Half a Decade of Operational Research for Developing New Command Support Capabilities in the Canadian Army

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Abstract

The Canadian Army is in the process of fielding a variety of command and control information systems (CCIS) and sensor systems across its Land Force, ranging from new communications equipment to situational awareness systems and on to planning and execution aids in battle group and brigade group command posts. The Coyote reconnaissance vehicle, a highly regarded surveillance asset, entered service in 1997-1998 and a sensor pod for the Griffon tactical helicopters will be fielded in 2003-2004. Since 1996, the authors – a cross-section of personnel from the Operational Research Team, the Army Experimentation Centre, and the Directorate of Army Doctrine – have been intimately involved in a spectrum of analytical tools – wargames, simulation-supported command post exercises, equipment tests, and field trials. The Coyote reconnaissance vehicle was subjected to a field trial at the reconnaissance-squadron level and a

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series of wargames and simulation-supported command-post exercises. The LAV III, a new armoured personnel carrier that brings with it new sensor capabilities and command challenges, has been the focus of a number of wargame- and simulation-supported analyses, culminating the largest instrumented field trial in Canadian Army history, in September-November 2001. The Situational Awareness System (SAS) was subject to both a field trial and simulation-supported analysis in a battle-group command-post exercise. The communications and information systems of the Canadian Army were tested in a coalition demonstration of standardization and interoperability at the BOREALIS exercise in June 2002 involving counterparts from the US, British, Australian, and New Zealand armies. Throughout all of these activities, operational research personnel from the Land Force Doctrine and Training System established the experimental design, invoked and supervised the collection and analysis of data, and provided their assessment of the process. Meanwhile the Army Experimentation Centre has established itself as an important venue for evaluating new procedures in command and control and the employment of new sensors. Throughout all of this the continuing theme has been the development of new doctrine in the areas of command, of command support, and of intelligence, surveillance, target acquisition, and reconnaissance (ISTAR).

1. **Introduction**

In 1997, LGen Mike Jeffery, then a brigadier general and commandant of the Army's Staff College, established a group in Kingston, Ontario, to look to the Canadian Army's future. His concern was that the army staff had become so engrossed in fighting the day-to-day issues that confronted the Army, they had lost sight of where the future would or could take them. From this activity arose a series of army experiments. Around the same time there were other mood changes in the Army that led to other initiatives in experimentation, field trials, and other similar activity. Over the succeeding five years, LGen Jeffery rose to become Commander of the Army, and his initiatives to have the Army staff look to the future have generated many benefits.

In the mid-1990s, the Director of Army Doctrine (DAD) tasked the Operational Research Team and the Army Experimentation Centre to study the implications of the introduction of advanced sensors on the battlefield, including how these would be integrated and used by Canadian soldiers. The introduction of modern sensors has the potential to revolutionize how we understand information gathering; however, the fielding of the technology alone is not synonymous with success. To be successful, we must address a wide range of non-materiel issues and ensure that the new capability is integrated in our Personnel, Leadership, Organisation, Training, Equipment, and Doctrine (PLOTED) imperatives.

The Canadian Army is in the process of fielding a world-leading capability in ground-based and helicopter-based sensors. For a time, these sensors were being fielded in a conventional fashion with little integration. But we are now more aware of the essential requirement to optimize and integrate existing information and sensor data into knowledge for commanders. Our aim must be to reduce the uncontrolled flood of data and present it concisely to commanders through fusion and analysis. The reduction of this flood must not come through commanders turning off sensors or discarding essential information that is buried within an unmanageable stack of data. In studying this issue, we must guard against any attempt to create a solution that would try to lift the fog of war completely. We must recognize that "better is the enemy of good enough" and that we could wait forever for the perfect system. Commanders of the future will still make decisions on ambiguous and incomplete information, and, in all cases, will have to project their understanding of the situation in the future.

1.1 *Command and Command Support*

While the Army is improving the assortment of sensor products that a commander and his staff may use, there are other projects to improve the quality of command support. Military command encompasses the art of leading, decision-making, motivating and directing all ranks into action to accomplish missions. It requires a vision of the desired end-state, an understanding of military science (doctrine), military art (the profession of arms), concepts, missions, priorities and the allocation of resources. It requires an ability to assess people and risks, and involves a continual process of re-evaluating the situation. Command Support is defined as "the integrated system of resources necessary to enable command".

