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Chief - Review Services

JOINT COMMAND CONTROL INTELLIGENCE SYSTEM (JC2IS)

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SYNOPSIS

This report presents the results of an independent review of the Joint Command and Control Intelligence System (JC2IS) Project. The Project's purpose is to deliver an automated strategic command, control and intelligence capability consisting of hardware, software, communications (LANs), documentation, training and related support. Recently, JC2IS became the Canadian Forces Command System, to reflect the fact that it is to provide a common capability across the CF. The system consists of two networks, Titan, rated for secret message traffic, and Spartan, rated for top secret.

As at the time of our review, the Project was well managed, utilizing a new delivery methodology which had overcome a number of the pitfalls which can adversely affect major capital IT projects. The project was progressing well and remained within budget and schedule, notwithstanding earlier delays due to a shifting of resources to Y2K efforts.

The JC2IS Project has made advantageous use of a phased, Evolutionary Approach (EA), supplemented by key management techniques which have further contributed to success. The Evolutionary Approach allows a Project to be parceled into small, manageable components. At the end of a given phase, a complete, useable capability is delivered which is then built upon during subsequent phases. Additional key attributes contributing to the success of the Project have been the effective use of contractor specialists, commercial-off-the-shelf (COTS) products, a low tolerance for technical-risk and an imposed 14-month timeframe for completion of a given phase. Requirements were being satisfied through the exclusive use of proven, COTS products, to which an in-house testing regime is applied before acceptance or rejection. Requirements are deferred if products are deemed unacceptable.

The Project is based on a high-level statement of requirement (SOR) supported by a concept of operations (CONOPS). In addition, a detailed refinement of the SOR supports each phase. However, because JC2IS is essentially providing a secure communications capability, similar to the non-secure capabilities found on any Departmental workstation, the need for upgrades and expansions will require monitoring. We raised some concern that the project could, and perhaps should, continue indefinitely and that it became difficult to appreciate the rationale for ongoing funding as a capital project.

JC2IS has now become the Canadian Forces Command System (CFCS) and the SOR has been amended accordingly. Notwithstanding, the benefits of the JC2IS as an effective enabler will be dependent upon important work to clearly articulate the over-arching doctrine as to how the environments and joint staff will function, from an administrative and decision-making perspective.

It is recommended the Project be reviewed in two years to determine how well the provision of common services and, therefore, the elimination of disparate system acquisition, is progressing, that senior level support continues and that an over-arching doctrine is developed. Other projects planning to use the Evolutionary Acquisition methodology should make note of the principles/techniques adopted for the JC2IS and should review the supplemental material

presented in Annex A to this report. Annex A presents a discussion of Evolutionary Models in contrast to more traditional project delivery.

The principal stakeholders have generally agreed with the conclusions of this review and the corresponding recommendations. The value of this report as a learning tool has been acknowledged. Key improvement recommendations are being actioned. Comments and proposed actions appear under the section on Program Management Response at the end of this report (See pp. 11-12).

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RESULTS IN BRIEF

1. In the past, Joint Headquarters Staff have been unable to plan, direct, monitor and exchange intelligence information with CF formations deployed abroad, due to a proliferation of non-networked, stove-piped Information Systems. Likewise, Canadian forces in theatre were unable to digitally exchange information with allies.

2. To overcome the difficulties, in late 1994, a proof of concept project based on an American counterpart, resulted in the provision of a capable and expandable system that went into service as the JC2IS Operational Prototype. A Test and Integration Laboratory (TIL) was also established to examine the performance and integration of solutions incorporated into the prototype.

3. Evolving from the prototype, JC2IS was set up as a project in February 1995, at an indicative estimate of $72 million. It was to deliver an automated strategic command, control and intelligence capability consisting of hardware, software, communications (LANs), documentation, training and related support. The JC2IS project is now entering cycle 3 and is being renamed the Canadian Forces Command System (CFCS), with a view to providing a common capability to the environments as well as the Joint Staff. The system consists of two networks, one a DWAN "encrypted tunnel" and the second a top-secret connection to the AUS/CAN/UK/US network. All requirements are being satisfied through Commercial-Off-the-Shelf (COTS) Hardware/Software. A 75 per cent to 80 per cent solution is considered acceptable.

4. The DMS/Acquisition Process. The project staff are using an Evolutionary Acquisition (EA) approach in the realization of JC2IS. That is, the project is broken into phases. Each phase consists of an implementation and requirements definition cycle. The two run in parallel. A useful, useable functionality results at the end of each implementation cycle. Current successes are partly due to the application of this methodology, but primarily because of a zero technical-risk approach to the acquisition of tested COTS products.

5. Annex A to this report contains more detailed information on the EA methodology that will be of use to other project offices considering this approach.

6. Project Organization. The JC2IS project structure allows for a team approach to project management. The direction and procurement staffs are called the Integrated Capability Delivery Team (ICDT); it meets biweekly. Effective use is made of contractor expertise and, in addition, user input is essential and is sought for each cycle.

7. Statement of Requirement. Evolutionary projects have broad general requirements with detailed evolving requirements, all based on a valid concept of operations (CONOPS). The current JC2IS cum CFCS SOR reflects the CONOPS, contains the detailed requirements for cycle 3 implementation and is adequate for the EA approach. Requirements undergo thorough assessment, cost and feasibility analysis with review and approval by senior staff.

8. JC2IS is essentially providing a secure communications capability not unlike the non-secure capability that is available on any Departmental workstation. As such, the need for upgrades and expansions, represent an ongoing concern. This means JC2IS can continue in some form indefinitely as developing technology allows for the automation of more and more functions.

