TASK ANALYSIS FOR COMMAND ON THE MOVE

by:

Harry Angel and Chris Ste-Croix

Human*Systems*® Incorporated
111 Farquhar Street
Guelph, ON N1H 3N4

Project Manager:

HSI® Project Manager: Harry Angel
(519) 836-5911

On Behalf of

Department of National Defence

As represented by

Defence Research and Development Canada – Toronto
1133 Sheppard Avenue West
Toronto, ON, M3K 2C9

Project Scientific Authority:

Dr. Justin Hollands

416-635-2073

March 2014

Author

Harry Angel
Human*Systems*® Incorporated

Approved by

Dr. Justin Hollands
Scientific Authority

Approved for release by

Name of Document Review Chair
Chair, Document Review and Library Committee

Abstract

Currently the Battle Group commander in the Canadian Army has very limited connectivity back to the main Command Post (CP) when they command from the Tactical Command Post (TAC CP). The Land Command Support System Life Extension (LCSS LE) project will provide on-the-move, high capacity, tactical, Beyond Line-Of Sight (BLOS) voice and data reach back for the tactical commander. Defence Research and Development Canada (DRDC) and the Canadian Army Land Warfare Center (CALWC) have undertaken the Unit Commander on the Move project with the purpose of discovering what tools/systems/capabilities best benefit a unit commander while on the move away from the main unit CP. A Goal Directed Task Analysis (GDTA) cognitive task analysis approach was utilized to collect information from 74 participants to identify what tools and capabilities should be provided in the LCSS-LE to help the BG commanding officer command more effectively. Participants from 1 Brigade, 3 Brigade, 5 Brigade and staff from the Canadian Army Command and Staff College (CACSC) participated in the GDTA. Based on preliminary research and information captured in the interviews it was determined that the BG CO had one major goal – Command and lead the Battle Group (BG). Four sub-goals of the GDTA were also identified: Protect the organization, Prepare the Battle Group for Operations, Accomplish the Mission, and Provide Motivation and Influence the Battle Group. The sub-goal of Accomplish the Mission was examined in detail. The SMEs identified the need to access capabilities currently found at the Main CP while on the move and the need to rapidly visualize and describe how they want their BG to exploit opportunities detected. This will require new digital communication channels, collaborative planning capabilities and novel visualization tools. There was universal consensus on the need for new collaborative planning and commander intent visualization tools as well as a new digital non-command net radio duplex voice communications channel. A number of other potential tools and capabilities were identified by the SMEs but the utility of these tools was challenged by some SMEs. The SMEs were distinctly worried about the potential workload implications of providing new tools in the TAC CP and the improper shift of the CO's attention from being the commander and leader to becoming a staff officer. Further studies are required to the assess the impact of the tools on the BG CO situational awareness, workload, and their ability to effectively and efficiently command while away from the Main CP and on the move.

This page intentionally left blank.

Executive Summary

Task Analysis for Command on the Move

Harry Angel and Chris Ste-Croix, Human*Systems*® Incorporated; March, 2014.

Mandate: This study was conducted between October 2013 and March 2014 on behalf of DRDC Toronto under PWGSC Contract No.W7711-088136/001/TOR; Task No.8136-51.

Purpose: The aim of this project was to conduct a cognitive task analysis (CTA), using the goal direct task analysis method, to investigate the unit commander's ability to command on the move. The outcome of this project was to identify potential tools and capabilities that would aid the unit commander's ability to command on the move.

Background: Existing Land Command Support System (LCSS) Command and Control (C2) applications (e.g., BattleView, Sensor Command and Control Planning Suite (SC2PS), Tactical Information Management System (TIMS)) were designed for the static Headquarters (HQ) context. The LCCS Life Extension (LCSS LE) project is intended to improve the exchange of information within CF vehicular fighting platforms. Currently, mounted commanders have limited connectivity between their vehicles and static HQs, or various sensor or intelligence services.

Battle Group (BG) Commanders are typically the Commanding officers (CO) of infantry and armour Battalions and Regiments. The BG COs preference is to command and lead from the point where they can best influence and best visualize the battlefield. Theoretically, this should at the point of the main effort. However, due to the lack of connectivity that the BG CO has while on the move, the best place to influence the battle has recently been at the Main Command Post (CP) with the digital capabilities provided by the LCSS.

Defence Research and Development Canada (DRDC) and the Canadian Army Land Warfare Center (CALWC) has undertaken a Command on the Move project with the purpose of discovering what tools/systems/capabilities best benefit a unit commander while on the move (in the Tactical Command Post (TAC CP) and away from the Main CP).

Method: A Goal Directed Task Analysis (GDTA) was utilized to collect information from the subject matter experts (SMEs). Prior to the start of the GDTA the tasks and issues surrounding TAC CPs and activities embedded in main HQ CPs were investigated using relevant documents and Canadian Armed Forces (CAF) manuals. A World Wide Web and internal Human*Systems*® Incorporated search was conducted to identify recent and pertinent research. One of the outcomes of this research was to identify the potential major goals and first and second sub-goals of the BG CO at the TAC CP prior to the start of the interviews. A challenging scenario was drafted to guide the SMEs during the interview process.

Once the initial goal hierarchy was established, interviews with 64 SMEs were conducted at Canadian Forces Base (CFB) Edmonton, CFB Valcartier, and CFB Petawawa. Commanding Officers and staff officers who had served in HQs served as the Subject Matter Experts (SMEs). Most interviews were conducted in pairs with the draft hierarchy serving as a tool for the interview sessions. Each interview session lasted two hours. Two Human Factors (HF) consultants were present at each interview with one leading the interview and the other one taking notes. During the formal interview SMEs were asked whether the goal hierarchy captures all the relevant goals. Depending on the time available specific goals were selected for further investigation (sub-goals, decisions required, Situational

Awareness (SA) requirements, etc.). A series of probes were developed and used to determine SA requirements and how SMEs would want that capability delivered in a command post on the move.

