amount of research may only benefit a limited number of potential users unless mechanisms exist to allow a wider audience to know what research has been done in the past, how it can be exploited presently and how to avoid mistakes that were made in previous developments.

3.64 DRDC places significant effort on building its professional knowledge base to advance its R&D contribution both nationally and internationally. The existence of effective mechanisms for 'migrating ideas' will contribute to the transfer and building of knowledge within DRDC and is critical to an organization that values creativity, innovation and learning.

3.65 The following paragraphs will examine migration of ideas within DRDC from the perspective of scientific/professional knowledge and as it relates to the management and administration of the organization. On a scientific basis, successful migration of ideas is pivotal for DRDC to achieve its scientific goals and objectives in an efficient manner without unnecessary delays or duplication of effort. From an administrative perspective, migration of ideas focuses on more effective and efficient ways to carry out the management processes of the organization.

Migration of Ideas - Scientific and Professional

3.66 A fundamental axiom of research and development is that a comprehensive literature survey be conducted before a research project is proposed or initiated. While this is normally carried out on an individual scientist or project basis, it may not be carried out on an organizational basis, resulting in inefficiencies through “re-inventing the wheel”, as each research group conducts surveys on their topical areas. The concept of migration of ideas can contribute to successful innovation and research which requires the perspectives and intellect of many people to be brought to bear on a problem or the search for a solution. In order to be effective, this activity must be encouraged and facilitated by the organization, rather than imposed as a requirement.

3.67 Barriers to migration of ideas are frequently a cultural issue in a research environment more so than a technical issue. As reported to the evaluation team by many interviewees, there is a very parochial view among scientists and the various research establishments where scientific work and progress is not readily shared, particularly in its formative stages. This view was reiterated by some managers who observed that a natural conflict existed between the conduct of the science, protecting the resultant information and sharing of ideas.

3.68 Interviews with defence scientists indicated that they felt there was an absence of communication networks between the various DREs to facilitate communication, dissemination and exchange of information. They indicated full support for a corporately sponsored ‘centre of expertise’ to warehouse ideas and expertise and share the results of ‘technology watch’. The requirement for a ‘Knowledge Centre’ as part of the Knowledge Management Strategy within DRDC was supported. Defence scientists related that, while R&D lessons are often documented for research projects, they are usually filed and seldom discussed at information forums. As a result, it is felt there is considerable duplication of effort and lessons are learned repeatedly.

3.69 A common issue raised with the evaluation team at several DREs was that their establishments lacked a physical space which would facilitate or accommodate sufficient numbers of people to host formal or informal meetings or gatherings for sharing or exchanging ideas. With infrastructure management now the responsibility of the Agency, the priority of this requirement needs to be considered among other resource demands.

3.70 Development of the Thrust approach has had both positive and negative impacts on migration of ideas. While cross-DRE efforts can be managed and coordinated under a single Thrust initiative, there is the potential for DSs to specialize within a Thrust, making cross-thrust transfer of knowledge more difficult.

Current Migration of Ideas Initiatives

3.71 Within the S&T environment, the contribution of migration of ideas to innovation is recognized. DRDC management has put in place several initiatives to encourage this activity to take place. While it remains early in the implementation process of many of the Agency initiatives, their impact and contribution to migration of ideas and their impact on the research community should be monitored. DRDC has taken the following steps to facilitate and promote 'migration of ideas' within the S&T community:

- The Network of Defence Partners in Science and Technology has been initiated through the efforts of ADM(S&T) which operates horizontally across the DREs and S&T federal departments. Its utilization and effectiveness influencing the work of defence scientists should be monitored.
- The facilities and faculty of Royal Military College in Kingston have been utilized for and contributed to Agency sponsored symposia on S&T themes and issues. During this evaluation, interviewees within DND and DRDC indicated that increased benefit and leverage could be obtained by the defence scientific community through greater utilization and collaboration with RMC, despite limitations which exist on its ability to participate on classified R&D projects.
- Thrust Advisory Working Groups and Thrust Leader Workshops have proven to be useful mechanisms for the sharing and migration of ideas, particularly for those working on a common Thrust. However, the 'double-hatting' of section heads as Thrust Leaders has introduced an issue of balancing the interests of a specific DRE against the overall effectiveness of a Thrust initiative. Migration of ideas that have applications across Thrusts is still not being accomplished to the satisfaction of members of the DS community.
- Thrust leader workshops organized by DSTs (Directors of Science and Technology) have been organized to promote the sharing of ideas amongst thrust leaders who are geographically dispersed across several DREs. These workshops are viewed as mechanisms to permit a sharing of ideas amongst Thrusts that are performing work for a common Client Group.
- DRE-sponsored seminar programs are also organized on a periodic basis to provide a forum for the sharing of ideas. While invitations are frequently extended across the DRDC organization to sponsors and client groups, the effectiveness of these forums is dependent on the rate and quality of participation.

- A network of Chief Scientists has been established as an additional mechanism to further the concept of migration of ideas. The Chief Scientist at each DRE is responsible for disseminating the results of the work done in their establishment and for exchanging information with other labs that would be beneficial to the work conducted in their lab. Interviewees commented that while the Chief Scientist was well-positioned to promote the sharing of ideas between DREs, information was not consistently passed to researchers and other DRDC staff at the Group level and below. Accordingly, the potential of this forum has not yet been fully exploited.
- Knowledge Management and work being done in the Technology Outlook Thrust are two closely related activities being pursued by the Director Science and Technology Policy (DST Pol). These are relatively new initiatives in DRDC which have been recognized for their potential to leverage resources and efforts within the research community. The impact of Technology Watch and Knowledge Management may have limited impact unless migration of ideas concepts are in place and exploited. As progress in these areas is pursued, their contribution should become significant to supporting the concept of 'migration of ideas'.

Sharing of Ideas for Administrative Support

3.72 Migration of ideas is not a concept limited to professional or scientific staff. During the evaluation team's discussions with administrative and senior clerical staff, concerns were expressed relating to the lack of opportunity for this group to share ideas, management information or administrative procedures that would ensure that accurate and consistent administrative practices were being carried out across the five DREs. Clerical staff expressed the view that considerable administrative inefficiencies existed across the organization as each DRE functioned with a considerable degree of autonomy without the benefit of updated procedural manuals, administrative orders or corporate direction. These problems were being compounded by the additional management and administrative responsibilities that accompanied their new Agency status. Staff felt that better administrative practices could be put into effect if successful practices, procedures or lessons learned at individual locations could be shared with colleagues across the community. In addition, the availability of Standard Operating Procedures, manuals and updated administrative guidelines were also seen as necessary tools to ensure accuracy and consistency in Agency administration.

3.73 The implementation of the Functional Direction Initiative within DRDC is fully supported by the administrative staff to address the requirement to provide the Agency with a sound administrative support system in all its functional areas. The proposal to develop procedure handbooks, administrative tool kits etc., are seen as positive and supportive activities. In addition to drawing on the input of administrative and clerical staff, the involvement of the network of Business Development Officers across the DREs should also continue to be exploited. Utilization of this forum has the potential to draw on successful initiatives developed at individual DREs when compiling the DRDC toolkit and procedures to support revenue generation and business development activities. The development of these tools and documents

should draw on the migration of ideas concept to ensure that input from all stakeholders is incorporated and that practical and successful lessons learned from across the community are incorporated.

Conclusions Relating to Migration of Ideas

3.74 In order to succeed at research and technological development, DRDC requires an organizational culture that not only encourages innovation, but also encourages an extensive exchange of information. As the organization grows in size and complexity, the sharing of knowledge becomes more important to ensure a net organizational efficiency by avoiding duplication or overlap of effort and making information available to the broadest segments of the R&D community. The need for migration of ideas increases with the need to innovate.

3.75 The evaluation team concluded that:

- a. defence scientists felt greater opportunities should be sought to encourage and facilitate communication, dissemination and exchange of professional and scientific information;
- b. organizational inefficiencies result from a lack of dissemination of technology watch information or research projects' lessons learned;
- c. DRDC has recognized the value and contribution of 'migration of ideas' and put in place several initiatives to encourage this activity;
- d. the lack of a suitable facility at some DREs is an inherent barrier to providing the opportunity to exchange and share ideas; and
- e. development and documentation of administrative practices and procedures would benefit from a greater exchange of experiences and lessons learned from across the R&D community.

Recommendations Regarding Migration of Ideas

3.76 The evaluation team recommends that:

- a. efforts to pursue a 'knowledge management strategy' should be fully supported by DRDC;
- b. a priority should be assigned to ensuring a physical venue is available at the DREs to facilitate hosting forums for the exchange of ideas between DRDC staff; and
- c. the Functional Direction Initiative be fully supported and encouraged across the DRE network.

Research and Development Thrusts

3.77 The defence R&D program is structured around five major ‘Thrust’ areas that are conducted on behalf of their client groups. These Thrusts are further subdivided into 30 specific areas of focus across four Business Lines.

3.78 DRDC describes the Thrusts as ‘delivery packages of R&D activities’. This view and understanding of the Thrusts is shared by clients and deliverers of the research and is generally well understood by those interviewed by the CRS evaluation team. It is noteworthy that the Thrusts represent a relatively new way of planning and delivering the R&D program (1994/95), and is continuing to be refined to best meet the needs of DND/CF.

3.79 Implementation of the Thrust structure for the R&D program has permitted greater flexibility in the utilization of resources across the DREs and has reduced the emphasis on technology-focussed research. Rather than focussing resource utilization on environmental technological requirements, organizing along Thrusts or combat capabilities has allowed a broader-based research contribution to be made to delivering the program and meeting client needs.

3.80 ***Client and Scientist Involvement in the Thrusts:*** A significant benefit that has resulted from implementation of the Thrusts has been increased involvement of the DND/CF clients in the R&D process. The Thrust Advisory Groups (TAGs) which are comprised of both DND/CF clients and members of the research community provide a ‘push’ and ‘pull’ effect on the S&T program. The ‘push’ comes from the DRDC personnel who, through development of expertise, technology watch and working collaboratively with clients and colleagues, have a wealth of S&T capability to bring to the table. Clients and operators provide the ‘pull’ effect in that they bring their operational challenges and problems to the table in search of technological solutions. Both the push and pull effects contribute to the building of a program to meet client needs through the exploitation of technology.

3.81 The management processes associated with the Thrusts, such as the TAGs, bring the push and pull forces together to develop the S&T program in support of improved combat capability. As the Thrusts create thematic focal points for the S&T program, the appropriate people are brought together to participate in the advisory groups and the nature of the subject matter is generally expected and understood by the participants. For the most part, the Thrust process works well from the perspectives of the service deliverer and the client. The following two paragraphs, however, highlight some of the challenges related to the Thrust approach.

3.82 ***Cross-DRE Challenges of the Thrusts:*** While the evaluation team received many positive comments about the Thrusts from both clients and scientists, some weaknesses were also identified. Interviewees representing both clients and the research community indicated a potential conflict of interest when Thrust leaders must administer program activity that takes place in more than one DRE. As Thrust leaders have no line responsibility for researchers from other DREs assigned to their Thrust, capabilities that exist in organizations other than their own DRE may not be fully exploited, supported or supervised to the optimal benefit of the Thrust.

3.83 Accordingly, when assessing whether the current system is functioning as well as it could, it appears that there may be benefit in making adjustments to the Thrust process, such as expanding the oversight role of the Thrust coordinator. However, the overall consensus of interviewees indicated that the structure has been well thought out and is fulfilling its intended purpose.

Conclusions Related to Research and Developments Thrusts

3.84 The evaluation team concluded that:

- a. the Thrust structure permits the R&D program to focus S&T activities on addressing CF combat capabilities rather than environment-specific technological requirements; and
- b. the Thrust approach has brought the client and service provider together to build and monitor the DND/CF S&T capability with positive results.

Recommendation Related to Research and Development Thrusts

3.85 The evaluation team recommends that the periodic client satisfaction survey include client feedback on the applicability and effectiveness the Thrust concept to meet their operational requirements.

Technology Demonstration Program

3.86 ***Background Rationale Supporting the Need for the Technology Demonstration Program:*** Scientific research, particularly basic research, does not generally thrive in a time-constrained environment. The break-through, innovative nature of the work that probes into areas that await skilled exploration, means that results that can be translated into improved combat capability are often slow to come. Following basic research comes applied research, development, prototyping, testing and evaluation etc. The lengthy timeframe from R&D to providing the operator with a working solution can be a significant source of frustration for the client. Similarly, this process can be frustrating for the scientist who feels they have made a potentially relevant discovery, but is unsure sure how to progress to the next step.

3.87 Client concerns on issues related to the timeliness of R&D activities were captured extensively in the 1999 DRDC Client Satisfaction Survey.³⁶ While time horizons for the R&D community tend to be long, clients have certain timeliness expectations of the departmental S&T capability. A decade ago, the Lortie report described an environment where there was “...great pressure on government S&T facilities to respond to developments in increasingly complex fields of knowledge with static or shrinking resources and within time-frames that must

³⁶ AeroVations Associates, REPORT ON CLIENT SATISFACTION SURVEY - Conducted on behalf of Defence Research and Development Branch (DRDB), Appendix C, 30 August 1999., pages 3-8.

increasingly be compressed...³⁷ In 1999 the SAGE report offered its views on the timeliness issue by stating "...Accelerating changes in the global economy are creating a new environment in which governments must operate and to which federal S&T must contribute..."³⁸

3.88 While not all aspects of an R&D program can be adjusted to deliver a final product in a more expedient fashion, the Technology Demonstration Program is one which specifically addresses this issue. The TDP, whose primary objective is '...to demonstrate technologies fostered by Defence R&D Canada (DRDC) and Canadian industry in the context of real and potential future Canadian Forces capabilities, concepts, doctrine, operations and equipment...' ³⁹ addresses the timeliness issue through its sub- objective "...TDP projects are typically 3-4 years in duration and are necessarily fast paced to ensure relevance of the program results and access to state-of-the-art concepts for operational deployment..."⁴⁰

3.89 The TDP is unique from other aspects of the DRDC program in that it is not premised on furthering basic research - which is generally not well-suited to being accelerated according to pre-determined time-frames. As well, the TDP is not the former Major Development Program - which had a systems or hardware orientation. Rather, it has a specific focus on concept validation - exploring and evaluating advanced technologies to assess their applicability to the military client and to provide direct and timely input to force planners and acquisition managers.

3.90 In support of the TDP, DRDC has put in place a project management process that is similar to the Defence Management System (DMS) in support of DND/CF's Program Management Board (PMB). However, the TDP approval process is more streamlined for purposes of timeliness. Fiscal Year 2000/01 is the first year for the full TDP planning and management cycle. The TDP is well supported by comprehensive instructions provided for use by Agency and departmental personnel and can be accessed on the DRDC internet site. As well, a comprehensive governance framework and screening process overlay the Program to ensure that only valid and appropriate submissions are considered. In addition, all project proposals are subjected to a competitive process to obtain funding and resources through the TDP.

3.91 **Constraints of the TDP:** DRDC is clear in its *Technology Demonstration Guidebook*, that TDP is not suited to every potential S&T project. Accordingly, as discussed in the immediately preceding paragraph, clear criteria are applied in the screening process with the intent of ensuring the validity of this concept and that the program functions effectively.

3.92 **Alignment of the R&D and the Procurement Process:** The transition of R&D programs into subsequent engineering and acquisition stages has generally been a hurdle in the life of a research project. In spite of their orientation toward taking expedient approaches to project advancement, successful TDPs still face these challenges as DRDC strives to provide a leading edge, technologically-based capability to the military in a timely way. The challenge was

³⁷ Nation Advisory Board on Science and Technology, "Federal Science and Technologies Expenditures Committee", November 1990, page 6.

³⁸ Council of Science and Technology Advisors, *Science Advice for Government Effectiveness (SAGE)*. May 1999, page 10.

³⁹ Defence Research and Development Canada, *The Technology Demonstration Handbook*, Version 1.0, April 2000, Page 3.

⁴⁰ Ibid.

present before the union of ADM(Mat) and the former DRDB and continues today after the two organizations have separated. Interviewees expressed views on direction that the Department should and should not take in closing the chasm between successfully completing a TDP and actually putting the technology in the hands of military operators.

3.93 From the perspective of what should not be done, consistent views from within and outside DRDC indicated that placing comprehensive procurement and acquisition expertise within a scientific organization would not be practical when DND/CF already has this capability resident in ADM(Mat). In offering thoughts on what should be done, interviewees generally agreed that Directors General for Equipment Program Management in the Materiel Group should continue to provide a focal point for procurement for each environment. Recognizing these circumstances, interviewees also indicated that to fulfill their roles as departmental acquisition and procurement managers, EPMs are the logical choices as centres of expertise to ensure that proven S&T concepts advance along the acquisition / procurement route.

3.94 In spite of the apparent fit between the need to progress TDPs that have valid application in a CF environment and the existence of the ADM(Mat) capability to put acquisition mechanisms in place, finding ways of crossing that final hurdle remain.

3.95 While the US Advanced Concept Technology Demonstration (ACTD) program is premised on similar rationale to the DRDC TDP, the evaluation team was advised that the former provides for a transition manager with responsibility to move a concept from demonstration to actual technology development. As this aspect of the program is not addressed by the TDP, there would be value in examining whether the US experience, or some variant of it, would be applicable in a Canadian context.

3.96 ***Availability of Project Management Skills:*** Project managers and project leaders are currently appointed from the research and development community. These positions are normally staffed by defence scientists who manage the project, liaise with industry, and ensure that the required collaboration takes place. Evaluation team interviews with incumbents in these positions indicated that as defence scientists, they were not always well-equipped with the appropriate skill sets of project management. Accordingly, it was suggested that obtaining project management skills or suitable project management training be an essential component of the Technology Demonstration Program.

3.97 ***TDP in the Context of Risk Management:*** As discussed in the Risk Management section of this report (para 3.244), the short timeframes and relatively small investment in each Technology Demonstration Project to evaluate the technology contribute to risk management of the Defence Services Program. Prior to the TDP, large sums of money could potentially be put at risk through investment in technologies that would not be accepted or utilized by the CF. Through the TDP process only a modest investment is made to prove a technology and obtain a sponsor. It is only once the technology is proven and client interest and support is secured, that a larger and more expensive program can be initiated.

3.98 ***TDP as a Relatively New Program:*** The TDP is a relatively new initiative in DRDC (1999) and as a result, both DRDC staff and many potential CF clientele are not yet well-acquainted with the process. In order to improve the familiarity and acceptance of this program, DRDC has published a comprehensive TDP Guidebook (April 2000) which provides a tool kit of procedures and management structures to better acquaint stakeholders with this process. A final program review for each TDP evaluating its successes and lessons learned is required by the Guidebook. As the first TDP projects come to completion, there would be value in preparing a summary annual report evaluating overall program effectiveness and determining changes that would benefit future projects.

Conclusions Related to the Technology Demonstration Program

3.99 The evaluation team concluded that:

- a. the Technology Demonstration Program is a reasonable response to the requirement to address timeliness and relevance concerns related to delivery of the defence R&D program;
- b. DRDC has made the distinction that the Technology Demonstration Program is not intended to impact longer term basic research, but rather targets specific concept demonstration initiatives that can be progressed in shorter timeframes;
- c. the DND/CF and the Agency have experienced difficulty in the past in transitioning the results of research and development to the procurement/acquisition phase of the project life cycle;
- d. appropriate project management skills are essential to the success of the Technology Demonstration Program; and
- e. the Technology Demonstration Program contributes to departmental/CF efforts to mitigate and manage risk.

Recommendations Related to the Technology Demonstration Program

3.100 The evaluation team recommends that:

- a. consideration be given to the transition of the project management role from ADM(S&T) to ADM(Mat) for Technology Demonstration Projects that will progress to the acquisition/procurement phase;
- b. ADM(S&T) ensure that appropriate PM skills and training are employed on TDP projects; and
- c. ADM(S&T) ensure that an annual program level review and report be conducted and prepared for the Technology Demonstration Program.

CLIENT SATISFACTION

Background

3.101 DRDC has surveyed its clients in the past as a mechanism to determine program relevance, ensure that client needs were being met and assess where course corrections needed to be made to improve the R&D service delivery. The most recent broadly-based independent client satisfaction survey was conducted in 1999.⁴¹ Given the currency and apparent thoroughness of this assessment, the evaluation team did not duplicate this survey.

3.102 Discussions with the senior management cadre in DRDC however, indicated that the Level One leadership in DND and the CF had not been polled regarding their views of departmental S&T services being provided to their organizations. Accordingly, interviews were conducted by the evaluation team to determine the level of senior stakeholder satisfaction and highlight any issues or concerns that they might have.