9. Risk Assessment. The PPRA for each cycle accurately reflects the risks faced by the project team and mitigation strategies are in place. The zero tolerance for technical risk, with strict adherence to COTS products represents one of the major success factors for this project. Effective use of the test and integration laboratory (TIL) mentioned earlier and contractor specialists are contributing factors. Proceeding in an evolutionary fashion makes the overall process more manageable for the staff and resources available.

10. Cost. The greatest expense in JC2IS is in the provision of ADP hardware and software to additional users. The trend is expected to continue as more users are added with the migration of JC2IS into CFCS for inclusion of the three environments. A valid question may be whether the additional materiel should be funded via another mechanism such as National Procurement rather than through capital acquisition. The second major expense is for professional services. The project now enters the third of five phases having spent approximately $11.3 million of an approved $72 million.

11. Schedule. Delays in schedule have been due to external factors such as a shift in resources from the project to the Y2K problem, but it is now on target. An imposed 14-month turnaround for detailed requirements-definition and product delivery and/or deferment of the requirement and exclusive use of proven COTS, are contributing factors. The schedule though can be affected by the lack of an overarching doctrine that defines how the Department is to function in terms of command and control.

12. Performance. The acquisition and delivery of proven COTS products that have been tested and evaluated in the test and integration laboratory (TIL), is ensuring performance is satisfying user requirements.

13. Configuration Control. While the project is cognizant of, and is maintaining configuration control, over system documentation, local purchases of software packages, through the MR process can affect this. All such local additions must be brought to the attention of the respective system managers.

14. Canadian Forces Command System (CFCS). A concern expressed in the Auditor General's report of 1994 dealt with the lack of interoperability and commonality between C2 systems. The issue is being dealt with through the migration of JC2IS to CFCS. CFCS will provide common hardware and software to the three environments and joint staff. This should result in greater efficiency and effectiveness along with reduced maintenance and training costs. The impetus to continue on this path must be maintained as senior staff change. Also needed is

an overarching policy detailing responsibilities and entitlements under CFCS. To ensure that CFCS is in fact providing a common capability and that disparate systems then are no longer being purchased or developed, a downstream review should be conducted.

15. Recommendations. It is recommended that:

- JC2IS, cum CFCS, be reviewed in two years time in order to evaluate progress and ensure that disparate system acquisition and development has ceased;
- senior staff continue to support CFCS and that an over-arching policy detailing a combined Joint Staff and environmental Chiefs of Staff command and control decision making process be developed;
- projects planning to use the Evolutionary Acquisition approach fully understand and appreciate the strict guidelines under which JC2IS has been operating; and
- software/hardware applications being procured through MR funding are made known to CFCS if they are to interoperate with CFCS.

16. JC2IS has enjoyed considerable success to date but it is noted that a high percentage of the project involves extending the capability to more users. An alternate acquisition mechanism might be worth considering for this type of delivery, in terms of reducing approval and acquisition time. In addition, it is recommended that thought be given to enhancing the discussion of the EA methodology, in the DMS manual.

PART I - INTRODUCTION

BACKGROUND

1.1 During the 1991 Persian Gulf War, deficiencies were noted in the National Defence Headquarters (NDHQ) staff's capability to plan, direct, monitor and provide intelligence information to CF formations deployed abroad. Although members of the Joint Staff were equipped with desktop computers, these were not networked, making it impossible to readily exchange information between them or with deployed forces. Canadian forces in theatre were also unable to digitally exchange information with allies. The situation subsequently worsened with the continued ad hoc procurement of stovepipe Information Systems (IS), in the absence of a coherent, joint concept of operation.

1.2 The 1994 Auditor General's report noted the disparate nature of these information systems and called for "joint standards" and interoperability between them. He further recommended the Department use an evolutionary approach in the acquisition of information technology projects rather than attempting to provide complete systems which could take years to deliver a product.

1.3 The DCDS recognized the situation as unacceptable and tasked Director Intelligence, Security and Operations Automation (DISOA) to review and rationalize C2 requirements. In late 1994, under MR funding of $2.5 million, DISOA and Director Information Systems Engineering and Maintenance (DISEM) undertook a proof of concept project called Joint Command and Control Information System Structured Prototype (JC2ISP). A component of this project was the Test and Integration Laboratory (TIL), a test facility to examine performance and integration of given solutions to upcoming requirements. Based on the US Global Command and Control System (GCCS), the prototype produced a capable and expandable system that went into service as JC2IS Operational Prototype. In February 1995 the prototype evolved into JC2IS Project at an indicative value of $72 million. By July 1995, JC2IS was recognized as the keystone NDHQ-level command and control intelligence (C2I) project to address national-level C2I requirements. At least one other project was terminated, with requirements folded into JC2IS.

1.4 JC2IS is to deliver an automated strategic command, control and intelligence capability consisting of hardware, software, communications (LANs), documentation, training and related support. Stated another way, JC2IS includes ADP equipment, software and support for the provision of electronic mail, message handling, multimedia image capture and processing and map graphics, through a secure network(s), available to deployed forces and interoperable with allied forces networks. The system is built upon Commercial-Off-the-Shelf Hardware/Software (COTS). A 75 per cent to 80 per cent solution is considered generally acceptable to satisfy any valid requirement, otherwise, the requirement may be deferred. The JC2IS system consists of two networks, titan and spartan. Titan is rated for secret message traffic and rides in an "encrypted tunnel" through the DWAN. Spartan is a separate top secret rated network, not on the DWAN, with a firewall connection to a top-secret rated AUS/CAN/UK/US network.

