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Command and Control Simulation for Domestic Operations

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ABSTRACT

New missions, new requirements and new technologies are factors that are driving transformation in militaries, leading to innovative command structures and novel Command and Control (C2) policies and processes. This paper describes an approach for C2 simulation based on requirements analysis and architecture modeling to support these concepts. It describes the modeling and simulation of several key processes: mission planning, request for information/request for assistance, and maintaining situational awareness. Existing practices were observed, documented, and then expressed using Operational Views in the Department of Defense Architecture Framework (DoDAF). Subsequently these were converted into Use Cases in Unified Modeling Language (UML) and then modeled as workflow processes in a C2 business process simulation.

This approach has been applied to two problems; the simulation of C2 in joint operational level military headquarters responsible for domestic operations (DOMOPS) and for the simulation of Interagency C2 for tactical level joint DOMOPS and emergency management. Realistic simulation of the key C2 processes allows researchers to test hypotheses before conducting experiments to optimize their designs. The paper describes the design of the simulation models and how it will be used to support experimentation.

INTRODUCTION

In the spring of 2005, Canada's newly appointed Chief of Defence Staff, General Hillier, outlined his vision of an "objective force". He singled out a number of underlying themes; to wit, a commitment in principle to Effects Based Operations, recognition of the importance of pervasive interoperability, an integrated "whole of government" approach, and a return to "command centricity" supported by a focus on technological exploitation, staff planning and operational oversight.   In subsequent concept development work data management, knowledge creation and information sharing were acknowledged as key enablers to transformation of the Canadian Forces (CF), and decision support and governance key enablers to the success of the new Command & Control construct characterized by the establishment of Strategic Joint Staff and new operational level Headquarters.

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Transformation poses a number of conceptual, analytical and integration challenges. Establishing clear causal relationships in complex adaptive systems is difficult but key to realizing Effects Based Planning (EBP) and Effects Based Operations (EBO). Instilling "command intent", leveraging expertise and maintaining trust between dispersed teams are central to Network Enabled Operations (NEO). Compressed decision cycles enable our own forces to retain the initiative but, equally, demand continued investment in education and training and in increasingly sophisticated collaboration tools and techniques. The traditional distinction between planning and operations is blurring; the CF and Allies are moving towards developing a continuous planning capability and increased "teaming" between headquarters and within staffs.

Given this backdrop two conclusions can be reached. First, concept exploration, experimentation and spiral development will be required to realize this vision. It follows, second, that to understand interdependencies, a means to capture, manipulate and examine new combinations of people, process and tools is needed. This paper outlines our attempt to exploit architectures, process modeling and simulation to effectively support such initiatives. Earlier efforts to develop architectures in preparation for building simulations have been documented [Ref 1].

Joint Command Decision Support for the 21st Century (JCDS 21) is a Technology Demonstration Project in Defence Research and Development Canada (DRDC)[5]. Its aim is to demonstrate a joint net-enabled collaborative environment to achieve decision superiority. It is envisaged that JCDS 21 sponsored studies and experiments will validate assumptions with respect to decision superiority and provide insight into what are believed to be its key enablers. The JCDS 21 project was established to support the CF in developing operational and system requirements for a net-enabled collaborative environment to support strategic decision-making, within a joint, interagency, multi-national and public (JIMP) framework. This paper will present an approach for the simulation of the C2 processes in two different contexts based on requirements analysis and architecture modeling.

METHODOLOGY

Applying an Architecture Framework to C2 Processes

Architecture frameworks continue to evolve. Most can trace their roots to the Zachman Framework [Ref 2]. The US Department of Defense Architectural Framework (DoDAF) was used by this study to analyse the processes. Architecture products are perspectives of a system-of-systems[6] construct when viewed through the lens of operations (what needs to be done and the various organizations involved in performing actions), systems (how systems will support operations and their functional characteristics) and technical standards (what governs system implementation). Therefore DoDAF, which contains operational views (OVs), system views (SVs) and technical standards views (TVs), was ideally suited for this work. It is not necessary to document all available views immediately while using a framework. Key views can be developed as required; the existence of an overarching framework provides the logic and structure for the integration of additional views as requirements materialize during the analysis and life cycle of a project.

[5] DRDC is an agency in the Canadian Department of National Defence

[6] Although 'system' is referred to in the DoDAF construct, DoDAF was developed from the C4ISR Framework and tends to focus on system interoperability issues. The extension to 'system-of-systems' is suitable when used to develop an architecture of a capability (e.g., sense, command, ISR, etc.).

It is noteworthy that the DoDAF was derived from attempts to come to grips with C4ISR imperatives. Technological advances have fostered and enabled new concepts such as Decision Superiority. Architectures provide a means to develop a common ontology and structure of data to capture and integrate stakeholder perspectives. They can be used to portray routine enterprise functionality and/or "endeavours" when linked to a scenario. This is important; increasingly defence is envisaged as part of a broader public security agenda and the number and diversity of actors and perspectives has grown significantly. Pervasive communications links have altered the way business and government operate. Communities of Interest have developed and multiple interdependent chains of command [Ref 3] are the norm. Depiction and modeling of net-centric operations and a collaborative information environment remains a challenge.

At best; however, architectures provide but one piece of the puzzle. They are extremely useful in managing complicated endeavours and generating a common view of the enterprise. Simulations can augment architectures in the understanding of dynamic system behaviour which is key to appreciating causal effects and directing complex endeavours. Hence there is an urgent requirement to relate architecture models to simulation models, i.e. to develop executable architectures, facilitate testing and forecast performance. This is an exciting area and a number of different approaches are being explored including using agent-based simulation [Ref 4] and discrete event simulation [Ref 5]. Linking architecture products to a business process model will be described in this paper.

Business Process Modeling

Business Process Modeling (BPM) can be used to represent C2 practices within a HQ. This project adopted an "activity based methodology". That is, actors and activities served as the key links between DoDAF products and the BPM [Ref 6]. A process can be thought of as an integrated set of sequenced activities that draws upon resources to transform inputs into outputs. Modeling business processes as cueing problems highlights and facilitates studies of stock and time consumption where constraints and bottlenecks are identified and alternative optimization strategies can be explored.