Level One Issues

3.103 *Finding the Balance*: Generally, senior stakeholders expressed high levels of satisfaction with the services being provided by DRDC. Environmental commanders were unanimous in their recognition of the importance of a strong R&D capability. The Level Ones recognized the need for both strategic and tactical R&D capabilities and expressed some concern about DRDC finding the right balance to meet their needs.

3.104 Finding the balance between preserving resources that can commit to long term research activities to yield results five to ten years downstream, and applying resources to meet nearer term operational requirements, is an ever-present challenge in the R&D world. DRDC clients are not consistently aware that DRDC's ability to respond in a timely way to a near term operational requirement is made possible largely because of the anticipatory work that has been done over several years preceding a particular event.

3.105 Senior DRDC managers, particularly at individual defence research establishments, feel that finding the balance is an on-going challenge that is demanding of considerable management attention. As well, it is noteworthy that this pressure varies across the DREs. The review team observed that physical proximity to the client was a factor that affected the degree to which this pressure was felt on an on-going basis. Defence Research Establishment Atlantic (DREA) is an example of a DRDC service provider being located closely with its Navy client in Halifax harbour. The Navy has become accustomed to receiving an R&D tactical service which consumes on average, about 25 per cent of DREA's human resource effort. Efforts by DRDC managers to place a more long term, strategic emphasis on the program must be balanced against the need for the provision of timely client-service to satisfy more immediate operational demands.

⁴¹ AeroVations Associates, REPORT ON CLIENT SATISFACTION SURVEY - Conducted on behalf of Defence Research and Development Branch (DRDB), 30 August 1999.

3.106 Figure 1 graphically depicts this significant program dynamic that characterizes an ever-present challenge facing deliverers and receivers of R&D services in DND/CF. This issue is raised to highlight that how this dynamic is managed by DRDC personnel interfacing with their DND/CF client will have a bearing on the level of satisfaction with the service they receive. A further factor deserving of consideration in this analysis is the spectrum of CF client needs that require DRDC attention.

**Figure 1
The Tactical and Strategic R&D Program**

20 per cent	5 per cent	75 per cent
Tactical (immediate to short term, operational orientation)	Flexibility (DRDC & client participation/negotiation)	Strategic (visioning/planning/innovating/2020)

The CF has a keen interest in DRDC being available to address its tactical R&D requirements by analyzing, trouble-shooting and providing near-term solutions to today’s high priority problems. The long term planners and others involved in positioning the CF for 2020, whose focus is more strategic in nature, are looking to that aspect of the R&D capability to provide visioning, planning, longer term innovative work and to participate in laying the ground work for the future. While this is not an easily managed issue, finding and maintaining an acceptable balance is essential to the optimal delivery of an effective R&D program.

3.107 This dynamic is discussed to highlight the on-going nature of this challenge and indicate the need for DRDC and their clients to work together to influence the fine-tuning of this balance. Monitoring how this dynamic changes and making program adjustments to accommodate those changes is important, as working for prolonged periods of time where the balance isn’t right will have a significant impact on the R&D program’s relevance and delivery.

3.108 ***Influence of the Level Ones on the R&D Program:*** A primary concern expressed by Level Ones to the evaluation team was that they did not feel current mechanisms allowed them sufficient opportunity to influence the DRDC program. In forums such as DMC, AFC and PMB⁴², Group Principals are briefed on an R&D program that has been developed for implementation. However, Environmental Chiefs of Staff (ECSs) feel that the plan is too far-advanced by then to allow any meaningful discussion or debate. Unanimously, the Environmental Chiefs saw value in having the opportunity to sit down at least annually with ADM(S&T) personally to discuss issues that were of concern and relate how the R&D program integrated with programs and strategies of their respective environments. The evaluation team is fully supportive of such a process, as dialogue at this strategic level should clarify understandings among the key stakeholders of the work done by DRDC and its potential to contribute to improved combat capability.

⁴² Defence Management Committee, Armed Forces Council, and Program Management Board.

3.109 The perception exists at the ECS level that the DRDC program is structured along silos serving different segments of the CF. This is in contrast to the intent of the ‘Thrust’ approach implemented in 1995, which strives to go across DREs and places a greater emphasis on improved CF combat capability. While the Thrust approach is relatively young in comparison to the more than fifty-year-old Canadian defence R&D program, it has been in place sufficiently long that its cross-DRE functioning should be evident. Discussions with DRDC personnel at various levels indicated that the cross-DRE aspect of the Thrust program is functioning to a greater or lesser extent depending on the area of science, the personnel involved and the degree to which the work is advanced. There would be benefit in DRDC reinforcing with the ECSs how the Thrust approach is functioning to ensure full understanding of the principles underlying delivery of the R&D program.

3.110 **Leadership:** There was unanimous agreement among the ECSs and senior departmental managers consulted by the evaluation team that DRDC has a strong senior leadership cadre in place. These interviewees attributed recent successes such as CRAD obtaining Level One status, being re-titled ADM(S&T) and obtaining Agency status for the overall organization, as accomplishments made possible largely through the efforts of DRDC’s current senior leadership cadre.

3.111 Level One Managers expressed support that the R&D function was represented at the ADM level and that the organization was now better positioned to serve the interests of DND and the CF more effectively. The evaluation team has highlighted the favourable leadership circumstances that exist in the DRDC organization as leadership is critical in keeping the right strategic focus for the Agency and has a significant influence on levels of client satisfaction with the resultant R&D service.

General Issues Related to Client Satisfaction

3.112 **Renewal and Downsizing:** A key finding from a departmental study of organizational change and management renewal in the mid 1990s was captured in the following quote. “...Organizations that attempted to renew and downsize concurrently found that downsizing created such a high level of anxiety among employees that it was difficult to focus sustained attention on reengineering until the downsizing was completed...”.⁴³ During this period of departmental downsizing, DRDC realigned some of its internal processes and reduced its administrative and support staff. However, the successful new initiatives and changes in program delivery currently in place in DRDC, such as the Thrust System, the Technology Investment Strategy and the Technology Development Program were not implemented until *after* the cloud of downsizing was lifted from the organization. As a result, the defence R&D community was more receptive to implementing new approaches to doing business as they had regained some of their previously diminished enthusiasm.

⁴³ Department of National Defence, Chief Review Services Program Evaluation Report - E6/95 Organizational and Renewal in DND and the CF, March 1996, page14/23.

3.113 Following this sequence of implementing change has resulted in a more successful introduction of new programs and initiatives by staff that believe the threat of downsizing has passed. There is now a more positive outlook in the new Agency environment. This sentiment has not been lost on the client population that perceived a sense of a rejuvenated atmosphere and relationship with the providers of R&D services.

3.114 **Overall Client Satisfaction:** The 1999 Client Satisfaction Survey⁴⁴ captured the following view of the defence R&D organization as expressed by those polled: "...DRDB staff are unfailingly professional and helpful. Advice and guidance are usually insightful and always sound. Additional adjectives such as 'dedicated', 'competent' and 'eager' were often used by client representatives...". These comments align with the views obtained by the evaluation team from the majority of interviewees with whom discussions were held during the course of the evaluation.

3.115 **Action Taken Resulting from the 1999 Client Satisfaction Survey:** While there were many positive results apparent in the 1999 survey⁴⁵, areas requiring management attention and action surfaced as well. In its Annual Report⁴⁶ following the survey, DRDC discussed some of the actions it had taken to address deficiencies or apparent deficiencies that surfaced during the survey. Some of these actions included: examining the timeliness of service delivery to the CCIS Client Group and clarification of R&D's role in command and control in the Department; responding to the client survey report recommendation to provide Client Groups with a better understanding of the DRDC capability; improving the effectiveness of the R&D Program Review Committee and improving user friendliness of Service Level Agreements with the five Client Groups; and addressing issues related to the operational medicine program.

3.116 It is noteworthy that DRDC has taken steps to address aspects of their operation that were deemed to be deficient rather than consider the client survey as only a routine evaluation tool. The DRDC view is that the client survey serves as a valuable management tool to be used to strengthen the departmental R&D capability.

Conclusions Related to Client Satisfaction

3.117 The evaluation team concluded that:

- a. DRDC recognizes that client satisfaction is an important aspect of its business and has put mechanisms in place to monitor it on a periodic basis. DRDC has also taken steps to address deficiencies that surface as significant issues;
- b. finding a balance between meeting the tactical (operational) and strategic R&D needs of the military client is an on-going challenge requiring judicious management by the ADM(S&T) Group and significant client involvement and participation;

⁴⁴ AeroVations Associates, REPORT ON CLIENT SATISFACTION SURVEY - Conducted on behalf of Defence Research and Development Branch (DRDB), Appendix C, page 3, 30 August 1999.

⁴⁵ Ibid.

⁴⁶ Defence Research and Development, Annual Report 1999 - 2000, page 32.

- c. clients of the departmental R&D service at the Environmental Chief of Staff (ECS) level feel they do not have sufficient opportunity to influence the strategic direction of the R&D program, and would benefit from periodic one-on-one dialogue with ADM(S&T);
- d. ECSs perceive the R&D program to be functioning in silos and do not have a full understanding of the cross-DRE intent of the R&D program Thrusts;
- e. the senior management team of DRDC is generally highly regarded by senior client stakeholders in the Department and the CF and by members of the R&D community;
- f. continuity and relative stability in the management cadre during this period of standing-up new program initiatives and the Agency supports the notion of management accountability and should contribute favourably toward program success; and
- g. overall, client satisfaction with the Department's R&D capability is high and program delivery areas requiring improvement that have come to the attention of DRDC leadership are being addressed.

Recommendations Related to Client Satisfaction

3.118 The evaluation team recommends that:

- a. DRDC continue to obtain an independent, bi-annual Client Satisfaction Survey, ensure that it is thoroughly analyzed and briefed to DRDC staff and that an appropriate action plan is developed to overcome identified deficiencies;
- b. DRDC work closely with its client groups to find and maintain an appropriate balance between strategic and tactical work conducted at the DREs; and
- c. ADM(S&T) meet annually on a one-on-one basis with each of the Environmental Chiefs to discuss the alignment of DRDC's programs with operational priorities.

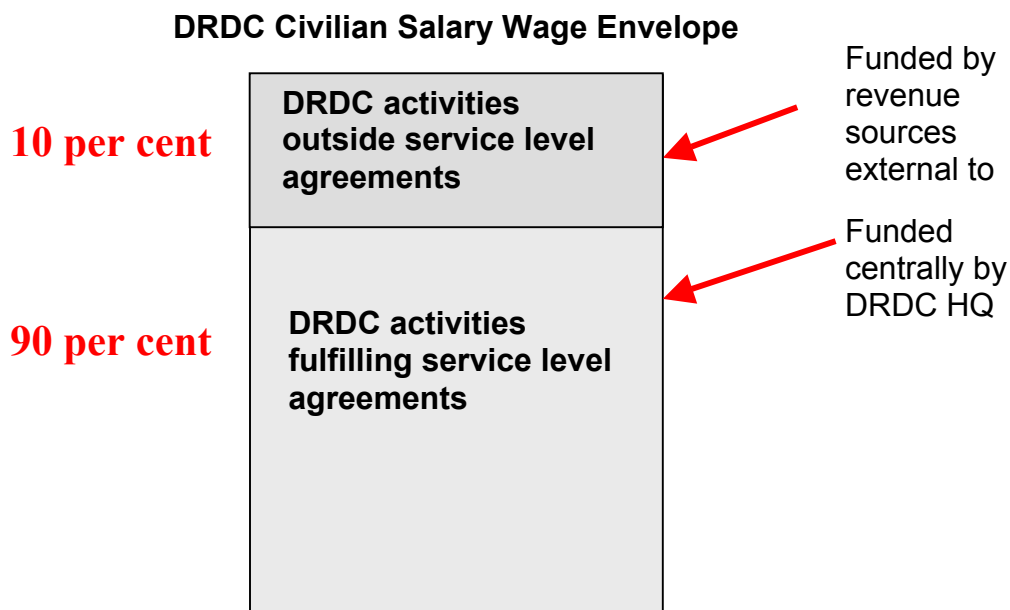
REVENUE GENERATION

Background

3.119 As a result of budget reductions during the last decade, DRDC senior management examined the departmental R&D program to look for ways to best manage an effective program with 25 per cent less funding forthcoming annually in its departmental allotment.⁴⁷ As the organization looked at options to absorb the last, and perhaps most difficult of the budget reductions, the ability to maintain a critical mass of personnel and infrastructure became an issue. As Defence Research Establishment Pacific (DREP), a significant CF Naval-oriented research capability had already become a casualty in the down-sizing process, DRDC leadership explored a range of options with the intent of preserving the remaining five establishments. As well, there was a conscious effort made to preserve an appropriate number of professional and support personnel to continue to fulfill the R&D mission and mandate.

3.120 The option of revenue generation surfaced during these planning discussions. A notional formula of 10 per cent of the Salary Wage Envelope, which would yield approximately \$10M per year by FY 2004/05, was established as a target for revenue generation from external sources⁴⁸. It was also decided that there would be a gradual ramping-up to this figure over a four to five year period. Revenue targets were assigned to each DRE, proportional to the DS population at each of the respective sites.

FIGURE 2



⁴⁷ Director General Research & Development Business Administration, “Historical Funding Analysis” table, 20 September 2000 - in budget year dollars displays nominal overall budget reduction of \$57M between 1991/92 and 2000/01 - this does not take account of inflation that would result in a larger percentage budget reduction in real terms.

⁴⁸ DRDC HQ, Looking Forward and Staying Ahead - Defence R&D Canada 2000, undated.

Reaction of the DRDC Community

3.121 The ADM(S&T) organization's reaction to the prospect of generating revenue externally in order to meet salary wage envelope shortfalls has been mixed. Some DRDC staff see it as an opportunity to exploit under-utilized facilities, preserve a critical mass of highly specialized professionals, preserve unique and aging infrastructure and position the organization to renew and re-build for 2020 and beyond. Others felt somewhat neutral to the notion of revenue generation and are taking a laissez-faire attitude.

3.122 A third group within the defence R&D community, which is not large but nonetheless vocal on the topic, expressed reservations about the notion of revenue generation. Some of the concerns expressed by interviewees included:

- coping with pressures to generate revenue will distract DRDC staff from doing sound and operationally relevant science;
- there are no reward or recognition mechanisms in place to ensure DSs are given adequate professional credit for participating in revenue generation activities;
- as DSs, they do not normally have the skill sets to do revenue generation; and
- policies, procedures and lexicons are not yet in place to support the activity

Benchmarking Revenue Generation with Other Nations

3.123 As noted in Table 2, 'Benchmarking DRDC with Other Defence S&T Organizations', neither Australia, New Zealand nor Denmark have invested significant effort in revenue generation in the past. However, Denmark is now looking more seriously at this notion for the future. By contrast, the United Kingdom's Defence Evaluation and Research Agency (DERA) has an established revenue generation process in place and the resultant revenues are retained for Agency use. Clearly, organizations that are authorized to retain revenues for their own use have a much greater incentive to pursue revenue generation opportunities than those who must return generated revenues to a central fund. With Agency status, DRDC now has the authority to retain its revenues. With a departmentally-imposed target of internally funding up to 10 per cent of its SWE, it is motivated to pursue this source of funding.

3.124 Interviewees in defence establishments in the US shared their revenue generation experiences with the team as well. In order to support the marketing of their services and ensure appropriate fees were levied, representatives from the US Naval Research Centre at Carderock described the costing system they put in place to capture such items as labour rate, materials, sub-contracts, testing fees, and other overhead. Carderock determined a requirement for four labour rates and three site specific overhead rates resulting in 12 different composite rates being charged depending on the nature of the work and where it was done. As well, the US Navy applies varying surcharges dependent upon whether the client comes from the private or public sector.

3.125 It is noteworthy that many of the issues that have already been faced by other nations are common to those being dealt with by DRDC. Accordingly, it is clear that there is much that can be learned from allies that have put revenue generation mechanisms in place prior to DRDC.

DRDC Approach to Revenue Generation

3.126 As is the case in launching any new initiative, there is a range of ways to implement revenue generation in DRDC. The approach selected by DRDC has been to establish target criteria relative to the population of DSs at each of the DRE sites. With what the DREs perceive to be minimal guidance, they have been requested to start small if necessary and build up their respective revenue generation capabilities so that the overall DRDC organization will have sufficient business initiatives, contracts and relationships in place by FY 2004/05 to generate approximately \$10M in annual revenues. The following table⁴⁹ depicts revenue generation targets established for each DRE.

Table 5

DRDC Revenue Generation Targets				
Revenue Targets (\$K)	FY 1999/00	FY 2000/01	FY 2001/02	FY 2002/03
DREA	779	1090	1744	1980
DREV	1055	1700	2723	3095
DREO	624	1235	1973	2245
DCIEM	445	770	1233	1400
DRES	498	705	1127	1280
Totals	3401	5500	8800	10000

3.127 *Establishment of Business Development Capabilities:* DRDC HQ has established a corporate business development office and directed that each DRE put in place a business development capability at their respective sites. In visiting the various DREs, the evaluation team observed that the individual establishments are at varying stages of establishing their business development capabilities. While most of the DREs are of the view that the business development officer should be a scientist first and acquire the business/marketing skills later, one DRE has taken the opposite approach. In this instance, they have taken the position that the business understanding is the more needed ingredient now and the scientific expertise can be obtained as needed, from within the respective laboratories. Each DRE has been given the latitude to implement their business development capability in a way that is best suited to their unique circumstances.

⁴⁹ Department of National Defence, ADM(S&T), 'Business Plan - Business Line 3, FY 2000/01', 15 September 2000.

3.128 While most DREs have established a full-time business development officer, one DRE has staffed the position on a part-time basis with a senior DS resource. Some of the DREs felt comfortable that sufficient business would come to them and there would be little need to actively market their services. Others were concerned that they did not have products that were readily in demand in the commercial marketplace and would have more difficulty meeting revenue generation targets.

3.129 The initial skill sets required by the business development officers across the DREs will vary, at least at the outset. However, with relatively weak costing systems or costing systems that are in the very early development stages across most of the DREs, there will be a near-term requirement for a focus on the business, costing and accounting aspects of the business development process. Over the longer term, once sound costing capabilities have been established, the right mix of business and scientific skills will need to be re-assessed and the balance determined and fine-tuned to meet local circumstances.

3.130 *A Framework for Business Development:* In discussions with personnel in various positions across the DREs, there appeared to be widely disparate views on what qualified as revenue. Some readily acknowledged that lack of a centrally provided framework or guidelines has left them to draw their own conclusions on many matters related to revenue generation. Some DRDC personnel believe that any in-flow of funds is eligible for consideration as 'generated revenue' whereas others felt that it needed to be generated from outside of DND and some selectivity as to sources of revenue was important. Others were concerned about the problems associated with adoption of an 'anything-for-a-buck' attitude which could serve as a significant source of distraction from the core R&D program and run the risk of incurring excessive expenditures in order to meet established targets.

3.131 As discussed in the preceding paragraphs, the DRDC approach to revenue generation has been to get out of the starting blocks fairly quickly, albeit in a relatively small way. This process has involved establishment of revenue targets, getting the DRDC personnel used to the notion of generating revenue and allowing systems such as costing guidelines, criteria for assessing opportunities for revenue generation, a policy framework and other central guidance to follow. The outcome of this approach is indicated in following paragraphs.

3.132 Although DRDC is only at the early stages of transitioning to an Agency, all of the DREs have had some experience in revenue generation that predates this status. However, reporting on and accounting for program accomplishments and recognition of the need to maintain a 'critical mass' of scientific resources, has placed greater visibility and importance on revenue generation activities. As a result, questions are being raised by the DREs regarding revenue generation that require consistent solutions across the community. Questions raised by the DREs during this evaluation regarding revenue generation include:

- What types of revenue should or could be included as revenue generation for a DRE?
- What will be the basis for charging fees?
- For DREs that might provide common services, would rates for those services be determined nationally or locally?
- Will more than full costs be recovered in certain circumstances?

3.133 In addition to these questions, DREs expressed the following concerns. Contractual issues regarding revenue generation opportunities frequently require the benefit of legal counsel in the areas of contract and commercial law which is not readily available to business development officers at individual DREs. While legal advice can be sought through the CF Legal Advisor (CFLA), concerns regarding availability, timeliness and validity of this type of counsel in the Department/CF were raised. As well, some concern was expressed about the inefficiency of DREs individually exploring various matters related to contractual arrangements or discovering ways of dealing contractually on an international basis, but not having an opportunity to share this knowledge with colleagues (see Migration of Ideas, para 3.63).