Command Support is enabled by two primary activities: Information Management and Systems Management. Information Management is defined as "The set of policies, controls, procedures and structures which enable an organization to manage information as a corporate resource". In a military context, it includes five major activities: collection, processing, storing, displaying and disseminating relevant information. Systems Management is defined as "The policies, procedures, tools, personnel and structures that ensure a consistent and robust communications and information system (CIS) environment is provided to all users". This definition encompasses both communications and computer related resources. [CFP 331 (1), 2002]

1.2 *Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR)*

ISTAR links intelligence, surveillance, target acquisition and reconnaissance systems and sensors to cue manoeuvre and offensive strike assets, with particular emphasis on the timely passage of critical and targeting information. It encompasses the collection, co-ordination and management of information and intelligence. The Situational Awareness (SA) provided by tailored ISTAR capabilities is fundamental to good decision-making. ISTAR is based on the Intelligence Cycle. The goal of the Intelligence Cycle at the operational and tactical levels is to produce intelligence for Situational Awareness (SA) and target development. ISTAR is applicable to the full spectrum of operations. Integral to ISTAR is the component of the Command, Control and Information Systems (CCIS) infrastructure which links ISTAR capabilities and enables the timely passage of information and intelligence to the appropriate commanders and staffs.

2. A Chronology of Army Experimentation

Army experimentation has been going on for nearly a century, but the current round of experimentation began about five years ago with a series of trials and wargames. The first activity that was officially called an 'army experiment' took place in the spring of 1998.

2.1 *Army Experiment 1: ISTAR*

The first Army Experiment was a limited objective experiment to provide a proof of concept for the experimentation process developed for the Army Experimentation Centre. A seminar war game was used to determine the optimal integration and management of ISTAR sensors in a future less dense battlefield. A seminar war game is, in essence, a structured-judgment exercise to examine the possible application and value of new technology, tactics, and doctrine. The interaction between scientists and military prompted discussion and generated valuable insights.

The scope was limited to brigade-level organic and attached sensor assets (like Coyotes or helicopters), multi-platform sensor integration and fusion of data, and surveillance organization for the best coverage of extended areas of operations, intelligence responsibility and influence. Results from previous wargames on the topic of reconnaissance (or recce) indicated a need to reassess the composition of the recce organisations, the ISTAR procedures, the role of counter-recce, the role of unmanned air vehicles (UAV) and tactical aviation, and logistics of dispersed forces. Results from Coyote field trials were in the area of recce tactics, techniques and procedures (TTPs) and the recognition of the strengths and weaknesses of the Coyote as a sensor and recce platform. The main issues raised were the need to reassess the composition of recce organisations, the IPB (intelligence preparation of the battlefield) procedures, the role of the dismounted observation post (OP), the importance of acoustic detection, maintenance problems, and the need to improve communications. Due to the fiscal reality of the 90s, the Canadian brigade recce squadron had been reduced to three troops of five Coyotes (not a doctrinal structure), with each troop consisting of two patrols of two vehicles each. The main limitations with the Coyote were that messages had to be passed by voice on standard military radios. There is no datalink, so radar contacts were passed as plastic overlays and video images sent by videotape. In terms of reliability, it was often the case that patrols needed two sensor suites to keep one functional, due to breakdowns, breaks in cables/connectors, etc. [Roy et al, 1999]

This experiment provided a better understanding of capabilities and problems by the field force soldiers, staffs and defence scientists and resulted in the following conclusions:

- The reduction to three troops of five Coyotes in a recce squadron leaves very little flexibility in the use of the surveillance sensors in conducting reconnaissance on the move.
- Techniques to integrate, co-ordinate, and manage sensor assets must be developed. Responsibilities of different command and control nodes to de-conflict the data needs to be addressed. This includes analysis capabilities for troop leaders, the squadron headquarters, a brigade data-fusion cell and other sensor assets (electronic warfare (EW) sensors, UAV, helicopters, or artillery observers).
- The formation of some form of an ISTAR unit should be considered to provide greater flexibility for Canadian units and sub-units. The ISTAR unit should include armoured reconnaissance assets, other ground sensors (EW sensors, unattended ground sensors, counter-battery radar), access to aerial or airborne assets (UAV or helicopters), and intelligence analysis. It is also essential to access strategic or allied reconnaissance assets, such as satellites, aircraft and long-range UAVs.
- An integrated formation-level ISTAR unit is essential for training and to insure operational success. The current dispersion of ISTAR components makes it very difficult to coordinate training and force generation activities. The level of knowledge, specialized training, and maintenance of skills required means that the Army cannot afford to constantly be training new sensor operators. There may be a need to consider creating sensor and counter-sensor NCO/officer career streams to maintain a cadre of personnel expert in ISTAR doctrine, tactics and procedures.
- There must be a coordinated approach to improve the ISTAR system. Coyote needs to integrate its sensors to a digital command support system to automate the capture and transmission of its information. Squadron headquarters can then quickly process