AIM OF THE REVIEW

1.5 The aim of this review was to examine the JC2IS project in light of the Evolutionary Acquisition approach being taken and to determine if the requirements of the environment-specific projects were being consolidated in some fashion. The thrust of the review was to determine if the Statement of Requirement (SOR) was sufficient for an Evolutionary Acquisition approach and that steps were taken to assure the operational suitability and effectiveness of the delivered capabilities.

PART II - DISCUSSION AND CONCLUSIONS

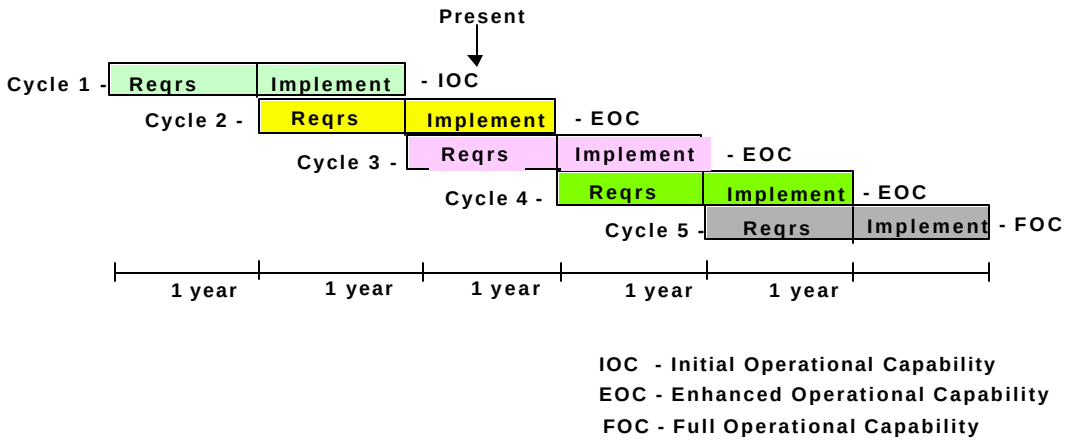
THE DMS/ACQUISITION PROCESS

Evolutionary Acquisition

2.1 The Defence Management System manual does not use the term evolutionary acquisition but rather, describes evolutionary development as a project, "…parceled into phases and cycles with a useable functionality delivered at the end of each cycle." Each phase consists of a cycle of requirements definition followed by one of implementation. The requirements definition cycle of the next phase overlaps the implementation cycle of the current phase. This is shown in Figure 1 for JC2IS. At the end of each phase, an SS(PPA) is submitted for authority to proceed to the next while functional capability is delivered. The next phase then builds on the previous one. This allows the project team to examine the effectiveness within each phase and incorporate user feedback into subsequent phases. In such a project, the Statement of Requirement (SOR) evolves as well. This type of approach is suited to rapidly changing technology or information technology (IT) projects. Annex A contains a more detailed description of the "Evolutionary" approach and the differences to other methods of delivery.

Figure 1

JC2IS Evolutionary Acquisition



2.2 JC2IS has followed the evolutionary methodology described above with success. Primary contributors to this success though are the constraints that have been imposed in the area of technical risk and schedule rather than exclusively the approach itself. It is also noted that JC2IS benefited from and built upon the JC2IS Operational Prototype that in turn was based on the American GCCS project mentioned earlier. The prototype was developed with MR funding.

Conclusion

2.3 The project has been successful to date but this is due only in part to the chosen methodology of evolutionary acquisition. Project constraints in the areas of technical risk and schedule, discussed later, are providing the most significant reason for success.

Project Organization

2.4 The JC2IS project management organization makes use of contracted expertise to support a team of military personnel called the Integrated Capability Delivery Team (ICDT). The primary responsibility of the ICDT is to deliver all SRB endorsed functionality for each implementation cycle. The ICDT brings together the project direction, management and procurement staff through biweekly meetings, to assess the risks, schedule and feasibility of satisfying each requirement. For systems architecture and requirements management, the PM is supported through an Engineering Management and Support Services (EMSS) contract. The systems architect maintains currency through constant dialogue with industry and conducts a thorough cost and feasibility analysis of all detailed requirements, before any product is purchased. Only proven COTS products are tested and evaluated at the Test and Integration Laboratory (TIL), to ensure compatibility within JC2IS. Products are then purchased through National Master Standing Offers (NMSO), DND's Information Systems (IS) National Individual Standing Offer (NISO), and through Foreign Military Sales (FMS).

2.5 Feedback from users is a cornerstone of the EA approach. Each phase delivers stand-alone functionality. The follow-on phase builds upon it. During the implementation cycle of each phase, feedback from users is sought and used in the definition work and later implementation of the next cycle. One difficulty with this approach is that during implementation of cycle 2 for example, cycle 3 definition was occurring in parallel. Users typically do not have enough time or experience with the capability delivered in cycle 2, in order to influence the cycle 3 implementation but can better influence cycle 4. In a project involving considerable software development, this could be a serious concern. In JC2IS, while existent, the impact is not as great due to the constraint of using COTS only products.

Conclusion

2.6 The JC2IS project is making effective use of contracted expertise through an Engineering Management and Support Services contract (EMSS). Although user input is deemed essential, because implementation of one cycle and definition for the next occur in parallel, users may not have enough time to gain experience with the immediate delivered functionality, in order to provide much input for the next cycle definition. This is not seen as a serious problem impacting design, as delivered products are all COTS.

Statement of Requirement (SOR)

2.7 According to the ADM(Mat) Guidance on the Preparation of a Statement of Requirement, in an evolutionary project, the original SOR will state both high level requirements for the overall project and detailed requirements for phase 1. Detailed requirements for subsequent phases are then developed accordingly. Typically, the SOR in an evolutionary acquisition is based on a valid Concept of Operations (CONOPS) as discussed in Annex A.