3.134 It is noteworthy that when business development is being conducted locally with minimal corporate guidance, there is significant potential for this to be a costly and inherently inefficient endeavour. The DRDC organization must recognize that these inefficiencies become an added cost of approaching an activity such as revenue generation in the absence of a policy framework. A potentially positive outcome of such an approach is that follow-on policy and procedure development should benefit from the input of experiences from the field.

3.135 ***Criteria for Assigning Revenue Generation Targets to the DREs:*** Some concern was expressed by interviewees relating to the appropriateness of the present criteria used to assign revenue generation targets to the DREs. The evaluation team was advised during discussions with interviewees in DRDC that basing the revenue targets on numbers of DSs per DRE was somewhat of an arbitrary formula to assign responsibility for meeting revenue generation objectives. Basing revenue generation objectives on the proportion of the DS population at each DRE reflects the assumption that each DS has an equal opportunity to make a revenue contribution towards established targets. However, this assumption is not universally supported across the defence R&D community in light of the diversity of research activity conducted, nature of scientific specialties and the commercial marketability of research products, skill sets or facilities that are available across the DREs.

3.136 The initial criteria used as a basis to assign revenue generation objectives to the respective DREs, although considered by some to be somewhat arbitrary, enabled targets to be established at the outset. As the current criteria have already been assigned, they could serve as interim, notional planning figures for the DREs. However, there is a need in the longer term for site-by-site assessments to determine longer term potential revenue generation opportunities that would better align with work already being performed in support of the DRDC mission. Once these assessments are completed, there would be value in revisiting the revenue generation targets at each DRE to ensure that they take adequate consideration of practical revenue generation potential at each site. As well, the capacity of each DRE to generate revenue is constantly evolving and varies as new skill sets and areas of expertise are developed. Accordingly, a static formula for assessing potential to generate revenue may be less appropriate than a periodic reassessment of a broader range of criteria.

3.137 ***Training for Revenue Generation:*** Acquisition of skill sets related to generation of revenue is not normally part of the training of a defence scientist. Accordingly, when entering the arena of revenue generation and business development, most DSs are doing so without the benefit of some of the requisite tools. Some DSs expressed frustration as they felt that pursuit of revenue generation goals was made more difficult when provision of tools to accomplish the objective lagged the requirement to proceed with the initiative and meet established targets.

3.138 ***Strategic versus Tactical Approach to Revenue Generation:*** Another issue that surfaced during interviews in the field was the notion of strategic and tactical approaches to revenue generation. Some interviewees were concerned about potential negative impacts of revenue generation on their other scientific work. They were also concerned that taking an approach to revenue generation that involved pursuit of numerous small contracts could be administratively burdensome and time-consuming while yielding only modest results. This issue relates to having appropriate costing tools in place and developing a sense of return on investment. An informed assessment of the worth to the Agency of engaging in revenue generation activities from an economic perspective is needed, so that the right revenue generation opportunities are pursued for the benefit of DRDC and the client.

3.139 ***Client Concerns Related to Revenue Generation:*** Clients expressed concern regarding what impact DRDC's pursuit of revenue may have on program delivery to the CF client. DRDC personnel were generally well-informed about the concept that revenue generation work falls outside of the service level agreement and that only 90 per cent of the DRDC salary wage envelope was available to be applied towards work agreed to in those agreements. In contrast, the client was less clear on these notions and expressed concern that the DREs would get caught up in the pursuit of revenue opportunities at the expense of delivering on the service level agreements.

3.140 In early days of meeting revenue generation targets, DRDC personnel responsible for revenue generation will have to be mindful of keeping the right balance between satisfying revenue generation requirements and meeting commitments agreed to in the various service level agreements. While in theory this should not be a problem, in reality, surge demands on either service level agreements or revenue generation aspects of the program could potentially present challenges in delivering both services adequately.

Intellectual Property as a Source of Revenue Generation

3.141 Intellectual property is a complex area requiring knowledgeable staff to manage these assets effectively and to be available to provide on-going policy development and advice. Due to its relative complexity, intellectual property is not normally a source of revenue that is accessed quickly, but rather one that builds up over time. Funds yielded through the exploitation of IP ebbs and flows depending on market conditions for the related technology. Accordingly, building a revenue stream from IP results from judicious management and monitoring of this group of assets.

3.142 *Importance of IP to DND/CF*: As defined in the current draft DAOD ‘...IP is property that is the product of the human mind or intellect (i.e., innovation or creativity). IP is distinct from real estate or personal property though the law grants it property-type protection. IP is an all-encompassing term widely used to designate as a group, those forms of subject matter covered by the following fields of law: patent, trademark, unfair competition, copyright, trade secret and the right of publicity...’⁵⁰

3.143 IP is important to the Department and the CF as it can have commercial value and the owner can apply for and secure legal rights to this created information in much the same way as legal entitlement to a tangible piece of property. In arguments supporting a business case for the Agency, ADM(S&T) declared the importance he placed on IP by stating “...Effective Intellectual Property Management is a pillar of our strategy to generate revenues and leverage the R&D program to the benefit of our stakeholders...”⁵¹ As well, while IP has not been closely managed in the past in the Department, there was little incentive to do so as resultant revenues flowed back to departmental reserves or the consolidated revenue fund. With revenues now retained by ADM(S&T) and available to support the R&D program, there is clear motivation for the organization to pay increased attention to monitoring and managing its IP. From a personal perspective, staff in DRDC are motivated to pay attention to IP as a result of the Public Servants Invention Act. While in the past, 15 per cent of generated revenues was the ceiling for amounts that could be paid to PS inventors, a TB policy change in the mid 1990s now enables up to 35 per cent of generated revenues to be paid to the inventor.⁵²

3.144 Policy guidance pertaining to Intellectual Property from the Treasury Board Secretariat is limited. However, in response to this general guidance, DND has issued two interpretation documents⁵³ which have proved to be effective in providing a framework for the management of IP in the Department. While this policy guidance has been beneficial to the DND/CF’s IP function, the major area of weakness has been the tracking and inventorying of IP in departmental stove-pipe data bases. As a result of this shortcoming, tracking and monitoring of revenues that should have been forthcoming from IP has not been managed vigilantly and consistently. Interviewees felt that license renewals and revenues from other IP sources may not have been collected consistently in the past. Maintenance of IP data in stove-pipe data bases has limited access to this information and views were expressed that the information in these data bases may be inaccurate and/or incomplete.

⁵⁰ Department of National Defence, Directorate of Intellectual Property, ‘DAOD 3008-1, Reporting and Ownership of Intellectual Property’ DRAFT October 1998.

⁵¹ Department of National Defence, CRAD, “DEFENCE RESEARCH AGENCY BUSINESS CASE: SUPPLEMENTARY REPORT”, 1959A-1(CRAD), 28 June 1999.

⁵² Department of National Defence, Directorate External Scientific Activities, ‘A Guide to the Technology Exploitation Process - for CRAD Scientists and Managers, Annex D DND Award Formula for Inventors’, 1996.

⁵³ Department of National Defence, Directorate of Intellectual Property, ‘DAOD 3008-1, Reporting and Ownership of Intellectual Property’ DRAFT October 1998 and Department of National Defence, Directorate External Scientific Activities, ‘A Guidance to the Technology Exploitation Process - for CRAD Scientists and Managers, 1996.

3.145 While responsibility for departmental management of IP formerly rested with ADM(Mat), the operational responsibility for IP management of R&D IP has now shifted to ADM(S&T) with Agency status. Policy responsibilities and IP management for the remainder of the Department remain with ADM(Mat). ADM(Mat) and ADM(S&T) staff work together to ensure consistent application of IP policies. DRDC business development staff is anxious to address tracking and data base issues to ensure that a solid management structure is in place to provide optimum support to its revenue generation objectives.

Conclusions Related to Revenue Generation

3.146 The evaluation team concluded that:

- a. The concept of revenue generation as means of preserving a critical mass of S&T personnel and infrastructure is a well-reasoned response to budgetary pressures.
- b. The requirement to generate revenue at the DRE level has preceded the establishment of the necessary management framework to support this effort over the long term.
- c. While active pursuit of revenue generation targets in advance of building the requisite support structures is inherently inefficient, it is producing early results to meet interim targets and is generating valuable lessons learned. This approach should contribute to further policy and procedural development.
- d. Criteria for allocating revenue generation targets for each DRE may not readily align with the capacities and capabilities of those organizations to generate sustainable revenue.
- e. Concerns exist among DND/CF clients that revenue generation may be carried out by DRDC at the expense of client service.
- f. Some allied defence R&D organizations have well-established revenue generation capabilities that offer significant potential as information sources for DRDC as it develops its strategies, lexicons, policies and procedures in support of revenue generation.
- g. The value of intellectual property is recognized in DRDC and progress is being made to position the organization to ensure that maximum benefit is derived from these assets.
- h. DND has sound IP policy and guidance documents in place that align with TBS direction.
- i. Database management for IP has been lacking in the past and this deficiency is recognized as an immediate concern within the ADM(S&T) Group.

Recommendations Related to Revenue Generation

3.147 The evaluation team recommends that:

- a. DRDC HQ draw on the revenue generation experiences of the DREs to develop practical policies and toolkits in support of the revenue generation activity;
- b. DRDC leverage on the benchmarking information available from allied forces with well-established RG capabilities in place;
- c. support capabilities (such as appropriate legal counsel and training) be put in place to facilitate implementation of revenue generation in DRDC;
- d. criteria for establishment of revenue generation targets at the DREs be revisited, validated, and adjusted periodically based upon site-by-site assessments of opportunities to generate revenue; and
- e. DRDC progress activities to secure management controls related to IP to ensure that revenues to which the Department is entitled are monitored and collected.

HUMAN RESOURCE MANAGEMENT

Introduction

3.148 In order to fulfill its role as a critical contributor to the combat capability of the CF, DRDC must employ enthusiastic, innovative, creative and highly educated scientists, engineers and supporting personnel to carry out their mission. DRDC must be able to compete with the private sector for the best talent, make job offers in a timely manner, and offer rewards and recognition that are practical, relevant and meaningful to the employee and the organization. Although DRDC has been established as a Separate Operating Agency, an accepted premise is that it is people and not structure or management systems alone, that create, innovate and conduct research and develop technologies that meet the current and future needs of its clients. Human resource (HR) issues that affect the provision of research and development/science and technology have been core discussion topics in the many studies and reviews of science and technology conducted in the past decade and the subject of specific studies by the Auditor General.⁵⁴

3.149 During the conduct of this evaluation, the following principal themes emerged in the arena of human resources. These major themes (along with several minor themes) will be discussed in the section below: workforce demographics, recruitment and retention, morale and leadership. Several more general HR issues will be discussed at the end of this section.

⁵⁴ 1994 OAG Report - Chapter 10 - Management of Departmental Science and Technology Activities.
1994 OAG Report - Chapter 11 - The Management of Scientific Personnel in Federal Research Establishments.
1999 OAG Report - Chapter 9 - Management of Science and Technology Personnel - Follow Up.
1999 OAG report - Chapter 22 - Attributes of Well Managed Research Organizations.

Discussion

3.150 **Workforce demographics:** Of the many human resource management issues facing government S&T organizations, the demographics of the scientific workforce, characterized by a generally aging population, is one of the more serious. Current demographics are also a fundamental contributor to many of the additional HR issues faced by S&T organizations that must be addressed to ensure a sustainable R&D/S&T capability. Benchmarking conducted by the CRS review team, research conducted by the Canadian Council of Science and Technology Advisors⁵⁵ and findings reported by the OAG in 1999⁵⁶ identified the universality of this phenomenon and the impact that it has on the national capability to conduct government-sponsored R&D.

3.151 The demographic trend that has been experienced in S&T communities worldwide is attributed to several factors. A significant portion of scientists employed by governments were hired three decades ago and will exit the workforce within five to seven years. In North America, this situation has been aggravated by a slowing of the number of foreign students and scientists that are arriving from off-shore⁵⁷. Workforce reductions during the 1990s resulted in cuts to the S&T communities compounding the effects of normal attrition. In addition, recruiting and hiring efforts remained in a hiatus for several years after those reductions took place, thereby accentuating the aging workforce.

3.152 The following tables present a demographic profile of the workforce within DRDC. A preponderance of employees in the 40 to 65 year old age-bracket in all occupational categories emphasizes the community's concern regarding rejuvenation, recruitment and its ability to sustain a 'world-class' defence science capability.

Table 6 - DRDC Age Profile

Work Group	under 24	25-39 years	40-65+ years	Total Population
Defence Scientists	.003 %	26 %	74 %	377
Professional Scientific Support	2 %	29 %	69 %	97
Technical Support	1.2 %	23 %	76 %	251
Admin Support	1.6 %	17 %	81 %	304
All Staff	1 %	23 %	76 %	1,029

⁵⁵ Hickling, Arthurs, Low. The Roles of the Federal Government in Performing Science and Technology: An International Perspective. Prepared for Canadian Council of Science and Technology Advisors Secretariat Industry Canada, April 1999.

⁵⁶ 1999 OAG Report - Chapter 9 - Management of Science and Technology Personnel.

⁵⁷ OECD 1998. Technology, Productivity and Job Creation - Best Policy Practices.

Table 7 - Years on Strength at DRDC

Work Group	less than 10 years	11-25 years	26-35+ years
Defence Scientists	22 %	53 %	25 %
Professional Scientific Support	27 %	55 %	18 %
Technical Support	17 %	49 %	34 %
Admin Support	20 %	55 %	25 %

3.153 In addition to the 1,029 civilian positions, there are 32 established military positions in DRDC HQ and across the DRE network. These positions are augmented by approximately 20 reservists. There are also 80 DGHS (Director General Health Services) military personnel who work at DCIEM in Toronto, but they are not DRDC positions. One of the functions of the military positions is to provide project management functions for R&D projects conducted on behalf of military clients and participation in the TDP. In addition, military positions at the DREs also provide a formal liaison role between scientists, their research projects and their military clients. This role is particularly vital to facilitate two-way access between the CF and the scientific community, which would not easily be achieved by research scientists alone. In addition, support roles such as administration support, public relations and communications functions are provided or complemented by CF members, allowing scientific staff to perform functions more appropriate to their classification.

3.154 The integration of military personnel throughout the DRDC organization was considered a strength of the Agency by clients interviewed by the CRS team. Although most military personnel are not involved in the conduct of R&D projects, their presence and availability to scientists at the DREs provides immediate input and feedback to scientists on the practicality and applicability of many projects under development. Military personnel provide scientists with client contacts and access to the departmental matrix that would be time-consuming and distracting to develop on their own. While some CF positions are specifically designated as liaison positions, all military members in DRDC have a liaison role to fulfill in addition to their primary duties. Military personnel who have completed a posting with the research organization have developed an enhanced perception of the role of R&D and become more knowledgeable clients and users of the capability subsequent to their posting in DRDC. As a result, employment of military personnel in the DRDC environment and follow-on postings should be managed in order to exploit their R&D experiences. Utilization of military personnel within DRDC and on subsequent postings provides valuable leverage of limited R&D resources.

3.155 As noted at Tables 6 and 7, 70 per cent to 75 per cent of all categories of R&D staff are over 40 years of age and 75 per cent to 80 per cent have between eleven and thirty-five years of experience within the defence science community. While this maturity and experience offers real strength to the organization where scientists have established a strong international reputation in the scientific community, it now offers a significant challenge to replace or sustain this calibre of expertise. Some inroads have been made in the demographic profile of the organization as recruitment efforts are being focussed on the technological growth areas directed by the Technology Investment Strategy. One example is the establishment of the Information

Operations Section (IO) at DREO that provides the opportunity to address some of the demographic imbalance that has evolved in recent years. Establishment of this section has resulted in recruiting 'new blood' from universities in a new technological area. Tasking of the IO section with critical and highly topical internet information and system security work has provided the opportunity to affect community demographics by attracting young scientists in an emerging field, as well as meet critical R&D requirements. Further application of the TIS in other technological growth areas should continue to improve the demographic imbalance within DRDC's scientific community.

3.156 As the spectrum of scientific issues expands, researchers within DRDC have become spread very thinly as they try to represent Canadian interests at international forums or collaborate internationally on a broad range of topics. Due to the limited number of scientists who are able to represent Canadian defence interests at tri-lateral Technology Cooperation Program meetings, bi-lateral networks and at NATO meetings, it is difficult to conduct both ongoing R&D projects in the labs as well as carryout collaboration and representation functions internationally. Maintenance of a critical mass of R&D resources is an essential contributory factor to ensuring that an acceptable level of productivity and efficiency exists within an R&D organization.

3.157 Establishing an absolute number to define an appropriate critical mass of scientific capability is very subjective. However, having insufficient resources available may also contribute to inefficiencies that prove false economy for the organization. Maintenance of a critical mass of R&D capability allows researchers to carry out their work in an environment where they can focus on the conduct of their research activities and competently represent that expertise in other fora. Without the existence of a critical mass, researchers find they may be spread so thinly that they are not able to demonstrate emerging technologies, complete new research, represent national defence science interests, conduct ongoing management and administration responsibilities, as well as mentor and supervise assigned staff. In addition, maintenance of a critical mass of researchers contributes to greater organizational efficiencies by allowing for greater synergy amongst scientists, fruitful migration of ideas and increased creativity and leveraging on the work of others. Similarly, ensuring that sufficient resources are available allows researchers to carryout lengthy research experiments without being frequently disrupted to become involved in other issues.

3.158 DRDC has recognized this need to maintain a critical mass of scientific capability by establishing an objective in its 2001/2002 Business Plan to increase its in-house effort devoted to R&D by 20 per cent by 2004. Similarly, DRDC identified in its Business Plan that 200 additional S&T workers would be required to staff nine of the 21 technical areas identified in the Technology Investment Strategy that are required to meet the objectives of Strategy 2020. While Departmental funding has not been provided for such growth, DRDC has pro-actively committed to generating funds internally through its own revenue generating activities to augment its salary wage envelope. The ability to make the commitment to generate funding that is considered essential to maintain a defence science capacity and a 'critical mass' appropriate to meet the objectives of the organization, has only been possible by obtaining the status of a Special Operating Agency.

3.159 **Recruitment and Retention:** In the 1994 OAG Report, it was emphasized that renewal of the scientific workforce in the federal government would be essential if it is to remain creative and productive over the long term. In 1996, the OAG found that work force reduction had meant a loss of experienced scientists to the community and that the challenge of renewing and recruiting scientific personnel was even greater than in 1994. Following work force adjustment, recruiting and hiring efforts remained in a hiatus for several years and remain a challenge due to competition from industry, academia and from other countries. In Canada and particularly DRDC, additional hiring and recruitment challenges are presented due to competition for highly qualified and relatively scarce scientific specialists and the salary disparities which exist between some scientific specialties in government and those in industry. DRDC, as a defence research organization, is constrained in its attempts to attract new scientists by federal government hiring policies and practices which are not sufficiently timely, flexible or innovative in comparison to those used by private industry or to meet the expectations of recent university graduates. The requirement for DRDC employees to obtain a security clearance further limits the pool of potential candidates from which DRDC can select. As a result, DRDC management, particularly at the DRE level, expressed a concern that they are constrained in obtaining the numbers of new recruits that will be necessary in the next decade, and not be able to attract the 'best and the brightest' to maintain a leading edge reputation for defence R&D.

3.160 DRDC does engage in recruiting efforts through its support of university graduate research programs, sponsoring ongoing graduate studies for DSs, providing researchers access to DRDC facilities and monitoring high potential term employees and contractors. However, at this stage in the transition to Agency status, both employees and DRDC managers indicated there was little visibility of any formal or corporate recruitment efforts by DRDC that would assist or facilitate individual DREs in their hiring efforts. As they have had very little experience in the past five years hiring scientific staff, coupled with only recently acquiring personnel management and staffing responsibilities as part of its Agency status, DRDC is current lacking a visible and sophisticated recruitment strategy that will be required to successfully recruit scientific staff on a large scale in the near future. Further development of the HR tool kit and HR strategies by DRDC HQ staff with particular attention to recruitment strategies, will better position the organization to attract top quality candidates to DRDC as an employer of scientific professionals. Active support is encouraged by DRDC of the federal government recruitment strategies recommended in the Public Service Commission study, *Facing the Challenge - Recruiting the next Generation of University Graduates for the Public Service* and reiterated in the 1999 OAG Report (Chapter 9). It is anticipated that these efforts will further improve recruitment options for the science and technology community.