The methodology applied was aimed at facilitating the capture of data in an architecture data model; maintaining and modifying the database; generating simulation models based on the data; and preparing for future integration with other simulation models. The information collected was captured in a database in the form of use cases - identifying the actors, goals and activities involved in key C2 business processes within a military headquarters. The schema was designed intentionally to accommodate various scenarios, i.e. to explore actors and activities interactions under different operational contexts. A flexible simulation framework was developed using a BPM application to represent the business processes identified in the initial phase of architecture development. The simulation framework provided a baseline for further decomposition of activities within the BPM environment. In addition, the simulation framework allowed for the extension and the re-use of the C2 model in simulation interactions with other models that exploit this framework. The key to success lay in the concept of executable architectures.

Executable Architectures

While architecture frameworks are useful in depicting relational dependencies, they have only a limited ability to support process optimization. This is especially true when an organization wants to explore options and reengineer "systems" which are highly dynamic i.e. instances when behaviour is sensitive to the influence of time. In the current era, where the "just in time" philosophy and business practices reign, the ability to review and analyze complex processes is increasingly a priority.

This has given rise to concept and creation of executable architectures: a symbiotic combination of an architecture framework and a simulation environment. Within the latter, the sequence of activities depicting organizational process and rule sets (know-how) is developed as a model. DoDAF can encapsulate dynamic governance elements using operational views and a simulation model can confirm that the description in the view is correct. The model can be executed to monitor and analyze behaviour over time, e.g. delays, resource usage, etc.

The scrutiny and evaluation of complex business processes is fundamental to system optimization. A simulation model allows the organization to analyze behaviour over time and to periodically extract relevant performance data. This information, in turn, can then be studied in detail to validate assumptions and, more importantly, to revise the original model in the simulation environment and/or to furnish feedback which can be used to enhance the architecture framework. The following diagram (Figure 1) illustrates the important link between the architecture framework and the simulation environment through, in this case through an XML bidirectional line of communication.

This continuous co-evolvement of architecture and simulation requires use tools that move information easily between architecture views and simulation models. There are tools such as CORE[7] which provide the means to manage architecture views but host an integrated simulation system as well. Alternatively, the architecture information can be transferred to a standalone BPM tool. This suggests there is a requirement for a common language across all software involved in the process development. It follows that there is a need for a standard which addresses the needs of both architecture and executable frameworks. The UML format fits the bill. It is easily parsed and archived without a need for a heavy maintenance database for example.

[7] http://www.vitechcorp.com/

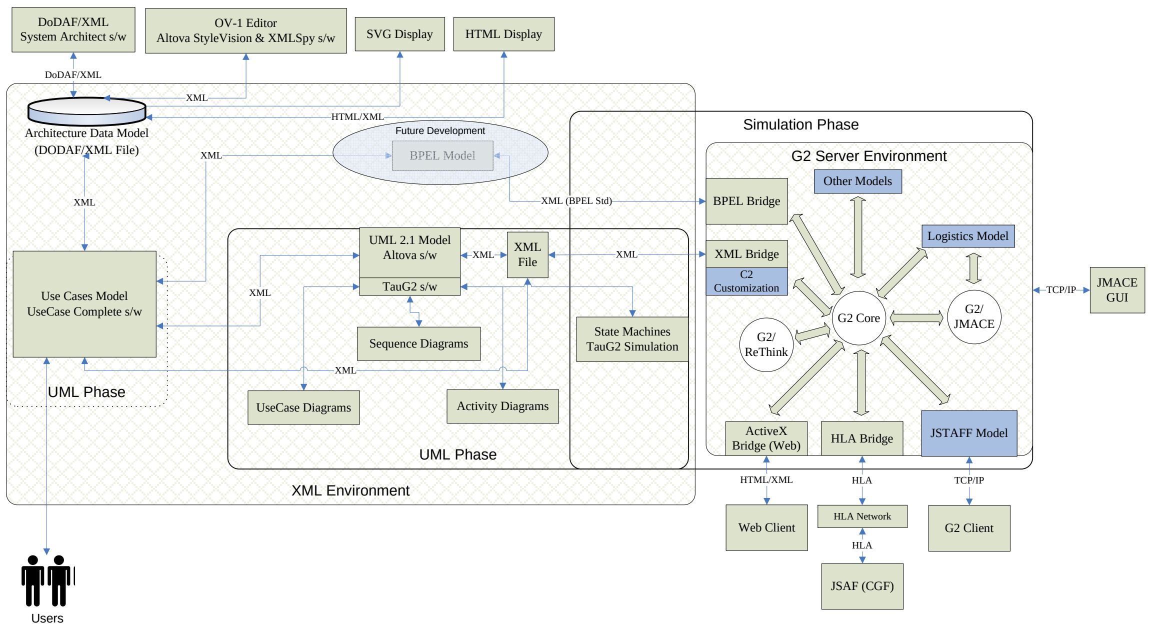


Figure 1: Process Development Schematic

Simulation of C2 Processes

Simulations of C2 processes were developed to assist JCDS 21 scientists with the design of experiments for newly established operational headquarters such as Canada Command. These simulations will also be used to assist scientists to assess potential C2 gaps and deficiencies and validation of measures of effectiveness (MOEs) and measures of performance (MOPs). The goal is to empower concept development and experimentation through modeling and simulation capabilities in order to enable operational concepts to be examined and evaluated. In short, the objective was two fold: to simulate C2 process models to validate each joint operational staff process and to develop a simulation framework to analyze the cumulatrive effects of the various process models.

G2/ReThink software produced by Gensym Corporation[8] was the BPM application used to simulate the C2 processes. It has proven to be very stable and relatively easy to use; it has sound basic functionalities and a good interface for the modeller. One of its main attractions is this ability to connect easily to and draw information from many sources. G2 is an object-oriented development environment that allows model developers to use natural language to express objects, business rules and procedures. The G2 platform combines real-time reasoning technologies, including rules, workflows, procedures, object modeling, simulation, and graphics, in a single development and deployment environment. ReThink is a software application developed within the G2 environment. As a rules-driven BPM product, ReThink incorporates time-sensitive business rules, process modeling and simulation in a single, holistic environment. G2/ReThink is packaged with libraries of objects, instruments, blocks, functions and rules to suit default process behaviour. In addition, it also offers predefined computing capability for managing resources, constraints, cost, time, etc.