2.8 The CONOPS for JC2IS dates from 1997. The CONOPS states that JC2IS will allow commanders and staff at all levels to share information in an automated fashion, in a secure environment, across any geographic location in a timely manner. This is to be achieved through the provision of the necessary hardware and software applications and through connectivity with existing and allied networks. This includes the provision of desktop computers and applications software, not unlike that provided to any desktop in Headquarters for email and receipt and transmission of digital data.

2.9 Detailed requirements are established during each phase by the Future Requirements and Definition (FRD) team led by the Project Director (PD). They link back to the original CONOPS and SOR. These detailed requirements are expressed in terms of user functionality or sometimes as a problem or deficiency to be addressed. They are assessed in terms of defined criteria including rationale, otherwise stated as maturity of CONOPS, organizational and personnel impact, support issues and technical feasibility. In JC2IS, while an overall CONOPS existed for phases 1 and 2, an overall SOR did not. Detailed requirements though were contained in work breakdown structures. As discussed later in the report, JC2IS has now become the Canadian Forces Command System (CFCS). The current SOR for CFCS reflects the overall CONOPS and overall project SOR as well as the detailed requirements for phase 3 implementation. It is adequate for the EA approach being followed. Future detailed phase requirements shall be added as they are developed.

2.10 For management purposes, the detailed requirements are also categorized in terms of extensions, integrations and expansions of the existing network and interoperability with others. For example, extension means providing the existing functionality or part of it, to more users. Integration involves adding a functionality that exists elsewhere, into the JC2IS baseline. An example would be the integration of the Modernized Intelligence Database (MIDB), in order to allow command control and intelligence communities to share the same intelligence database in a secure environment. Expansion is the addition of a new functionality such as interactive voice, to the base JC2IS system. Interoperability involves connecting JC2IS to another system such as a secure, Allied network. This categorization is not definitive, but simply assists in the management of work packages.

2.11 Eventually the detailed requirements are approved by the Command and Control Oversight Committee (C2OC), chaired by the DCDS and composed of the three environmental chiefs of staff (ECSs) and the Assistant Deputy Minister for Information Management (ADM(IM)). The Project Management office then conducts a thorough cost and feasibility study, the results of which are used to determine what is achievable in a given cycle and what may need to be deferred. The cost and feasibility analysis is essentially based on a zero development/

technical risk as only mature commercial-off-the-shelf (COTS) options are considered. This allows for the delivery of useable products at the end of the phase. In this scenario, the PM knows exactly what functionality can be and will be delivered in a given phase and what will be deferred. Deferred requirements remain non-automated until a COTS application is found.

2.12 As technology allows for new possibilities for data or information transfer, JC2IS will likely expand accordingly. This is not unlike the provision of personal computers, software and support, to employees of the Department on an ongoing and regular basis. In other words, JC2IS can continue in some form, indefinitely as hardware/software allows for the automation of more and more functions.

Conclusion

2.13 Evolutionary projects have broad/general requirements with detailed evolving requirements, all based on a valid CONOPS. JC2IS, now CFCS, is following this scheme. Although an overall SOR was not originally in place, a valid CONOPS existed. Detailed phase 1 and 2 requirements were contained in work breakdown structures. The current overall SOR now reflects the CONOPS and contains the detailed requirements for phase 3 implementation. It is adequate for the EA approach being followed. Requirements undergo thorough assessment, cost and feasibility analysis with review and approval by senior staff. If a requirement cannot be met through acquisition of a suitable COTS product, it is deferred. Expansions and upgrades to the products provided are to be expected as technology moves forward.

Risk Assessment

2.14 The project has submitted a Project Profile and Risk Assessment Plan (PPRA) for each phase. All are based on a Risk Assessment and Management Plan that was prepared for the project by a contractor in 1996. This plan addresses risk in terms of probability of occurrence and impact and provides mitigation strategies. The plan focuses on project related risk areas such as staff turnover and procurement issues. It specifically precludes technical risk. The reason given is that this risk is mitigated by the fact that only COTS products are to be chosen. Government (GOTS) and military (MOTS) products are included in the definition of COTS. Further, it notes the project's effective use of the test and integration laboratory (TIL) established under the prototype project discussed earlier. When a COTS product is identified, it is tested in the TIL for performance and integration in order to confirm final selection. In addition, products are purchased through National Master Standing Offers (NMSO), the departmental IS NISO, or Foreign Military Sales (FMS) contracts.

2.15 The PPRAs for each phase show the technical risk as low on the basis of COTS. In fact, if a cost and feasibility study provides a negative analysis with respect to satisfying a given requirement, that requirement is deferred. The project will not undertake to develop a solution. This means that product choice is in fact a zero-risk undertaking, not simply a low risk one. The strict adherence to entertaining only workable COTS solutions and proving them out on the TIL represents a major factor in the success of the project to date.

2.16 An internal risk area worthy of mention is related to staff turnover. This has been an issue in projects that have experienced difficulty in the past. In JC2IS, this is partly mitigated through the use of an Engineering and Management and Support Services contract. The first challenge in this approach is to have solid criteria for the selection of a knowledgeable contractor and secondly, to ensure that there is sufficient depth of contractor staff to sustain any turnover of key personnel.