3.161 As stated in the Report of the Standing Committee on National Finance (1999), the government's future capability and capacity in science and technology will depend on its ability to recruit and then retain high-calibre scientists. Given the cost to recruit and train new employees (particularly in the area of defence science where it takes several years before a scientist becomes a knowledgeable defence scientist), it is essential that efforts are equally visible to retain employees as it is to hire them. Without high-calibre employees in place to nurture and develop young scientists and technologists, there is the risk that the community will not achieve the results it expects from recruitment⁵⁸.

⁵⁸ 1999 OAG Report - April - Chapter 9.

3.162 Both DND/CF and DRDC have expressed a desire to establish themselves as ‘employers of choice’ to help recruit and retain employees. This involves not only providing competitive salaries, but also creating a work environment in which employees feel challenged, valued, and have the opportunity to grow and develop. Discussion at paras 3.163 and 3.171 regarding *Morale* and *Leadership* address internal factors impacting retention efforts in DRDC.

3.163 **Morale:** Having attained departmental and Special Operating Agency Status, DRDC management is now able to devote time and attention to building a performance culture in the organization. A performance culture is one that allows innovation and creativity to flourish, garners commitment from all levels in the organization to achieve its objectives, encourages ownership and responsibility for results, simplifies business practices and rewards performance. A measure to gauge progress in this direction is an assessment of the morale of the scientific and support community and the steps that are being taken to address existing issues.

3.164 DRDC recognizes that the success of the R&D function is critically dependent on the skills, innovation and expertise of its staff and their support and commitment to achieving the goals and objectives of the organization. During the timeframe of this evaluation, there was considerable transition activity taking place as Agency status was being acquired and new directions and strategies were being developed. Concurrent to this implementation activity, human resource management at DRDC HQ and at the DREs were active in identifying HR issues and concerns of their community to develop strategies and programs to capitalize on their strengths and address problem areas expressed by their staff. The following paragraphs are an overview of the concerns and perceptions that were reflected by the staff to the CRS team. Although many of these concerns have already been voiced to DRDC in various HR fora, their continued existence within the community indicates that further attention and monitoring will be required if real changes are to be made in the delivery of a defence R&D capability.

3.165 A common message communicated to the evaluation team is that both management and the scientific community are striving to achieve a common organization culture and environment in which to work. The desirable attributes of the organization culture that were described and sought by all staff included an environment that fostered innovation and risk-taking, encouraged sharing of ideas, was a learning organization and encouraged teamwork, while rewarding and recognizing individual contributions. Members of the scientific and scientific support community also indicated that they expected maximum internal communication respecting future plans and ongoing activities, supportive management and a lean administrative overhead structure. Their expectation of the administrative overhead structure is that it would relieve professional staff of many administrative and management tasks rather than assigning, delegating and coordinating tasks which are to be carried out by the professional staff as a result of de-layering in the organization. In addition, DRDC staff stated that they valued clear organization goals which should be reflected in their research projects, having specific strategic direction, crisp project execution and a meaningful reward structure that would reflect and reinforce organizational goals.

3.166 During the course of the fact finding interviews of this evaluation, the following issues and concerns were presented to the evaluation team which reflect the sentiments and perceptions held by the scientific and support communities. While Agency status has provided DRDC management with authorities and administrative flexibilities in HR management, it is uncertain at this early stage of transition, what impact they will have on the attitudes, culture and overall morale of the community. While DRDC has several initiatives underway to address these issues, the following is an overview of both the positive and negative perceptions held by DRDC staff.

3.167 The following HR concerns were expressed to the evaluation team which impact the morale of the defence science community:

- a. DRDC staff in all classifications have been given the expectation that they will be career managed in a fashion similar to that used for defence scientists. This has elevated expectations of the engineering and technical support staff to a level that, in the absence of any visible outcome, will generate a degree of cynicism and skepticism that may affect their commitment to fulfilling other aspects of the Agency vision.
- b. While 1/3 of DRDC is comprised of management and administrative support personnel, scientific and technical personnel feel that their management and administrative responsibilities are increasing at the expense of conducting their scientific and research activities. While the preparation for and transition to Agency status has imposed a degree of administrative workload, the ongoing involvement of scientific personnel to support, contribute or participate in management activities is seen as excessive in light of their professional expectations and workload and the criteria against which they are evaluated.
- c. Wage discrepancies cited between industry and public service scientists were frequently quoted as an area of concern for DSs and engineering staff. However, the successful efforts by the DRDC leadership on behalf of the scientific community before Treasury Board to secure the one-time “terminal allowance” demonstrated to the community management’s efforts on their behalf and recognition of their value in the marketplace. However, the inequitable distribution of the allowance over all categories of scientific and technical support categories has been counter-productive to the concept of teamwork within the community. Despite these issues, all staff within the Agency were able to cite many positive factors about working in DRDC which offset perceived salary discrepancies. These positives included working in an environment of professional and scientific freedom, flexibility in pursuing research topics and the nature of defence R&D work in general.
- d. The introduction of revenue generation by the Agency has received mixed reviews by DRDC staff. Although the financial implication of revenue generation is not a large portion of DRDC’s program, it has received significant attention from the DS staff. While revenue generation provides new opportunities and approaches to conducting R&D activities, staff are primarily concerned that they

have received insufficient training, direction or guidance to carry out this activity, and that their professional responsibilities in the area of revenue generation are unclear. A significant concern of the DS staff is that traditional personnel evaluation programs and reward/recognition mechanisms will not take into account revenue generation efforts or achievements and that R&D efforts on behalf of defence clients may be affected. It became apparent to the evaluation team that additional communication efforts on the part of management specifically to address the concern of staff are required to further assuage the DS community.

- e. Many staff felt that the personnel evaluation system used for defence scientists and scientific support staff was not congruent with the actual responsibilities of providing an R&D capability to the CF or the accomplishment of the objectives set forth by the Agency. While a streamlined appraisal system has been developed and criteria for ranking performance defined, staff felt activities such as mentoring or supervising new or young scientists was not recognized, time spent doing field experiments was detrimental to their publishing efforts, liaising and problem-solving for CF clients was unrecognized and revenue generation activities were not included in performance criteria. Again it became apparent to the evaluation team that specific communication efforts must be made to address these concerns of the DS community and provide answers to their questions.
- f. DRDC staff in position-based classifications, expressed concern regarding the inconsistency of classification levels for similar work and responsibility between DREs. Many employees felt their classification levels were determined by comparing classification levels assigned to other DND employees in the same geographical area rather than similar functional areas in other DREs. Similarly, personnel in position-based classifications felt they had insufficient opportunities for promotion at DREs where there were a limited number of positions, despite their own personal growth, experience and initiative. Similarly, position-based employees were managed inconsistently between DREs as some establishments offered few promotion opportunities while others would offer promotion through the re-writing of job descriptions to reflect increased experience and responsibilities. The Functional Direction Initiative has the opportunity to make improvements in this area. Strategies and progress to implement greater consistency in classifications and personnel management should be communicated on an ongoing basis to the R&D community.
- g. A significant factor impacting the morale of DRDC research staff is a perceived lack of understanding or appreciation of their role and function by their primary stakeholder - the CF. The competing demands and expectations placed on the defence scientist is not always fully understood or appreciated by the military client. One instance is the publishing of scientific research results, which may be necessary for the establishment and maintenance of their international reputation and credibility in the scientific community, while at the same time, the military client looks to the DS to satisfy his immediate operational requirement. While the

CF client seldom attends scientific conferences, poster sessions or reads scientific journals, they do expect leading-edge technology to be available. A balance needs to be found between the expectations of the client populace and an understanding of the activities and functions that are necessary on the part of the researcher to address those needs.

- h. A positive factor impacting the work environment of the R&D staff is that they feel their research work is well supported by the provision of unique facilities and computer and scientific equipment at their respective DREs to accomplish the projects that they undertake. Although the physical infrastructure is generally dated (1950 - 1960 vintage) and relatively inflexible in its adaptation to frequent changes in program emphasis, it did not present a significant factor in the morale or levels of employee satisfaction in the R&D community.

3.168 DRDC has been made well aware of the importance of issues impacting morale as they have pursued and begun to make the transition to Agency status. They appear to have made it one of their highest priorities to continue to develop a supportive relationship with their employees and to provide them with a working environment conducive to first-rate individual performance.

3.169 Although Separate Employer Status was originally sought as an approach to address some of these issues, decisions were made in consultation with TBS and senior DND management to seek improvements through the existing governance structure. DRDC HR management has instituted a Cultural Change Working Group representing all sites and occupational groups to assess and devise strategies to improve existing issues. While there has been insufficient time for changes or improvements to take effect, the R&D community has placed high expectations on this group achieving visible, positive and concrete outcomes. Management must remain vigilant that the expectations of their staff and commitments made to their staff during the planning and transition phases of Agency status, do in fact address the issues that have been brought to the foreground.

3.170 Individual DREs are also making positive strides at the local level, such as DREV, which has initiated its Odyssey 2000 project. Measurable improvements in worker satisfaction have been achieved to date through this project and should continue to be monitored on an ongoing basis as part of DRDC's performance measurement framework. The S&T workforce has gone through considerable change and restructuring throughout the 1990's (as have other groups throughout the Department) with the expectation of concrete and positive changes taking place. Addressing these HR issues should not be considered a short term effort but a continuous management activity and responsibility as a demonstration of the long term commitment to the objectives and values of the Agency. Similarly, the S&T community requires some assurance that they will be given sufficient time to develop business cases, strategies and processes to meet revenue generation and other goals and targets that have been established, and that the administrative tools and support will be in place to assist them.

3.171 **Leadership:** As stated in the 1990 report of the National Advisory Board on Science and Technology⁵⁹, “it is people, not systems that create, innovate and transfer technology. Individual and collective leadership is thus a necessary condition for success.” Along with the establishment of the correct mission, governance structure and effective relationships with stakeholders and clients, leadership and management of the R&D human resources is one of the most critical elements in establishing a ‘best practices framework’ for science and technology. The importance of leadership in both the day-to-day and strategic management of the organization cannot be overlooked in the effectiveness of the organization. Leadership plays a critical role in recruiting the ‘best and brightest’ into the organization, rejuvenating the S&T community, encouraging creativity and innovation and establishing productive relationships with stakeholders, clients, customers and scientific peers and colleagues.

3.172 Throughout the fact finding portion of this evaluation, the review team received a strong endorsement of the leadership team of DRDC from senior management within the Department and the CF and from the S&T community. It was generally expressed that current leadership has strongly influenced the direction of the Agency, both through its formation, establishment of a clear and progressive direction, and elevation of the status of S&T and R&D to an appropriate level in the Department where it can influence strategic direction and contribute to achieving the vision of Strategy 2020.

3.173 Departmental and CF clientele have acknowledged that current DRDC leadership has positioned the R&D function within the ‘political’ context of the Department. They have made senior decision-makers aware of the potential contribution of the R&D function and the requirements of the S&T community to enable it to make that contribution. DRDC leadership has been seen to take dynamic steps representing defence R&D to industry. These efforts have been made in support of achieving its progressive revenue generation targets, partnering with other countries to further collaboration and provision of services initiatives, and to show leadership within the federal government scientific community in the areas of Universal Classification and obtaining the terminal allowance for scientists.

3.174 Within the defence S&T community, the following positive comments were expressed to the evaluation team. Senior DRDC management is viewed as a management team that has grown up in the organization and has garnered an understanding of the business, their clients, the organization, its workforce and the conditions in which they are working. It was felt that senior DRDC managers have also seen what has not worked well in the past and are equipped to avoid taking the organization down paths that were previously unsuccessful and would not be beneficial to the client or the DRDC organization. There is generally a very positive perception across the organization of the skills and capabilities of the current management team. They are seen to be introducing positive changes, they have a vision for the organization that did not exist in the past and there is a strategic vision in place to achieve the goals and objectives that have been set for the organization. As a whole, the S&T community has generally accepted the vision that has been articulated for the organization.

⁵⁹ Report of the Committee on Federal Science and Technology Expenditures, Revitalizing Science and Technology in the Government of Canada, November 1990.

3.175 DRDC management is now actively addressing many human resource issues that have existed within the S&T community, both internally and external to the Department. Establishment of internal committees such as the Culture Change Working Group and the Compensation, Performance Evaluation, Rewards and Recognition (CPERR) Sub-Team have served as visible attempts to address outstanding issues. ADM(S&T) has become personally involved in addressing the compensation issue for defence scientists and the federal scientific community as a whole, as well as making a personal investment in marketing the organization and being an ambassador for the S&T role nationally and internationally. While the re-engineering of the S&T function in DND occurred after the surge in this activity in the mid-1990's, DRDC management has been seen to have learned from the experiences of others and successfully managed the transitional activities. In response to the criticism from within the organization that there was little visible progress or change resulting from Agency status, the *Roadmap* publication and communication vehicle was initiated and implemented across the organization less than four months after SOA status was approved (see discussion under *Internal Communication* at para 3.196).

3.176 The role of leadership within the S&T community cannot be overlooked as a critical factor in the 'framework of best practices' for the management of the R&D function. While a 'summative' assessment cannot be made at this point of the achievement of program objectives, leadership attributes appear to be in place in DRDC which form the basis for positive outcomes in other HR issues such as recruitment, retention and instilling a positive S&T culture within the organization.

3.177 ***Additional HR Management Issues:*** In addition to the major HR management themes that have already been discussed, there are several other personnel issues that impact the S&T community within DRDC. These are competency profiles, the impact of the Universal Classification System (UCS), and professional development.

3.178 ***Competency Profiles:*** In its 1994 report, the OAG noted the requirement to develop a stronger and more effective management capability within the federal research and development environment. It was proposed that this be achieved through the use of 'competency profiles' to describe the skills and knowledge expected at various levels of science and technology management and to assist in the selection of managers and supervisors. In 1998, the Treasury Board endorsed this concept in its *Science and Technology Blueprint for Human Resources Management* as a component of the recruitment, training, reward, promotion and compensation systems. As a departmental Agency, DRDC is complementing its responsibility for personnel management by developing its own competency profiles that reflect their own organization rather than relying on generically developed profiles. Competency profiles are being used to describe the key skills that employees require to be successful at their jobs and to provide a transparent basis for advancement within the organization. These profiles will be particularly useful in communicating to employees the kinds of skills and behaviours that are expected by the Agency such as partnering, revenue generation and client services competencies. The profiles can also provide a basis for individual performance assessment and development of training plans.

3.179 Within DRDC, S&T managers at the Group Leader and Section Head levels stated that in addition to a generic profile of management competencies, there is the requirement for a community-wide database of existing scientific expertise within the DS population. Currently, it is the Section Heads who are familiar with the expertise that is resident in their sections but they are unfamiliar with skills that are available elsewhere across the community. The requirement for this type of database is becoming more evident as the accomplishment of Thrust initiatives must be managed across many Defence Research Establishments and across scientific specialties. The requirement for a database of scientific expertise is becoming more evident to the mid-level managers due to the rate of turn-over of Section Heads, the expectation of a more timely response to clients' requirements, and their increased involvement in administration and management matters rather than personnel management and supervision. In addition, the changing demographics of the DS community, along with the imminent retirement of significant numbers of DSs and the resultant knowledge gaps, would make such a database a useful tool. While an informal skills database exists for DSs at the Section Head level and above, there is no database for the engineering or technical support positions. Once a database identifying the organizational matrix of skills is established, its long term maintenance would be both useful and relatively easy to maintain as many researchers tend to become long term employees within DRDC (70 per cent - 80 per cent have between eleven and thirty-five years service in DRDC). Changes to the database would only occur as new qualifications or expertise is obtained, or when new employees are brought on strength.

3.180 **Universal Classification System:** The introduction of the Universal Classification System (UCS) is an issue causing concern in the S&T community. The first concern is that scientists feel the UCS undervalues knowledge workers. Given that one of the objectives of UCS is to provide a means of comparing all jobs in the public service for the purposes of establishing internal relativity for pay equity purposes, undervaluing knowledge workers could create pressure to restrain S&T salaries relative to other public service employees. Treasury Board plans to use UCS to determine internal relativity while providing "terminal allowances" to certain groups to address the issue of external market relativity. The \$7,000 terminal allowances awarded to defence scientists, CRC and NRC researchers, are examples of market relativity adjustments. Unions have been critical of this approach, as market allowances effectively defeat the objective of providing equal pay for work of equal value. Similarly, the inequitable availability of such an allowance amongst all workers, including scientific and professional support workers, has contributed to polarizing classifications within the DRDC community.

3.181 The Professional Institute of the Public Service of Canada is also concerned that the UCS system does not effectively distinguish between the various levels of researchers. The current classification systems for defence scientists and research scientists are person-oriented. In effect, the function is classified as a research position and an incumbent's level is based on their record of accomplishments. There is union concern that UCS, which is a position-oriented system, does not effectively differentiate between research levels based on job criteria alone.

3.182 Finally, a normal consequence of introducing a new classification system such as UCS is that some positions may be found to be over-classified. Although Treasury Board has indicated that no one would suffer a reduction in pay due to reclassification, a determination that a position is over-classified usually has a demotivating affect on the incumbent of the position. While organizations with Separate Employer Status are not subject to UCS, DRDC is not currently pursuing this avenue. However, many organizations with this status have opted to adopt or develop systems similar to UCS, while NRC, which has a large contingent of S&T workers, has not decided whether it will adopt UCS at this point in time. Because of the high level of credibility of the current DRDC leadership within the Department and the federal S&T community, the interests and concerns of DRDC personnel on this issue have been aired and considered in the UCS implementation strategy.

3.183 **Professional Development:** A concept that has been the subject of a recent COSO sub-committee report⁶⁰ has been the need to establish the Public Service as a learning organization. A learning organization is one that is constantly scanning its environment, adapting to change and growing its intellectual capital. It is also the type of organization that provides its employees with an opportunity to learn, grow and develop. A learning organization is also expected to adapt more easily to the increased emphasis on technology transfer, partnerships and collaboration opportunities.

3.184 The Canadian Forces have made adjustments to their officer and NCM professional education systems to ensure that their training programs enhance the abilities of their leaders to take account of the impact of technological change on operational doctrine⁶¹. With a more knowledgeable and demanding CF clientele, DRDC has adjusted its governance structure to take advantage of this evolution and to further involve their clientele. Professional, scientific and technical support personnel in DRDC reported to the evaluation team that training opportunities, facilities and management support of professional development activities in the S&T field was fully satisfactory. Similarly, feedback from senior clients was that they were fully satisfied regarding the competency and currency of the knowledge and training of DRDC personnel. However, DSs indicated a lack of suitable training courses and opportunities to prepare them for managerial and supervisory positions. While generic departmental management courses were reported to be readily available, DSs entering managerial or supervisory positions indicated there was no training directed at managing in the S&T environment or orientation to effectively managing Thrust initiatives, Technology Demonstration Projects, partnering or revenue generation opportunities. While many of these areas are relatively new and evolving, both current mid-level managers and scientists in the labs indicated there is little opportunity for peer mentoring, personal supervision, or learning from the managerial experiences of others. As a result, many scientists feel unprepared to assume managerial responsibilities in DRDC. The discussion on *Migration of Ideas* at para 3.63 also explores this issue.

⁶⁰ Committee of Senior Officials (COSO) June 2000.

⁶¹ Lieutenant-General V.M. Caines, ADM(HR-Mil), Science and Technology Symposium, RMC, 1 June 2000.

Conclusions relating to HR issues in DRDC

3.185 The evaluation team has concluded that:

- a. Current demographics of the DRDC community reflecting a generally aging population, is one of the more serious and fundamental concerns of the S&T community.
- b. Attention to the growth areas identified by the TIS and successful recruiting to address these technology areas, will help to improve the demographic imbalance within DRDC.
- c. Maintenance of a 'critical mass' of professional scientific resources is essential to ensure that productivity, efficiency and effective R&D contributions can be made. Insufficient R&D resources contribute to inefficiencies that may prove false economy for the organization.
- d. At this early stage of Agency status, there is little visibility of corporate-sponsored recruitment activity that would facilitate individual DRE's in their hiring efforts.
- e. While both DRDC management and the members of the R&D community are striving to achieve a common organization culture and work environment, perceived performance gaps remain in the areas of administrative support to scientists, visible reward and recognition systems that reflect organizational values, and communication.
- f. The DRDC R&D community is aware of the many positive aspects of their work environment. This recognition has contributed to a positive shift in the morale of the R&D community. However, the transition to Agency status has heightened expectations in the areas of career management, performance evaluation, and management and administration which must be successfully addressed at the risk of introducing skepticism about the Agency into the community.
- g. The perceived lack of understanding or appreciation of the role and function of the R&D community by their principal client has a negative impact on staff morale.
- h. The current leadership team of DRDC has received strong endorsement from senior Departmental management, R&D clients and the S&T community.
- i. There is a requirement for a DRDC database of existing scientific skills and expertise within the research community.
- j. DS staff indicated a lack of suitable training courses to prepare them for management, administrative and supervisory positions.

