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Chapter 4
National Defence—
C4ISR Initiative in Support of Command and Control

Office of the Auditor General of Canada

The April 2005 Report of the Auditor General of Canada comprises six chapters, and a Message From the Auditor General of Canada and Main Points. The main table of contents is found at the end of this publication.

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Chapter

4

National Defence

C4ISR Initiative in Support of Command and Control

All of the audit work in this chapter was conducted in accordance with the standards for assurance engagements set by the Canadian Institute of Chartered Accountants. While the Office adopts these standards as the minimum requirement for our audits, we also draw upon the standards and practices of other disciplines.

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Main Points

4.1 National Defence estimates that by 2015 it will have invested almost $10 billion on projects to improve the way it gathers, processes, and uses military information. This is needed to provide commanders with better information for decision making in order to exercise faster and more effective command and control in both joint and combined operations. It is also to allow National Defence to keep up with the progress and changes being made by allies. This is a key part of the transformation of the Canadian Forces into the 21st century. The Command, Control, Communications, Computers (C4), Intelligence, Surveillance, and Reconnaissance (ISR) initiative is a strategy to help make this information-technology transformation happen.

4.2 The Department has made a good start in managing C4ISR and has put in place some guidance and methodology to help it achieve its goals. However, some of the key elements required to ensure successful implementation of the C4ISR initiative are not yet in place. National Defence must put a priority on producing its joint C4ISR doctrine, a concept of operations, a clear definition of interoperability, and a common understanding of what C4ISR means to better guide its development. National Defence has already invested about $4 billion of the almost $10 billion planned for projects that have a C4ISR component; however, without these key elements the Department is at risk of developing non-compatible or duplicate systems.

4.3 C4ISR is complex and expensive and constitutes a significant investment by the Department in improving the way it collects, processes, and uses information for operations, in particular joint and combined operations. The Department recognizes that the individual services cannot afford to pursue, nor should they pursue, C4ISR separately. The Navy, Army, and Air Force must work jointly to take advantage of economies of scale and achieve fully interoperable and integrated systems. While the Deputy Chief of Defence Staff is responsible for joint operations, the individual services have traditionally been responsible for generating what they need for those operations; therefore, C4ISR-related development has tended to be pursued along individual service paths rather than jointly. As well, existing joint-requirements committees need clearer authority and a stronger role in project approval to ensure that activities co-ordinate and meet joint expectations.

4.4 To have a C4ISR initiative that is affordable and achievable, National Defence needs mechanisms that help it choose which projects to pursue and to guide how systems will be developed. The Department is using a

methodology that helps it define and refine C4ISR needs over time and has begun working on a common approach to designing its systems to meet those needs. However, projects already under way or being developed have not followed a common design approach and need to be reviewed to ensure they still meet the Department's intent. Without this adherence to a common approach, the Department has no assurance that its systems will converge and integrate as planned. Both a common design approach—or enterprise architecture—and a review of all projects need to be completed if the Department is to move forward in a structured, efficient, and disciplined way.

Background and other observations

4.5 The goal for the Canadian Forces, like other militaries around the world, is to improve the way it collects, analyzes, disseminates, and shares information gathered through C4ISR means to provide commanders with trusted and relevant information for decision making. Militaries are putting renewed efforts into C4ISR because of the opportunities information technology provides to enhance their own command and control.

4.6 In December 2003, the Department of National Defence released its C4ISR Command Guidance and Campaign Plan document to provide the Canadian Forces with high-level guidance and an integrated approach to develop and transform the capability into one that supports Forces-wide command and control into the 21st century.

4.7 By 2008, the Department wants to achieve its first C4ISR timeline and to have completed three overall phases—concept development, consolidation of projects and initiatives, and initial transformation; these involve the creation of an information-based culture and a network-enabled organization.

4.8 Our 1994 Report, Chapter 25, Information Technology recommended that command and control systems be able to interoperate in joint and combined operations, which the Department accepted as a mandatory requirement. The Information Technology Infrastructure and the Canadian Forces Command and Control Information System were both actively addressing these requirements. The Department acknowledged that joint interoperability had not received a high priority in these activities until the recent past. Nevertheless, our 1996 follow-up chapter concluded that the interoperability of command and control communication systems needed further development for joint and combined operations.

4.9 In our 1998 Report, Chapter 3, Equipping and Modernizing the Canadian Forces, we reported that, as far back as 1994, the Army had not kept pace with technology to modernize its equipment; this left it vulnerable to threats in low-level and mid-level operations. Some of those problems have since been corrected, but some have not. For example, National Defence has been working on implementing an Army communications system, which was to be completed by 2001 and was to be fully interoperable with other Canadian Forces command and control systems. By 2004, however, this was still not fully operational.

The Department has responded. The Department has indicated the action it has taken or intends to take to address the recommendations. Its detailed response follows each recommendation throughout the chapter.

Introduction

C4ISR—Command and Control, Communications, Computing, Intelligence, Surveillance, and Reconnaissance consists of the doctrine and concepts, the connectivity, the information systems, the sensors, and the tools required to effectively support Command across the entire spectrum of Canadian Forces operations through the timely attainment of trusted and relevant information.

4.10 A priority of the Department of National Defence and the Canadian Forces is to transform the way it conducts operations by taking advantage of advances in information technology. The goal is to support this operational transformation by developing C4ISR systems that can provide trusted, relevant, and timely decision-quality information to commanders. This will reduce uncertainty to the point where the commander is confident that the decisions being made are the best obtainable in the operational context.