individual contacts into enemy unit formations, observe on trends and develop a logical tactical picture for higher headquarters. Headquarters needs to access and disseminate surveillance information from UAVs, helicopters, aircraft and satellites. Data fusion systems can then process recce and surveillance information to provide improved battlefield visualization for commanders and more effective situational awareness at all levels.

2.2 *Army Experiment 2: Anti-Personnel Mine Replacement Study*

The aim of the second army experiment was to quantify the impact of removing anti-personnel mines from the Land Force, while demonstrating the usefulness of the Modular Semi-Automated Forces (ModSAF) simulation. When ModSAF simulates a unit, it not only creates the entities in the unit, it also builds a structure corresponding to the unit hierarchy. The user can then issue orders to top-level units or drop down the chain of command to give orders to subordinate units or individual vehicles. ModSAF entities can exhibit realistic rates of fire and trajectories, combat damage to their mobility and firepower, and accurately simulate resource depletion for both fuel and ammunition. Other simulated capabilities include inter-visibility, target detection, target identification, target selection, fire planning, and collision avoidance and detection. Preliminary experimentation with ModSAF did confirm that the modeling of the entities conformed to expected norms.

Results of a mounted mechanized armoured attack on a mechanized infantry defending in open terrain showed that the battle was fought at the maximum range of anti-armour weapons. The conclusion was that when mechanized forces are employed, the battle is one mainly of anti-armour weapons and there was very little impact of using anti-personnel land mines.

This experiment did not represent command and control or ISTAR systems to any great degree. But the results led to discussions of modeling issues like morale, unit cohesion, and leadership skills, all issues that are fundamental to the command function.

2.3 *Army Experiment 3: Situational Awareness System (SAS) Preliminary User Trial*

The main focus of the Situation Awareness System (SAS) user trial was on evaluating the ease of use and utility of SAS in a field environment during an armoured battle group (BG) level training exercise conducted in the Gagetown training area 1-9 May 1999. The BG conducting the trial was provided with prototype SAS software, computer hardware, and ancillary equipment, along with the training and technical support necessary to permit users to use the SAS equipment. Observers were attached to the Battle Group HQ and to each of two combat teams. Data capture employed direct observation, ad hoc interviews, questionnaires and a focus group after the exercise. At the conclusion of the BG exercise, the participants requested that the SAS equipment be left in the vehicles for the duration of the Combat Team Commanders' Course. A further evaluation was conducted on 24-25 May to incorporate additional comments and observations from the officers and soldiers who used the system.

The participants on the trial explored three key functions of SAS, namely: 1) the ability to send traces and overlays, 2) the tracking of friendly forces and assessment of potential enemy locations [i.e. "Battle Tracking"], and 3) the ability to pass operations orders, and key reports and returns. User feedback illuminated many areas where improvements are required mainly related to ease of use (touch screen, simple drawing tools, easier planning and reporting functionality). Some of the major benefits of a digital Situational Awareness System are:

- Ability to control/monitor locations and disposition of friendly units on the ground quickly and accurately without having to request constant updates from subordinates of their positions.
- Reduce the need for voice communications and provide a text burst transmitter, which is more flexible, and user friendly than previous systems. Situation reports, returns and requests can all be sent as formatted messages.
- Improve the clarity of message traffic and reduce misunderstandings. The system provided the ability to send/receive fragmentary orders (FRAGOs), traces and attachments over radio to all sub-units with no misinterpretation of map traces.
- Contribute to situational awareness: There is a real potential to provide quick and accurate snapshots of the relative positions of friendly and enemy units and transmit the situation to all friendly units, including higher HQ. These will be greatly enhanced when the situation can be input quickly and easily.