Recommendations relating to HR issues in DRDC

3.186 The evaluation team recommends that:

- a. employment of military personnel in DRDC and their follow-on postings be managed in a manner to fully exploit their experiences in the DRDC environment;
- b. DRDC initiatives to maintain a critical mass of scientific expertise through increased internal R&D activity and revenue generation, be fully supported;
- c. corporate-sponsored recruitment efforts be made on behalf of the entire defence R&D community which would facilitate individual DREs in their hiring and recruitment for specific positions;
- d. communication efforts by DRDC should strive to present a balance between the expectations of the R&D clients and an explanation of the nature of R&D activities and functions that are necessary to meet their needs;
- e. a database of scientific skills, expertise and experience resident in the DRDC establishment, be established; and
- f. specific professional development opportunities be provided to prepare DS staff to assume managerial, administrative and supervisory duties as they apply in the S&T community.

COMMUNICATION

Background

3.187 This section of the report addresses communication issues related to Defence Research and Development Canada. Communications touch virtually every aspect of an organization and an effective communications capability becomes pivotal to all organizations undergoing change. This evaluation is occurring at a particularly opportune time to examine communications in DRDC. In their work on organizational reengineering circa mid 1990s, Michael Hammer and James Champy emphasized the notion that an organization cannot over-communicate, but that some venues are more effective than others. Whether reinventing, reengineering or merely managing an organization that is relatively stable, there is general acceptance and recognition of the potential power of carefully selected effective communications for internal and external impact.

3.188 In more recent work addressing issues of application of communication theory and practice in organizations, one author pointed out "...Communicators face unique dilemmas; when their craft is executed well it's invisible; but when it is done poorly it is blatantly obvious to the whole organization...".⁶² The author amplifies on this notion by pointing out that organizations are, at times, slow to support communications - or will even trim back on communications capability when all is going well. It is often only when deficiencies become apparent that communications becomes a renewed concern and resources shift back in support of that effort.

3.189 ***Rationale for a Strong Communications Capability at DRDC:*** The evaluation team questioned DRDC's rationale for allocating the number of scarce resources (personnel and funding) to their communications capability at a time when the organization is feeling the pressures of budgetary constraints. The 2001/02 budget for the DRDC HQ Communications Directorate is currently \$456.5K for salaries and \$335K for O&M. As well, the communications cell has grown from the shared time of a director and one full-time internal communications officer, to a nine person directorate focussed on both the corporate internal and external communication needs of the Agency. The evaluation team was advised that there were several reasons why a high priority is now being placed on the DRDC corporate communications capability.

3.190 Firstly, a reason for becoming an Agency was to support the establishment of a national identity for the defence S&T capability that goes beyond DND and the CF. Planning and visioning documents include phrases such as those that follow. "...provide science and technology leadership to the Department, the Canadian Forces and the Canadian Industrial Base..."⁶³ and "...we are a significant contributor to the Canadian Economy..."⁶⁴ both of which imply recognition of responsibilities that include and go beyond meeting the needs of the DND/CF client. In addition to and in support of a strengthened communication capability, DRDC has plans to approach the Federal Identity Program (FIP) to apply for their own signature to be used on official letterhead which will distinguish them from the Department of National Defence. In DRDC's view, successful application to the FIP will contribute to building the organization's national identity.

3.191 A second reason for assigning high priority to the communication function in DRDC is the requirement to support revenue generation. The marketing of defence capabilities has not been an area of emphasis for DRDC in the past, but has become particularly important as revenue generation goals are pursued. Thirdly, the lifeblood of an S&T organization is knowledge and information, and mechanisms must be in place to manage and impart knowledge and information effectively, both internally and externally. Fourthly, DRDC recognized that there were weaknesses in its communications and determined that significant steps were required to overcome these deficiencies. Among these deficiencies was the lack of an overarching communications strategy that would provide strategic guidance and direction to this capability in the DRDC organization.

⁶² Strategic Communication Management, August/September 2000, Thornton, Sandra "Proving the Value of Communications", August 2000.

⁶³ DRDC HQ, Looking Forward and Staying Ahead - Defence R&D Canada 2000, page2 (undated).

⁶⁴ DRDC HQ Brochure. Road Map to our Vision (undated).

3.192 A final reason for increased attention to the communication function in DRDC is that consideration was given to using the services of the current DND/CF departmental communications resource (Director General Public Affairs) to meet the DRDC requirements. A DRDC analysis of this option indicated that the range of services offered by DGPA and their inability to ensure that a consistent priority would be assigned to the Agency's needs, proved to be limiting factors that were not acceptable to the new Agency. Accordingly, DRDC has decided to expand its own communications capability to meet its requirements.

3.193 For purposes of this evaluation, the team examined issues that relate to internal DRDC communications, external communications and those that have an impact on both areas. The balance of the *Communications Section* of this report will highlight recent accomplishments and planned initiatives that DRDC assesses to be pivotal to reaching the desired end-state.

Internal Communications

3.194 *History of Internal Communications in DRDC*: DRDC HQ has long recognized the need for internal communications⁶⁵ and has had a designated internal communication capability intended to address that need for many years. This capability was provided for by one individual working in a cell that also had responsibility for information management and information technology. As part of the alternative service delivery activity (ASD) that preceded the S&T organization's decision to pursue Agency status, it was determined that a communications cell consisting of one individual was insufficient for an organization of more than 1,000 personnel. This observation was premised on the fact that existing efforts were focussed almost exclusively on internal communication matters.

3.195 In recognition of this shortfall, and in order to take a more holistic approach to R&D communications (both internal and external), a dedicated communications cell was established at the time of standing up the Agency, 1 April 2000. The DRDC HQ communications cell has evolved to a nine person directorate focussed on both the internal and external communication needs of the Agency. The DREs have their own limited communications capabilities with varying levels of skill and experience in the communications field. Over the longer term, through the Functional Direction Initiative, the intention is to strengthen the communications capabilities in the respective DREs in order to contribute to the accomplishment of corporate communication objectives for the Agency.

Internal Communications Issues

3.196 *Size of the Organization*: The size of the DRDC organization with its focused mandate and clear objectives, enables the communications group to have some assurance that their intended messages can reach the target audience with a manageable level of effort. As well, face-to-face communication of key messages (generally regarded as the highest-impact method of communication) is facilitated by the DRDC organization's relatively small size.

⁶⁵ For purposes of this report *internal communications* refers to those communications that take place within and across the Agency, whereas *external communications* refer to those outside the Agency including DND/CF, and other individuals and organizations not included in the ADM(S&T)/DRDC organization.

3.197 International members of the defence science community in the US and UK advised the evaluation team that they envied Canada for its relatively small defence R&D population from the perspective of communication and work coordination. An additional advantage to DRDC's small size is that cost-effective means can normally be found to handle internal communication matters through written material, the CF message system, electronic mail, teleconferencing and other means.

3.198 In spite of the apparent advantages that organizational size would contribute to good internal communication, the evaluation team received mixed messages in terms of how well the process functioned. Generally, from the most senior management level down to section head, the level of satisfaction with internal communication was relatively high. Interviewees felt they had a good sense of the corporate strategy and were well-informed of progress and development of initiatives in the Agency. By contrast however, from the section head level and below, there was less consistency in satisfaction levels with internal communications. Interviewees below the section head commented on the significant amount of communications leading up to the launch of the Agency, but during the period following that time, there seemed to be very little in the way of information forthcoming.

3.199 As summarized in Table 8 (para 3.217) showing major DRDC communication accomplishments since becoming an Agency, DRDC leadership has recognized that there was a void in its internal communications, particularly in keeping staff informed on progress of change initiatives. In response to this need, DRDC established a new communication vehicle called *Roadmap* as a means of addressing this issue. *Roadmap* is a web site on DESCARTES, the Internet based DRE-Net system available to all personnel in DRDC. *Roadmap* is dedicated to keeping DRDC staff apprised of ongoing change initiatives. For each initiative, it identifies the objective, the responsible DRDC official, milestones for the initiative and how it will assist DRDC in realizing its vision. The manner in which *Roadmap* was launched is a tribute to the attention being given to DRDC's Communication Strategy. In advance of its launch date, all Agency staff received a professionally prepared brochure introducing the new electronic publication. On launch date all DRDC personnel were greeted with an introductory e-mail encouraging staff members to avail themselves of the new publication. It is expected that *Roadmap* will complement *Leo On-Line*, which is the existing bimonthly DRDC electronic newsletter that provides S&T employees with news items not related to new initiatives. In the view of the evaluation team, these two complementary, on-line sources of information have the potential to contribute significantly to resolving some of the internal communications deficiencies that were expressed during our interviews.

3.200 ***Impact of Organizational Change on Internal Communications:*** A factor impacting communications that was raised frequently by section heads and group leaders, was the removal of the director level from the DREs during the downsizing that took place during the mid to late 1990s. The cascading of duties which were formerly carried out by the DRE directors, down to section heads and group leaders, has increased their administration and other workload which impacts on time available for communication with their staffs. While these comments were offered anecdotally, the consistency with which they were raised provides some validation of the statements.

3.201 While *Leo On-Line* and *Roadmap* are two communication vehicles which offer opportunities to enhance delivery of DRDC corporate messages, DREs must ensure that local mechanisms are in place to distribute and disseminate information to all levels within their organization. While these communications may have been more easily accomplished when the additional layer of management was available in the DREs to share some of the administrative and management workload, alternatives will now need to be sought that best meet local level needs.

External Communications

3.202 ***History of External Communications - DRDC Publications Mechanism:*** A cornerstone of the DND/CF professional S&T activity, both nationally and internationally, is their publication record. Documentation serves both as a record of the work that has been performed and provides the basis for broader publication. A principal means for scientists to acquire and maintain recognition of their expertise in a particular field is to broadly share the results of their work through the production of high-quality, peer-reviewed papers that are published in scientific journals.

3.203 While DRDC's capability to publish quality documents has its origins in the numerous professional papers that have been produced within the organization over the past fifty years, the Agency derives additional benefit from this skill in the production of its administrative and management documents. Widely distributed DRDC corporate publications such as *Looking Forward / Staying Ahead*, *DRDC Annual Report*, *Technology Investment Strategy* et, are professionally presented and informative documents that reflect the extensive publication capability resident in the ADM(S&T) Group. The production of these high-quality documents offers DRDC an opportunity to communicate their message to a diverse audience and put useful and relevant reference material in the hands of clients and stakeholders.

3.204 At the time of writing this report, DRDC HQ was transitioning responsibility for the publication of its corporate reports from the Directorate of Science & Technology Policy to the Directorate of Communications. While responsibility for content of published material remains with DRDC's policy organization, shifting production responsibilities to the communications directorate better aligns organizational capability and responsibility.

3.205 It is noteworthy that the draft Corporate Identity Standards (CIS) handbook being developed by the communications directorate in DRDC headquarters, provides comprehensive guidance on presentation standards for the full range of DRDC publications. The comprehensiveness of this guidance is intended to be such that whether a publication originates at DRDC HQ or one of the DREs, there will be a standardized approach in terms of graphic elements, typography, the application of corporate signature items etc. The intent of standardizing presentation format for all publications originating from the Agency is to establish a national identity for Defence Research and Development Canada.

Issues Having Both Internal and External Communications Impacts

3.206 **Electronic Communication:** A frequently cited problem among clients and DRDC personnel related to the awkwardness and inconvenience of not being able to electronically communicate easily with each other. A significant amount of communication within DRDC takes place over the Defence Research Network (DRENET) which is an internet-based system that preceded the departmental Defence Wide Area Network (DWAN). In contrast, the DWAN is the platform more commonly used across the Department for electronic mail communication. This notion was also captured in the Client Satisfaction Survey where the authors highlighted "...A number of people noted that DRDB's presence on the Internet was not very useful. The majority of potential CF users are connected to DWAN and deal with restricted sites. There is a threshold that must be passed over to access DRDB on the internet, and many people find this very user unfriendly."⁶⁶

3.207 This situation continues to exist as DWAN terminals for most personnel in the DREs are only available for communal use. As a result, it is a common occurrence that individuals only access their DWAN electronic mailboxes infrequently. The consequence is that departmental and CF personnel are often frustrated in their attempts to communicate with DRE personnel. This has contributed to a perception of inaccessibility of research scientists.

3.208 As discussed earlier, it was below the section head level that the evaluation team received the most mixed messages of dissatisfaction with internal communications. It is noteworthy that the DWAN is a commonly used mechanism for broadly disseminating corporate messages such as CANFORGENS, organizational changes, corporately led activities and initiatives etc., to the Department and the CF, yet is not readily accessible at the working level of many DRDC personnel. Some interviewees suggested that e-mail messages could be administratively managed between incompatible systems. DWAN based e-mail addresses that are not used regularly could be deleted from the system or an 'Out-of-office' message could be entered providing the alternate DRENET/Internet address of the DRDC member.

3.209 **Web Sites:** DRDC has a corporate level Internet Web Site. In addition to its 'Splash Page' and linkages to other pages that present corporate themes, accomplishments, challenges and other information, this site has further linkages to individual sites for each of the DREs. The DRDC Web Site was redesigned in 1999 as a means of introducing the new corporate identity. DRDC recognized the value in exploiting this tool as one means of broadly communicating in a cost-effective way, on a range of S&T issues.

3.210 In keeping with an emphasis on the Branch's corporate image, an annex in the DRDC draft Corporate Identity Standards has been devoted to the provision of guidance on Branch Web Sites.⁶⁷ The evaluation team found, however, that the guidance on the Branch Web Site to be confusing and, at times contradictory. While the *Requirements* section of the annex on Branch Web Sites indicates that "... Organizations may use their own official crest in place of the

⁶⁶ AeroVations Associates, REPORT ON CLIENT SATISFACTION SURVEY - Conducted on behalf of Defence Research and Development Branch (DRDB), page 3, 30 August 1999.

⁶⁷ Department of National Defence, Defence Research and Development Canada, "Defence R&D Canada Corporate Identity Standards", April 2000.

Canadian Forces crest...”⁶⁸ the *Foreword* to the same document indicates that “...Crests and other logos formerly used by the Branch (including all Research Establishments) shall no longer be used...”⁶⁹ While the evaluation team recognizes that this document is still in draft form, it has been disseminated to the DREs and this contradictory information is a source of confusion. Paragraphs 3.214 to 3.216 in the *DRDC Corporate Logo* section of the report provide further discussion on the issue of the use of logos in the Agency.

3.211 It is noteworthy that the web sites offer a relatively inexpensive way for DRDC to advertise its unclassified capabilities and accomplishments to a broad audience. The evaluation team offers the following comments that stem from general observations of these sites. The first page of each of the web sites features the corporate logo and a brief description of the respective DRE. Follow-on pages are headed by the DRE unique logos and the departmental/CF icon. While most of the DRE web sites have somewhat similar formats, one site takes its own unique approach. As well, the further one drills down in each of the sites, the less standardized they tend to become.

3.212 Due to the varying approaches to the web sites, it is not clear whether DRDC is striving to emphasize and convey a particular message through this media or if they are supporting each of the DREs going their own way in terms of web site content. The evaluation team noted that the DRDC-issued central guidelines to web site development provide some guidance on format for the ‘splash pages’ of web sites, but stops short of providing any advice on format as one drills further down in the sites. Provision of some advice, direction or guidance on web site content would contribute to the presentation of a corporately-led departmental/CF approach to defence R&D that is somewhat lost when too unique an approach is taken by the various DREs. Depending on the corporate theme the organization wishes to promote, ADM(S&T) is well-positioned to examine existing sites and find an optimal corporate web site structure. Looking at the spectrum of different approaches to the various sites gives DRDC a range of sources to draw upon for web site design ideas.

3.213 The evaluation team looked at the DRDC HQ and individual DRE web sites in early March 2000 and again toward the end of November 2000, and noted significant work had been done on several sites. It is noteworthy that web sites have been modified to reflect the change to Agency status and certainly the home page of each strongly reflects the DRDC identity. While there continues to be some outdated items and editorial improvements to be made (articles using future tense to talk about completed events), for the most part the sites provide a professional presentation. Occasional references to ‘Branch’ instead of ‘Group’ or ‘Agency’ need to be corrected to minimize confusion for the site visitor.

⁶⁸ Ibid, page Annex 10-1.

⁶⁹ Ibid, page ii.

3.214 *Use of the DRDC Corporate Logo*: During field visits by the evaluation team, it became evident that personnel in the DREs who were used to working independently and autonomously, were embracing the notion of a stronger, central, corporate identity with varying degrees of enthusiasm. Many people in the Agency have worked for long periods of time at a particular location and have formed close ties. Allegiances to the corporate DRDC organization are often still secondary to the allegiances personnel feel towards their respective DREs. This phenomenon is exemplified by the reluctance on the part of some DREs to relinquish using the DRE logo and replace it with the corporate symbol.

3.215 The DRDC draft Corporate Identity Standards document has attempted to provide clarification and standardization to Agency publications. However, contradictions continue to exist in the guidance provided in support of DRDC web sites. While this publication clearly states that DRE crests are not to be used with the new corporate identity⁷⁰ they have continued to appear on the Agency's various web sites.

3.216 During the course of this evaluation, use of the corporate DRDC logo and potential discontinuance of individual DRE logos and crests surfaced as an issue of debate amongst members of the research community. While in the evaluation team's assessment this appears to be a minor issue, clarification is required due to its potentially polarizing affect within the Agency. Presently, DREs are not clear whether there is any continued opportunity to display local crests and logos. In addition, some long term employees felt that by giving up their DRE logo, the Agency no longer recognized their unique contributions or valued their work. It became apparent to the evaluation team that any corporate decisions regarding the use of individual logos should not only be clearly and unambiguously communicated through the Corporate Identity Standards publication, but acknowledged in a personal and formal manner by ADM(S&T) recognizing the cultural and human resource impact of this issue on the community.

Major DRDC Communication Accomplishments Since 1 April 2000

3.217 For the most part, the communications issues that surfaced during the evaluation were either already recognized or certainly acknowledged by DRDC senior leadership. Accordingly, significant steps have been taken by DRDC staff during the evaluation to address weaknesses in this area. The following chart highlights some of the recent communications accomplishments by DRDC since standing-up of the Agency. These recent accomplishments provide evidence of DRDC's commitment to take an active approach in addressing deficiencies in its communications capability and more closely align the capability with the needs of a world class S&T organization.

⁷⁰ Ibid "...Crests and other logos formerly used by the Branch (including all Research Establishments) shall no longer be used..." & "...Defence Research Establishment crests are not to be used with the new Branch corporate identity...".

Table 8

Major DRDC Communications Accomplishments Since 1 April 2000	
Time Frame	Accomplishment
July 2000	Confirmed communications functions and organizational design
July 2000	Established a Communications Budget
August / September 2000	Transitioned <i>Knowledge and Information Management</i> to new directorate separate from communications cell
October 2000	Classified and began staffing positions in DRDC HQ Directorate of Communications
Fall 2000 RDEC approved November 2000	Obtained strategic direction for DRDC's <i>Corporate Communications Strategy</i> : Obtained Approval for DRDC <i>Communication Principles</i> . Obtained Approval for DRDC <i>Communication Objectives</i> .
December 2000	Stand-up <i>Road Map</i> (a corporate capability to report electronically to all DRDC personnel on new initiatives in terms of objectives, progress, accountability and linkages to progressing the organization to the new vision).

General Observations on DRDC Communications

3.218 As has been highlighted in the preceding discussion, the Agency is taking a very different approach to communications than it has in the past. The commitment of resources at the headquarters level to bring this approach to fruition indicates the priority being assigned to the communications function. As only portions of the corporate communications strategy were approved in November 2000 by RDEC (communications principles and objectives) and other aspects of policy direction are still being developed, the revitalization of the DRDC communications capability remains an evolutionary process.

3.219 While communications issues will be addressed further as part of the DRDC Functional Direction Initiative, standing-up renewed communication capabilities at most of the DREs will likely lag the recent progress made at DRDC HQ. However, where innovative and effective practices are being developed at the DRE level, the DRDC HQ communications directorate has shown a willingness to incorporate them into its corporate, strategic communications initiatives.