4.11 According to National Defence, the conduct and character of war is changing. Rapidly integrating technologies are effecting important changes in our global society and in how the military operates. Many view the application of advanced technologies as a revolution in military affairs. Canada's allies are also pursuing these developments to ensure that they maintain modern and interoperable forces into the future.

4.12 Part of National Defence's role is to ensure Canadian sovereignty and to contribute to the defence of North America. In this role, National Defence sees a need for a greater ability to function jointly. As well, National Defence is now often required to work with other government departments and non-governmental organizations. In DND's view, our allies in NORAD and NATO want National Defence to be a competent partner capable of taking a meaningful part in combined operations. Therefore, the Canadian Forces must be interoperable with its defence partners; this means that it needs to keep pace with new military concepts, doctrine, and technological change.

4.13 *Shaping the Future of the Canadian Forces: A Strategy for 2020* provides the official strategic vision for the development of the Canadian Forces in the 21st Century. In its strategy, the Department states

> At its core, the strategy is to position the force structure of the Canadian Forces (CF) to provide Canada with modern, task-tailored, and globally deployable combat-capable forces that can respond quickly to crises at home and abroad, in joint or combined operations.

4.14 How well the strategy goals can be achieved will be determined in part by how well National Defence can integrate advanced information technologies with appropriate operational and organizational concepts.

Command and control—The exercise of authority and direction by a designated commander over assigned forces in the accomplishment of the force's mission. The functions of command and control are performed through an arrangement of personnel, equipment, communications, facilities, and procedures that are employed by a commander in planning, directing, co-ordinating, and controlling forces in the accomplishment of the mission.

4.15 In July 2002, National Defence reviewed its capabilities and identified gaps in its five capability areas in the document, Capability Outlook 2002–2012. It determined that a very serious shortfall existed in intelligence and information for command and control and that it needed to better develop joint doctrine, operational concepts, and training. The Department recognized that initiatives should be integrated and that failure to do so could result in a lack of interoperability within the Canadian Forces

and with allies. The Capability Outlook 2002–2012 set out as priorities the following:

- the development of a truly CF-wide joint command system;
- a comprehensive plan for joint policy, concepts, and doctrine development;
- the development of a comprehensive strategic-operational joint command structure;
- the procurement of a coherent and fully integrated suite of intelligence, surveillance, and reconnaissance assets; and
- the establishment of intelligence and information fusion centres.

4.16 The Department has begun its C4ISR initiative to take advantage of information technology opportunities and address its capability deficiencies in a strategic way but also to ensure that operational requirements of the Navy, Army, and Air Force are met.

4.17 In its C4ISR capability analysis, the Department identified several areas to improve, such as the following:

- underutilization of existing network capabilities,
- no common goals or standards,
- lack of integration between projects,
- lack of a management system,
- need for cultural and organizational change,
- need for more personnel and training,
- bandwidth constraints, and
- funding constraints.

Focus of the audit

4.18 We evaluated the Department's progress in implementing key organizational and operational changes that would allow it to build toward C4ISR goals. Specifically, we focussed on progress that the Department has made in developing C4ISR guidance at the strategic level, which includes establishing clear and jointly accepted definitions, doctrine, lines of authority and accountability, a framework for a department-wide C4ISR architecture, and performance measures.

4.19 We also examined the progress National Defence has made in bringing together work already started to address capability deficiencies through C4ISR-proposed solutions. We examined the expected costs of implementing C4ISR solutions to determine whether the Department is putting forward requirements that are affordable and achievable. More information is available in **About the Audit** at the end of the chapter.

Observations and Recommendations

National Defence is moving in the right direction

4.20 We found that the Department has made progress toward addressing its C4ISR capability gaps. Under the Vice Chief of Defence Staff and the Deputy Chief of Defence Staff (DCDS), National Defence has set up the Joint Capability Requirement Board and the C4ISR Oversight Committee to provide a strategic perspective and leadership. These committees give senior management a forum to discuss joint C4ISR initiatives.

4.21 The Department has also initiated a Joint Capabilities Assessment Team to review identified operational requirements and assess whether specific projects and initiatives are consistent with joint goals. This Assessment Team can then advise the Oversight Committee and the Requirement Board on C4ISR opportunities.

4.22 The Department has produced its C4ISR Command Guidance and Campaign Plan as a vision and guidance for achieving C4ISR goals. In the Campaign Plan, the Department states that the services (Navy, Army, and Air Force) must not independently develop information systems for command and control. To do so could result in the services taking divergent paths, developing duplicate systems, and failing to take advantage of efficiencies. This would increase the risk that systems would not be able to interconnect when they need to, which is contrary to the Canadian Forces C4ISR goals.

4.23 To prevent this, the Department has adopted an enterprise model that brings together all information management activities and investments as part of a larger Defence strategy. Under this model, the services and groups are getting out of the business of doing their own information management work. The three services and the groups are responsible for identifying and determining their requirements and the Assistant Deputy Minister (Information Management) is responsible for systems design. By adopting this approach, National Defence wants to ensure that common protocols are followed as systems are developed. The Department expects that this will provide structure and discipline for C4ISR initiatives, so that by 2008 the Department will have integrated systems across functional areas.