Some of the biggest concerns with SAS are:

- In the prototype configuration, the radio networks carried a mixture of voice and data. The very low bandwidth constraints of the analog radio nets disrupted operations by inhibiting voice communications to the point that the Commanding Officer suspended digital traffic on several occasions. A voice priority system or a separate data net for SAS traffic was recommended.
- The software is not yet user friendly. The biggest problem is the difficulty and length of time it takes to input contacts, and to draw of overlays and positions on the digital map. Icons and buttons are not big enough for touch screen access with a finger.
- During battle procedure, EMCON silence (a reduction of emissions to reduce detectability) is usually in effect. Commanders below battle group, when not engaged in fighting, need to be able to use the system during periods of EMCON restrictions.
- In the prototype configuration, civilian pattern batteries were used for some of the installations. In the final implementation, vehicle power must be used for SAS. The power source in the fielded design should accommodate batteries that are already in quartermasters' inventory.

2.4 ***Army Experiment 4: Organisational Issues of Brigade ISTAR Resources***

In 2000, the Operational Research Team in LFDTS was tasked by the Directorate of Army Doctrine to execute an ISTAR operational research experiment that would investigate alternatives for the collection and analysis of ISTAR information and the tasking of ISTAR sensors in a brigade group headquarters. The central issue for the experiment was to examine three command and control alternatives or models. The first alternative, Model A, was the *status quo*, although with a more robust intelligence staff than is currently available in an existing brigade staff. The second, Model B, had an ISTAR Coordination Centre that could collect, analyze and distribute information from the ISTAR sensors. In this alternative tasking and re-tasking of sensors were conducted by the operations staff (G3) in the brigade command post. The third alternative, Model C, incorporated an ISTAR Coordination Centre that performed as in the second alternative for information coming from ISTAR sensors, but would additionally have authority to task and re-task the sensors without recourse to the G3 staff. [Cameron, 2000]

The general setting for the exercise was a Canadian mechanized brigade group in a defensive scenario with two battle groups defending a Main Defensive Area along a river. The conclusions were:

- In general the participants felt that Model A (*status quo*) is the weakest in terms of providing the clearest picture of RED situational awareness. Of the two models with an ISTAR CC (Model B and Model C), the participants were split in their support.
- The mean rate of first detections of selected RED manœuvre vehicles was higher for Models B and C than for Model A. Furthermore, the mean casualties (‘K’ Kills) among the sensor Coyotes in the Recce Squadron were lower in Models B and C than for Model A.
- Highly valuable BLUE sensor platforms (especially Coyotes in the Reconnaissance Squadron and LAV IIIs with artillery observer parties) absorbed considerable casualties and by game’s end would have been unable to contribute much more to maintaining or to developing further a RED picture. A longer scenario in future experimentation could well result in more careful stewardship of these critical resources.
- Potential measurable improvements over the *status quo* may have been subsumed by random factors in this experiment – e.g., the reactions of participants, or variations in the execution of the plan. Additional iterations of the application of each of the models could potentially establish greater statistical significance. This would require more experimentation.

The participants made a number of recommendations that should be considered when similar experimentation is conducted again. The more notable were:

- The scenarios should include a wider variety of factors like different missions and terrain and iterations should be longer to determine the effectiveness of various ISTAR models over the long term.
- More attention should be paid to the ‘orders process’, including commander’s intent for the brigade and for the ISTAR Unit, the Operational Planning Process, Course of Action (COA) analysis, and Intelligence Preparation of the Battlefield (IPB). More time should be given to the players before commencing each iteration to conduct these battle procedures.
- Manœuvre units and indirect fire systems should be more completely represented so that the nature of the ‘sensor-to-shooter’ link could be assessed.
- A brigade commander and more of his staff should be included as players. As some of the most critical consumers of the ISTAR process, their assessments of the worth of the different models for the delivery of the ISTAR product needs to be assessed.

2.5 ***Army Experiment 5: Company Group and Combat Team TTP Development for LAV III***

The introduction of the LAV III armoured personnel carrier and Leopard C2 main battle tank will have a significant impact on the Army’s operational capability. To ensure that appropriate and relevant Tactics, Techniques and Procedures (TTPs) are developed and validated, a combination of constructive and live simulation trials have been conducted. The aim of AE 5 was to extract qualitative and quantitative information through the use of a constructive simulation (ModSAF), containing validated models and warfighting scenarios, to assist in the development of LAV III TTPs from section level to combat team level.