Conclusions Related to Communication

3.220 The evaluation team concluded that:

- a. DRDC presents strong rationale for significantly strengthening its communications capability that will be pivotal to the achievement of its corporate and establishment level goals.
- b. DRDC has strengthened its communications capability by combining internal and external communications activity within one directorate. Disengaging communications from information management and information technology activities has provided a more focussed approach to DRDC's communications capability.
- c. The recently introduced *Roadmap* publication on the DRENET should complement the existing electronic newsletter *Leo-On-Line*. *Roadmap* should fill a significant internal void in the Agency related to communicating progress of new initiatives in DRDC.
- d. While the current draft of the Corporate Identity Standards document requires further refinement, it is well-thought-out. In its final form it should contribute significantly to improved Agency communications and provide clarity of corporate identity.
- e. There are communications deficiencies that will not necessarily be addressed through currently planned initiatives and remain as issues that require resolution. Some of these issues include -
 - (1) communications within the DREs are not reaching the lower levels of the organization,
 - (2) incompatibility of the DWAN and the DRENET impedes communication between the Department / CF (the Agency's primary client) and the DREs,
 - (3) while DRDC web sites, as they are currently structured, present the regional uniqueness and diversity of the DREs, they may not be adequately seizing the opportunity to showcase the organization as a national entity, and
 - (4) while existence of the new DRDC Agency logo is evident at all DRDC sites, confusion and concern remain at the DREs regarding the appropriate use of the national and local logos.

Recommendations Related to Communication

3.221 The evaluation team recommends that:

- a. Final editorial adjustments be made to the Agency's Corporate Identity Standards in a timely way in order to put an approved version of this document in the hands of users as soon as possible.
- b. The individual DREs establish strategies to strengthen communications and distribution of information to all levels within their organizations.
- c. An Agency approach be taken to overcoming frustrations related to incompatibility between the DWAN and DRENET. While some electronic solutions may be possible, an emphasis should be placed on administrative solutions that may be more appropriate and economically more feasible.
- d. DRDC take strategic decisions related to how it wants to leverage use of the various web sites for the organization to deliver the desired message, then validate the current structure and content of each site to ensure that they are meeting the intended objective.
- e. DRDC HQ issue clear policy guidance on the use of logos in the organization.

RESEARCH AND DEVELOPMENT PERFORMANCE MEASUREMENT

Introduction

3.222 In recent years, both public and parliamentary expectations of government programs have changed dramatically with concerns about deficit control, fiscal management and improving the value for money generated by public expenditures and programs. As part of this process, accountability expectations have also evolved which are being defined in terms of expected results and outcomes of government programs.⁷¹ DRDC, as the sole sponsor of defence research and development in the federal government, is not immune to these responsibilities to account for the selection and conduct of its research programs and their contribution to the organization's overall mission. As a Departmental and Special Operating Agency, DRDC has the responsibility to participate in the Level One business planning and reporting activities and ensuring that a performance measurement system is in place. ADM(S&T) is responsible for implementing a performance management system that will provide management with the information to make decisions regarding the business of the Agency and which will permit reporting to the DM, clients and stakeholders on the performance of the Agency.

⁷¹ Black, Hubley. CRS Review of Benchmarking of Performance Measurement in DND/CF with Other Public Sector Organizations, August 1999.

3.223 Recently, and in conjunction with the issuance of Strategy 2020, there is the increased requirement to link the research and development program and its objectives to the strategic goals of the organization. R&D, with its long term horizons, must now be held accountable for its resources in light of other urgent and high priority departmental activities. As a result, DRDC has the responsibility to develop an accountability or performance measurement framework that will provide programmatic and quantified information that will substantiate and justify resource allocation decisions.

3.224 In order to address its accountability responsibilities, a Directorate of R&D Program Oversight was created in August 1998 to develop a strategy and process for measuring the performance of the Agency, its program relevance and effectiveness. A program oversight concept paper was published describing a performance measurement framework with linkages to the Department's performance measurement framework. The performance measurement concept for DRDC is structured around the key objectives and four business lines of the Agency which are described in the document *Looking Forward - Staying Ahead*. The areas where performance metrics are intended to be gathered include qualitative progress reports on major initiatives, achievement of milestones, resource expenditures, client satisfaction feedback and peer review of the defence technology areas.

Performance Measurement in a Research and Development Context

3.225 One of the principal design elements recommended in the Lortie Report a decade ago for the successful performance of a large R&D organization, is the establishment of an evaluation regime or performance measurement system for the organization... "The board of directors and the chief executive officer (must) have explicit authority and accountability to ensure that S&T activities and personnel are evaluated in ways that promote the highest standards of excellence, responsiveness and productivity, including the use of peer reviews and other internationally recognized methods and criteria of assessment."⁷²

3.226 For service, production and some types of development programs, quantitative indicators are applicable, meaningful and useful in the assessment process. However, in the area of fundamental and applied research there does not appear to be uniform agreement on the validity of quantitative indicators for assessment purposes. Even amongst those who feel quantitative indicators have a role in research assessment, there is not universal agreement as to which indicators are valid and how they should be combined with other quantitative indicators and qualitative approaches to arrive at a complete and meaningful system for research assessment. The very nature of research and development, where innovation and creativity are cornerstones, necessitates that some unproductive work must be pursued along the way in seeking true breakthroughs. While the results of some R&D work will merely tell the scientist what avenues not to pursue further - *that* in itself may be viewed as productive work. While performance measurement systems may be able to report on the quality of the research that is being conducted, performance measurement indices alone cannot evaluate whether the right research is being done.

⁷² Report of the National Advisory Board on Science and Technology, Federal Science and Technology Expenditures Committee, November 1990.

3.227 Two limitations on the application of performance metrics to research and development became apparent to the CRS review team during the course of this evaluation. First, while DRDC and the CF (as principal clients) share the common goal of contributing to improved combat capability, there is the need to recognize that there is a difference in perspectives of the two groups. While there is a small cadre within the CF involved in visioning and long term planning, a much greater portion of the CF is involved in day-to-day operations. By the very nature of their work, they have a much shorter time horizon and expectation for deliverables, output or economic return. Basic research by its very nature, tends to have long time horizons. Accordingly, researchers must face the ever-present challenge of balancing the application of resources amongst competing demands - one being meeting the requirements of the operators who have immediate or imminent problems in need of a solution, and the second being the long term visioning and related research involved in anticipating future requirements and completing relevant R&D today to meet those needs.⁷³

3.228 A second caveat as it applies to performance measurement in R&D/S&T is as follows. The Department, in response to broad government initiatives, embarked on business planning in the 90's. An underlying principle behind this initiative has been to operate government in a more business-like way than has been done in the past. While some business-oriented approaches are generic across organizations and make perfect sense for adoption on a Departmental/CF-wide basis, others are not as applicable to all organizations and should be applied more selectively. For example, sound business practices bring to the fore the need to relate inputs to outputs, and where possible, to outcomes. By their very nature, innovation and research activities demand high levels of input for what may appear to be modest amounts of output in the short term. This contrasts with more production-oriented organizations where outputs and outcomes are more apparent and measurable. It is therefore important to recognize that application of traditional measures of productivity and efficiency may not easily align with the fundamental nature of the work conducted by DRDC.

3.229 Despite these limitations in applying performance measurement indices to S&T, there are two perspectives that can be employed in the measurement of the R&D function. First, indices can be selected that will examine the final research output, and the second perspective is to report on the management processes and activities that support the conduct of R&D. In order to have a meaningful PM system, the performance measurement framework must present a balanced report from both of these perspectives.

3.230 ***Status of Performance Measurement in DRDC:*** In August, 1998, the Defence Research and Development Branch put in place a new headquarters organization structure which included a Program Oversight Directorate. Its main role was to develop a strategy and processes for measuring the performance of the organization in program delivery and assessing overall program performance. In May 1999, a Program Oversight Concept Paper was prepared which laid the groundwork for the preparation of the Annual Performance Report and the processes and arrangements for an operating performance measurement system. A "Best Practices" approach has been adopted for the performance measurement system based on the establishment of clear

⁷³ "If you only concentrate on areas where currently there's excitement and economic relevance, I would claim you are guaranteeing the eventual death of this complex organism (basic/fundamental research)." Quote from Dr. John Hepburn, Friends of the Library Lecture series 2000. University of Waterloo, Fall 2000.

statements of mission, values, strategic objectives and corporate objectives. These in turn, have been put into effect through annual business plans and the establishment of operational objectives. The finalization of input measures, output measures and outcome measures remain areas for discussion and refinement throughout the organization as performance management continues to evolve within the Department.

3.231 Despite the rate of evolution of PM across the Department, DRDC has made positive strides in implementing its PM system. Using the 'Best Practices' model, DRDC has set and published its key objectives for the organization each year, which are to be accomplished in the upcoming year. This process began in the fall of 1998. These objectives are stated annually in the DRDC document *Looking Forward Staying Ahead* and are reported on in qualitative terms in the subsequent DRDC Annual Report. Major initiatives for client groups, as accomplished through the Thrust program, are also reported on, along with resource consumption, achievement of milestones and description of deliverables. Within DRDC's Business Line 2 - Policy Development and Business Advice - performance measurement is identified and managed as a Thrust within the research and development Thrust Structure. This ensures that the performance measurement function is visible within DRDC, has resources assigned to it, and that progress and achievements made in this area must be reported on.

3.232 A key to the relevance of any performance measurement system is its integration into the strategic management processes of the organization. When performance measurement metrics and other complementary management decision aids are linked to the strategic objectives of the Department, organizationally appropriate objectives and goals serve as the basis upon which to select metrics and gather data. In the development of a PM system, data gathered for the monitoring of tactical and strategic business operations should be derived from the organization's overall objectives. The DND publication *Defence Strategy 2020*, which articulates the Department's long term objectives and short term targets for the future, has identified eight key strategic objectives to guide defence planning and investment into the next century. These eight defence objectives are, in turn, clearly reflected in the current concerns of the CDS regarding the pursuit and application of new technologies. The following questions reflect concerns that have been expressed by the CDS:

- Does the new technology contribute to the kinds of capabilities the CF is seeking?
- Does the technology improve the CF's ability to deploy?
- Does it improve the combat effectiveness of our Forces?
- Does it fill a capability gap that has been identified?
- Is it going to improve our ability to operate with others?
- Is it cost-effective?

Within the DRDC Management Framework Document (April 2000), DRDC strategic objectives have been identified and mapped to the overall DND objectives. While generic performance indicators have been identified to report on each of these objectives, a corporate data-gathering methodology has yet to be fully implemented.

3.233 Individual DREs have also made concerted efforts to establish their PM systems in order to fulfill their performance reporting responsibilities. To date, a universal or comprehensive approach has not been adopted across all the DREs, but a framework is being developed at each site with sufficient commonality to permit a corporate assessment of overall organization performance. By way of example, the Defence Research Establishment at Valcartier (DREV) has established 27 performance indicators that are representative of their activities and organization. They report on program achievement, resource utilization, personnel and organization morale factors. Although management acknowledges that their performance indicators do not measure all aspects of DREV activity, they do account for R&D activities as well as provide a measure of their progress on HR issues. Progress being made at DREV has been shared with other DREs to assist them in the development of their PM frameworks.

3.234 In November 1998, the Joint Systems and Analysis Group of the Technology Cooperation Program (TCCP) established an Action Group to examine and document the best practices in science and technology management amongst the member countries.⁷⁴ DRDC took the lead in this action group, publishing a compendium of 'best practices' based on input from member nations. A significant reporting area was Performance Evaluation and Management Tools that would assist S&T research programs to be relevant to customer needs, report on technology transition efforts and be cognizant of affordability and quality issues. Compilation of this compendium provided DRDC with exposure to the most currently available performance measurement tools and metrics in use within the TTCP R&D community and provided the Agency with the opportunity to include them in their own performance management framework. DRDC's role as a lead in this Action Group identified Canada as being in the forefront of developing a PM strategy for an S&T organization.

Perspectives on Performance Measurement from the DRDC Community

3.235 The development and implementation of a performance measurement system as part of the business planning and reporting functions of the Agency has been met with varying responses from the DRDC research community. The following compilation of those perspectives should assist in the further development and refinement of performance measurement systems and performance indicators as they are implemented in DRDC.

- Performance measurement at the DRE-level is generally acknowledged and accepted as a positive initiative which supports the management responsibilities that accompany Special Operating Agency status.
- Given the current stage of development of a DRDC performance measurement framework, it is generally felt that metrics have not yet been sufficiently developed or data captured, which will measure whether the expectations set for the Agency are being achieved.

⁷⁴ The Technical Cooperation Program, Joint Systems and Analysis Group - Action Group 9. Winning Techniques in Science and Technology Management: A Compendium of Best Practices, 14 June 2000.

- It is felt that a balance must be struck between establishing a comprehensive performance measurement system and imposing one that would be overly burdensome administratively. Researchers are currently concerned with an existing increase to the management and administrative workload that has been delegated to their levels.
- Many members within the research community felt that within an R&D environment, the measuring of achievement of project milestones was not a rigorous metric of performance. The measurement of performance in R&D is seen as the successful achievement of a final objective, which may not coincide with a pre-determined milestone as the results or impacts of research may not become evident in the short term. Many researchers expressed concern that the implementation, acceptance or utilization of their research is dependent on many factors external to their sphere of influence and would be difficult to account for in a PM metric.
- There was a strong feeling within the R&D community that positive performance indicators based on R&D management activities such as milestones, budgets and activity levels may not reflect positive R&D outputs and outcomes. The development and promulgation of performance metrics which balance R&D costs and effort against the utility and application of the R&D output, must be clearly evident in the performance measurement framework.
- Selection of the performance indicators used to measure the effectiveness and efficiency of the R&D activity will have a strong influence on the culture of the organization. In order to foster an innovative and 'risk-oriented' R&D organization, restrictive or static performance indicators may be inhibitive and counter-productive to the goals and values of the organization.
- While the Technology Investment Fund (TIF) and the Technology Demonstration Program (TDP) are seen as positive initiatives by both clients and researchers, it was felt that specific performance indicators and monitoring efforts should be developed to provide ongoing feedback on these programs.

Benchmarking of Performance Measurement

3.236 A brief description of benchmarking findings on performance measurement in research and development/science and technology is presented in Part II of this report and at Table 2. In addition, the *Compendium of Best Practices in Science and Technology Management* also summarizes performance measurement and evaluation initiatives as they are being implemented elsewhere.

3.237 In general, all government R&D organizations are using performance management tools and techniques to help focus and maintain S&T research programs to ensure relevance to customer needs, successful technology development and transitions, and address affordability and quality issues. All organizations used peer reviews to assess the quality of their research efforts, but acknowledged that this did not ensure that the 'right' research was being conducted.

It was also acknowledged that performance measures for S&T organizations cannot be universal, as each organization is trying to achieve goals and objectives that are specific and often unique to their client, their national geopolitical situation and fiscal environment.

3.238 While the role and importance of performance measurement for R&D activities is widely acknowledged, it is being implemented with varying degrees of effort and success. Several countries with defence R&D organizations smaller than Canada reported that they found the domain of performance measurement for R&D extremely complex and their efforts to date had not yet resulted in a satisfactory measurement framework. Countries participating in the TTCP are approaching performance measurement of their R&D activity with considerably more interest and are developing frameworks that encompass performance measures at the organizational, research project and individual researcher level. Defence research and development activity in the United States has taken particular interest in developing performance criteria in the area of measuring the effectiveness of technology transfer into the hands of the military client and defence industry.

3.239 Two significant caveats in selecting performance measures were brought to the attention of the evaluation team by R&D performance measurement practitioners within the US DoD. First, caution was expressed in *relying* on metrics taken from ongoing R&D management and administrative operations to evaluate an R&D program, as R&D metrics must reflect the objectives of the program and the ultimate value of the program deliverable rather than just the efficiency of the management processes to produce a program output. Mature performance measurement programs were found to be more effective if they assessed the impact of an R&D program and whether the program impacted the capability requirements as stated by the client. In order to answer these questions, project assessments must be done comprehensively - which would include use of quantifiable metrics *and* qualitative longitudinal evaluations of inputs, outputs, impacts and client satisfaction.

3.240 A second caveat brought to the attention of the evaluation team while benchmarking performance measurement was that, while the number of research programs or projects undertaken may be important, identifying and documenting the impact of those programs is critical. A large number of low risk projects may have little or marginal program impact, while a single high-risk project may result in a significant impact or breakthrough. As a result, reliance on quantifiable metrics alone without a balanced retrospective evaluation explaining context and impact, may result in an incomplete performance measurement framework.

3.241 The following Table presents a list of generic performance management criteria and metrics that are being proposed or used successfully by government or defence R&D organizations.⁷⁵

⁷⁵ From discussions with performance measurement practitioners in the Office of Naval Research, DoD Director of Science and Technology Plans and Programs, Dr. Ron Kostoff (former Director Technical assessment, ONR), and the writings of Dr. E. Geisler, Stuart Graduate School of Business, Illinois Institute of Technology.

Table 9

Generic Performance Measures Applicable to R&D/S&T Organizations	
Management Area	Potential Performance Measure
Program Quality	<ul style="list-style-type: none"> - Analysis of professional citations - licenses, awards, prizes - publications - peer review
Discovery and Innovation - the leveraging of advances in knowledge and technology by initiating investigations or progressing areas of particular interest	<ul style="list-style-type: none"> - analysis of program content - patents, licenses, awards - publication record - number of new projects initiated
Technology Development - putting into practice new ideas and techniques, proceeding to acquisition and application	<ul style="list-style-type: none"> - number of projects or ideas transitioned to industry - longitudinal analysis of outcomes of TDP initiatives
Human Resource Management - assessment of the culture, morale, work environment, recruitment and retention	<ul style="list-style-type: none"> - measurement of employee training - level of qualifications - amount of management and supervisory training - employee surveys - recruitment and attrition rates, per cent of effective personnel against establishments
Financial Management - development and execution of improved financial management processes	<ul style="list-style-type: none"> - attainment of budget targets - percentage of allocations between objectives and priorities - efficiency, effectiveness and probity measures
Business Processes - streamlining, consolidating and automating of business functions used to facilitate accomplishment of organizational objectives or lead to management improvements	<ul style="list-style-type: none"> - benchmarking of management and administrative processes and costs - existence of organizational standards and consistency - management, supervisory and employee feedback.

Conclusions Relating to Performance Measurement of Research and Development:

3.242 The evaluation team concluded that:

- a. The selection of meaningful performance metrics is particularly difficult within an R&D environment and the risks of selecting the wrong metrics as a basis for assessing organizational success are high. While a significant up-front and ongoing investment must be made in performance measurement in the R&D community in order to strive for meaningful PM results, in the end, the usefulness of the results and the appropriateness of the metrics may be questioned.
- b. As basic research provides the fundamental underpinnings for many of the technological advances that have occurred, a research organization will require longitudinal impact evaluation assessments supplemented with quantifiable process metrics in order to confirm the linkages between basic research, technological innovation and the transition to operational applications.
- c. Through the establishment of its Program Oversight Directorate, DRDC has laid the groundwork for its performance management framework and a performance reporting mechanism. The agreement on input measures, output and outcome measures remain areas in need of discussion and refinement.
- d. DRDC has made positive strides in implementing a 'best practices' approach to performance measurement in light of the state of evolution of performance measurement in the Department. Establishing the management function of PM as a R&D Thrust ensures the process is visible and there is accountability for its progress.
- e. DRDC's PM framework has established strategic linkages to the overall objectives of DND/CF as expressed in Defence Strategy 2020.
- f. Individual DRE's are progressing 'tailor-made' PM systems with sufficient commonality to permit a corporate assessment of overall organizational performance. 'Migration of Ideas' between DREs permits lessons learned to be shared in the development of parallel systems.
- g. DRDC has demonstrated leadership in the international S&T forum for PM through the direction it has provided to TTCF in developing the *Winning Techniques in Science and Technology Management: A Compendium of Best Practices*.
- h. A balance must be achieved in establishing a R&D performance measurement framework between reporting on management process efficiencies and the impact and outcomes of R&D projects.

- i. When benchmarked against other government S&T organizations, DRDC is taking a pro-active approach to implementing a system that will meet ongoing program management needs as well as overall government reporting requirements.