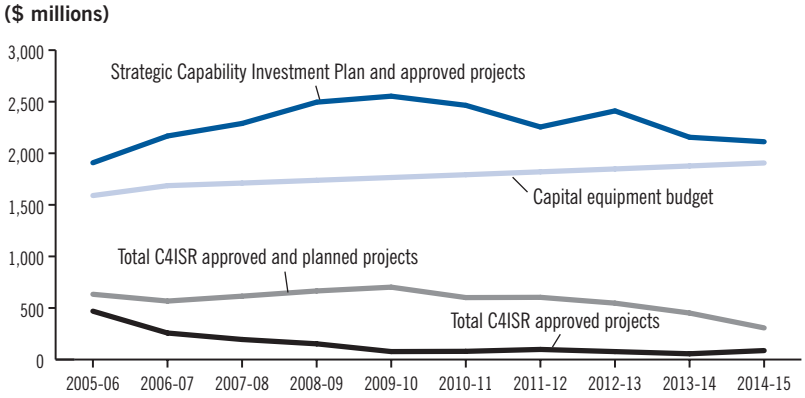
Affordability

Funding pressures could put some C4ISR projects at risk

4.24 We reviewed the planned spending for 91 projects that National Defence identified as a baseline for planning and implementing its C4ISR transformation. We estimate that expenditures related to C4ISR could total approximately $9.7 billion, of which about $4 billion has been expended to date and a further $5.7 billion in spending is planned by the Department over the next 10 years. In some years, annual spending for C4ISR will reach as much as 40 percent of the funding available in the capital equipment budget.

4.25 Exhibit 4.1 shows the forecast spending requirements for C4ISR projects and the total demand that this places on the available capital equipment budget. Even though the Department has had to make some hard choices in allocating its capital budget, more spending is forecast to complete already existing projects plus start projects identified in the Strategic Capability Investment Plan than the funding available in the capital equipment budget. This funding pressure could result in some C4ISR projects being scaled back, deferred, or cancelled.

Exhibit 4.1 C4ISR budget requirements for National Defence



Source: National Defence

4.26 C4ISR goals and timing could be at risk if the right projects cannot be funded or are deferred. The Department recommended a review of its C4ISR projects to ensure they are still operationally required, but we found that this had not yet been undertaken. This review is necessary to ensure that projects that are planned or already under way adhere to C4ISR guidance to avoid unnecessary duplication and to obtain the best result.

4.27 In its Strategic Capability Investment Plan 2004, National Defence identified which C4ISR projects it intends to start as a priority. There are three types of C4ISR projects that the Department estimates will need about $5.7 billion in funding.

- **Enabler projects.** These are considered key to implementing C4ISR. For example, the Canadian Forces Command System Phase II project ($102 million) is key to enabling better information integration. In all, the Department plans to spend about $882 million on 13 enabler projects over the next 10 years. All enabler projects have already been approved or are priorities for funding.
- **Related projects**. These are part of the C4ISR initiative to address capability deficiencies and continue the C4ISR transformation. For example, the Joint Space Support project and the Tactical Information Distribution Enhancement project are related projects. The Department plans to spend about $1.7 billion on related projects over

the next 10 years. We found that of 19 related projects, 10 have already been approved and are underway or completed. The other nine related projects, if approved, will require about $1.25 billion in funding over the next 10 years.

- **Other projects identified as part of C4ISR**. There are 59 other C4ISR projects that the Department has planned or already started. The Department has identified a need for about $3.1 billion in ongoing spending for these projects over the next 10 years.

C4ISR Implementation Strategy

C4ISR systems have been developed without a joint C4ISR doctrine or concept of operations in place

Doctrine—The set of fundamental principles that guide military actions in support of objectives.

Concept of operations—A clear and concise statement of the line of action chosen by a commander in order to accomplish the mission.

4.28 To be operationally relevant, defence programs are based on supporting doctrine and concepts of operations. A concept of operations guides planning, which translates strategic objectives into military operations by clearly stating the action needed to accomplish the mission. Doctrine is essential as it sets out the fundamental principles for how military operations are to be planned, trade-offs addressed, and actions conducted. The Canadian Forces Command System Framework Concept of Operations states that any equipment program, which includes C4ISR projects, must be based on supporting doctrine.

4.29 The C4ISR Command Guidance and Campaign Plan states that doctrine, concepts, and systems need to evolve along a single, convergent path that is interoperable across all environments. Without these, the Canadian Forces would not have a blueprint for how it intends to pursue C4ISR development to support the operational demands of the three services in a common way.

4.30 We found that the 91 C4ISR projects are proceeding without this blueprint in place. Therefore, it is difficult to link the projects back to an overall joint C4ISR objective or to obtain assurance that C4ISR work that is planned or already under way is proceeding in a common, interoperable way.

4.31 The three separate services—the Navy, Army, and Air Force—are responsible for developing and maintaining their own concepts of operations and doctrine. The Deputy Chief of the Defence Staff is responsible for doctrine and concepts of operations for joint and combined operations. The Department has stated that it has not yet bridged the gap between the joint level and the service level doctrine.

4.32 In August 2002, the Department noted that no effort was under way for the development of joint doctrine for C4ISR. At the time of this audit, the Department still had no plans to develop C4ISR doctrine even though the Defence Plan had called for joint interoperability doctrine and procedures to be developed and implemented by July 2004.