This first major ModSAF experiment included the development of a synthetic environment (SE) tailored to the player personnel, and included ModSAF, 3D visualization and data capture tools (ModIOS) linked together via the Distributed Interactive Simulation (DIS) protocols. The Subject Matter Experts (SMEs) involved with the LAV III TTP development process were an integral component of all aspects of AE 5 experimentation. This included three months of data validation experiments conducted by users to ensure that the ModSAF simulation accurately represented the capabilities of the LAVIII and Leopard C2, as well as the many other anti-tank weapons. Data capture into text files using ModIOS allowed for near-real-time analysis by importing the data into EXCEL for analysis. Three types of data were collected for this experiment: numerical data recorded by ModIOS during the course of play, a series of questionnaires that participants completed and returned over the course of the experiment, and verbal feedback from players and other participants through after action reviews which provided judgements and insights. [Roy et al, 2000]

The experiment was very successful, confirming the TTPs and indicating that the LAV III provides a significant enhancement to both offensive and defensive operations. In defensive operations, siting considerations that take full advantage of the 25mm gun of the LAV III appear to have a significant impact on the overall mission effectiveness. Similarly, the synergistic impact of adding LAV III to a Leopard C2 countermoves force provides a greater killing capability and reduces the vulnerability of the Leopards. Although LAV III cannot engage heavy armour, it can engage and distract BMP2s, providing increased freedom to friendly tanks when facing an enemy threat comprised of both T72s and BMP2s. Although it is dangerous to interpret the simulation results on an absolute basis, a combination of a troop of tanks augmented with a platoon of LAV IIIs was able to withstand a surprisingly large enemy force in meeting engagements at 2000 meters.

2.6 *LAVIII Uninstrumented and Instrumented Field Trials*

The uninstrumented LAV III Trial was conducted from 10 to 15 September 2000 at the Combat raining Centre in Gagetown. Its aim was to examine LAV company tactics from the individual vehicle to company levels. The trial was restricted to those areas that could be successfully examined without the use of instrumentation. It was a series of tightly scripted events that looked at specific portions of the employment of the LAV III. The trial provided TTPs for the location of section and platoon commanders in advance to contact and assault, and on LAV III mobility, navigation, seating arrangements and casualty evacuation.

The LAV III/Leopard C2 instrumented Field Trial with the Mobile Automated Instrumentation Suite (MAIS) was conducted from 01 October to 16 November 2001, although there was considerable preparation, the most significant part of which occurred between March and September 2001. MAIS is a real-time control, monitoring and data collection system for simulated force-on-force (FOF) combat exercises. MAIS was deployed from the US Army's Operational Test Command at Fort Hood, Texas, to Gagetown for this trial. Players in MAIS-controlled exercises are fitted with instrumentation to simulate weapon firings, report hits, player locations, and player status. The MAIS system is built around the core concept of real-time casualty assessment, which provides immediate player attrition and survivability information without exposure to live fire.

Components of the trial were scheduled, by design, to address many of the same scenarios that had been previously experimented with in constructive models. The predominant measure of effectiveness (MOE) was vehicle casualties.

A trial of this scope has never been undertaken before in Canada. It successfully ended approximately three to four years of combat development and associated effort on both the LAV III and Leopard C2. This has yielded a rich return in the forms of lessons learned, experimental methodologies and the emerging impact of modeling and simulation on the future of combat development. The MAIS runs did point out the value of force-on-force training compared to simply achieving Battle Task Standards. The MAIS runs also showed an increase in frontages used by the Blue force company over the time of the trial. This could be due to increased soldiers' confidence in each other and a better intuitive understanding of the capability of the LAV. It also pointed out the importance of the location of commanders and on the succession of command issues within combat teams.

2.7 ***Army Experiment 6: Evaluation of Battle Group and Brigade Group decision-action cycle and information management procedures (TTPs), employing the LFC2IS.***

The introduction of Land Force Command and Control Information System (LFC2IS), especially the Situational Awareness System (SAS) and the Athene Tactical System (ATS), will have a significant impact on the Army's operational capability. In order to assess this impact, the Army Digitization Office in Kingston (ADOK) was created and given a broad mandate to help ensure these systems are smoothly integrated into the Canadian Army. Part of this mandate includes the development of appropriate and relevant tactics techniques and procedures (TTPs) to support the decision-action cycle. The TTPs were validated in user trials/experiments culminating in a one-week BG computer-assisted exercise (CAX) nicknamed Sleeping Tiger (AE6A) and a two-week Bde Gp CAX nicknamed Athene Warrior (AE6B).