RISK MANAGEMENT AND RESEARCH AND DEVELOPMENT

Introduction

3.243 The conduct of research and development is a function that inherently must embrace 'risk'. In order to exist as a responsible and accountable organization within the government context, risks that are assumed must be identified and managed through a clear and identifiable 'risk management strategy'. The following assessment of the conduct of defence research and development within the context of risk management is premised on the following definitions:⁷⁶

Risk: "...is the uncertainty of future events that could influence achievement of organizational objectives expressed in terms of likelihood and impact."

Risk management: "...is the process of creating value by achieving alignment between objectives, risks, results and controls. It includes risk identification, assessment, response, monitoring and continuous communication."

Integrated risk management: "...is the continuous, pro-active and systematic process to understand, manage and communicate risk from an organization-wide perspective to aid decision making to improve achievement of corporate goals."

3.244 Basic scientific research represents the first step in the process of scientific discovery and development. It provides the basis for technological development and systems acquisition. This kind of research is practiced at the leading edge of science with the purpose of identifying developments or technologies that may be beneficial to achieving the objectives of DND and the CF. DRDC's responsibility is to manage this research while identifying new concepts and opportunities that will serve the CF in the future. DRDC's investment in basic research is focussed primarily on maintaining a critical scientific foundation that facilitates long term opportunities. While some research may lead to results that can be quickly transferred to the CF, much research by its fundamental nature, may take years to be incorporated into an application. To some, investing in the risk of an uncertain future for a research activity may be unacceptable. However, history has shown, as has the emergence of the concept of RMA⁷⁷, that new knowledge borne of basic research has proven to be militarily, economically and socially valuable. A review of the *Emerging Strategic Environments* which were identified and described in the Department's Strategy 2020⁷⁸, reveals that military organizations have a critical and increasing reliance on the contribution from a scientifically based research and development

⁷⁶ Brodtrick, Otto. Centre for Public Management. *Risk, Innovation and Values - Examining the Tensions*, 15 April 1999.

⁷⁷ Revolution in Military Affairs.

⁷⁸ *Shaping the Future of Canadian Defence: A Strategy for 2020*, June 1999. *Emerging Strategic Environments* page 4.

function. While it continues to provide the basis for expanding the horizon of scientific knowledge, basic research is a 'high risk' endeavour. However, the inherently unpredictable nature of the research is what leads to the impacts that are sought through innovation.

Discussion

3.245 In line with the definitions of 'risk management' and 'integrated risk management', DRDC has identified in its Level 1 Business Plan for FY 2001/02 specific risks and challenges that will impact on the Agency's conduct of R&D activities. It has also identified its associated ability to provide science and technology advice and guidance to DND and the CF which is intended to mitigate these risks. The strategic approach identified by DRDC in its business plan is not inconsistent with the recommendations that were made in the 1999 report from the Council of Science and Technology Advisors (known as the SAGE Report)⁷⁹, which identified principles and a framework for ensuring effective use of science and technology in the government context that apply to risk management. These principles included (but are not limited to) early identification of the potential contribution of S&T advice, assessment and management of uncertainty and risk, and communication of that risk to decision makers. The framework described in the SAGE Report also establishes best practices which would ensure that sound decisions are made based on S&T advice. The strategic approach adopted and planned by DRDC and summarized in the following paragraphs, reflects a logical and effective response to managing the risks inherent in a research and development program and adhering to the principles, as they apply to risk management, identified in the SAGE Report.

3.246 **DRDC Risk Management Initiatives:** In DRDC's Business Plan for FY 2001/02, the Agency has identified eight generic areas of risk⁸⁰. These risks range from the pace of technological change and its impact on the battlefield, to DRDC's internal capacity to meet increasing demands for S&T advice and 'emerging asymmetric threats' both home and abroad. Following the definition of 'risk management', having identified, assessed and communicated its risk environment, DRDC has assumed a pro-active series of management initiatives to address these risks. Some of these strategies are outlined below:

- a. **Technology Investment Strategy.** The Technology Investment Strategy (TIS) is the Agency's response to operating in an environment of rapid technological change as it affects military operations. The purpose of the TIS is to provide a focus for DRDC research and development activities on technology competencies that will address the future needs of the CF. The TIS identifies 21 R&D and technology areas that will serve as niche areas for DRDC and provide a strategic guide for further investments in people, infrastructure, partnerships and technologies. A sub-component of the TIS is the Technology Demonstration Program (TDP) and the Technology Investment Fund (TIF), which both serve as 'risk management' initiatives.

⁷⁹ Secretary of State (Science Research and Development) 1999, Framework for Science and Technology Advice: Principles and Guidelines for the Effective Use of S&T Advice in Government Decision Making.

⁸⁰ A complete list of risks identified which may impact on the Agency's R&D activities and its role in the Defence S&T community are described in the ADM(S&T) Business Plan FY 2001/02. *Strategic Risk Assessment and Program development Factors* page 19.

The TDP program provides an opportunity to validate and demonstrate the potential impact of technology solutions and new or emerging operational concepts to both military and industry stakeholders prior to going to full development of systems or making procurement decisions. Total time and expenditures invested in any one initiative are capped, thereby minimizing investment in non-productive ventures. Prior to the introduction of the TDP, the linear process of approvals and experimentation could take up to ten years leading to acquisition, thereby rendering some technologies obsolete before they could be put into service. The TDP process allows a technology to be assessed for its capability and applicability before additional resources are invested in research and development leading to acquisition.

The Technology Investment Fund (TIF) provides financial resources to internal and external research collaborators to pursue new areas of basic research which are considered to be high-risk but with a potentially high pay-off. TIF funding is approved at \$6M for FY 2000/01 and for subsequent years. Projects are selected based on scientific merit and military relevance. The TIF is a 'risk limited' initiative ensuring the exploration of new research areas without jeopardizing or reducing DRDC activity in existing R&D activity.

- b. ***Defence Industrial Research Program (DIR)***: To accommodate the growing demands on DRDC for S&T assistance and to capitalize on the increasing pace of commercial technology development, the Defence Industrial Research (DIR) Program is being used to solicit innovative R&D proposals from industry that have potential defence application. The DIR program is a 50/50 cost shared arrangement with industry where both the potential benefits and risks associated with innovative research are equally shared. In 1999/00, DRDC leveraged \$27.4M worth of S&T from national sources, with an Agency goal to further expand this base.
- c. ***Defence Against Asymmetric Threats***: In order to provide an ongoing S&T capacity to deal with emerging (asymmetric) threats, DRDC conducts ongoing research and technology watch to identify and assess potential threats. Two specific areas of R&D that have received attention through threat assessments are Network Information Warfare and Chemical/Biological/Radiological Threat Assessment and Detection.
- d. ***Concept Development and Experimentation, Modeling and Simulation (CDE/M&S)***: In order to derive maximum advantage from advancements in emerging technologies in an effective and efficient manner, DRDC is taking a lead in the departmental approach to Concept Development and Experimentation and Modeling and Simulation. These tools are proving effective for conceptualizing and assessing the way new systems and technologies can be used to meet defence requirements prior to the development and acquisition activities

taking place. Furthermore, these approaches allow informed judgements to be made on S&T contributions to the overall CF capability and effectiveness while minimizing R&D investment in time, resources and infrastructure.

- e. **Collaboration:** One principle of risk management discussed in the SAGE report is that of *Inclusiveness*, which suggests that S&T advice be drawn from a variety of scientific sources. The source and market for S&T advice is global and this growing body of scientific knowledge should be brought to bear on issues of defence R&D. Inclusiveness aids in achieving sound and comprehensive scientific information, reduces the risk of serious omission, leverages S&T capability and enhances stakeholder confidence in the products delivered. DRDC has engaged in a network of collaboration efforts at the Departmental, inter-departmental and international level through multilateral and bilateral agreements with our allies, the Technical Co-operation Program (TTCP) with Australia, New Zealand, UK and US, as well as participation in the NATO Research and Technology Organization. Several successful technology demonstration programs have also included international collaboration efforts. Collaboration initiatives are also included at the university and industry level. The Agency has reported leveraging or ‘receiving in kind’ over \$75M worth of S&T from national and international sources in FY 1999/00 to enhance internal defence R&D capability.
- f. **Technology Outlook:** A Technology Outlook Program has been adopted as a formal Thrust of the R&D program as a focussed means to monitor technology trends and opportunities that are developing around the world and assess their potential relevance to Canadian defence. As science and technology knowledge grows, it is impossible to maintain an in-house expertise in all existing and emerging areas. The Technology Outlook Thrust is a component of the R&D program to scan the world for any defence-relevant information. However, both the absence of, or over-reliance on a technology watch program exposes the CF and Canada to risk. As 98 per cent of scientific research is conducted outside of Canada, our national S&T efforts would be considered woefully inadequate without knowledge of world developments. Similarly, without the complimentary conduct of a rigorous and internationally respected R&D program of our own, DRDC would risk being excluded from a ‘quid pro quo’ information exchange in the scientific community and be denied the opportunity to leverage our expertise for ‘in kind’ S&T knowledge.

3.247 ADM(S&T) has also identified an internal initiative to develop a “Technology Risk Assessment” activity which is directed at identifying technologies that may have a significant impact on Canadian defence and security capabilities. This initiative also has the capability of assessing the risk to national defence and security of not being able to keep abreast in these areas.

3.248 An additional principle of ‘integrated risk management’ is “...the continuous, pro-active and systematic process to understand, manage and *communicate* risk...to aid decision making”. DRDC appears well-positioned to adhere to this principle through its status as a Level One organization and the participation of ADM(S&T) as a Level One advisor. Similarly, the role of its DGs as Scientific Advisors to their respective Client Groups provides the opportunity to communicate and participate at the highest levels presenting an S&T perspective to mitigate threats and risks which present themselves. The role and contribution of S&T advice in the Departmental Risk Management Strategy should be clearly enunciated in the communication strategy being developed by DRDC and be integral to the role of the scientific advisors.

3.249 **Further R&D Opportunities:** Coincident with assessment of risk is the identification of further opportunities. Research and development and science and technology are functions that can be defined as instruments of ‘change management’ in an organization. The progression of activities that have occurred within the S&T organization as it evolved from the Defence Research Branch to a Departmental/Special Operating Agency, has been an example of organizational reengineering that began with an impetus for change and resulted in a new organizational entity. DRDC has had considerable experience in successfully introducing change to its organization. This experience, combined with R&D’s inherent contribution to innovation and change, provides an opportunity for DRDC to be a positive and active influence in monitoring and introducing continuous improvement initiatives to the Department and to the CF.

3.250 While research and development provides a focus or emphasis on developing new technologies, further opportunity exists in developing strategies to facilitate *how* it will be integrated into the CF to ensure cross-service application. With increased emphasis on the implementation of Strategy 2020 to promote interoperability and collaboration with our Allies, there will be a growing requirement to determine how best to resolve problems of integrating technology and operational capability. While the Technology Demonstration Program and CD&E/M&S have been recently introduced as mechanisms to expedite technology integration, further opportunity exists to develop ways of placing technology in the hands of the military operators. This may require developing a research capability in the areas of advanced management and systems methodologies focusing on streamlining processes in such areas as acquisition, procurement and other management areas.

Conclusions

3.251 The evaluation team has concluded that:

- a. DRDC has taken an appropriate, pro-active role in determining areas where the Departmental/CF R&D capability can contribute to corporate risk management;
- b. DRDC has demonstrated its capability, both to manage risks inherent in its own program and also demonstrate its ability to contribute to the containment of risk on behalf of the Department and the CF through such internal initiatives as the TIS, TIF, TDP and Technology Outlook; and

- c. DRDC plays an important role now and is positioning itself through the evolution of new and existing programs, to be an increasingly important player in the area of risk management.

Recommendations Related to Risk Management

3.252 The evaluation team recommends that:

- a. DRDC communicate to both its clients and stakeholders, that risk and risk-management are fundamental components of the research and development program; and
- b. DRDC remain alert to opportunities where its expertise can be applied in support of Departmental and CF activities to permit the management of risk.

PART IV – SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

4.1 Part IV of this report provides a summary of the significant conclusions and recommendations that have been made by the evaluation team on issues which impact the effectiveness and efficiency of the Departmental R&D function. Stemming from a strong impetus for change in the past decade in the management, organization and structure of R&D organizations in general and government sponsored R&D capabilities in particular, DRDC has undergone significant and fundamental changes by becoming a Departmental and Special Operating Agency. Accompanying this change has been the necessity to develop and implement management and administrative initiatives to accompany this new status and the requirement to put in place R&D programs that will continue to deliver an R&D capability to support the strategic direction of DND and the CF. In addition, DRDC has had to address the R&D requirements and expectations of a knowledgeable client and function in a political and fiscal environment faced with rapidly changing technological trends. The following summary of conclusions and recommendations address the major R&D management issues that contribute to meeting the strategic objectives of the Department and the CF.

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS ON RESEARCH AND DEVELOPMENT ISSUES

Conclusions Related to Benchmarking DRDC with Other Defence S&T Organizations

4.2 The Review Team has concluded that:

- a. All government-sponsored defence R&D organizations have had to realign their governance structures, management processes and research focus in response to similar 'driving forces for change'. These forces include fiscal restraint, public accountability, globalization of research and development, the rate of technological change and management of their intellectual capital (HR issues).
- b. All sponsoring organizations recognize the need to retain a defence research and development/science and technology capability.
- c. DRDC has undertaken more fundamental changes than most defence R&D organizations.
- d. Maintaining relevance and responsiveness to their principal client is receiving increased priority amongst R&D organizations.
- e. Downsizing of defence R&D organizations benchmarked was generally achieved through reductions in support overhead and redistribution of the workload to preserve professional and scientific expertise.
- f. Technology watch and collaboration with partners and allies is becoming a strategic and cost-effective R&D activity for most organizations.

- g. All defence R&D organizations are facing similar HR management issues: aging demographic profile of their community, recruitment and retention concerns and salary disparity with industry in some areas of specialty.

Conclusions Relating to Governance Issues

4.3 The evaluation team has concluded that:

- a. DRDC has adopted a governance structure which includes Special Operating Agency status which supports the management principles espoused in the 1990 Lortie Report and subsequent advisory and OAG Reports.
- b. The value, contribution and relevance of the DSAB has been questioned, particularly as it relates to meeting the requirements of the operational environments.
- c. The large number of R&D committees and the degree of client involvement required is often viewed as excessive by departmental clients and stakeholders.
- d. Despite the coordinating efforts of the existing R&D committee structure, overlap and duplication of R&D programs and activities conducted on clients' behalf appear to be happening across Defence Research Establishments.
- e. There is not a clear or consistent understanding or acceptance of the role of RDEC within the research community. This has led to inconsistent interpretation and application of decisions taken by this committee.
- f. Despite the aforementioned comments, R&D stakeholders felt the committee structure remains essential to ensure stakeholder involvement in the R&D program.
- g. Special Operating Agency Status for DRDC has been received positively by internal and external stakeholders to the organization. DRDC is now better positioned as a pro-active contributor to the strategic direction of the Department as well as providing an R&D/S&T capability.
- h. The working relationship between DGOR and DRDC is evolving and strengthening through the coordination of efforts at the Directors General level.
- i. As program activities, such as the TDP become more mature, identification of cooperation and collaboration opportunities between DGOR and DRDC should increase.

Recommendations Regarding Governance Issues

4.4 The evaluation team recommends that:

- a. support be provided to the DSAB Revitalization Plan to ensure a source of sound external science and technology advice is available to the Department and DRDC;
- b. mechanisms be developed and supported, such as the Defence Science Advisory Board Revitalization Plan, to ensure that departmental stakeholders and interested parties are provided ready access to the deliberations, analysis and advice that is presented by external S&T advisory groups;
- c. the role and decision-making authority of the R&D Executive Committee be clarified and communicated across the R&D community;
- d. the R&D committee structure be cognizant of the potential conflicts of interest that may exist between prioritizing activities between DREs and conducting R&D projects on behalf of their client organizations; and
- e. mechanisms for sharing information between DGOR staff and DRDC at the working levels be developed and encouraged, as well as the early identification of R&D projects that would benefit from mutual involvement in projects sharing common interests and skills.

Conclusions Related to the Technology Investment Strategy

4.5 The evaluation team concluded that:

- a. the Technology Investment Strategy (TIS) is a well-reasoned and structured mechanism to ensure that investment in research and development activities is linked to the objectives defined in Defence Strategy 2020;
- b. when used as intended, the TIS should serve as an effective means of assisting DRDC in bringing closure to R&D work on older technologies that are no longer relevant; and
- c. the TIS has become a familiar working document for DRDC senior leaders and managers, but is less so further down the Agency's organizational structure.

Recommendations Related to the Technology Investment Strategy

4.6 The evaluation team recommends that:

- a. efforts be made to increase awareness and understanding of the TIS at levels below senior management, and that its use as a working document and tool be encouraged and promoted; and

- b. section heads and group leaders actively use the TIS as a mechanism to assess and validate the on-going relevance of R&D work.

Conclusions Related to the Technology Investment Fund

4.7 The evaluation team concluded that:

- a. the Technology Investment Fund is a reasonable means for researchers in DRDC and organizations with which it collaborates, to obtain short term funding to pursue high risk and reward research activities; and
- b. while it is early to make meaningful assessments on the overall effectiveness of the TIF program, DRDC has put mechanisms in place to manage and monitor this activity.

Recommendation related to the Technology Investment Fund

4.8 The evaluation team recommends that implementation of the recommendations resulting from the February 2000 Annual Report on the Technology Investment Fund take place in a timely way.

Conclusions related to Technology Watch and Knowledge Management

4.9 The evaluation team concluded that:

- a. the importance of Technology Watch as a strategic tool to prepare the CF to deliver a combat capable force for 2020 is recognized departmentally and by the ADM(S&T) Group;
- b. Technology Watch is not a substitute for the conduct of scientific research, but is an important component of that activity;
- c. ADM(S&T)'s appreciation of the importance of Technology Watch is demonstrated by the establishment of a specific program Thrust (Technology Outlook - in Business Line 2) to address this issue and support assignment of resources;
- d. Technology Watch offers significant potential to leverage DRDC resources and capabilities to provide a comprehensive R&D program in support of the objectives of Defence Strategy 2020;
- e. optimum return on the DND/CF investment in Technology Watch will only be achieved if adequate structures are put in place to support the activity;
- f. DRDC has made significant contributions in advancing Technology Watch as a discrete activity in the defence scientific community;

- g. insufficient involvement of DRDC in the early stages of departmental projects limits the potential benefits that could be derived from knowledge gained through Technology Watch;
- h. some of the benefits to be derived from Technology Watch will be lost if DRDC fails to hone and maintain a certain level of data mining skill sets within the departmental S&T community; and
- i. while knowledge management is still in its infancy in DRDC, the defence S&T community recognizes the corporate value of having a knowledge management capability and has assigned responsibility and invested resources to progress this activity.

Recommendations Related to Technology Watch and Knowledge Management

4.10 The evaluation team recommends that:

- a. Technology Watch be promoted within the DRDC organization and the Department as a tool which is complementary to the conduct of scientific research and development;
- b. DRDC support the Technology Outlook Thrust with formal structures such as technology watch data bases, mechanisms for sharing and disseminating information, and training in data mining to optimize investment in this activity;
- c. DRDC strongly promote the early involvement of the S&T community in departmental projects that may have new technology implications; and
- d. DRDC assess its specialized skill sets related to accomplishing Technology Watch to make sure that maximum benefit is derived from time invested in this activity.

Conclusions Relating to Migration of Ideas

4.11 In order to succeed at research and technological development, DRDC requires an organizational culture that not only encourages innovation, but also encourages an extensive exchange of information. As the organization grows in size and complexity, the sharing of knowledge becomes more important to ensure a net organizational efficiency by avoiding duplication or overlap of effort and making information available to the broadest segments of the R&D community. The need for migration of ideas increases with the need to innovate.

4.12 The evaluation team concluded that:

- a. defence scientists felt greater opportunities should be sought to encourage and facilitate communication, dissemination and exchange of professional and scientific information;

- b. organizational inefficiencies result from a lack of dissemination of technology watch information or research projects' lessons learned;
- c. DRDC has recognized the value and contribution of 'migration of ideas' and put in place several initiatives to encourage this activity;
- d. the lack of a suitable facility at some DREs is an inherent barrier to providing the opportunity to exchange and share ideas; and
- e. development and documentation of administrative practices and procedures would benefit from a greater exchange of experiences and lessons learned from across the R&D community.

Recommendations Regarding Migration of Ideas

4.13 The evaluation team recommends that:

- a. efforts to pursue a 'knowledge management strategy' should be fully supported by DRDC;
- b. a priority should be assigned to ensuring a physical venue is available at the DREs to facilitate hosting forums for the exchange of ideas between DRDC staff; and
- c. the Functional Direction Initiative be fully supported and encouraged across the DRE network.