The GDTA was analysed and restructured on a continuous basis. Information captured was organized by goals, cues, desired format, SA level, etc. A GDTA table was developed that examines the decisions made, the information needs, and the desired presentation form / tools for a command post on-the-move. This final goal hierarchy was validated by 10 SMEs at the Canadian Army Command and Staff College (CACSC).

Main Results: Based on preliminary research and information captured in the interviews it was determined that the BG CO had four major goals while commanding and leading their troops. The major goals included *Protect the organization, Prepare the Battle Group for Operations, Accomplish the Mission, and Provide Motivation and Influence the Battle Group.* During a battle the BG CO may be focused on different goals and sub-goals. A number of the major goals are independent of the location of the BG CO and thus not relevant to the project at hand.

The SMEs reported that the role of the CO was to command and lead the BG and that the provision of new tools and capabilities must assist the commander in commanding more effectively; the new tools should not relocate the tasks done at the Main CP into the TAC CP. The staff at the Main CP, help the CO manage the operations of the BG and provide the CO with information and analyzed products. Shifting workload onto the CO does not allow them the time to properly understand the operational environments and problems faced, visualize the desired end state and operational approach, describe the commander's visualization in time, space, purpose and resources, and direct forces and warfighting functions throughout the preparation and execution of missions.

The results of the interviews identified two potential tools (a tablet device and digital voice communication channels) with various capabilities that would aid the battle group commander in commanding and leading his troops more efficiently and effectively while they are on the move in the TAC CP.

Main Conclusions: Currently, the BG CO has very limited access to digital information while commanding in the TAC CP; the BG CO only has access to physical maps, manually updated traces and the Command Net Radio (CNR). Once the BG CO leaves the Main CP, the maintenance of the CO's understanding of the Common Operating Picture (COP) is challenging and labour intensive. While there is a relatively modest size of staff at the BG Main CP, the size of the staff is significantly smaller in the TAC CP. The size of the staff found in BG and higher formation headquarters increased dramatically while Canada had troops deployed in Afghanistan. This has led to the establishment of permanent HQs which while appropriate for COIN operations may not be suitable for conventional warfighting. The SMEs identified the need to access capabilities currently found at the Main CP while on the move. The SMEs identified the need to rapidly understand, visualize and describe how they want their BG to exploit opportunities detected. This will require new communication channels, collaborative planning capabilities and novel visualization tools. The SMEs envisioned tools and processes that will help the BG CO command more effectively but at the same time make the Main CP more effective in supporting the CO when they are in the TAC CP.

A large number of potential tools and capabilities were identified by the SMEs. The utility or desirability of providing a number of tools was not universally accepted. The design philosophy of providing everything, if possible, and having the user turn off capabilities was challenged by a large number of SMEs. The SMEs were distinctly worried about the workload and proper focus of the CO. After conducting interviews with over 70 past, current, or future BG COs two separate tools were universally identified that could aid the BG CO in commanding and leading their BG while in the TAC CP. One of the tools identified was a portable tablet device that would have a screen size the

same as most current tablet devices (i.e. 9" – 10") and the system would have a satellite connectivity capability. The second tool that was unanimously selected by the SMEs was the provision of a non-CNR voice and data communication channel.

Future Direction: Results of this study identified a number of potential tools that could aid the BG CO in commanding and leading their troops more effectively while they are away from the Main CP. Both the preliminary need and utility of the tools need to be validated and verified. Given periods of bandwidth degradation, the tools to be retained need to be prioritized.   The capabilities within each of these tools were not as clearly defined and there was no consensus on the amount of data that should be sent to the BG CO from the Main CP or the level of collaboration needed to support the BG CO.

Therefore, further studies need to be conducted the assess the impact these tools with various capabilities have on the BG CO situational awareness, workload, and their ability to effectively and efficiently command while away from the Main CP and on the move.

This page intentionally left blank.

Table of Contents

List of Figures

List of Tables

1. Background

The Land Command Support System Life Extension (LCSS LE) project is intended to improve the exchange of information among CF vehicular fighting platforms. Currently, mounted commanders have limited connectivity between their vehicles and static Headquarters (HQs), or various sensor or intelligence services.

LCSS LE will improve the availability of information on LCSS through multiple capabilities, including tactical vehicle network modernization and support to battle command on the move. LCSS LE will provide on-the-move, high capacity, tactical, Beyond Line-Of Sight (BLOS) voice and data reach back for the tactical commander. The Battle Group (BG) Commander in a vehicle will have access to a range of command and control applications through a high bandwidth "pipe" anywhere on the battlefield.

Existing LCSS Command and Control (C2) applications (e.g., BattleView, Sensor Command and Control Planning Suite (SC2PS), Tactical Information Management System (TIMS)) were designed for the static HQ context - see Figure 1 for a screen shot of the BattleView application.
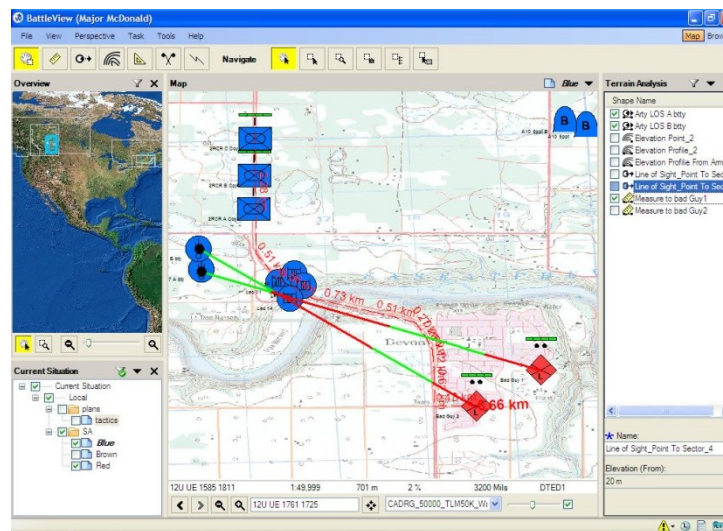
Figure 1: BattleView screen shot (from www.thalesgroup.com/canada/)

The Canadian Army is also in the process of fielding the Tactical Battle Management System (TBMS) at the Combat Team level and below. TBMS will provide touch enabled displays, near real-time position updates, and base map data. TBMS will be deployed in vehicles – see Figure 2. At present, it is not known whether TBMS will fill the needs of the BG CO operating from the TAC CP.