4.33 In order to develop systems consistent with its C4ISR vision, the Department needs to have doctrine and a concept of operations in place to ensure that it is not going in the direction it had warned itself against—that is, the development of duplicate or incompatible systems. With planned

C4ISR expenditures totalling almost $6 billion over the next 10 years, these key elements should be in place as soon as possible.

4.34 Tactical data links and bandwidth requirements are two examples of C4ISR projects that need a C4ISR concept of operation to guide development (see Tactical data links and bandwidth requirements on page 11).

Interoperability is not yet defined for C4ISR

Interoperability—The Canadian Forces does not have a definition of interoperability. NATO defines interoperability as the ability of Alliance forces and, when appropriate, forces of Partner and other nations to train, exercise, and operate effectively together in the execution of assigned missions and tasks.

4.35 National Defence has also expressed concern over its current level of doctrinal interoperability with its allies. An assessment conducted in 2002 concluded that most interoperability concerns could have a major or significant impact on operations.

4.36 National Defence does not have an approved definition of interoperability for joint and combined operations. It has not adopted the NATO definition of interoperability for joint and combined operations into its documentation. According to departmental documents, the NATO definition is NATO-centric and does not suit Canadian Forces requirements. However, no other definition has been developed. The Department plans to establish an interoperability working group to address the need for a departmental interoperability plan.

Some important elements of a C4ISR implementation strategy need to be better developed

4.37 **Tasking**. The Defence Plans make it clear that National Defence will develop its C4ISR capability; further, the Plans give specific direction to the DCDS, Chief of the Maritime Staff, Chief of the Land Staff, Chief of the Air Staff, ADM (Information Management), and ADM (Science and Technology) to do so. The services and groups are to "self-synchronize" their activities and efforts using the C4ISR Command Guidance and Campaign Plan and the Target Integration Model 2008 increments.

Self-synchronization—The alignment of Groups' and Services' activities, to coincide with and complement the overall Campaign Plan, without external control.

4.38 This self-synchronization is to occur through the business planning process, in which the three services and the groups identify their operational requirements and any related C4ISR needs. The services and groups need to determine how they will self-synchronize their activities. However, the C4ISR Command Guidance and Campaign Plan explains that self-synchronization will take place as synergy is created between C4ISR doctrine, concepts, and capabilities. Therefore, in order for self-synchronization to work, the Department needs to have in place the necessary doctrine and concepts of operations.

4.39 **Directives.** The C4ISR Command Guidance and Campaign Plan was approved by the C4ISR Oversight Committee and signed by the DCDS as the Chair of the C4ISR Oversight Committee. A presentation was made to the Defence Management Committee on the progress achieved so far, in February 2003, and the Requirement Board endorsed the Campaign Plan in December 2003. However, we did not find any directive issued by the Deputy Minister or the Chief of the Defence Staff to implement the C4ISR Command Guidance and Campaign Plan. Nor did we find any directives issued by groups and services to their subordinate levels.

Tactical data links and bandwidth requirements

The C4ISR initiative is intended to reduce uncertainty to the point where commanders are confident that the decisions they are making are the best obtainable in the operational circumstances. The overall vision is to develop a C4ISR capability that supports the command and control function by providing commanders with situational awareness and a common operating picture in real or near-real time. Investment in C4ISR will enable networked forces, tailored by task, to conduct integrated operations across the full range of military activities.

Tactical data links. Tactical data links (TDL) are a technology that enables standardized communication pathways to commanders during operations. TDLs connect commanders in networks to a continuous flow of information, so that each commander can then make best use of available sensors and weapons.

Tactical data links are primarily for wireless transmission via radio and satellite, but connections through secure landline are also vital to support deployed operations. TDL capabilities have been identified as a "must have" for coalition operations. The Chief of the Defence Staff has also underscored the need for joint force development and to properly situate TDL development within the Department. However, there is a high risk that TDL capabilities will be implemented without a consolidated joint strategy across the Canadian Forces. There is no one source in the Canadian Forces that provides an overview of wireless systems employed or planned for use in the Canadian Forces. A Concept of Operations for Tactical Data Link Systems was drafted in February 2003 but has not yet been approved.

In 2004, there are three projects to develop TDL capability within the Navy and the Air Force, estimated at $175 million, of which $25 million has already been spent by the Department.

Bandwidth. Bandwidth refers to the size of the connecting "pipe" that information flows through between communication terminals. Bandwidth determines the rate at which data can be transmitted: the greater the bandwidth, the greater the amount of information that can be sent to networked commanders in a given amount of time. Sufficient secure bandwidth must be provided to carry out C4ISR functions.

The Canadian Forces' bandwidth use has increased eight-fold in eight years and is expected to continue to increase due to the demands of new sensor data, information systems, and ISR fusion requirements. By 2010, unless changes are made, National Defence expects it will not be able to meet bandwidth requirements. The Department has endorsed a strategy to develop capability to respond to the need to provide sufficient bandwidth to deployed operations. The endorsed strategy emphasizes increasing joint investments in satellite technology.

Currently, however, there is no common concept of operations to manage satellite channels and bandwidth demand within the Department. The capabilities for managing channels that exist have been developed on a system-by-system basis. No standardized architecture or commonly recognized interface standard exists to address needs for increasing bandwidth capacity over satellite data links for command and control. Without this architecture, there could be a proliferation of independent communication systems instead of networked systems.