The C2 processes were documented through observation and/or interviews with operational level headquarters staff in the CF [Ref 7] and with staff from various government departments [Ref 8].

[8] http://www.gensym.com/

The simulation created in ReThink was based upon the DoDAF architecture information. This provided a convenient method for expressing capabilities in a dynamic simulation that offered traceability to doctrine and operators' concepts and could also be used to support the JCDS 21 metrics framework for C2 capabilities. The JCSDS 21 metrics framework was developed as a spin-off of MITRE's National C4ISR Imperatives [Ref 9] and NATO's SAS-050 project [Ref 10]. It will be employed to indicate the degree to which performance objectives can be achieved in a simulated scenario. The C2 processes were described using DoDAF products.

The next step was to create Use Cases based upon the observations and interviews. These were modeled using UML which provided a common language to communicate the architecture information. A sample UML Use Case diagram is shown in Figure 2. It will be familiar to many. It portrays Actors (Operational Nodes) and the things Actors do (Operational Activities). In essence, it is a hierarchical activity diagram (OV-5) representing a single parent activity which is decomposed into several child activities. It illustrates two of the important elements of any capability: people and process. The diagram depicts child processes as being "included" in the parent process (i.e., "Govern Canada"). The hierarchy emerges typically from left to right with the parent process portrayed on the left side. The actors are shown to underscore their association with specific processes.

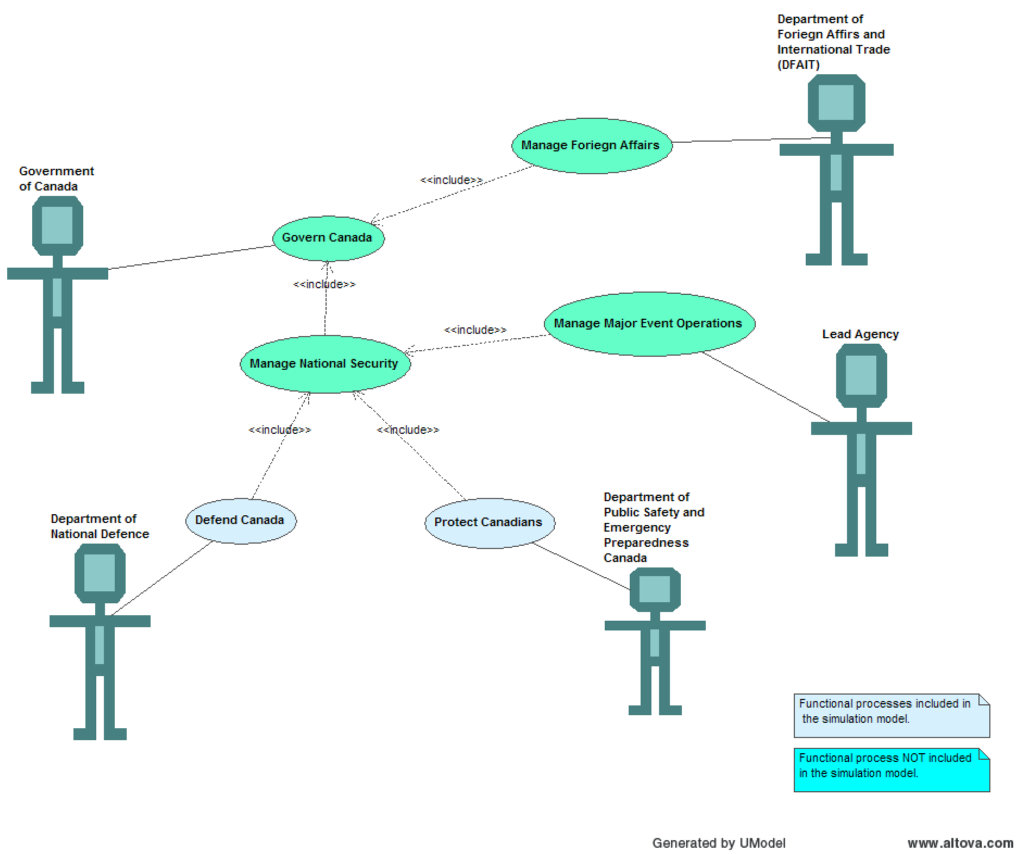


Figure 2: National Command Use Case Diagram

As indicated in Figure 1, the Use Cases described in UML are translated into the ReThink simulation. In the initial simulations, this translation was performed manually by the process modellers, in future XML will be employed to automate the translation.

SIMULATION OF JOINT C2 IN DOMESTIC OPERATIONS

Operational Level Military HQ

As noted previously, joint operational C2 processes were documented through observation and interviews /liaison with CF headquarters staffs. One of the key decisions was agreement on the critical business processes. It was determined to concentrate on the following business processes:

1. Mission Planning - The main focus (initial "golden thread") of the model involves the Operational Planning Process (OPP). Doctrine is well established and CF C2 capabilities are related to the OODA Loop framework.

2. Requests for Information (RFI) - Inputs such as government policy, intelligence products and task force situation reports were modeled - as inputs rather than full processes.

3. Common Information Environment[9] (CIE) - A portal was conceived as the primary tool of the CIE. Related activities focused on two elements: (1) posting information, and (2) accessing (pulling) information. Other tools defined as attributes for facilitating information exchange and communications were email, fax, phone and meetings.

4. Battle Rhythm - Captured by modeling battle staff meetings to execute planning (OPP) and the daily Situation Report process which drive the daily briefings.

Mission Planning

The Canadian Forces have well established mission planning doctrine; the steps and related products are clearly identified and roles and responsibilities understood and practiced on a daily basis. This process is similar to planning processes used by many other military organizations. A high level depiction of the OPP modeled in G2/ReThink is pictured in Figure 3.