Figure 2: TBMS screen shot (from www.thalesgroup.com/canada/

As mentioned earlier the LCSS-LE Satellite communication On-The-Move (SOTM) capability will be made available on a number of army tactical vehicles that should improve the sharing of intelligence, surveillance, and reconnaissance information throughout the battlespace, suitable for a BG CO while on-the-move. The vehicles outfitted with the SOTM capability are expected to automatically relay battle management information to distant headquarters, Command Posts or deployed elements (Public Works and Government Services Canada, 2013). While a new SOTM capability is forecasted, the size of the "pipe" and what is being sent in the pipe is not defined. Identifying what information, how it will be presented and to whom is the focus of this study

Battle Group Commanding Officer's prefer to fight battles with significant numbers of troops in contact from the point where they can best influence and visualize the battlefield. Theoretically, this should be at the point of the main effort but due to the lack of digital capability of the BG CO in the TAC CP the best place to influence the battle is currently at the Main Command Post (CP). During Adaptive Dispersed Operations (ADO) which, Canada faced in Afghanistan, a tremendous amount of data and information flowed to the Main CP. The nature of this mission resulted in the construction of a permanent HQ and a significant build-up of staff. The BG CO could effectively monitor a number of minor operations from the Main CP given the number of assets available and staff to support the control functions. For major operations the CO would leave the Main CP and would command from the TAC CP. It was at this point that the "digital divide" became apparent and the CF used a variety of methods to keep the commander in the picture. If the point of most influence on the battlefield is at the point of the enemy main effort then there is a need to transfer information from the Main CP to the TAC CP.

A tactical command and control system should facilitate the BG COs ability to perform his job while on the move. According to US Army doctrine, a TAC CP does not share the same primary functions as a Main CP. The TAC CP performs functions such as synchronizing the battle, conducting the deep battle, and planning future battles (Taylor, 1988). Due to the reduced size in personnel at the TAC CP compared to the Main CP, the reduced connectivity, and the need to stay mobile the focus of the TAC CP is reduced. The primary function of the CP is conducting the close-in battle (Taylor, 1988). Monitoring the deep and rear battles and planning for future battles are secondary functions of the TAC CP. Even though the scope of activity of the TAC CP is reduced, a number of command functions remain. The TAC CP does not replace the Main CP, it needs to rely on the Main CP for planning, detailed analysis, and coordination functions. The BG CO operates out of the TAC CP

while away from the Main CP and interactions between the CO and staff that occurred in the Main CP must be facilitated in the TAC CP.

The data, information, knowledge, wisdom hierarchy (Figure 3) can be used as a schematic to explain the potential options of data transfer from the Main CP to the TAC CP. The TAC CP could be an extension of the Main CP and share all of the same information or it could involve a subset of the Main CP where only certain capabilities are retained. One option is that all of the *data* that is available at the Main CP be transferred to the TAC CP without further analysis. Another option is that just *information* (e.g. a message created at the main from the data intended to change the TAC CP's perception) is sent to the TAC CP. In this case the raw data needs to be analysed to some degree at the Main CP. Another option is to send *knowledge* to the TAC CP, the data into some context of the overall situation, and finally the Main CP can just send *wisdom* to the TAC CP as a collection of knowledge across the entire battlefield. These options slice the hierarchy transversely at different levels with all information from the CP being passed to the TAC CP with varying levels of analysis.

Another option of data transfer between the Main CP and the TAC CP is to selectively choose what information is passed on. Therefore, instead of sending all of the information to the TAC CP with varying levels of analysis you can send a small sample of the information (raw data) to the TAC CP while the rest of the data remains at the Main CP.

Lastly a hybrid approach of data transfer between the Main CP and the TAC CP can be employed. This means that some of the data will be analyzed prior to being sent to the TAC CP with some other data being transferred to the TAC CP in the raw format for analysis by the BG CO. To this point little analysis has been conducted to determine the requirements of the BG CO while he is on the move.

Figure 3: Data, Information, Knowledge, Wisdom Hierarchy

DRDC Toronto and the CALWC has undertaken the Unit Commander on the Move (UCOTM) project with the purpose of how best to make the commander more effective while on the move (mounted in the vehicle and away from the Main CP). Information captured in the first phase of the project will be verified and validated in a future series of experiments using the Conceptual Vehicle Testbed (CVTB) at Kingston, ON.

1.1 Aim

The aim of this phase of the project was to conduct a cognitive task analysis (CTA) to investigate the unit commander's ability to command on the move. The outcome will lead to an understanding of user needs, the missions, functions, and tasks performed by the unit commander, and the associated workload and implications for situation awareness. Based on interviews with representative commanders, this project will identify potential tools/systems/capabilities thought to benefit a BG CO while on the move.

1.2 Tasks

The following tasks, taken directly from the Statement of Work (SOW), were performed:

- Become familiar with the Unit Commander's roles and tasks through a review of Army Doctrine and Capability Development documentation, provided by the Technical Authority (TA), including but not limited to: (a) Land Operations 2021: Adaptive Dispersed Operations – The Force Employment Concept for Canada's Army of Tomorrow (b) DRDC CORA TM 2009-003 Bounding the Force Employment Concept (c) LCSS LE Statement of Operational Requirements; (c) B-GL-300-001-FP-001-Land Operations; (d) B-GL-300-003-FP-001 Command in Land Operations; (e) B-GL-331-001-FP-001-Command Support Operations; (f) B-GL-331-002-FP-001-Staff Duties for Land Operations; (g) Army 2021 Scenario.
- Conduct interviews with subject matter experts (SMEs) for knowledge elicitation purposes.
- Based on the results from the literature review and SME interviews, conduct a Cognitive Task Analysis and summarize in a written report.