Conclusions Related to Research and Developments Thrusts

4.14 The evaluation team concluded that:

- a. the Thrust structure permits the R&D program to focus S&T activities on addressing CF combat capabilities rather than environment-specific technological requirements; and
- b. the Thrust approach has brought the client and service provider together to build and monitor the DND/CF S&T capability with positive results.

Recommendation Related to Research and Development Thrusts

4.15 The evaluation team recommends that the periodic client satisfaction survey include client feedback on the applicability and effectiveness the Thrust concept to meet their operational requirements.

Conclusions Related to the Technology Demonstration Program

- 4.16 The evaluation team concluded that:
- a. the Technology Demonstration Program is a reasonable response to the requirement to address timeliness and relevance concerns related to delivery of the defence R&D program;
 - b. DRDC has made the distinction that the Technology Demonstration Program is not intended to impact longer term basic research, but rather targets specific concept demonstration initiatives that can be progressed in shorter timeframes;
 - c. the DND/CF and the Agency have experienced difficulty in the past in transitioning the results of research and development to the procurement/acquisition phase of the project life cycle;
 - d. appropriate project management skills are essential to the success of the Technology Demonstration Program; and
 - e. the Technology Demonstration Program contributes to departmental/CF efforts to mitigate and manage risk.

Recommendations Related to the Technology Demonstration Program

- 4.17 The evaluation team recommends that:
- a. consideration be given to the transition of the project management role from ADM(S&T) to ADM(Mat) for Technology Demonstration Projects that will progress to the acquisition/procurement phase;
 - b. ADM(S&T) ensure that appropriate PM skills are, and training is employed on TDP projects; and
 - c. ADM(S&T) ensure that an annual program level review and report be conducted and prepared for the Technology Demonstration Program.

Conclusions Related to Client Satisfaction

- 4.18 The evaluation team concluded that:
- a. DRDC recognizes that client satisfaction is an important aspect of its business and has put mechanisms in place to monitor it on a periodic basis. DRDC has also taken steps to address deficiencies that surface as significant issues.

- b. Finding a balance between meeting the tactical (operational) and strategic R&D needs of the military client is an on-going challenge requiring judicious management by the ADM(S&T) Group and significant client involvement and participation.
- c. Clients of the departmental R&D service at the Environmental Chief of Staff (ECS) level feel they do not have sufficient opportunity to influence the strategic direction of the R&D program, and would benefit from periodic one-on-one dialogue with ADM(S&T).
- d. ECSs perceive the R&D program to be functioning in silos and do not have a full understanding of the cross-DRE intent of the R&D program Thrusts.
- e. The senior management team of DRDC is generally highly regarded by senior client stakeholders in the Department and the CF and by members of the R&D community.
- f. Continuity and relative stability in the management cadre during this period of standing-up new program initiatives and the Agency supports the notion of management accountability and should contribute favourably toward program success.
- g. Overall, client satisfaction with the Department's R&D capability is high and program delivery areas requiring improvement that have come to the attention of DRDC leadership are being addressed.

Recommendations Related to Client Satisfaction

4.19 The evaluation team recommends that:

- a. DRDC continue to obtain an independent, bi-annual Client Satisfaction Survey, ensure that it is thoroughly analyzed and briefed to DRDC staff and that an appropriate action plan is developed to overcome identified deficiencies;
- b. DRDC work closely with its client groups to find and maintain an appropriate balance between strategic and tactical work conducted at the DREs; and
- c. ADM(S&T) meet annually on a one-on-one basis with each of the Environmental Chiefs to discuss the alignment of DRDC's programs with operational priorities.

Conclusions Related to Revenue Generation

4.20 The evaluation team concluded that:

- a. The concept of revenue generation as means of preserving a critical mass of S&T personnel and infrastructure is a well-reasoned response to budgetary pressures.

- b. The requirement to generate revenue at the DRE level has preceded the establishment of the necessary management framework to support this effort over the long term.
- c. While active pursuit of revenue generation targets in advance of building the requisite support structures is inherently inefficient, it is producing early results to meet interim targets and is generating valuable lessons learned. This approach should contribute to further policy and procedural development.
- d. Criteria for allocating revenue generation targets for each DRE may not readily align with the capacities and capabilities of those organizations to generate sustainable revenue.
- e. Concerns exist among DND/CF clients that revenue generation may be carried out by DRDC at the expense of client service.
- f. Some allied defence R&D organizations have well-established revenue generation capabilities that offer significant potential as information sources for DRDC as it develops its strategies, lexicons, policies and procedures in support of revenue generation.
- g. The value of intellectual property is recognized in DRDC and progress is being made to position the organization to ensure that maximum benefit is derived from these assets.
- h. DND has sound IP policy and guidance documents in place that align with TBS direction.
- i. Database management for IP has been lacking in the past and this deficiency is recognized as an immediate concern within the ADM(S&T) Group.

Recommendations Related to Revenue Generation

4.21 The evaluation team recommends that:

- a. DRDC HQ draw on the revenue generation experiences of the DREs to develop practical policies and toolkits in support of the revenue generation activity;
- b. DRDC leverage on the benchmarking information available from allied forces with well-established RG capabilities in place;
- c. support capabilities (such as appropriate legal counsel and training) be put in place to facilitate implementation of revenue generation in DRDC;

- d. criteria for establishment of revenue generation targets at the DREs be revisited, validated, and adjusted periodically based upon site-by-site assessments of opportunities to generate revenue; and
- e. DRDC progress activities to secure management controls related to IP to ensure that revenues to which the Department is entitled are monitored and collected.

Conclusions Relating to Human Resource Management Issues in DRDC

4.22 The evaluation team has concluded that:

- a. Current demographics of the DRDC community reflecting a generally aging population, is one of the more serious and fundamental concerns of the S&T community.
- b. Attention to the growth areas identified by the TIS and successful recruiting to address these technology areas, will help to improve the demographic imbalance within DRDC.
- c. Maintenance of a 'critical mass' of professional scientific resources is essential to ensure that productivity, efficiency and effective R&D contributions can be made. Insufficient R&D resources contribute to inefficiencies that may prove false economy for the organization.
- d. At this early stage of Agency status, there is little visibility of corporate-sponsored recruitment activity that would facilitate individual DRE's in their hiring efforts.
- e. While both DRDC management and the members of the R&D community are striving to achieve a common organization culture and work environment, perceived performance gaps remain in the areas of administrative support to scientists, visible reward and recognition systems that reflect organizational values, and communication.
- f. The DRDC R&D community is aware of the many positive aspects of their work environment. This recognition has contributed to a positive shift in the morale of the R&D community. However, the transition to Agency status has heightened expectations in the areas of career management, performance evaluation, and management and administration which must be successfully addressed at the risk of introducing skepticism about the Agency into the community.
- g. The perceived lack of understanding or appreciation of the role and function of the R&D community by their principal client has a negative impact on staff morale.

- h. The current leadership team of DRDC has received strong endorsement from senior Departmental management, R&D clients and the S&T community.
- i. There is a requirement for a DRDC database of existing scientific skills and expertise within the research community.
- j. DS staff indicated a lack of suitable training courses to prepare them for management, administrative and supervisory positions.

Recommendations Relating to Human Resource Management Issues in DRDC

4.23 The evaluation team recommends that:

- a. employment of military personnel in DRDC and their follow-on postings be managed in a manner to fully exploit their experiences in the DRDC environment;
- b. DRDC initiatives to maintain a critical mass of scientific expertise through increased internal R&D activity and revenue generation, be fully supported;
- c. corporate-sponsored recruitment efforts be made on behalf of the entire defence R&D community which would facilitate individual DREs in their hiring and recruitment for specific positions;
- d. communication efforts by DRDC should strive to present a balance between the expectations of the R&D clients and an explanation of the nature of R&D activities and functions that are necessary to meet their needs;
- e. a database of scientific skills, expertise and experience resident in the DRDC establishment, be established; and
- f. specific professional development opportunities be provided to prepare DS staff to assume managerial, administrative and supervisory duties as they apply in the S&T community.

Conclusions Related to Communication

4.24 The evaluation team concluded that:

- a. DRDC presents strong rationale for significantly strengthening its communications capability that will be pivotal to the achievement of its corporate and establishment level goals.

- b. DRDC has strengthened its communications capability by combining internal and external communications activity within one directorate. Disengaging communications from information management and information technology activities has provided a more focussed approach to DRDC's communications capability.
- c. The recently introduced *Roadmap* publication on the DRENET should complement the existing electronic newsletter *Leo-On-Line*. *Roadmap* should fill a significant internal void in the Agency related to communicating progress of new initiatives in DRDC.
- d. While the current draft of the Corporate Identity Standards document requires further refinement, it is well-thought-out. In its final form it should contribute significantly to improved Agency communications and provide clarity of corporate identity.
- e. There are communications deficiencies that will not necessarily be addressed through currently planned initiatives and remain as issues that require resolution. Some of these issues include -
 - (1) communications within the DREs are not reaching the lower levels of the organization,
 - (2) incompatibility of the DWAN and the DRENET impedes communication between the Department / CF (the Agency's primary client) and the DREs,
 - (3) while DRDC web sites, as they are currently structured, present the regional uniqueness and diversity of the DREs, they may not be adequately seizing the opportunity to showcase the organization as a national entity, and
 - (4) while existence of the new DRDC Agency logo is evident at all DRDC sites, confusion and concern remain at the DREs regarding the appropriate use of the national and local logos.

Recommendations Related to Communication

4.25 The evaluation team recommends that:

- a. Final editorial adjustments be made to the Agency's Corporate Identity Standards in a timely way in order to put an approved version of this document in the hands of users as soon as possible.
- b. The individual DREs establish strategies to strengthen communications and distribution of information to all levels within their organizations.

- c. An Agency approach be taken to overcoming frustrations related to incompatibility between the DWAN and DRENET. While some electronic solutions may be possible, an emphasis should be placed on administrative solutions that may be more appropriate and economically more feasible.
- d. DRDC take strategic decisions related to how it wants to leverage use of the various web sites for the organization to deliver the desired message, then validate the current structure and content of each site to ensure that they are meeting the intended objective.
- e. DRDC HQ issue clear policy guidance on the use of logos in the organization.

Conclusions Relating to Performance Measurement of Research and Development

4.26 The evaluation team concluded that:

- a. The selection of meaningful performance metrics is particularly difficult within an R&D environment and the risks of selecting the wrong metrics as a basis for assessing organizational success are high. While a significant up-front and ongoing investment must be made in performance measurement in the R&D community in order to strive for meaningful PM results, in the end, the usefulness of the results and the appropriateness of the metrics may be questioned.
- b. As basic research provides the fundamental underpinnings for many of the technological advances that have occurred, a research organization will require longitudinal impact evaluation assessments supplemented with quantifiable process metrics in order to confirm the linkages between basic research, technological innovation and the transition to operational applications.
- c. Through the establishment of its Program Oversight Directorate, DRDC has laid the groundwork for its performance management framework and a performance reporting mechanism. The agreement on input measures, output and outcome measures remain areas in need of discussion and refinement.
- d. DRDC has made positive strides in implementing a ‘best practices’ approach to performance measurement in light of the state of evolution of performance measurement in the Department. Establishing the management function of PM as a R&D Thrust ensures the process is visible and there is accountability for its progress.
- e. DRDC’s PM framework has established strategic linkages to the overall objectives of DND/CF as expressed in Defence Strategy 2020.

- f. Individual DRE's are progressing 'tailor-made' PM systems with sufficient commonality to permit a corporate assessment of overall organizational performance. 'Migration of Ideas' between DREs permits lessons learned to be shared in the development of parallel systems.
- g. DRDC has demonstrated leadership in the international S&T forum for PM through the direction it has provided to TTCP in developing the *Winning Techniques in Science and Technology Management: A Compendium of Best Practices*.
- h. A balance must be achieved in establishing a R&D performance measurement framework between reporting on management process efficiencies and the impact and outcomes of R&D projects.
- i. When benchmarked against other government S&T organizations, DRDC is taking a pro-active approach to implementing a system that will meet ongoing program management needs as well as overall government reporting requirements.

Conclusions Relating to Risk Management

4.27 The evaluation team has concluded that:

- a. DRDC has taken an appropriate, pro-active role in determining areas where the Departmental/CF R&D capability can contribute to corporate risk management;
- b. DRDC has demonstrated its capability, both to manage risks inherent in its own program and also demonstrate its ability to contribute to the containment of risk on behalf of the Department and the CF through such internal initiatives as the TIS, TIF, TDP and Technology Outlook; and
- c. DRDC plays an important role now and is positioning itself through the evolution of new and existing programs, to be an increasingly important player in the area of risk management.

Recommendations Related to Risk Management

4.28 The evaluation team recommends that:

- a. DRDC communicate to both its clients and stakeholders, that risk and risk-management are fundamental components of the research and development program; and
- b. DRDC remain alert to opportunities where its expertise can be applied in support of Departmental and CF activities to permit the management of risk.

ANNEX A

Memorandum

Note de service

7053-41-4 (CRS)

7053-41-4 (CS Ex)

May 00

Le mai 00

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Liste de distr

NOTIFICATION OF CRS REVIEW - PROGRAM
EVALUATION OF RESEARCH AND
DEVELOPMENT IN DND AND THE CF

AVIS D'EXAMEN DU CS EX – ÉVALUATION
DU PROGRAMME DE RECHERCHE ET
DE DÉVELOPPEMENT AU SEIN DU MDN ET
DES FC

Ref: Chief Review Services Review Plan -
1999-2000

Réf : Plan d'examen du Chef - Service d'examen -
1999-2000

BACKGROUND

CONTEXTE

1. The Department of National Defence (DND) and the Canadian Forces (CF) are preparing for the defence environment of the 21st Century. In order to build an effective operational force, the CF must be prepared to meet and respond to an increasingly diverse set of challenges. The Defence Research and Development program provides a critical capability in addressing the defence objectives set out for the Department in Defence Strategy 2020.

1. Le ministère de la Défense nationale (MDN) et les Forces canadiennes (FC) se préparent à l'environnement de défense du XXI^e siècle. Pour bâtir une force opérationnelle efficace, les FC doivent être prêtes à relever des défis de plus en plus variés. Le programme de recherche et de développement de la Défense assure une capacité essentielle à la réalisation des objectifs de défense énoncés dans la Stratégie 2020 du Ministère.

2. At reference, the Chief Review Services has been tasked to conduct a program evaluation which would address issues related to the contribution of the research and development program to the achievement of the strategic objectives of the Department. While several specific issues affecting Defence R&D Canada (DRDC) have been audited in recent years, a comprehensive program evaluation of the R&D Program and its operations has not been done. In the process of establishing a Research and Development Agency (as of 1 Apr 00), defence research and development has undergone considerable scrutiny through ASD analysis, preparation of a business case and development of a management framework. The CRS review will be cognizant of the analysis that has already been completed.

2. Dans le document de référence, le Chef - Service d'examen a été chargé d'effectuer une évaluation de programme sur les questions liées à la contribution du programme de recherche et de développement à l'atteinte des objectifs stratégiques du Ministère. Bien que plusieurs questions précises touchant Recherche et développement pour la Défense Canada (RDDC) aient été vérifiées ces dernières années, le programme de R&D et ses activités n'ont fait l'objet d'aucune évaluation exhaustive. Dans le contexte de l'établissement d'une agence de recherche et de développement (au 1^{er} avril 2000), le programme de R&D de la Défense a été soumis à de nombreux examens lors de l'analyse de DMPS, de la préparation d'une analyse de rentabilisation et de l'élaboration d'un cadre de gestion. L'examen du CS Ex tiendra compte des analyses déjà effectuées.

ANNEX A

AIM AND SCOPE

3. The overall aim of this review is to provide senior departmental management and research and development program management with findings, analysis and recommendations regarding R&D issues which contribute to the achievement of the strategic objectives of the Department. The following is a list of some of the issues that will be pursued by the review team:

- a. benchmarking DRDC management practices with other S&T organizations, such as those cited in the November 1999 OAG report on “Attributes of Well-Managed Research Organizations”;
- b. provide an assessment of client satisfaction with the R&D program from the perspective of senior departmental stakeholders;
- c. assess the effectiveness of the management framework, internal management and support systems of DRDC to achieve the mandate and mission of the Agency;
- d. assess the human resource management issues and strategies employed by DRDC which impact delivery of the science and technology (S&T) program;
- e. assess the impact and influence of DRDC on the strategic planning processes of DND and the CF; and
- f. assess those issues related to the transition to agency status.

BUT et PORTÉE

3. Dans l'ensemble, cet examen vise à fournir à la haute direction du Ministère et du programme de recherche et de développement des constatations, une analyse et des recommandations en ce qui concerne les questions de R&D qui contribuent à la réalisation des objectifs stratégiques du Ministère. Voici quelques-unes des questions sur lesquelles l'équipe d'examen se penchera :

- a. effectuer une analyse comparative des pratiques de gestion de RDDC avec celles d'autres organisations de S&T, notamment celles mentionnées dans le rapport de novembre 1999 du BVG sur « les caractéristiques des organismes de recherche bien gérés »;
- b. fournir une évaluation de la satisfaction des clients à l'égard du programme de R&D, du point de vue des intervenants supérieurs du Ministère;
- c. évaluer l'efficacité du cadre de gestion ainsi que des systèmes internes de gestion et de soutien de RDDC, pour ce qui est d'exécuter le mandat et la mission de l'Agence;
- d. évaluer les questions de gestion des ressources humaines et les stratégies employées par RDDC qui ont une incidence sur la prestation du programme de science et de technologie (S&T);
- e. évaluer l'impact et l'influence de RDDC sur les processus de planification stratégique du MDN et des FC;
- f. évaluer les questions concernant la transition au statut d'agence.

ANNEX A**METHODOLOGY**

4. While the program evaluation will not exhaustively examine the full DRDC Program, it will be sufficiently comprehensive to address the most relevant program evaluation issues. Program evaluation and review guidelines prescribed by the Treasury Board will be adhered to in the conduct of this review. Information gathered through literature and file reviews will be augmented by interviews and other fact-gathering techniques which will encompass DND, the CF, other government departments and agencies, as well as other Defence S&T organizations internationally.

PROJECT DELIVERABLES

5. The completed CRS review will provide conclusions and recommendations regarding the appropriateness of management systems, strategies and service delivery options for the achievement of performance objectives established for DRDC. A draft report will be issued for OPI comments followed by a final report.

TEAM COMPOSITION

6. The team will comprise the following membership:

Approval Authority:	Mr. Jim Van Adel Director General Review Services
Team Leader:	Mr. Norm Black Review Principal
Team Member	Mr. Harry Hubley Review Principal

MÉTHODOLOGIE

4. Même si le programme de RDDC ne sera pas examiné de façon exhaustive dans le cadre de l'évaluation, cette dernière sera suffisamment approfondie pour traiter les questions les plus pertinentes. L'examen sera effectué conformément aux lignes directrices du Conseil du Trésor sur l'évaluation et l'examen des programmes. Aux renseignements recueillis grâce à l'étude de la documentation et des dossiers s'ajouteront des entrevues et d'autres techniques de collecte de faits qui engloberont le MDN, les FC, d'autres ministères et organismes, ainsi que d'autres organisations de S&T de défense à l'échelle internationale.

PRODUITS À LIVRER

5. Une fois terminé, l'examen du CS Ex fournira des conclusions et des recommandations sur la pertinence des systèmes de gestion, des stratégies et des options de prestation de services aux fins de la réalisation des objectifs de rendement fixés à l'égard de RDDC. Une ébauche de rapport sera distribuée aux BPR pour commentaires et suivie d'un rapport final.

COMPOSITION DE L'ÉQUIPE

6. L'équipe sera composée des personnes suivantes :

Autorité approbatrice :	M. Jim Van Adel Directeur général - Service d'examen
Chef d'équipe :	M. Norm Black Gestionnaire d'examen
Membre de l'équipe :	M. Harry Hubley Gestionnaire d'examen

ANNEX A

7. Any queries concerning this review should be directed to CRS or the Review Team Leader, Mr. Norm Black at 613-996-4534, fax 613-992-0528.

7. Prière d'adresser les questions concernant cet examen au CS Ex ou au chef de l'équipe d'examen, M. Norm Black, au 613-996-4534, fax 613-992-0528.

CS Ex
Mgén

K.G. Penney
MGen
CRS
995-8561

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H. Hubley, CRS/Principal, 996-5664/R&D Notif Review-bil.doc
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