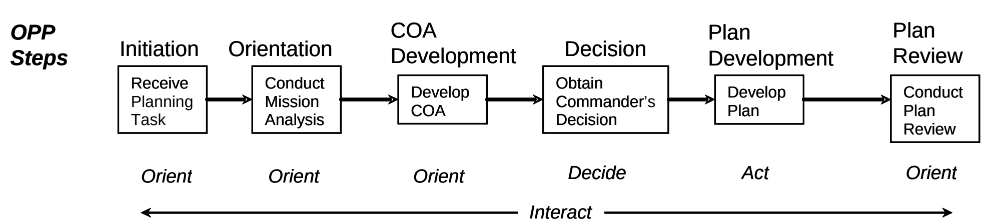


Figure 3 Mission Planning: the Operational Planning Process – Top Level

Request for Information

A Request for Information (RFI) is a standing requirement or time-sensitive call for data collection and analytical support initiated to support an ongoing operation or in response to an

[9] http://www.dtic.mil/doctrine/jel/other_pubs/jwfcpam5.pdf

emergent crisis. The objective of an RFI process is to collate relevant information and intelligence from various stakeholders to support decision making. A RFI is initiated to solicit external support in response to operational requirements from a commander or his Operations Staff. The RFI solicits input to the key business processes and is managed by the intelligence and information section. Again the process model was derived from doctrine as templates and routines are in place and employed regularly.

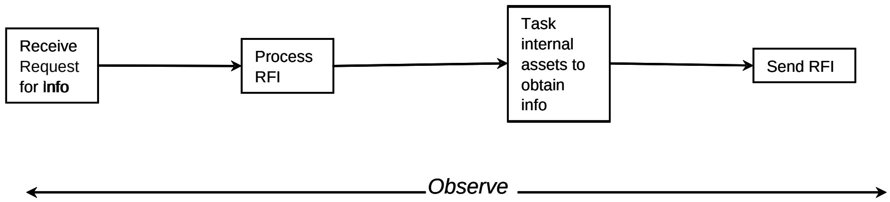


Figure 4: RFI Process Model – Top Level

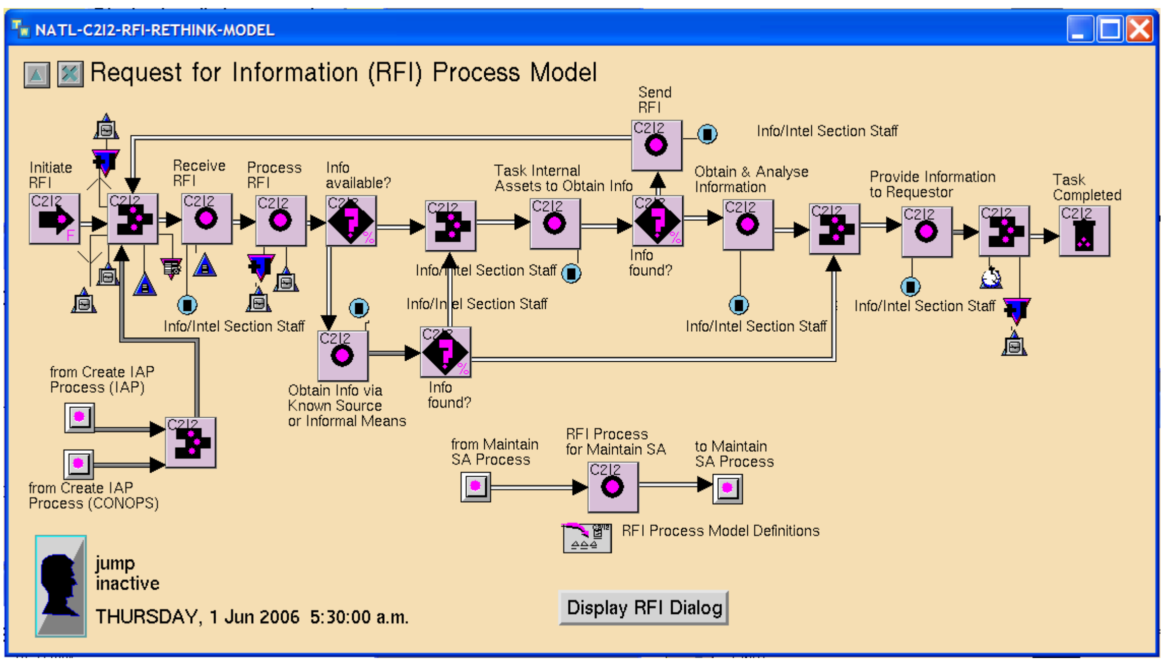


Figure 5: RFI Process Example in ReThink

Battle Rhythm Process

The history of battle staff development may be considered a long standing attempt to impose a discipline of sorts on an inherently chaotic military endeavour. This is a human centric activity and the conduct of operations necessitates a cyclical approach to management of staff activities and orchestration of information management to support effective decision making. The Chief of Staff or J3 Ops schedules and directs recurring activities to administer operational rhythm and battle rhythm.

Battle Rhythm can be thought of as the 24 hour cycle of scheduled staff activities, strategic, operational and coalition/OGD members, which is repeated over time and oriented to achieving the mission desired effects and outcomes. It serves to optimize tempo and ensure unity of effort by synchronizing battle staff activities in a predictive and repeatable schedule and includes the scheduling of preparation, submission, and integration of mission situation reports and battle staff meeting and briefings as shown below in Figure 6. A predictable continuous schedule to allow the staff to focus on providing the commander with the right information in the right format at the right time is required to simplify and manage the complexity of the decision-making process.

The Battle Rhythm also facilitates and coordinates the exchange of information through the various staffs and working cells at all echelons of command because subordinate elements can anticipate when information is required and decisions taken. In an era of pervasive communications and increasing interdependence, effective task force operations require synchronized, strategic, operational, and tactical Battle Rhythm across time zones and attuned to the decision cycles of superiors, peers, partners and subordinates. Establishing a Battle Rhythm can be particularly challenging when an operation encompasses a large geographic region spanning multiple time zones and involves multiple agencies or coalition members. These issues affect communications and collaboration and must be considered in a simulation of the battle rhythm process.