2. Methods

2.1 General Overview

To accomplish this tasking, a Goal Directed Task Analysis (GDTA) was utilized to collect the required information from the participants. Prior to the start of the GDTA the tasks and issues surrounding TAC CPs and activities embedded in main headquarters command posts were investigated using relevant documents and CF manuals. A World Wide Web (WWW) and internal search was conducted to identify recent and pertinent research. One of the outcomes of this research was to identify the potential major goals and first and second sub-goals of the Battle Group (BG) Commanders (COs) TAC CP prior to the interviews. We shall refer to this outcome as the *goal hierarchy*.

A scenario was drafted to help orient the SMEs into a combat mindset while taking part in the interviews (see section 2.3).The initial set of goals and scenarios were validated by the project team prior to the start of the GDTA.

Once the initial goal hierarchy was verified by the project team, interviews were conducted at Canadian Forces Base (CFB) Edmonton, CFB Valcartier, and CFB Petawawa with COs and HQ staff who served as the subject matter experts (SMEs). For the most part interviews were conducted with pairs of SMEs. The draft hierarchy served as a tool for the interview sessions. Each interview session lasted a total of two hours. Two Human Factors (HF) consultants were present at each interview with one leading the interview and the other one taking notes. At the onset of the interview SMEs completed the informed consent form, as well as, a personal information form. During the formal interview SMEs were asked whether the goal hierarchy captured all the relevant goals. Depending on the time available specific goals were selected for further investigation (sub-goals, decisions required, situational awareness (SA) requirements, etc.). A series of probes was used to determine SA requirements and how SMEs would want that capability delivered in a command post on the move. At the end of end of each interview session each SME completed a command style questionnaire where SMEs subjectively rated across 13 different command traits. Interview sessions were recorded as a back up to the simultaneous note taking. The recordings were referenced if any notes needed clarification. SME ideas were noted on white boards and black boards by the interviewers. SMEs were also encouraged to utilized the white and black boards to illustrate their ideas. The notes captured on the white boards and black boards were captured as well. Information from 64 participants was captured during this effort.

At the end of each day the interview team collated and compared notes. Missing data or areas requiring further investigation were identified for investigation in subsequent interviews. After each series of interviews (Edmonton, Valcartier, and Petawawa) the GDTA was restructured to reflect the results of the interviews. The results of the GDTA were validated in a final session at CFB Kingston with 10 more SMEs.

The GDTA was revised on a continuous basis. Information captured was organized by goals, cues, desired format, SA level, etc. A GDTA table was developed that examines the decisions made, the information needs, and the desired presentation form / tools for a command post on-the-move.

2.2   Goal Directed Task Analysis

A GDTA focuses not only on determining a list of data needed by the user but also identifies how the data are used to form the user's situational awareness (SA) of the job (in this case the battlefield) (Jones and Endsley, 2005). The GDTA is based on creating a hierarchy of goals and sub-goals the user must accomplish, the decisions they must make to accomplish these goals, and the information required to make these decisions.

The GDTA has three main components; goals, decisions, and SA requirements (Jones and Endsley, 2005). Typical levels of goals associated with the GDTA include: the overall goal, the main goals (required to accomplish the overall goal), and the sub-goals associated with each main goal. In our analysis of the Unit Commander-on-the-Move (UCOTM) a number of associated sub-goals have been identified for specific sub-goals. An example of the goal hierarchy of the GDTA is shown in Figure 4. Since the goal of this project was to identify what tools/systems/capabilities best benefit a unit commander while on the move, the GDTA documents the information required for the SMEs to complete their job and how they can integrate all of the information entering the TAC CP (Jones and Endsley, 2005).
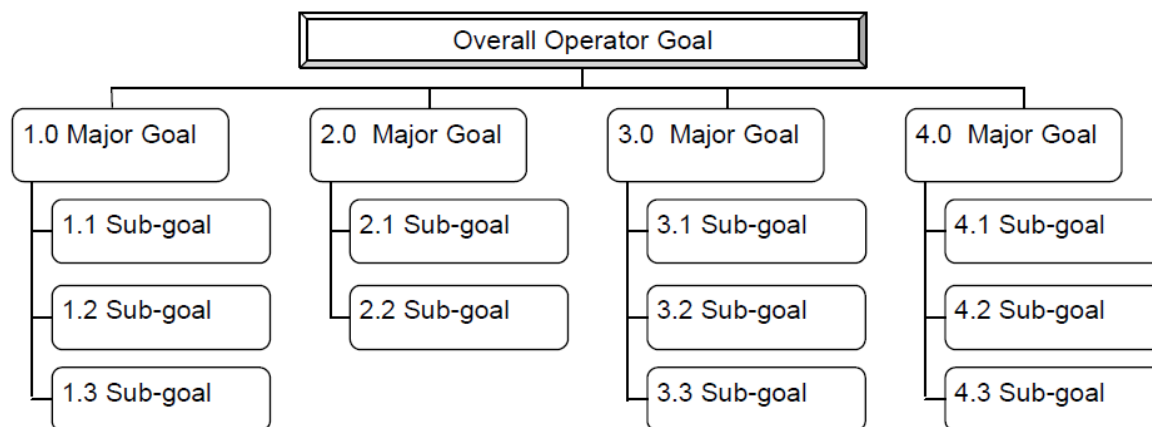
Figure 4: GDTA goal hierarchy

GDTA identifies goals to be achieved without implying any temporal relationship between goals or supporting activities. This feature of GDTA caused some problems for participants as they were all well versed in the Canadian Operational Planning Process (OPP) (CFJP 5.0, 2008) with its detailed steps in how to conduct operations. The OPP is a problem solving process but does not reflect what the commander is doing before or after the OPP is complete. It was only when the participants were asked what did they did in their TAC CP that commander goals were elicited.