Conclusion

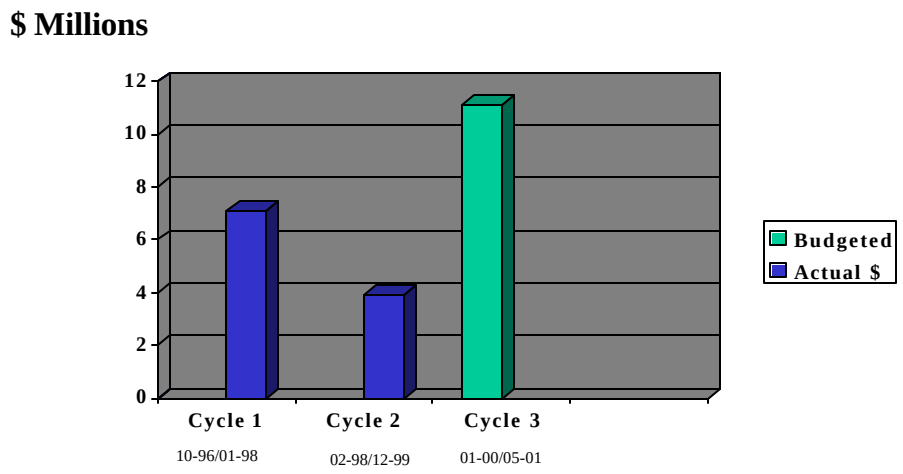
2.17 The PPRA for each cycle accurately reflects the risks faced by the project team and mitigation strategies are in place. The zero tolerance for development/technical risk, with strict adherence to COTS products available through NMSO or FMS, represents one of the major success factors for this project. Effective use of the previously established TIL and contractor specialists are contributing factors. Proceeding in an evolutionary fashion makes the overall process more manageable for the staff and resources available. Additionally, care must always be taken to ensure that contractors consistently work to specific deliverables and do not become integral to the project staff.

COST

2.18 At its inception in 1995, project approval of $72 million was obtained. It was to be spent over 5 cycles. Figure 2 shows expenditures of $11.3 million to date. Of this, $5.8 million was spent on ADP hardware and software, $3.8 million on professional services and the remaining balance on items such as mil/civ pay, training and travel. Projections for Cycle three are $11.1 million. This includes $5.6 million for hardware, software, training, and travel; $1.9 million for professional services and $1.413 million for cycle 4 definition. The balance is for mil/civ pay, contingency and related expenses. This leaves approximately $50 million for the remaining cycles.

Figure 2

JC2IS Total Expenditures Cycles 1 & 2
Budgeted Cycle 3



2.19 In examining the details of the hardware/software, a considerable portion has gone to extensions, that is, providing installations of more of the same thing. With addition of Land, Air and Maritime requirements when JC2IS formally becomes the Canadian Forces Command System (CFCS), this trend will likely continue. Perhaps a valid question is whether provision of more of the same capability should be part of capital project money or if it should be financed through another mechanism. Another significant expense is for the professional services contract.

Conclusion

2.20 The greatest expense in JC2IS so far has been the provision of ADP hardware and software to additional users. The trend is expected to continue as more users are added for the three environments. A valid question may be whether the additional materiel should be funded via another mechanism such as National Procurement rather than through capital acquisition. The second major expense is for professional services.

SCHEDULE

2.21 JC2IS is divided into five cycles consisting of a period of requirements definition followed by implementation. Each cycle has been restricted to a 14-month duration wherein requirements for the next cycle and delivery of products for the current cycle are completed. This has posed a challenge to project staff but has not been onerous, due in large part to the strict adherence to COTS and the deferment of requirements if necessary.

2.22 The project is approximately sixteen months in slippage. This was due to a requirement to shift emphasis away from the project and focus on Y2K related matters. A partial "freeze" placed on all IM/IT projects in 1996/97 contributed to the slippage. Both factors were beyond the control of the project. Some schedule delay has also been due to the delay in availability of COTS products.

2.23 In general, the project schedule is vulnerable to the lack of a current, over-arching departmental and C2IS architecture plan. This is not referring to a physical layout of wires and terminals but rather to a higher level vision of how the Department wishes to conduct business in terms of command and control with respect to the three environments in addition to the Joint Staff. From a hardware perspective for example, if connectivity is required between JC2IS and another group, it can likely be achieved but, if the doctrine or rationale for that interconnection is still being debated at senior levels, the project cannot deliver and a delay will ensue. As JC2IS becomes CFCS, these overarching principles of operation must be sorted out.

Conclusion

2.24 The JC2IS project is proceeding on target. Delays in schedule have been due to external factors such as a shift in resources from the project, to the Y2K problem. Reasons for the success in maintaining the project schedule include the strict adherence to COTS and an imposed 14-month turnaround for detailed requirements definition and product delivery and/or deferment of the requirement. As JC2IS becomes CFCS, the schedule can be affected by the lack of an over-arching doctrine that defines how the Department is to function in terms of command and control across the environments and the Joint Staff.

PERFORMANCE

2.25 JC2IS is operating in an environment that allows the use of proven, COTS products without modification, save for ensuring compatibility between hardware and software applications. This is determined through test and evaluation in the TIL. Products are purchased from NMSOs, the IS NISO, and through FMS cases.

Conclusion

2.26 The acquisition and delivery of proven COTS products that have been tested and evaluated in the TIL, is ensuring performance is satisfying user requirements.

CONFIGURATION CONTROL

2.27 In any EA project, configuration control is critical in ensuring subsequent system builds are included in overall project documentation. JC2IS has a configuration control manager who maintains the overall system design documentation current. Configuration Control can be vulnerable to users who, through the MR process, add their own local applications without informing the System Managers for TITAN and SPARTAN, who are the configuration control authorities. The project team also has to become informed so that subsequent developments on JC2IS will mesh with what's out there.