In experiment AE6A, ModSAF was used to stimulate the SAS systems of the lower controllers who were all trained members of the battle group. Through the use of the Situational Awareness Tactical Internet Data Server (SATIDS), lower controllers were able to receive SAS inputs from their simulated combat teams in a manner very similar to what will be achieved during operations. In Army Experiment 6B, the Command and Staff Trainer (CAST) was used to simulate reporting of sub-unit locations (through the use of a software interface called VCCI) to be displayed on unit-level ATS systems as Consolidated Position Reports (CPRs), and for the detection of enemy units which were reported by e-mail and the use of ADatP3 message formats.

Data was passed through a Local Area Network with voice communications simulated through the ModIOS communications interface. Both experiments demonstrated that voice radio nets could then primarily be reserved for command purposes while data nets are primarily used for control purposes.

Four mechanisms were used to collect data: daily questionnaires provided players with the opportunity to comment on the day's activities; interviews with selected commanders provided an assessment of the value of the system for command and control; judgement and insight discussions allowed players and observers to reach consensus on problems and proposed changes; and observer data sheets provided an opportunity for everyone to comment on any aspect of the system, the TTPs, Personnel, Leadership, Organization, Training, Equipment and Doctrine (PLOTED) issues.

SAS was found more useful than ATS for maintaining up-to-date BLUE and RED SA. Users found that the full value of ATS at BG level cannot be determined until an interface between SAS and ATS has been developed. When the BG HQ had SAS and RED information was sent digitally, SAS provided an excellent current situation picture. When RED info was sent analogue, it was very difficult to maintain real-time RED SA. Since sub-units have SAS, BLUE SA is automatically sent through SAS. Furthermore, it is faster and more accurate to have RED contacts entered digitally at the lowest level than passing the information by voice with the possibility of transcription errors. One solution is to exploit laser technology to provide real time SA, by having lased contacts appear on the SAS screen and automatically processed to ATS. There is still a requirement to overcome the slow process of converting “voice to data”. One solution is to adopt user-friendly report templates (such as AE6A Contact Report employing ADatP3 messaging), but the optimum would be to move towards voice recognition technologies that would automatically convert voice messages to data.

ATS appears to be best employed as a planning tool. ATS is the more useful system for deliberate planning as the statistical tests show. If the technology works as planned, ATS is the preferred system due to the many functions not available in SAS. Course of Action (COA) analyses and wargames were found to be very useful in ATS, particularly with geomatics product interoperability, since it provides the flexibility to show each COA on a different overlay, icons can be moved easily, and ATS allows for discussion around large graphical displays. Detailed Graphical Orders are then easily developed from the COA analysis. ATS also allows for cooperative planning to produce an operations order, allowing several users to work on different paragraphs simultaneously. Since ATS is the main system used to communicate between battle group and brigade HQ, it seems to be the only choice for the receipt of orders from higher HQ.

ATS was found more useful in managing digital documents. The only capability that SAS provides is a message log similar to e-mail and a system log of the communications between SAS systems. ATS, however, has a much better information management structure with each user in a domain having his private workspace and able to publish overlays and folders to a public workspace. Users can subscribe to public overlays and thus get automatic updates when they are published. ATS also has a message log and provides an Electronic Document Manager function to manage all the electronic documents received in the system. [Roy et al, 2001]

2.8 *Army Experiment 7A: Electro-Optical Reconnaissance Surveillance And Target Acquisition (ERSTA) Employment In A Helicopter Reconnaissance Section*

The aim of this experiment was to determine whether a section of two reconnaissance helicopters requires one or both helicopters to be equipped with ERSTA mission kits in order to effectively conduct a reconnaissance mission and support the ISTAR process. This experiment employed a synthetic environment consisting of two virtual simulations of ERSTA-like equipped helicopters operating within a constructive simulation world. ModSAF and the Griffon/ERSTA Synthetic

Environment proved to be an excellent simulation for giving insight into employment Tactics, Techniques and Procedures (TTPs) for helicopter reconnaissance operations.