A review of the GDTA process suggested a variety of approaches by authors differentiating goals and sub-goals. The paucity of available examples suggested that there appears to be some "art" in differentiating goals and that SME identification of their goals and sub-goals was valid if the results supported the intent of the study. One concrete example of goals for commanders is detailed in McDermott and Allender (2010), which examined the development of a tool to support military transition teams.

CDR goals	Ops officer goals	Intel officer goals
Empower IA to maximize operation success	Improve counterpart competence and host nation independence	Mitigate knowledge gaps and provide intel structure for MiTT and Iraqi
Ensure operation readiness	Ensure operation within established MiTT parameters	Sustain intel acquisition, usage and security
Support training programs development and enforcement	Foster counterpart S3 training and professional development	Develop and evaluate training programs
Ensure proper communications are established	Ensure effective communication flow	Sustain intel acquisitions, processing, distribution and security
Foster relationship with Iraqi counterpart	Foster positive Iraqi-US relations	Foster Iraqi relationships
Ensure BN continuity	Promote continuity	Ensure continuity
Promote local stability	Ensure insurgents do not impede IA development	Collect and disseminate intel to promote Iraqi stability
Adopt culturally sensitive leadership style	Operate effectively with cultural differences	Account for cultural differences

Figure 5: GDTA assessment of commander goals to support military transition teams (from McDermott and Allender, 2010)

Some GDTAs have been developed for the military but they are specific to a phase of war – see Figure 6.
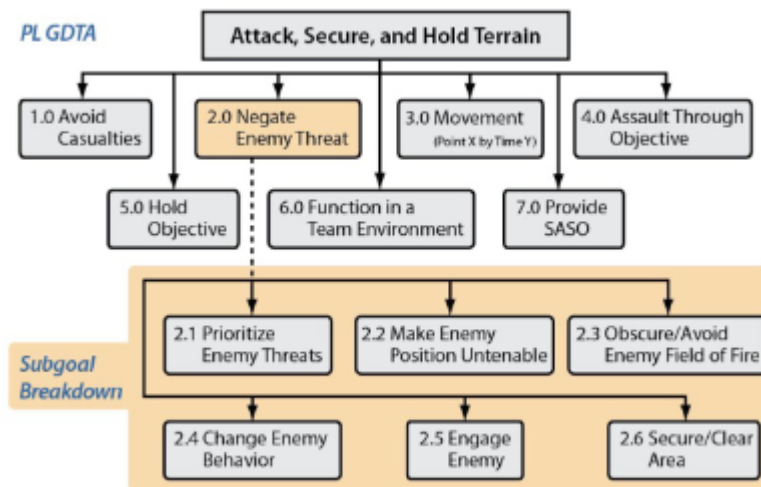
Figure 6: Platoon leader GDTA (from Jones, Connors, Mossey, et al. 2010)

The literature review failed to identify any relevant GDTA at the BG commander level. It is unknown how much of this information is transferable to the BG commander.

2.3   Scenario Overview and Development

A scenario was developed in order to orient the SMEs to an operational context where they could visualize the goals they would typically have while being a commander on-the-move. The scenario was

atypical of situations that have been prevalent over the last decade of operations in Afghanistan and was meant to represent more traditional/conventional warfare and adaptive dispersed operations (ADO). Each SME was given a brief background on the area of operations (AO) which included the following:

- Non-linear, non-contiguous battlespace,
- Region is an unstable failed nation,
- Major drug cartel operating with sophisticated weaponry,
- As BG CO you are on-the-move visiting combat teams,
- Majority of infrastructure has been damaged,
- Battle group radius of 80km,
- Sub-units dispersed at cardinal points of AO,
- Adaptive Dispersed Operations (ADO),and
- AO divided between stability and security operations.

Following the initial briefing the HF consultant described the scenario to the SMEs as follows (visual depiction of the battlespace is seen in Figure 7):

'*As part of a larger coalition force Canada has deployed a BG in Sector West. Sector E is manned by a mechanized battalion from an allied country. The BG has been divided the AO into sectors – N, S, E, and W. The following tasks are given to the combat teams in each sector: AO N – prevent infiltration/incursion of regular forces from the N, stop the guerilla raids, and clear insurgents; AO S – stop movement of drugs along river corridor, stop guerilla raids, and clear insurgents; AO E – protect hydroelectric dam, stop guerilla raids, prevent infiltration/incursion of regular forces from the N, and clear insurgents; and AO W – stop guerilla raids, clear insurgents, and protect trans-national railway line.*'
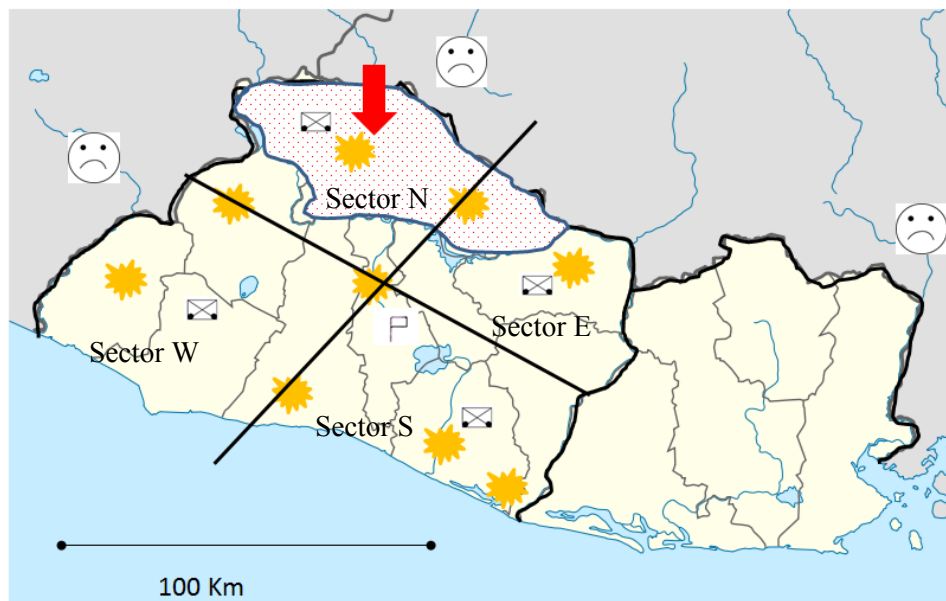
Figure 7: Graphical representation of the scenario battlefield

The SMEs were given access to any asset they could wish – Unmanned Aerial vehicles, Naval Gunfire, Air assets, Rocket launcher systems, etc. The SMEs were told not to disagree with the details of the scenario.