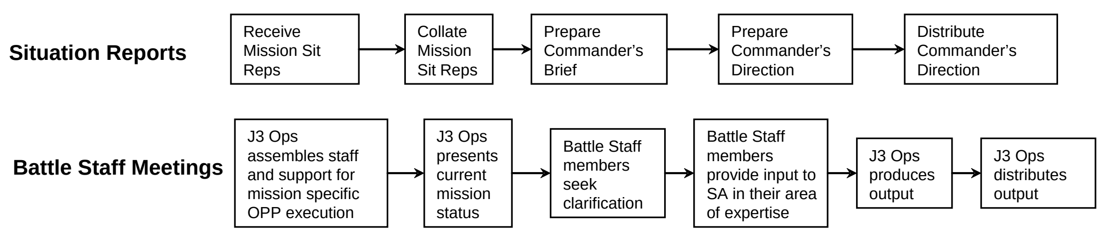
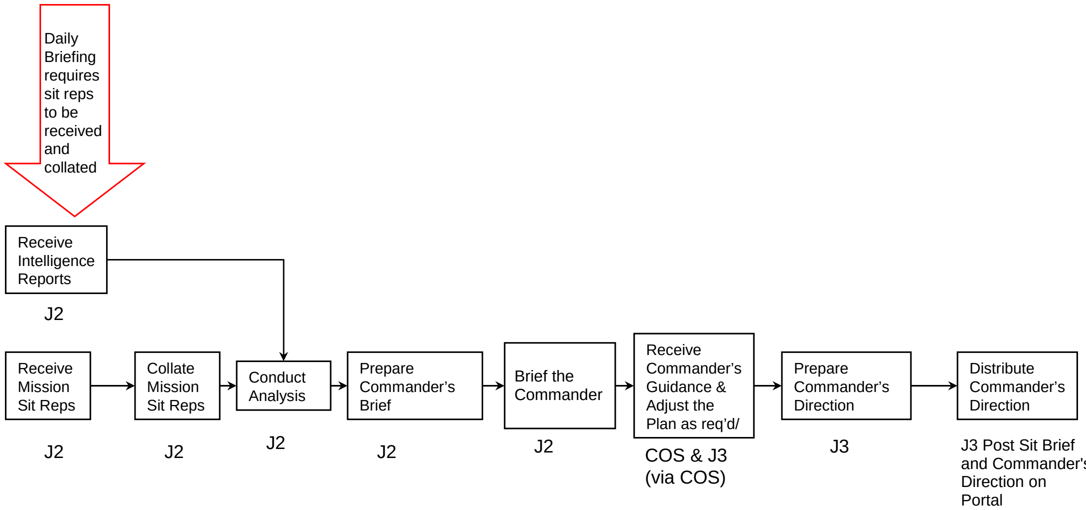


Figure 6: Battle Rhythm Process Model – Top Level

Operations relating to overseeing security for a Major Event (e.g. an international sporting competition or meeting of political leaders) were examined in an effort to appreciate fully how Canada's Department of Defence and the Canadian Forces might contribute to and will align with external decision making processes. The obvious starting point was to model a simple standard process. A situation report (SITREP) culminates in a routine report generated by an operational commander (i.e. from a Task Force, or in the case of a Major Event Security Operations (MESOps), from a venue) to describe the status, progress and issues relating to active operations. Typically, in the case of a sporting competition, it gives an update of the security, site and event situation, providing the lead agency with updated information on each of the venues. It serves as input to the daily Commander's Guidance document and may provide stimulus for further guidance. A fused situation report from the Command HQ for the event is distributed to stakeholder partner agencies.

Figures 7 and 8, below, illustrate the architectures representing the situation report process at the top level.



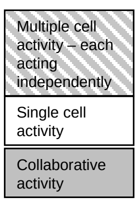
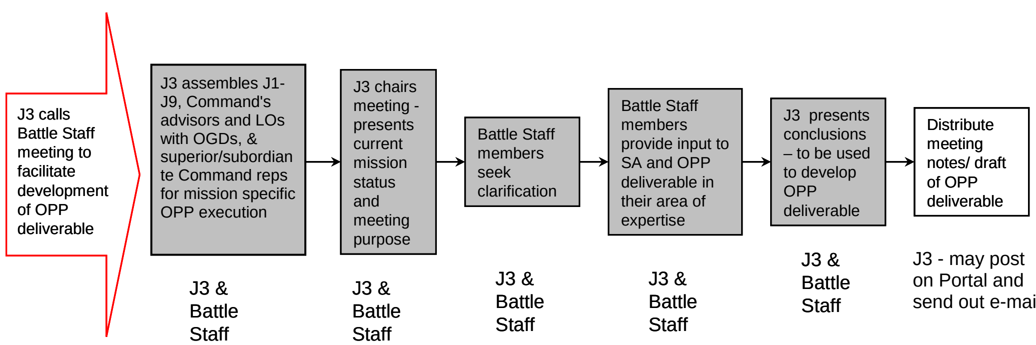


Figure 7: Battle Rhythm Process – Situation Report



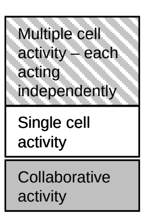


Figure 8: Battle Rhythm Process – Battle Staff Meetings

Collaborative Information Exchange

The Collaborative Information Exchange (CIE) process provides the capabilities required for the headquarters to communicate and handle information. It consists of a set of network services that permit individuals and collective groups of users to perform such functions as messaging (email and formal military messaging); voice communications (such as phones, radio and satellite communications); information storage, search and retrieval using military and external data repositories and portals; and collaboration services (shared workspaces, whiteboard, chat services and web-enabled distributed document authoring).

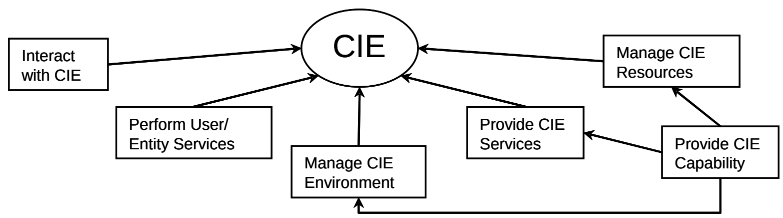


Figure 9: Provide Collaborative Information Exchange – Top Level

The high level architecture for a complete CIE is shown in Figure 9, however, only those elements of the CIE related to the OPP and JCDS 21 experiment objectives were implemented in the simulation: messaging, voice communications and information storage and dissemination for the command portal. In the simulation environment, the CIE module performs the communications and data/storage retrieval capabilities integral to the same concept as the net-enabling capabilities of the future transformed architecture for the CF. The CIE module provides a common set of objects that imitate the exchange of information. In simulations, like live exercises, it is important to emulate the real-life communications environment to include delays, bandwidth and connectivity behaviours characteristic of real networks. In this respect the simulation CIE module is more representative of phone and radio networks than an already networked infrastructure.