In 2003, the Department spent $18.7 million to lease commercial satellite capacity to support deployed operations. Currently, there are five projects in the Department to develop satellite broadcast capabilities and improve joint satellite communications, estimated at $693 million.

4.40 The Department may issue a departmental administrative order and directive to announce the departmental policy to implement the C4ISR initiative, but this has not been done. Such an administrative order could provide specifications on definitions, policy direction, roles, responsibilities, and authority.

4.41 **Definition.** We found that different people interpret C4ISR to mean different things; the Department also commented on this issue in its documentation. The C4ISR Command Guidance and Campaign Plan needs to be updated to include achievable goals, criteria to declare success, mission, resources, constraints, and strategic direction to commanders as outlined in the Canadian Forces Operational Planning Process. If this is done, it would better clarify C4ISR.

4.42 **Groups and services plans.** Consistent with the Department's enterprise model, in March 2004 the Assistant Deputy Minister (Information Management) requested that groups and services produce an information management/information technology plan by June 2004 to interface with the information management group. However, at the time of our audit, ADM (IM) had not received all of the expected information.

4.43 **Supporting plans.** We found that of the ten supporting plans identified in the C4ISR Command Guidance and Campaign Plan, work had started on only four. Work on the ten plans was to have been initiated by April 2004. Although departmental documentation indicates that four plans were developed, the Department was not able to provide us with copies of any of the plans.

4.44 **C4ISR implementation risk assessment.** National Defence has an Integrated Strategic Risk Management Framework to define corporate risk and how to manage it. The framework is intended to suggest risk-management actions and methods that will support Defence objectives. The Treasury Board concept for an integrated risk-management function expects that departments will set up the corporate infrastructure for risk management to provide clear direction and senior-management support. National Defence has chosen to depart from the Treasury Board approach and use its existing committee structure and planning process.

4.45 The Department has not yet conducted a risk assessment for its strategic C4ISR initiative. The C4ISR Command Guidance and Campaign Plan identified "risk mitigation decisive points," which talk about five possible risk weaknesses. However, the Department needs to fully assess these areas against risk likelihood and potential impact and then develop a risk-management strategy.

4.46 **Recommendation.** National Defence should put a priority on developing joint C4ISR doctrine, concept of operations, and a definition of interoperability by the end of 2006.

Department's response. Agreed. Doctrine, operating concepts, and clear definitions are recognized as important elements of C4ISR implementation, and their development continues to be a high priority. Although the writing and approval of doctrine and concepts of operations are complex undertakings, the Department will endeavour to have these elements developed by the end of 2006.

Stronger C4ISR management is needed

4.47 The C4ISR Oversight Committee and the Joint Capability Requirement Board were created in 1999 and 2000 respectively in response to a need for more co-ordination of requirements. The Joint Capability Requirement Board's responsibility is to facilitate a joint understanding of concepts of employment and operations, reach consensus for statements of operational requirements, and resolve issues of project scope at the corporate level. The C4ISR Oversight Committee provides a strategic perspective and leadership on all C4ISR—related matters.

4.48 Departmental documents indicate that there are problems with this committee structure due to a lack of clear lines of authority. Although the C4ISR Oversight Committee is in place to provide executive oversight and a co-ordinating role to manage the ongoing tasking of C4ISR, there is no one C4ISR authority enforcing important elements such as the implementation of the C4ISR Command Guidance and Campaign Plan or the review of projects.

4.49 We found that departmental officials often bypassed this committee structure prior to C4ISR projects approval. Therefore, we were unable to determine how these committees were able to fulfill their review and co-ordinating role for C4ISR. Since 1999, only 6 of 13 enabler projects and 2 of 19 related projects were submitted to either the C4ISR Oversight Committee or Requirement Board for discussion before going to the Program Management Board for funding approval.

4.50 We also found that about 72 percent of the C4ISR enabler and related projects were missing key documentation necessary for project review and approval. Projects were missing either the synopsis sheet to identify deficiencies or the statement of operational requirements, or both. To date, National Defence has spent about $2.9 billion, of the estimated $3.7 billion required, on enabler and related projects that did not have approved statements of capability deficiency or statements of operational requirement.

4.51 The Joint Capabilities Assessment Team noted that it was very difficult to create a list of prioritized C4ISR projects because such a process requires the comparison of a large number of dissimilar items. The Assessment Team also noted that the problem is further complicated by the breadth of issues being considered, which are so large that it is difficult to find a decision-making body with detailed knowledge of all projects.

4.52 Department officials informed us that the Requirement Board and C4ISR Oversight Committee do not have the resources to become more involved in the project selection process as much more staff effort would be required. As well, the Oversight Committee would have to meet more frequently.

4.53 **Recommendation.** Senior management should ensure that, in the future, all projects justified as part of C4ISR are reviewed and approved by the Joint Capability Requirement Board and the C4ISR Oversight Committee, as part of the project approval process to provide assurance that the projects will ultimately be compatible with C4ISR goals as they evolve.

Department's response. Agreed. Future C4ISR projects will be subject to review by the Joint Capability Requirement Board and the C4ISR Oversight Committee.

Work is starting on a C4ISR enterprise architecture framework

4.54 In 2002, an internal review of information management found that National Defence did not have a comprehensive, information-management architecture and found several instances of duplication and overlap. As a result of these findings, the Department adopted its enterprise model for information management, which included a commitment to create an enterprise architecture. The Assistant Deputy Minister (Information Management) has begun working on an enterprise architecture framework that includes developing a plan to show how information will be sourced, collected, and integrated within and across functional areas in the Department.