The scenario began with the overall Task Force Commander requesting the physical presence of the Canadian BG CO at a meeting at the border between the two Task Force BGs. The BG CO had to move by vehicle due to threats by insurgents and the imposition of a no-fly zone. Once at the meeting the Task Force Commander gave the following information:

'I have just received a FLASH message from UN HQ:

*Situation : The nation to the north has given the UN 48 hours to withdraw its forces from the contested province. The Nation to the north intends to assault and take the area by force.*

Higher UN Intent: The UN will protect the sovereignty and borders of this nation by all means necessary.

Task Force Commander Orders: The Canadian BG will defend this nation's sovereignty and defeat any enemy incursion.'

After each SME was presented with an overview of the battlespace and the AO they were told that while on-the-move the BG CO tried to return the Main CP but the bridges back to the Main CP were destroyed. Therefore, the BG CO could not physically make it back to the Main CP and would have to command the BG while on-the-move for a period of 48 to 72 hours. The following constraints were then given to the SMEs:

- They could not fly back to the Main CP,
- The TAC CP could execute long halts,
- The TAC CP had to remain mobile, i.e. it could not contain everything found in the Main CP,
- No physical access to the BG HQ but the TAC CP could collate with combat team HQs, and
- Access to new Satellite on-the-move capabilities.

After the SMEs were presented with the scenario they were queried on what their goals would be while trying to command on-the-move and what would their information requirements be for achieving their goals. This was the starting point for the interview process.

2.4 Participants and Schedule

A total of 74 SMEs were recruited from the LF, with members from 1, 2, and 5 Canadian Mechanized Brigade Group (CMBG) and the Command and Staff College. Sixteen SMEs were from 1CMBG, 23 were from 2CMBG, 25 were from 5 CMBG, and 10 were from the Command and Staff College in Kingston, ON. There were a total of 69 males and five females that took in the study. The SMEs were composed of 69 officers (2 Colonel, 21 Lieutenant Colonels, 43 Majors, and 4 Captains) and 5 senior non-commissioned officers (2 Warrant Officers and 3 Master Warrant Officers). The mean age of the SMEs was 38.7 years (SD=5.7, max=51, min=29). The mean length of service in the regular forces for the participants was 17.7 years (SD=5.8, max=31, min=4). All participants had operational experience including experience working at the battle group headquarters or battle group command experience.

Each SME completed a questionnaire on command style. There were a total of 13 different command traits that the SMEs evaluated themselves on. Each trait was evaluated using a 7 point bipolar scale. The results of the questionnaire are shown in Figure 8. For the majority of the traits the mean values were around the mid-point of the scale (4). The SMEs rated themselves as more mission command oriented, adaptive, and proactive. For the vast majority of the traits there was equal representation of ratings on either side of the mid-point suggesting no clear consensus of command style across the SMEs.
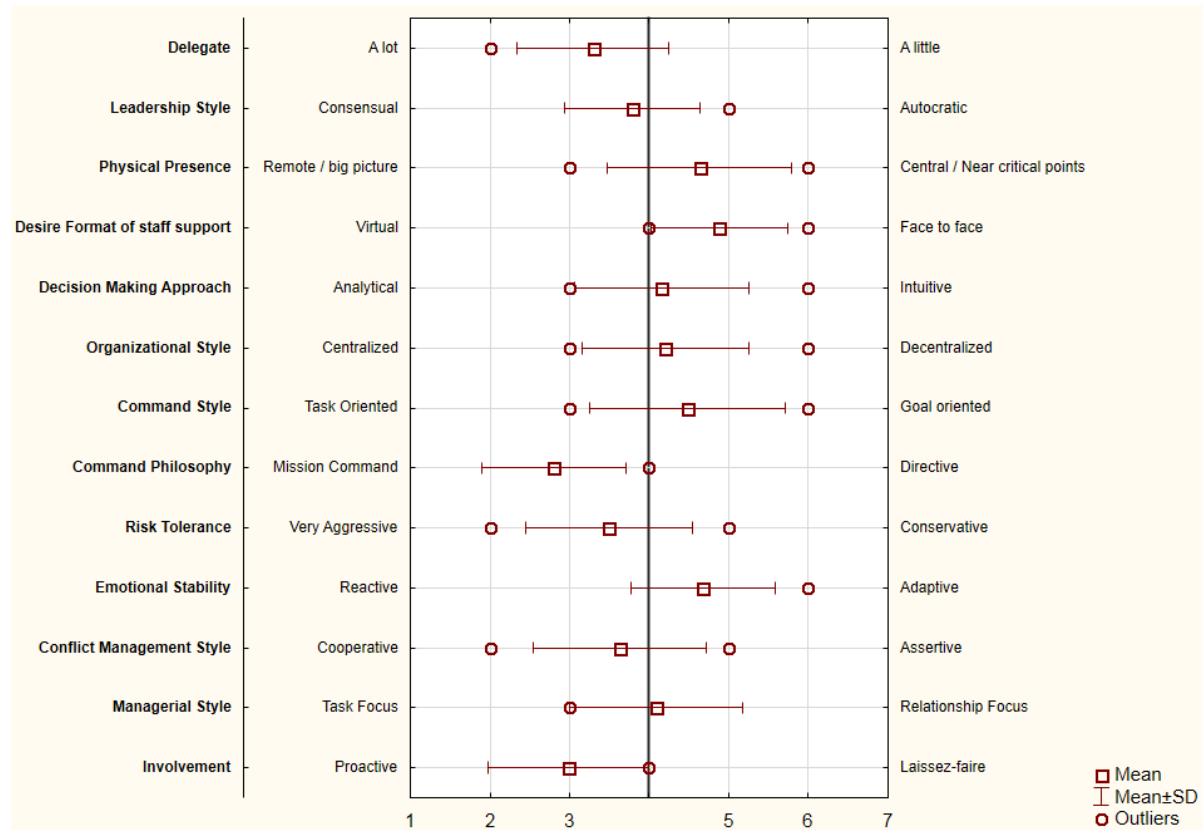
Figure 8: Command style ratings