Tactical Level Interagency C2

Resident at the other end of the spectrum is C2 at the tactical level that is composed of processes critically important in interagency operations. As interagency operations are stood up a requirement exists to establish a command centre, with one agency appointed as the lead. Although the various lead agencies candidates may operate in different manners corporately there is a case to be made for a flexible, but uniform template of "business" processes to be used to provide decision support and ensure the effective command and control of subordinate entities.

The work conducted by the Canadian Forces Experimentation Centre (CFEC) Interagency Team has focused on identifying these business processes and creating models and simulating them. The ultimate objective is to develop a robust and flexible template to implement critical business processes, procedures and organization as the operation is initialized.

Several federal agencies provided input and participated in the development work of these processes. The DoDAF products provided a valuable tool to integrate inputs and this served as a "Lynch Pin" for model generation. The initial business processes used in the study were:

- SITREP
- Maintain Situational Awareness
- Request For Information
- Incident Report
- Incident Action Plan
- Request for Assistance
- Transfer of Authority
- Handover
- Incident Public Affairs

For the purposes of this paper the discussion is limited to describing the rationale behind the Maintain Situational Awareness, Request for Information and Request for Assistance processes.

Maintain Situational Awareness

Given the ad hoc nature of Major Event Security Operation planning, operations centres have not traditionally taken a systematic approach to anticipating and handling the volume and diversity of information that will be received. Recent advances in sensor and information fusion have resulted in the increase in data intake by several orders of magnitude which continues to gather momentum. Media presence and widespread dissemination of information in near real time has generated the requirement to match if not operate within the news cycle, but with greater premium on accuracy and analysis. Within any Operation Centre there is the requirement to evaluate, categorize and prioritize the information as it arrives, and enter it in to a Knowledge Base. Historically these have been compiled as a centralized database but the current concept does not presume any particular configuration so the databases are being referred to as a Virtual Knowledge Base (VKB) [Ref 11]. The management of the VKB is a new function for all operations centres, including the Military, but for ad-hoc organizations there is a clear need to develop a process that can be agreed upon by all potential Lead Agencies.

The "Maintain Situational Awareness Process" is the process through which the operations center evaluates, categorizes, and prioritizes the information that is coming in from both internal and external sources. The definition used for Situational Awareness is [Ref 8]:

> "The ability to identify, process, and comprehend the critical elements of information with regards to overall mission accomplishment."

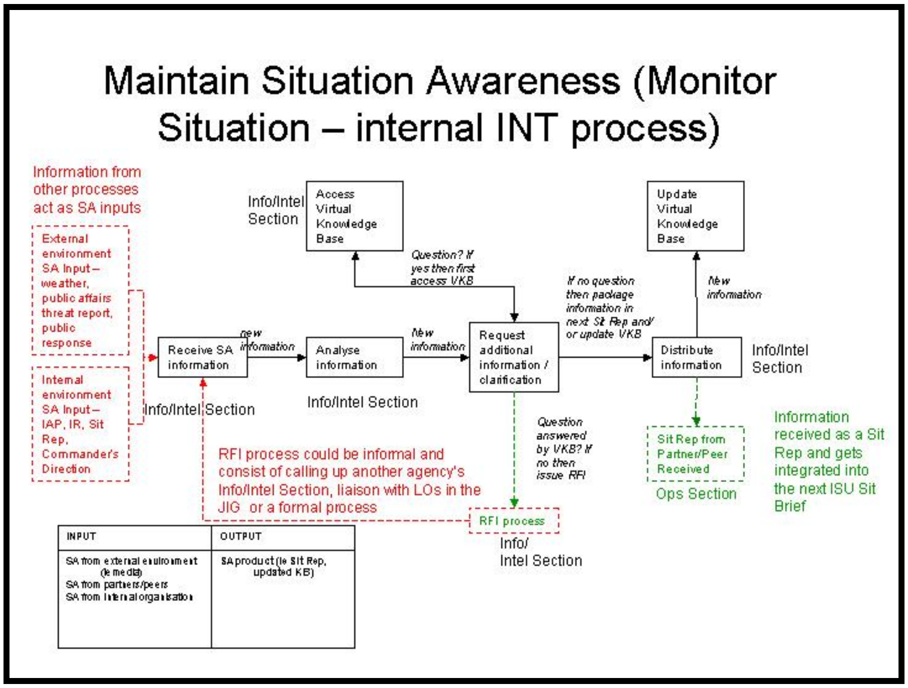


Figure 10: The process diagram for Maintain Situation Awareness.

Interagency Request for Information

Once information has been entered into the VKB it is theoretically available to everyone within the command post. However, given the nature of interagency operations where some members within the Operations Centre have security clearances of varying degrees, while others have none at all, there will be a need to have control access to portions of the VKB data. Therefore a process was developed to provide a means for members of the Operations Centre to request additional information. The reply to these interagency "Request for Information" submissions would be controlled by the Information & Intelligence section of the Operations Centre. This leverages and expands the basic RFI process that was described earlier. The RFI definition used was [Ref 8]:

> "The RFI is a 'formal' process to provide information from various stakeholders to help guide decision-making and to aid in the maintenance of effective situational awareness."

The RFI, once passed to the Intelligence & Information Section, may be answered locally or passed to other agencies for them to action.