Conclusion

2.28 While the project is cognizant of and is maintaining configuration control over system documentation, unknown add-on purchases through the MR can affect this. All local additions must be brought to the attention of the respective system managers.

CANADIAN FORCES COMMAND SYSTEM (CFCS)

2.29 As discussed earlier, the 1994 report from the Auditor General noted the disparate nature of command and control information systems within the Department. At the 14 December 1999 meeting of the Departmental Command and Control Oversight Committee (C2OC), it was decided that C2 functionality common to the environments and joint staff should be brought under the umbrella of JC2IS and that JC2IS would then become the CFCS. This would improve operational effectiveness, enhance interoperability between the environmental services, reduce

technical risk and reduce training, operating and maintenance costs. CFCS will still allow for environmental service unique requirements to be separately satisfied. Command and Control projects impacted by this move are Maritime Command Operational Information Network III (MCOIN III), Air Force Command and Control Information System (AFFCIS) and Land Force Command System (LFCS). MCOIN III has enjoyed close cooperation with JC2IS during its development and is in fact nearing the end of that development. LFCS is not as advanced as MCOIN III and therefore is in a position to integrate readily with CFCS. AFFCIS has been working with JC2IS and is already adopting a great deal of the JC2IS baseline. Another review downstream should be conducted to determine how the situation is evolving. It should also be noted that numerous other non-C2 projects such as the Military Message Handling System (MMHS) would also be affected.

2.30 From the perspective of the project manager, adding the requirements of the three environments, while presenting a challenge, does not impose an impossible or overly difficult technological burden. Deliverables from cycles one and two of JC2IS, will be extended to the environments under CFCS. As such, CFCS has incorporated the JC2IS SOR for the next phase and has expanded it as required so as to have an SOR adequate for the purposes of EA. What in fact is required, as mentioned above, is an overarching policy of how the pieces fit from an administrative and joint decision making perspective. The impetus to consolidate common requirements into CFCS must not be lost as senior staff changes take place.

Conclusion

2.31 A concern expressed in the Auditor General's report of 1994 dealt with the lack of interoperability and commonality between C2 systems being developed as stovepipes by the environmental services. The issue is being dealt with through the migration of JC2IS to CFCS. CFCS will provide common hardware and software to the three environments and joint staff. This should result in greater efficiency and effectiveness along with reduced maintenance and training costs. The impetus to continue on this path must be maintained as senior staff change. Also needed is an overarching policy detailing responsibilities and entitlements under CFCS. A downstream review should be conducted to determine how well the consolidation is taking place.

PART III - RECOMMENDATIONS

3.1 The following recommendations stem from this review. It is recommended that:

a. CFCS be reviewed in two years time in order to evaluate progress, to determine if in fact a common capability is being provided to the three environments and the Joint Staff and if the development of disparate systems providing a similar functionality has ceased;

b. senior staff continue to support CFCS and the vision to consolidate common requirements and that an overarching policy detailing a combined Joint Staff and environmental Chiefs of Staff command and control decision making process be developed;

c. projects planning to use the Evolutionary Acquisition approach fully understand and appreciate the strict guidelines under which JC2IS has been operating, that is, a zero technical risk tolerance policy, strict adherence to COTS without modification and deferral of requirements until such time as a COTS product becomes available; and

d. software/hardware applications being procured through MR funding be made known to CFCS if they are to interoperate with CFCS.

3.2 JC2IS has enjoyed considerable success to date but it is noted that a high percentage of the project involves extending the capability to more users. An alternate acquisition mechanism (O&M) might be worth considering for this type of repetitive delivery. In addition, it is recommended that thought be given to enhancing the discussion of EA, in the DMS manual. To this end, Annex A is provided.

MANAGEMENT RESPONSE

3.3. In general, the principal stakeholders, support the recommendations detailed above. Specifically:

a. <u>CFCF be Reviewed in Two Years</u>. All agree.

b. <u>Continued Senior Level Support and Development of an Overarching Command and Control Process</u>. The Command and Control Oversight Committee has the requirement to “direct and approve the C2 strategic plan and to focus on achieving an integrated, interoperable C2 capability.” At the project level, DISOA has noted, “A virtual PD team, comprising representatives of the individual Environmental Chiefs of Staff and the joint-staff user community, working under the leadership of the CFCS Project Director, has been created. This team has begun work on providing the over-arching definition and rationalization of the total project that will provide the vision of how the

Department will effect command and control at both the joint and individual environmental levels." The Information Resource Management Division has stated that, "We will use not only the C2 committee structure, but also the IM committee structure to support the CFCS project and to pursue C2 IM requirements with the Project Director in DCDS Group."

c. Projects Planning to Use the Evolutionary Acquisition Approach Fully Understand the Strict Guidelines Under which JC2IS has been Operating. This has been agreed by all. Wide distribution of this report as well as an enhanced presentation of Evolutionary Acquisition in the DMS Manual will contribute to this understanding. However, DISOA has offered the caution that EA creates a heavy demand for requirements definition at each phase of the project at the same time as implementation is underway. This can present demanding timelines, and potential slippage, given that requirements definition is a staff-intensive process.

d. Software/Hardware Applications Being Procured through MR Funding be made known to CFCS if they are to Interoperate with CFCS. DGIRM has indicated support for the overall goal but has noted that it is already a significant challenge to determine and pursue interoperability requirements between CFCS and other major projects (e.g. LFCS, PeopleSoft, MASIS). It is also anticipated that the C2 and IM committee structures will contribute to flagging pertinent MRs.