Enterprise architecture—A strategic information asset base, which defines the mission, the information necessary to perform the mission, the technologies necessary to perform the mission, and the transitional processes for implementing new technologies in response to changing mission needs.

4.55 The Department has identified activities it needs to do to begin developing its enterprise architecture. It issued an Integrated Defence Enterprise Architecture Plan (Draft)—October 2004 to communicate the core enterprise architecture principles of the Department and to plan which activities it will complete by 2006.

4.56 The Department acknowledges that its key challenges in enterprise architecture are to determine, identify, and plan which portions of its three defence information management portfolios—military, corporate, and common—must become interconnected, interoperable, or integrated to avoid duplication and increase flexibility. As well, the Department needs to devote the appropriate resources to the right priorities.

Portfolios—The **military** portfolio encompasses three generic system families—Command Decision Support, Sensor, and Weapon (control) system families.
The **corporate** portfolio encompasses one generic system family—the resources management systems family.
The **common** portfolio encompasses two generic system families—the information management and security system families.

4.57 Another challenge for the Department is to ensure that C4ISR projects already planned or currently under way will be aligned with the enterprise architecture that is to be developed. The Department needs to take appropriate action to ensure that systems will converge the way senior management expects. The Department recognized that a review of projects and initiatives, developed either centrally or by the separate services, should be done since many projects were begun before National Defence issued its C4ISR Command Guidance and Campaign Plan. As a result, the Department needs to ensure that projects planned or already under way are consistent with the direction now being developed.

4.58 Without an enterprise architecture, the Department runs the risk of buying and building duplicate systems or systems that are incompatible and unnecessarily costly to maintain and integrate. This architecture is critical because it serves to inform, guide, and constrain the decisions of the Department, especially those related to investments in information technology.

4.59 **Recommendation.** National Defence should complete its enterprise architecture as a priority.

Department's response. Agreed. Based on the findings of the Department's Information Management Strategic Review, and ongoing activity to establish an Information Management Strategic Plan, the establishment of an enterprise architecture is indeed a high priority. Enterprise architecture and the C4ISR Campaign Plan should build upon each other in an iterative, symbiotic manner in order to produce an enterprise architecture that best supports operational requirements and, by extension, C4ISR.

Use of spiral development methodology is appropriate but needs to advance

4.60 By 2008, National Defence plans to have implemented C4ISR through 11 increments of 6 months each, which are known as spirals. These are leading up to its Target Integration Model 2008. Each spiral has objectives and/or capabilities. At the end of each spiral, the objectives or capabilities acquired are used as a base for the achievement of the next spiral. Those not met may be deferred to future spirals or cancelled. Such flexibility separates spiral development methodology from the traditional method or waterfall development.

Spiral development methodology—A project development methodology, which means one stage is not wholly dependent on the successful delivery of the previous stage. In spiral development methodology, several stages can occur repetitively and concurrently.

4.61 Spiral development methodology seems appropriate to C4ISR implementation since the overall requirements are broadly defined, and the specific end-product is not yet known. This methodology allows for the evolution and refinement of requirements as necessary during development. At the time of our audit, the Department stated that it had completed the first and second spirals and was beginning work on the third.

4.62 One of the goals of C4ISR is to support the operational requirements of the three Services and Groups. Initially, the Department chose to develop its C4ISR plans centrally and, following the release of the C4ISR Command Guidance and Campaign Plan, would increase participation. However, the Department was unable to provide evidence of user involvement in defining C4ISR requirements at the operational level. We were informed that a process to solicit feedback does not currently exist; however, the Department has recently held a user workshop. Obtaining and assessing user requirements is critical to the success of spiral methodology because, without identified user requirements, there is a risk that the objectives and capabilities developed will not meet the needs of users.

4.63 The spiral objectives were developed in the absence of an enterprise architecture. We believe that future spirals should be re-aligned to the enterprise architecture as it is developed to provide senior management with assurance that the C4ISR initiative is going in the right direction. The

Department has recognized the need to align C4ISR with an enterprise architecture and informed us that ways and means of resourcing this task are currently under consideration.

4.64 We also noted that the spiral objectives stated by the Department are broadly defined and subject to wide interpretation, which makes it easy for the Department to conclude they have been achieved. Exhibit 4.2 provides our review of some of the objectives stated in spiral two and how they could be improved, so that they are more specific, measurable, achievable, relevant, and time-related.

Exhibit 4.2 A review of spiral-two objectives

Spiral-two objective	Long-form description of spiral-two objective	Suggested elements to add to transform to smart objective
7(h) – 2.21	"LOG COP [Logistics Common Operating Picture]: An analysis with regards to developing sustainment information on a CF-wide COP is to be initiated. It is requested that the Sustain JCAT [Joint Capabilities Assessment Team] act as lead agency."	• Define "initiated" • List specific outcomes (expected qualitative and quantitative benefits) to be gained from completing this analysis • Describe and define methodology to be used for the analysis or exercise • Describe analysis'/exercise's relevancy to C4ISR • Specify owner (individual's name) accountable for the completion of the analysis or exercise • Define completion (examples: "draft"; "mature draft"; "final approved draft") • Specify owner (individual's name) accountable for the review of the analysis/exercise after completion • Specify resources required • Specify stakeholder groups to be consulted, if any
8(a) – 2.22	"C4ISR CP—R&D (C4ISR Campaign Plan—Research & Development. Component: Identify links between current C4ISR R&D and OR (Operational Research) projects and the C4ISR CP, and, identify gaps, if any, in the current C4ISR R&D/OR program and resulting tasks."	• Specify outcomes (expected qualitative and quantitative benefits) to be gained from completing this analysis • Describe exercise relevancy to C4ISR • Describe and define methodology to be used for the gap analysis • Specify owner (individual's name) accountable for the review of the gap analysis • Specify if approval is required for completion to take place • Specify resources required • Specify stakeholder groups to be consulted, if any • Define whether the 6-month time frame is adequate or whether a portion will be deferred to the next spiral. If so, describe pieces expected to be deferred