The SMEs reported their command style as not static, i.e. it changes as the situation dictates. When working with new staff or new combat team commanders the CO may be more authoritarian and "hands on" than when working with a well-known, capable and trusted subordinate. For the most part the SMEs believed that they delegated duties to their staff and instilled a collaborative planning philosophy. The SMEs strongly believed in leading from the front and using face-to-face meetings whenever possible. The SMEs reported a balanced decision making approach, analytical when possible and intuitive when required. The majority of the SMEs reported that they were more goal-oriented in their command style but some SMEs noted that they had to be task oriented at times. Universally the SMEs followed the Mission Command approach. On average the SMEs believed they were more aggressive than passive.

The ratings suggest the need to support collaborative planning, adaptive planning, a balance between analytical and intuitive decision making, and the need to support the CO as they move to the critical point of the battle. Aggressive commanders must be equipped with the ability to quickly react to unforeseen enemy activities that could use their tactics against them. Any tool or capability that is chosen to aid the commander on-the-move needs to accommodate this set of command styles.

3. Results

3.1 Overview of a Main CP and TAC CP

This section will provide a brief overview of the elements and personnel of a BG's Main CP and TAC CP. More detailed results of the differences in the functions conducted at the Main CP and the TAC CP will be described in later sections when those functions are explained in more detail.

The Main CP is where all the critical information of the battle is collected, collated, assessed, and analyzed. According to Sajo (1988), the Main CP primary functions include synchronizing the entire battle, conducting the deep battle, and planning the future battle. This forces the Main CP to include a number of different staff to achieve these functions. Currently, Main CPs for a Canadian Army Battle Group (BG) may include the following staff:

- Commanding Officer,
- Regimental Sergeant Major,
- Deputy Commanding Officer,
- Operations Officer,
- Intelligence Officer,
- Duty Officer,
- Senior Duty Officer,
- Engineering Support Coordination Centre,
- Fire Support Coordination Centre,
- Signals Officer,
- Intelligence, Surveillance, Target Acquisition, and Reconnaissance staff,
- Airspace Coordination Centre,
- Liaison Officers,
- Legal Officers (rarely),
- Civil-Military Coordination staff (rarely), and
- Signalers.

The TAC CP primary function is to conduct the close-in battle while the secondary functions include planning for the future battle, and monitoring the deep (tactical level of war taken by tactical units) and rear battles (consists of actions behind the front lines typically performed by the support units) (Sajo, 1988). The TAC CP of a BG contains significantly fewer personnel than the Main CP. Personnel found in the TAC CP include the following:

- Commanding Officer,
- Regimental Sergeant Major,
- the Officer-in-Charge (OC) of the Engineer Squadron with vehicle crew,
- Artillery Battalion OC, with vehicle crew.
- Battle Adjutant or duty officer, and
- Signalers.

The number of vehicles found in the TAC CP is not standardized across the Canadian Army. Some units reallocate a LAV III for the RSM's use while in other units the RSM travels in the CO's vehicle. The vehicles used or may be used in the TAC CP vary considerably:

- Leopard II,
- LAV III,
- TAPV,
- Bison C3I, and
- LUVW G-Wagon

The SMEs did not support the fielding specialized TAC CP vehicles that were noticeably different from the vehicles in their BG. The tools and capabilities proposed for the Unit Commander on-the-move (UCOM) should be vehicle agnostic, i.e. the systems should be able to be used in a variety of platforms. The SMEs from the Light Infantry Battalions and a number of all arms advisors identified the need for portability with the potential tool. Frequently the CO and his advisor party will dismount and move across the battlefield on foot. Therefore, the BG CO should have a digital link to the vehicle. A number of SMEs questioned whether a commander should crew command, fight their vehicle, and command the BG at the same time. SMEs specifically questioned the effectiveness of having the CO command from a Leopard II tank.

The TAC CP usually consists of four vehicles to remain agile and to have a vehicle signature similar to mechanized platoons. There are instances where the TAC CP can increase to five or six vehicles if the CO decides that a force protection element or another element should be attached to the TAC CP. Each of the major elements of the TAC CP travel in their own vehicle with their own vehicle crew, including signal personnel who track information being passed over Combat Net Radio (CNR). When required advisors in the other vehicles of the TAC CP will dismount and join the BG CO in the back of the BG COs vehicle. The SMEs also noted occasions where the all arms advisors may not travel with the CO and thus used the CNR to maintain contact.

Over the last 10 years in Afghanistan the size of the BG Main CP has grown. In COIN operations, like Afghanistan, there is a significant amount of data that is collected and analyzed; therefore the number of personnel associated with the Main CP needs to be large to accommodate the influx of data. Multiple SMEs stated a preference for being present at the place that would best influence the battle. Typically, this is outside of the Main CP and at the point of main effort with their combat teams. However, due to the large amounts of information collected and analyzed back at the Main CP and the number of personnel at the main the best place to influence the battle may be back at the Main CP. One SME indicated that as the Army moves away from COIN operations and conducts more conventional operations the size of the Main CP should decrease. The SMEs reported that the CPs must become smaller and more mobile to defeat a more conventional threat.