3.4. The Review did not make a definitive recommendation, but noted that the demarcation as to when IT should be funded through capital vice O&M was not altogether clear, particularly with respect to upgrades and extensions of new systems. However, the reasonable opinion was offered that extending the CFCS capability to other users properly remained a capital activity which would generate ongoing O&M costs. Also, remaining in the capital process assists configuration control and the tracking of spending.

ANNEX A

EVOLUTIONARY ACQUISITION MODELS

BACKGROUND

1.1 The following information summarizes the salient points from three key documents on Evolutionary Acquisition that are referenced at the end of this Annex. This discussion is offered as input for consideration by project offices and authors of the DMS manual. It is noted that variations in the EA model presented in other papers do exist.

DEFINITION

1.2 The Armed Forces Communications and Electronics Association (AFCEA) defines evolutionary acquisition as, "…an approach in which a core capability is fielded and the system has a modular structure and provisions for future upgrades and changes are refined. An evolutionary acquisition strategy is well suited to high technology and software intensive programs where requirements beyond a core capability can generally, but not specifically, be defined."[1] An Australian report states, "The main thrust of EA is the specification, design, implementation, testing delivery, operation and maintenance of systems incrementally. Delivery of each incremental release increases the capability of the system until complete. Users have early access to system releases and are encouraged to provide feedback on performance."[2] The Australian EA model is shown in Figure 1.

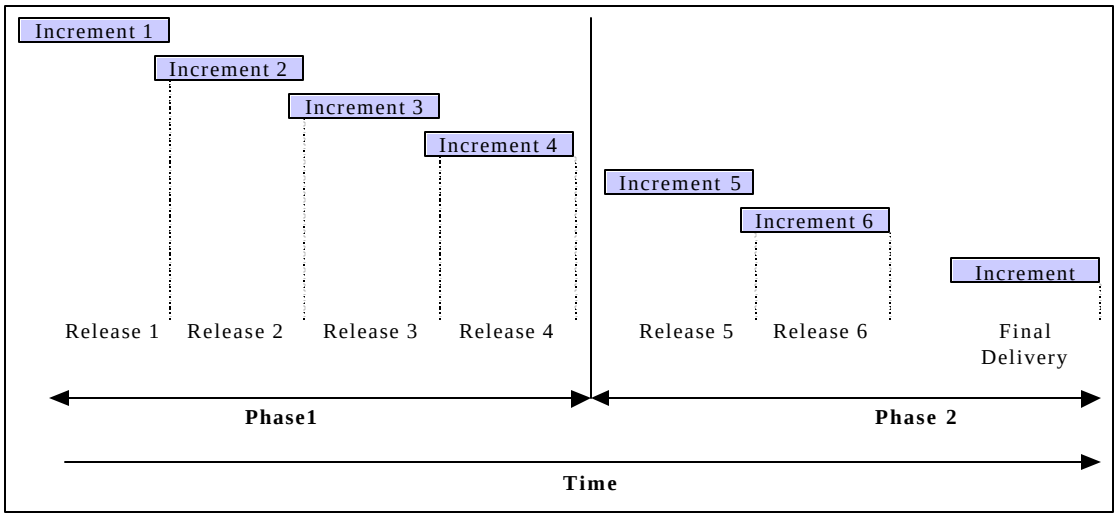


Figure A-1 The Basic EA Model

[1] Evolutionary Acquisition Study, June 1993 Armed Forces Communications and Electronics Association (AFCEA)

[2] Derek E. Henderson and Andrew P. Gabb, DSTO-TR-048, "Using Evolutionary Acquisition for the Procurement of Complex Systems" , March 1997, Information Technology Division Electronics and Surveillance Research Laboratory in Australia

1.3 Note that projects are divided into phases and increments. In the DMS, each phase consists of a cycle of definition followed by implementation. In Figure A-1, each increment may involve everything from specification through design to testing, fielding and maintenance. Each increment results in functions that increase the overall system capability. It is important to note that the contract for phase 1 results in a minimal system. Subsequent capabilities and price are agreed prior to the start of the next phase. Also, the same supplier may not be chosen for subsequent phases. Table 1 shows how EA differs from other methodologies.

Table 1 - Comparison of Acquisition Model Characteristics (Typical)[3]

	Grand Design (Traditional Method)	**Incremental Acquisition**	**Evolutionary Acquisition**
Requirements	Known at project start - remain relatively stable throughout the project.	Known at project start - remain relatively stable throughout the project.	Overall requirements are broadly defined - evolution and refinement of requirements during development.
Design	Determined early.	Determined early.	Architecture design and initial functions determined early - detailed design of other functionality evolves.
Acquisition activities	Acquisition activities. Occur sequentially.	Acquisition activities occur sequentially.	Many acquisition activities occur repetitively and concurrently.
Delivery	Single delivery.	Incremental delivery.	Incremental delivery.
Contractual arrangements	Competitive tendering. Winner awarded contract for the entire system.	Competitive tendering. Winner awarded contract for the entire system.	Competitive tendering for the first phase only - usually same source subsequently.
Acquisition costs	Assumed known at contract start, and capped.	Assumed known at contract start, and capped.	Assumed known for first phase only - cost for total system estimated and capped.
User involvement	Relatively low.	Relatively low, but some feedback from the use of interim fielded systems.	User involvement is essential and used to shape the requirements for the later increments.

[3] Ibid.

What EA Is Not

1.4 Evolutionary acquisition is not necessarily:

a. A Prototyping Approach. EA delivers a fieldable functionality that has been tested to specification and subject to quality control. Prototypes may be used in helping develop the functionality but are not generally fielded for final use.

b. Evolutionary Development (ED). Evolutionary development is an approach used by a system developer, and is common particularly in software intensive projects. An evolutionary acquisition strategy obliges the supplier to use an evolutionary approach to development.

c. A System Evolution Strategy. EA is not intended as a means for evolving a system throughout that system's lifetime. EA establishes the system, incrementally.

d. A Remedy for Poor Requirements. EA is not a substitute for poor requirements definition at project initiation. It allows for the *refinement* of requirements.