The experimentation indicated that a helicopter reconnaissance section equipped with two ERSTAs significantly improves 1) the number of ground target detections and 2) the rate of detections. It also reduces the number of misidentified targets since more than one viewing angle can be placed on the target. However, with stand-off distances and higher altitudes permitted with ERSTA, two ERSTAs may be detected more often. A helicopter section equipped with two ERSTAs also significantly improves the quantity and quality of situational awareness both at short and long range. This allowed both the helicopters and the ground reconnaissance troop to survive better since enemy vehicles were detected before coming into direct contact. There is also more confidence in the Common Operating Picture (COP) when two systems, not just one, are looking at the given area. [Chapman et al, 2001]

2.9 *Coalition Interoperability Demonstration BOREALIS*

The ABCA Armies Program is the organization developed over fifty years ago to discuss coalition interoperability issues originally between the American, British, and Canadian armies. The Australian Army is now also a full participant and the New Zealand Army has an observer role. The Program conducts a series of biennial exercises that address important areas of interoperability in the context of a coalition deployment. The most recent ABCA exercise – Coalition Interoperability Demonstration BOREALIS – was designed to conduct technical testing of the currently available communications and information systems that are deployed within the five armies. Within national armies, there is a well-recognized limitation of available bandwidth to carry command and control information. Within a coalition, the participating armies will come with a variety of equipment, doctrine, and procedures. These may induce interoperability problems not yet fully appreciated by those who address command and control problems only within a national framework.

BOREALIS, hosted by the Canadian Army in Kingston in June 2002, was an initiative to test and document the current capabilities and barriers in radio communications in the high frequency (HF), very high frequency (VHF), and ultra high frequency (UHF) components of the spectrum, and in area communications systems. Area communications systems provide higher bandwidth systems usually at the brigade headquarters level and higher.

The exercise brought together more than 400 soldiers and civilian technicians from the five armies for two weeks of intensive testing. Having determined those communications links that worked across national boundaries, these systems were then used to carry sample traffic. For example, the sample traffic included many of the message formats that have been developed to ensure that digital command and control systems, as nations continue to deploy them, will be able to pass the most critical and perishable data and information that commanders and their staffs need to conduct military operations.

The BOREALIS tests either proved that communications links worked as advertised, or that clever soldiers could make them work with minor adjustments in settings or procedures, or that the nations will need to address a list of changes, e.g., purchase new equipment, implement agreed protocols, or provide more training on the expected coalition environments.

3. **Command and Control Doctrine**

Command and command-support doctrine have stated in clear terms that the potential value of digitization lies in the realm of improved Situational Awareness (SA) and shared situational understanding, improved commanders' confidence and decision-making ability, and an opportunity to increase operational tempo among all levels of command. Improved Situational Awareness and shared situational understanding are achieved throughout a command and control system through the provision of timely, accurate and relevant information and knowledge according to the Commander's Critical Information Requirements (CCIRs).

Given the singular importance of CCIRs, Army Experiment 6 demonstrated that in answering CCIRs, three aspects of digitization warrant the most attention in terms of system and doctrinal development:

- Establishment and maintenance of a Common Operating Picture (COP) derived from BLUE SA (friendly units), RED SA (enemy units) and Brown SA (terrain, obstacles, routes, etc).
- The vital and inextricable link to intelligence and the ISTAR process, especially examining the functionality of an All Source Cell (ASC) and an ISTAR Coordination Centre.
- Establishment of efficient and relevant Information Management processes, procedures, and structures.

Command and control experimentation has provided valuable insight into the impact of digitization on the planning and execution of warfighting operations at the brigade group level. More importantly, it has established a baseline of understanding for the Army's combat development process and the issues and challenges in fielding and implementing the Land Forces Command and Control Information System (LFC2IS). [Bouayed et al, 2002]

4. **Development of an Army Experimentation Capability**

The evolution of the global and national security environment, coupled with resource constraints, has necessitated rapid change within the Canadian Army. In the past our approach has tended to be one of crisis management rather than a considered strategic approach oriented on a future vision. The Army senior leadership has recognized the need to change and has adopted a future focus. Development work in the Army is now divided into planning for the Armies of Today, Tomorrow, and the Future. Planning for 10 to 25 years in the future allows sufficient time to use the scientific method to arrive at an optimum solution to the Future Army's conceptual design. "Future Concepts" require a capability to experimentally test different concepts with simulations, war games and models. To support the Directorate of Land Strategic Concepts (DLSC) and the Directorate of Army Doctrine (DAD), the Army Experimentation Centre (AEC) was formed to develop, experiment with, and validate new and innovative concepts for the Future Army, such as the effect of battlefield digitization, future fire support or the use of non-lethal weapons. Through the use of simulations, war games, command post exercises (CPX) and field exercises, and the input of (simulated) intelligent C2 agents, the AEC assists in 1) doctrine development, through a process of developing and disseminating doctrine gathered from trials; 2) changes to operational structures, such as C2 or sensor management, through the linkage of tactical and operational level simulations; and 3) evaluating the effects of capability upgrades on equipment and software, through the analysis of the broader impacts on force operations resulting from materiel acquisitions and upgrades.