Exhibit 4.2 **A review of spiral-two objectives (continued)**

Spiral-two objective	Long-form description of spiral-two objective	Suggested elements to add to transform to smart objective
9(a) – 2.26	"Industry Engagement Strategy: DJFC (Director Joint Force Capabilities) and DBDO (Director Business Development Office) (DRDC) (Defence Research Development Canada) to lead efforts in developing an Industry Engagement Strategy for C4ISR development."	• Define "Engagement Strategy" and "pervasive procedures" • List specific outcomes (expected qualitative and quantitative benefits) to be gained from these analyses/exercises • Describe exercises' relevancy to C4ISR • Describe and define methodology to be used for the Strategy and pervasive procedures • Specify owner (individual's name) accountable for the review of the Strategy and pervasive procedures
9(c) – 2.28	"National Operations/ Intelligence Centre C4ISR Policy: DJFC, in conjunction with NDCC (National Defence Command Center) JOG (Joint Operating Group) and JIIFC (Joint Information and Intelligence Fusion Capability), is to lead efforts in establishing pervasive procedures and policy for common use throughout CF Operations/ Intelligence Centres."	• Specify if approval is required for completion to take place • Specify resources required • Specify stakeholder groups to be consulted, if any • Define whether the 6-month time frame is adequate or whether a portion will be deferred to the next spiral. If so, describe pieces expected to be deferred
10 – 2.30 to 2.35	"C4ISR Supporting Plans: Spiral 1 tasked the initiation of a series of plans to support the C4ISR CP. A number of these plans did not achieve maturity during Spiral 1."	• Define "initiation" • Cite assurances obtained that no other supporting plans are required and or relevant for C4ISR purposes, and how assurances were obtained • Specify outcomes (expected qualitative and quantitative benefits) to be gained from "initiating" these supporting plans • Describe and define of methodology to be used for the "initiation" of the supporting plans • Specify owner (individual's name) accountable for the review of each supporting plan • Specify if approval is required for completion to take place • Specify resources required for each plan • Specify stakeholder groups to be consulted, if any • Define whether the 6-month time frame is adequate or whether a portion will be deferred to the next spiral. If so, describe pieces expected to be deferred.

Source: National Defence spiral-two objectives

4.65 We found that key performance indicators had not yet been developed at the time of this audit. The absence of indicators means that the Department can declare that any or all of its objectives have been achieved. For example, the Department had concluded that 20 of the 41 spiral-one objectives had been significantly or totally fulfilled, but we were informed that this assessment was done subjectively, with no formal assessment criteria. Our review found that, for 12 of those 20 objectives, it was difficult to conclude, from the evidence presented, whether substantial completion had in fact been achieved. It was too early to assess the success of spiral-two objectives, as they were just being completed.

4.66 **Recommendation.** The Department should review its spiral objectives to ensure that they are sufficiently clear so that results can be measured.

Department's response. Agreed. The "spiral" objectives in the C4ISR Campaign Plan are under constant review. Spiral development is actually designed to evolve as implementation proceeds and the desired end state becomes clearer.

The tasks and objectives analyzed during this audit were in the first two spirals of the campaign plan. With the passing of each spiral, lessons are learned, tasking methodology is improved, and objectives are clarified. In this regard, many of the suggestions made by the audit team during the course of this audit have already been incorporated into spiral three and will be built increasingly into subsequent spirals.

4.67 **Recommendation.** The Department should develop key performance indicators that can provide senior management with a true measure of what has been achieved.

Department's response. Agreed. As outlined in the response to 4.66 above, the Department will establish and implement measurable indicators of success, where practicable.

Human resources management

Action to develop skilled C4ISR human resources is lagging behind other activities

4.68 C4ISR transformation will require the appropriate number of personnel with the right skill sets to exploit information technology opportunities. In 2003 the Canadian Forces was short more than 700 officers and enlisted members with the necessary skills and training in occupations needed for C4ISR. National Defence believes that most skill sets associated with developing C4ISR capability can be achieved from within the Canadian Forces. However, three critical skills sets have been identified that will be difficult to address within available and projected military human resource levels:

- ISR fusion analysts—for specific spectral systems,
- content managers—for information processing and database management, and
- Web administrators—for Web-based content management and dissemination.

4.69 Conversion training and modification of existing training plans for the necessary skill-sets and career paths will not begin until 2007. As well, according to National Defence, a four to seven-year lead time is required to recruit and train personnel with strong information management or information technology skills. Attrition is expected to add to the shortage of C4ISR skills. The Department recognizes that mitigating strategies must be developed to address issues such as training and technical support services.