Project Indicators for EA

1.5 EA should be considered for all projects that are complex and involve significant development. The following indicators are provided as an additional guide to applying EA. Note that these are also risk indicators.

a. software intensive systems;

b. systems using rapidly changing technology such as computer based systems which then require upgrading at substantial cost;

c. systems where humans are an integral part of the wherein users with differing experience and competencies may detect shortcomings and request modifications or system enhancements;

d. the system is unprecedented in that users have difficulty identifying requirements due to a lack of experience or knowledge with systems of the type to be introduced; and

e. operational demands dictate that a limited capability is required early.

In summary, systems suited to EA will have requirements, which are difficult to define, and which will likely change as the project progresses. Also, IT projects are particularly suited to EA given that technology is constantly evolving.

Requirements and EA

1.6 Requirements should be supported by a concept of operations and should be described in functional and performance terms. Requirements for the first increment and possibly for some subsequent increments, must be fully defined. Generally, the overall broad capability is identified, in terms of high level requirements, to ensure the system architecture will be flexible to accommodate future needs and to set limits for what may fall outside the project scope. It is a mistake to assume EA can be used where initial requirements are difficult to capture. This can lead to a number of negative consequences to cost and schedule and may result in low user acceptance.

1.7 Some requirements will remain inherently difficult to determine. For example, requirements for interoperability with other systems may change as the project progresses, emerging technology may impact existing solutions or may create additional requirements to satisfy other operational needs or, there may be a need to operate in different environments than originally planned. In these cases, changing requirements or requirements volatility is a known risk and needs to be managed as such. Requirements that might be considered volatile should be identified early, consequences assessed and mitigation measures determined.

1.8 In light of evolving requirements in EA, the following should be considered:

a. establishment of a plan to take into account the current level of maturity of requirements and that requirements for each increment are defined adequately prior to the start of that increment;

b. the establishment of a requirements review process including prioritization;

c. the mechanisms by which feedback on requirements will be generated, collected and analysed; and

d. management of the requirements to ensure everyone is aware of which ones have been satisfied, are upcoming or have been deferred.

1.9 In satisfying requirements, COTS presents an inviting alternative. Caution is recommended however since COTS components may restrict the need for flexibility in the overall design or may not allow for integration to other systems.

1.10 While many benefits to using EA are apparent such as the early fielding of a capability, greater user acceptance and the ability to incorporate evolving requirements, there are also some potential areas for concern.

ANNEX A

Areas of Concern

1.11 EA projects are inherently more intensive and difficult to manage than grand design or traditional projects. Since an EA methodology involves more activities, more changes, and more interactions between participants than for traditional approaches, EA can cost more and take longer to implement. For projects where EA is the best strategy, however, studies have shown that the probability of success is greater than if a traditional approach is used.

1.12 In EA, the project office needs to have more visibility of progress, with more discussion, negotiation and planning activities. EA is not a 'hands off' acquisition model. Because of the intensive and dynamic nature of EA projects, the project team requires higher levels of skills and experience in requirements engineering, systems analysis and systems architecture. Activities such as development, test, and support operations will occur concurrently, with interactions between staff working on different activities. This requires greater planning and coordination than for projects where these activities occur separately or sequentially.

1.13 Configuration management is essential in the EA environment. At most stages in an EA project, at least three aspects will be under consideration. These will include the most recently released deliverable, the deliverable currently under development, and the one being negotiated for the next increment. The project office must take an active part in configuration management because each deliverable will usually alter the baseline design.

1.14 EA requires a higher level of technical support for the project team because many decisions must be made jointly with the supplier such as decisions that tradeoff between operational, technical and development issues. The success of EA also depends on the continuous review and feedback from user representatives. Finding the right users, and coordinating their input can present a challenge.

1.15 In an EA project, each subsequent release or deliverable can have different characteristics from the previous ones. This can increase life cycle maintenance costs by impacting on training and life cycle support.

Risks

1.16 Once the EA option is chosen it involves higher levels of risk than more traditional models. In addition to cost, schedule and technical risks, the following must be considered:

a. Management Risk. EA is more difficult to control and needs a higher level of skill and experience in management by both the project office and supplier. Suppliers may find the evolutionary model difficult. The need for the project office and supplier to maintain a close working relationship with a high level of cooperation can also be more critical in EA projects.

b. Approval Risk. Funding approval for each deliverable will increase the schedule. Such delays may break the flow of development resulting in the loss of key development staff, and additional costs in winding development down and winding up again.

c. Architectural Risk. The architecture design is critical to success of the project. If the initial architecture cannot accommodate changes later in the project, the project may fail.

d. Exploitation Risk. EA may reduce the bargaining power of the Department, because the initial contract will not normally encompass the entire task and subsequent contracts may not be competed. In negotiating later increments and phases, the supplier may decide to exploit this situation by quoting unreasonably high prices.

REFERENCES

1. Evolutionary Acquisition Study, June 1993 Armed Forces Communications and Electronics Association (AFCEA).
2. Derek E. Henderson and Andrew P. Gabb, DSTO-TR-048, “Using Evolutionary Acquisition for the Procurement of Complex Systems", March 1997, Information Technology Division Electronics and Surveillance Research Laboratory in Australia.
3. CEPMAN Capital Equipment Program Manual, Australian Defence Organization.