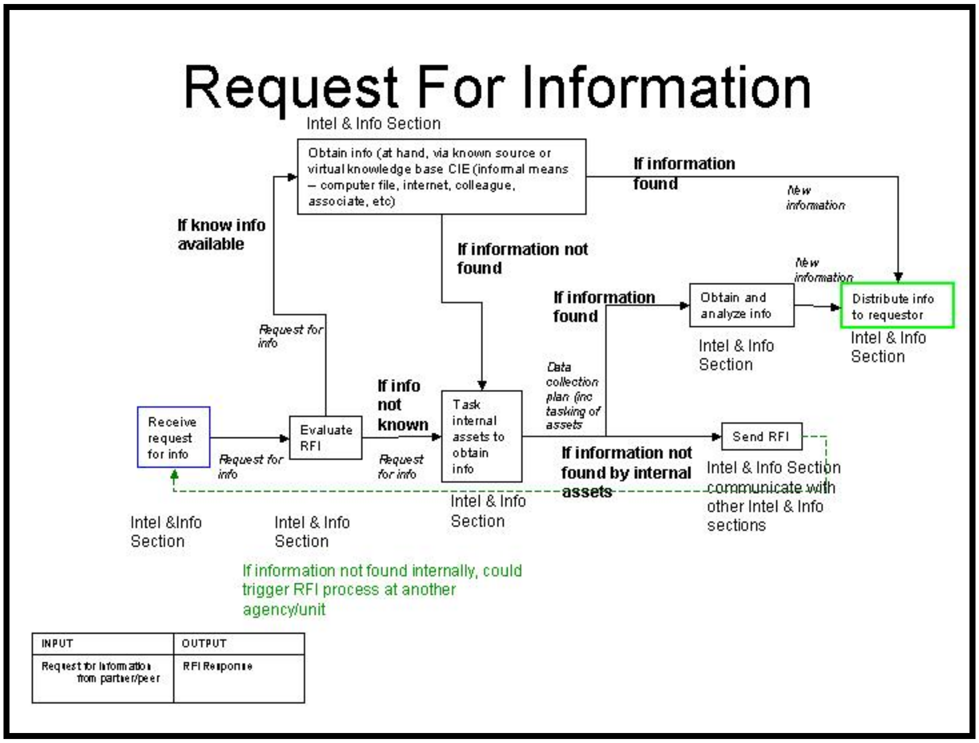


Figure 11: The process diagram of a Request for Information.

Interagency Request for Assistance

Upon the activation of an operation, whether the result of deliberate or responsive planning, the various agencies involved will agree to the level of participation. Normally, in the case of the former, this will be done in advance through Standard Operating Procedures, Memoranda of Understanding and prior approved contingency plans. There will arise occasions when either there are no such agreements in place or the situation changes to the point where the approved resources are insufficient. The Government of Canada has made provision for such circumstances and this was modeled. As might be expected, the Request for Assistance (RFA) is based on a very formal process that satisfies both legal and financial requirements that have to take place in order to protect those involved and frame the cost recovery.

The definition of a RFA used was [Ref 8]:

> "A formal request from an organizational component for additional resources to fulfill an assigned task and/or satisfy an objective."

The RFA process that was incorporated in the model can be implemented at various levels within the organizations. It does not preclude immediate action on behalf of the organizations involved, nor should it be used to create an unnecessary delay to the provision of services or equipment. It should be used as a means of ensuring that the necessary financial and legal requirements met in due course.

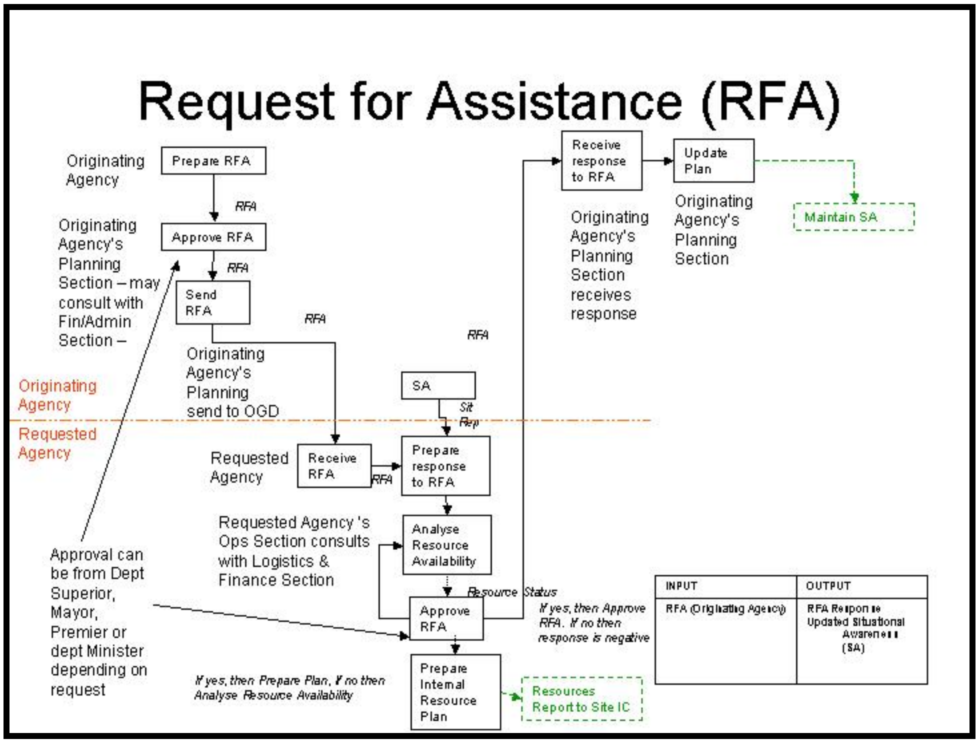


Figure 12: The process diagram of a Request for Assistance.

SCENARIO DEVELOPMENT

The requirement to relate architecture models to simulation models has been discussed. There is an equally valid requirement to accommodate various scenarios within the simulations, i.e. to explore actors, activities and interactions under different operational conditions. Scenarios provide context, and can be exploited to validate the architectures and models. The development of a scenario for a Joint C2 DOMOPS model is very important and must provide adequate detail to make the events seem real in description and timing, and in describing sufficient severity to stimulate actor response, yet not be so severe as to require a response from a higher authority. It was therefore decided to base the scenario being developed for the first test of the C2 process models on an existing exercise validated previously in a military environment. This exercise was named Ardent Sentry 2006 (AS 06).