Over the past five years, the Army Experimentation Centre, consisting of a small core of professionals, has provided the Canadian Army with timely, credible, scientifically sound and accurate assessments on issues germane to combat development through the use of operationally valid modeling and simulation and state of the art technology. The process started with Stage 1, where experimentation was limited to the use of constructive simulation only (AE2, AE4, AE5). In Stage 2, actual operational systems (SAS and ATS) were stimulated by constructive simulation (AE6A, AE6B). Army Experimentation 7A achieved Stage 3 of our Experimentation Capability Development - Virtual simulation within a constructive simulation world. The LAV III instrumented field trial showed the benefits of live simulation on the evaluation of TTPs. Stage 4, the last and final stage of Experimentation Capability Development, will be to interface these Virtual, Constructive and Live simulations.

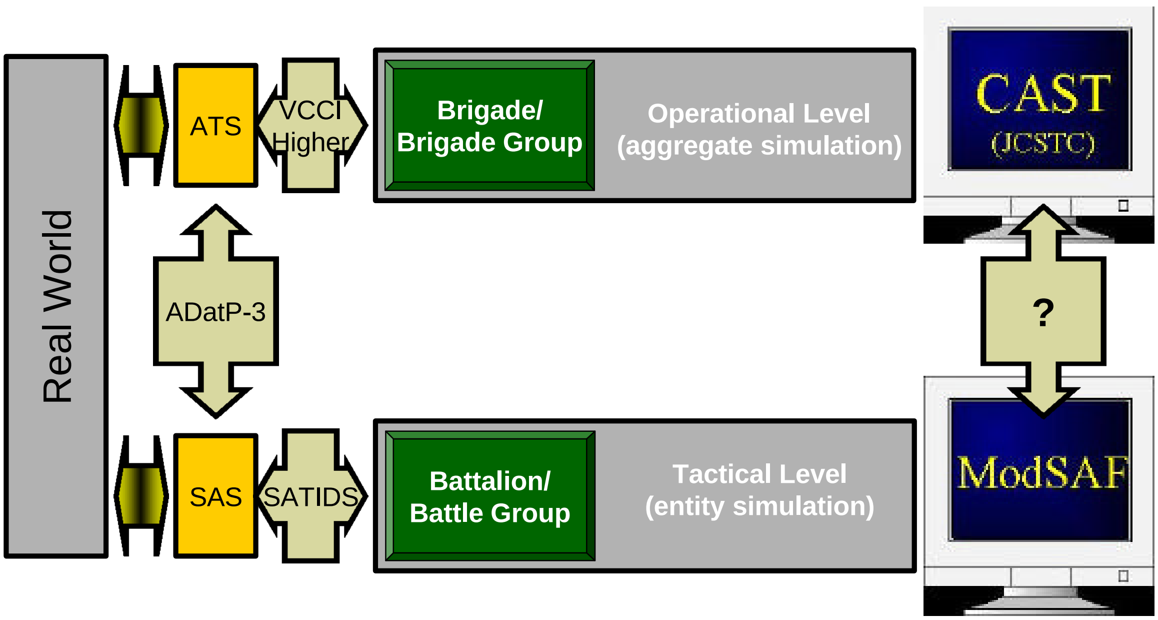

Figure 1: The Interactions between Simulations and Command Support Systems

The results of the various analytical activities are as diverse as the systems that were evaluated. Many of the results have spawned revisions or modifications of the respective systems' architectures. In other cases, the existing equipment designs were accepted, but procedural changes were made in how they were employed tactically. Some analysis has spawned activities in our R&D labs to find new and better ways to use these systems. And, as one might expect, in the nascent field of command and control analysis, most studies have spun off yet more studies.

6. **Conclusion**

For five years, the Canadian Army has developed and applied its own means to a sequence of experimental activities oriented around issues of command, command support, and sensor systems of various sorts. The Army has also been innovative in drawing in an ever-increasing network of resources to assist it to meet the many inherent challenges in this campaign. The Army contributes many of its own resources, most obviously the Army Experimentation Centre, but it also reaches out to the operational research community, to scientific personnel in research and development laboratories, and to many others inside and outside of Canada. On the Land Staff, the Directorate of Army Doctrine and the Directorate of Land Strategic Concepts are fundamental to the process. They provide guidance that to ensure that the experimental program will illuminate the appropriate path to the Future Army.

7. **References**

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