4.70 The Department is addressing some concerns through its Military Occupational Structure Analysis, Redesign and Tailoring (MOSART) project, but we were informed that identification of C4ISR human resources requirements will not be finished until fall 2007. The Department needs MOSART to determine its C4ISR-job requirements so that it can ensure that its C4ISR direction is realistic and achievable, given human resource limits. Training and recruiting programs must be developed in time to have skilled people available when needed. We are concerned that work to resolve human resource issues is not advancing at the same pace as the rest of the C4ISR transformation, putting at risk the ability of the Department to meet its own demands.

4.71 **Recommendation.** Senior management should take action to more fully and quickly integrate human resources planning into its C4ISR implementation strategy.

Department's response. Agreed. The Department is very cognizant of the importance of the human dimension of C4ISR, and we are currently making every effort to ensure that appropriately skilled personnel will be available when they are required to fill C4ISR jobs. In this regard, although it is acknowledged that it does take four to seven years from recruitment until technical personnel are fully trained, the majority of C4ISR jobs are expected to require senior military personnel. For the near future, therefore, these jobs will be filled by existing military personnel rather than by new recruits. Where practicable, the military personnel selected to fill these C4ISR jobs will receive any additional skill sets required for specific jobs. In addition, some skill-set shortages can be mitigated through the use of civilian resources.

In recognition of the importance of HR, the assistant deputy ministers responsible for military and civilian personnel are represented on all departmental decision-making and review boards. They have also put an HR plan in place to address C4ISR requirements. This plan has been fully integrated into the overall C4ISR Campaign Plan and is aggressively being followed to provide the HR requirements needed to achieve a fully integrated and interoperable C4ISR capability by 2008.

Conclusion

4.72 The C4ISR initiative that the Department is pursuing is the result of its assessment of critical command and control capability deficiencies, which it recognizes must be addressed. To ensure that it achieves its goal of providing commanders with decision-quality information when they need it, the Department wants to have fully integrated and interoperable command and control systems by 2008. If the Department is to achieve this timeline, there are some barriers to C4ISR implementation that it must resolve soon.

4.73 National Defence has put in place appropriate spiral methodology for identifying and refining requirements, which allows them to make necessary changes during development. With this methodology the Department needs to do the following activities to improve results:

- conduct a review of current and planned C4ISR projects,
- clearly define spiral objectives and performance measures,
- increase user involvement in defining requirements, and
- ensure that the development of an enterprise architecture is a priority and that C4ISR objectives are consistent with enterprise architecture intent.

4.74 Funding for C4ISR projects will have to compete with other capital budget priorities. The Department has identified priorities and planned its capital spending, but plans exceed budget availability. These funding pressures put these projects at risk. All projects need to be reviewed to ensure that the right projects are prioritized and that they are consistent with the stated C4ISR objectives.

4.75 Some components of the C4ISR initiative are progressing faster than others, and this puts the Department at risk of developing systems that duplicate each other or will not be interoperable and integrated. Systems are developing without joint C4ISR doctrine or concept of operations, including a definition of interoperability, or enterprise architecture in place to ensure that they develop in a common way. This system development guidance is necessary if systems are to integrate in 2008. As well, efforts to ensure that appropriate skilled personnel will be ready when they are needed are lagging.

4.76 Governance mechanisms that are guiding C4ISR progress are not strong enough. Questions of policy direction and authority have not been resolved despite departmental recognition of problems. As a result, some projects are not getting needed committee challenge and endorsement, uncertainty exists in defining C4ISR objectives, and joint and combined interoperability remains unclear.

About the Audit

Objectives

The overall objective of our audit was to determine how well National Defence has been able to identify and exploit information technology opportunities to support command and control and whether National Defence has a plan that is affordable and achievable.

More specifically, we assessed the extent to which

- the C4ISR concept could support the command and control capability of the Canadian Forces from the strategic level down to operational and tactical levels; and
- the C4ISR plans and projects were achievable and affordable.

Scope and approach

We conducted our audit at National Defence Headquarters, and conducted field visits to Maritime Forces Atlantic (Halifax) and Maritime Forces Pacific (Esquimalt), Land Forces Québec Area (Montréal), Area Support Unit and 5th Brigade Group in Valcartier, 1 Canadian Air Division and the Canadian Northern Region headquarters for NORAD in Winnipeg as well as Defence Research and Development Canada establishments in Valcartier and Shirley's Bay.

The audit team interviewed personnel in the DCDS and VCDS organizations as well as ADM (IM), ADM (S&T), ADM (Mat), and ADM (Fin CS) personnel; examined department files; and relevant documents. NATO and NORAD policies, standards, and agreements were referenced where appropriate.

Expenditures were tracked using data from the Financial Management and Accounting System, the Capability Initiatives Data Bank, and the Strategic Capability Investment Plan.

We looked for a clear understanding of C4ISR concepts and connectivity requirements. We investigated whether projects identified as needed were affordable and achievable, and examined interoperability for the conduct of joint and combined operations. We also examined how the C4ISR project approval process examines requirements for implementation of the C4ISR initiative.

Criteria

We expected that National Defence would

- clearly define C4ISR and articulate what the Department is trying to achieve through objectives that are specific, measurable, achievable, relevant, and time-oriented;
- ensure that the implementation of the C4ISR Campaign Plan is affordable within the planning time frame; and
- comply with the Treasury Board Secretariat and National Defence risk management policy and framework in implementing the C4ISR concept.

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