Within the CF, the main AS 06 players included the Strategic Joint Staff (SJS) and Canada Command in Ottawa, Joint Task Force Atlantic (JTFA) in Halifax, Joint Task Force Central (JTFC) in Toronto, Canadian Air Defence System (CADS) in North Bay and 1 Canadian Air Division in Winnipeg. The intent of the AS06 exercise was to provide a forum in which selected senior officials, federal departments and agencies and provincial emergency management organizations could rehearse their roles and responsibilities in dealing with significant emergency events affecting the national interest.

AS06 consisted of a number of events varying in severity and scope in multiple locations in both Canada and the US. Exercise scenarios involving Canadian participation revolved around several main threads:

a. Terrorist threat to critical infrastructure (CI) - a credible threat to CI in the Maritimes leads to a federal request for assistance from the RCMP to the CF to assist with the protection of these sites. Collaborative planning between Canada Command, JTFA and local RCMP resulted in real-world deployment of a CF Immediate Reaction Unit and the Halifax Port Security Unit;

b. Maritime Proliferation Security Initiative (PSI) - a foreign vessel off the East coast bound for a Canadian port has been identified as a Vessel of Interest (VOI) by the US Office of Naval Intelligence (ONI). It was anticipated that a decision would be made to board the vessel to inspect its cargo, following which the vessel would be quarantined;

c. Explosion of Radiological Dispersion Devices (RDD) - the detonation of two RDDs, one each in Detroit, MI and Windsor, ON. It also included the detonation of a Vehicle-Borne Improvised Explosive Device in Windsor. The intent of these depictions was to initiate cross-border collaboration to permit JTFC and the Province of Ontario to practice consequence management activities; and

d. Pandemic Influenza – situated on the East coast, this was designed to exercise federal and provincial departments to deal with this realistic threat. The CF remained fully aware of the situation as it evolved but there were no request for CF assistance in this scenario.

AS06 was developed over many weeks, with the inputs from many Government departments, each making sure that the story was believable, and the associated injects would create the right kind of response, by the targeted personnel, according to department policies and doctrines. The functional exercise play was conducted at two levels: domestically at the federal and the provincial levels and internationally between Canada and the US. The tactical exercise involved Canada Command joined by JTFA and JTFC. The scenario with supporting injects and implementers was presented to the players in order to create situations where the organizations would clearly recognize the need to communicate and hopefully coordinate, cooperate and collaborate on response activities.

A portion of this exercise was selected to be developed further as a scenario against which the simulation model would be run in support of an experiment. It was decided to develop the Ontario events as the basis of the scenario carried out over a 2-day period. All the other activities in the exercise would be simulated as collateral activities that Canada Command would be either action or monitor in parallel with the Ontario events. If there is a need for more activities (more stress), more injects could be added at any time related to RFI or RFA, being careful to avoid any type of new inject that might change the level of response to a planned inject.

The scenario and supporting documentation including a detailed Master Scenario Events List (MSEL) were developed. All the artificialities and simulations dealing with non-real-time play, deployment and subsequent movement of resources, weather, communications and interaction with non-participating organizations & Ops Centres, and media simulation were borrowed from AS 06 control and added to this scenario as required. A Microsoft Access database was created with appropriate forms and reports for easy entry, storage, and retrieval of the MSEL items. An Exercise Management Tool, based on an SQL database, has been developed to store and manage an MSEL, automatically creating email or other injects from the MSEL, and tracking and correlating the responses.

STATUS OF MODELING EFFORT

The simulation developed represents the culmination of considerable effort to establish contacts across government departments, to capture and depict information using the DoDAF, to create supporting Use Cases ensuring traceability. The simulation supports two distinct models: a business process model of the Canadian Forces C2 Headquarter and the Operational Planning Process, and a process model of national Major Event Security Operations and Integrated Security Unit (ISU). Both models will be tested, analyzed and refined in a series of workshops and experiments using a scenario such as the one described above as a backdrop.

Efforts are continuing to populate the simulation with representative data and to develop meaningful interfaces to aggregate and impart a clear visual depiction of results, e.g. completion times and resource demands. The simulation will be used to validate the organizational tasks, workflow, associated resource pools and rule sets. The model representation is the first factor to consider; any model needs to be tailored to the questions posed and decisions required. It should include sufficient detail but not compromise system insight, and should ensure accurate representation and generation of "legitimate" data epitomizing historical values and in accordance with participants' experiences.

We have found that an iterative approach works. Once agreement is reached on a high level depiction the next layer can be decomposed and constructed. The second factor to consider relates to timing. Again the challenge is to model the task process timing so the process dynamic simulated is realistic. Once these two issues are addressed the process dynamic can help highlight under or over utilization of resources and identify delays and bottlenecks. This requires an intuitive user interface so operators can use the output data to take advantage of full potential of the simulation environment. Therefore a dashboard-type display was created to summarize and display automatically pre-analyzed data from the simulation.

Once the model is proven to be credible the next step is to conduct explorations, make modifications to the model and investigate options to resolve process issues. The strength of this approach lies in the fact that the model designer/process engineer can optimize the model directly either within the simulation environment software or from his preferred architecture framework tool. The latter will require simulation specialist import and modification to align the model after changes are completed.

CONCLUSION

This paper has described how to accomplish a successful transition from architecture views to simulation models that can expand opportunities for concept development and experimentation. The simulations being created will support the process designer in developing an optimized process or a new process. These simulations will then be used to plan experiments to support projects such as JCDS 21 demonstrate a joint net-enabled collaborative environment to achieve decision superiority in the future Canadian Forces.

Two C2 simulations have been developed; one for a joint operational level military headquarters responsible for domestic operations (DOMOPS) and another for Interagency C2 of tactical level joint DOMOPS and emergency management. Plans for experiments are under development where realistic simulation of the key C2 processes will allow researchers to test hypotheses beforehand to optimize their designs. This paper has described a new approach to developing a C2 model, the design of the some of the C2 process models that will be used in the simulations and the scenario that will be used in the near term. The modelling approach used for the JCDS 21 TD is being adapted to other C2 projects including a model of the National Air Planning Process and Joint Fire Support.

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