A key difference between the Main CP and the TAC CP is that at the TAC CP there is a digital divide with the Main CP. At the BG level Main CP and higher there is the digital tactical command and control system known as the LCSS which is used for command and control functions. However, while the CO is on the move in the TAC CP, and at the combat team level and below there is no such system. In this case the only connectivity the CO has back to the Main CP is through CNR. Therefore, as information flows from the brigade level to the battle group CO in the TAC CP the information must be converted from a digital signal to analog (i.e. map). This is usually conducted by the transfer of the digital information via CNR to the signaller in the back of the COs vehicle where they plot the information onto a map using markers or grease pencils. When the CO is located at the Main CP no such conversion needs to take place as the LCSS is present at the Main CP. However, the Main CP still needs to convert this information to an analog signal in order to pass it down to the combat team level.

3.2 Overview of the Role of the Commander

The Canadian Army utilizes the concept of mission command where command is based on local initiative within the framework of command intent (Stewart, 2006). The fundamentals of mission command are described in CFP 300-003 (2007) as being:

- Unity of effort,
- Decentralized authority,
- Trust,
- Mutual understanding, and
- Timely and effective decision-making.

CFP 300-003 (2007) describes the decision-action cycle where a commander strives to complete their decision-action cycle faster than their opponents. The decision-action cycle includes consideration, decision (and planning), execution and direction processes. US Army doctrine (ADRP 5-0, 2012) uses a more linear process but one with multiple feedback loops at every process – see Figure 9. Commanders must understand the situation so that they can make decisions on how best to resolve the problem. The BG staff is tasked with providing timely information to the commander. Once the commander understands the problem space they must begin to visualize the desired end state and how the problem can be solved. If time permits the commander then describes the approach to their staff. Commanders describe their intent, critical information needs and planning guidance. BG staff use this information to begin developing plans to achieve the commander's goals. If time is too short commanders specify the approach and staff simply assist with coordinating instructions. Once the plan is developed and orders are given, the commander supervises the execution of the mission.
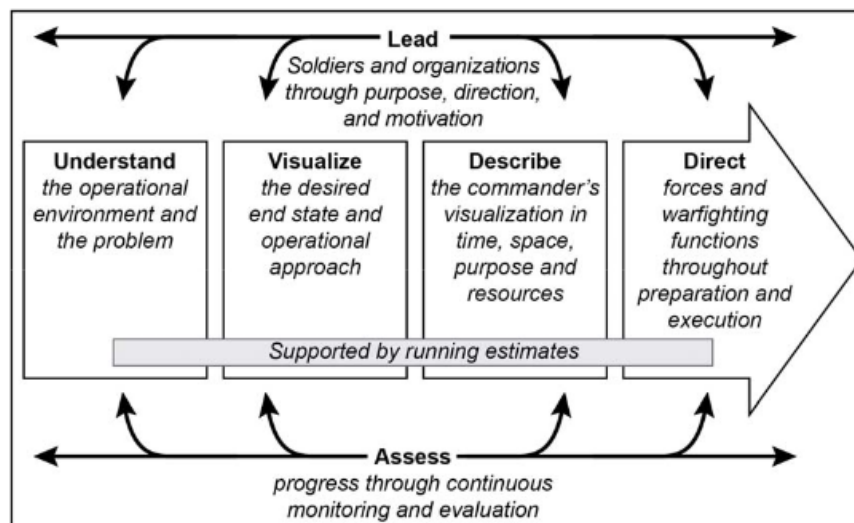
Figure 9: The commander's role in the operations process (from ADRP 5-0, 2012: pg 1-3)

Throughout the operations process, commanders must lead and assess. Besides accomplishing the mission, commanders also have other responsibilities as a leader. FM 6-22 (2006) examines the duties and responsibilities of leaders in detail. A number of common leadership goals include:

- Protect the organization,
- Loyalty,

- Build trust,
- Prepare their BG for operations,
- Develop team work,
- Develop staff,
- Encourages initiative,
- Motivate and influence the soldiers under their command,
- Enforce standards,
- Lead by example,
- Communicate,
- Balance mission and the welfare of the soldiers,
- Take care of soldiers, and
- Adapt to changes.

These leadership goals are universal in nature and are present whether the commander is in the TAC CP or in the Main CP.

3.3 Overview of the GDTA Hierarchy Developed

A Goal Directed Task Analysis approach was used to elicit information from the SMEs on the goals and information requirements of the BG CO while they were away from the Main CP, traveling in their TAC CP. Knowing the goals and information requirements for the BG CO while on the move allowed the exploration of potential tools and capabilities that would allow the commander to perform their normal duties while outside the Main CP.

The GDTA began with a literature review of command and leadership goals with a focus on operations in the TAC CP. Main goals included protecting the organization, preparing the BG for operations, accomplishing the mission, and providing motivation and personally influencing the BG – see Figure 10.

Figure 10: Overview of commander goals

The goal of *Accomplishing the Mission* was germane to this study and likely the mos relevant to operations in the TAC CP and thus investigated in detail.

At CFB Edmonton the structure of the GDTA *Accomplish the Mission* goal hierarchy was developed and then refined with the SMEs from CFB Valcartier, CFB Petawawa, and members of the Command and Staff College in Kingston. The SMEs suggested the following goals and tasks for the *Accomplish the Mission* major goal:

- Command/ Influence the battle,
- Lead,
- Shield,
- Prepare,
- Manage staff,
- Sense making/make sense of the situation,

- Get a picture,
- Master the context,
- Understand the problem,
- Anticipate need,
- Assess,
- Monitoring changes,
- Communicate,
- Access maps/traces,
- Decision making/Direct,
- Provide direction/guidance,
- Commanders intent,
- Intuitive/recognition primed,
- Planning /Provide planning direction,
- Collaboration with advisors and staff,
- Mission analysis,
- Prepare and deliver orders,
- Rehearse plan,
- Execution,
- Synchronization,
- Monitor battlespace geometry,
- Dynamic re-adjustments,
- Fight,
- Shield subordinates from information overload,
- Assess and analyze,
- Playback/identify lessons learned,
- Perform After Action Reviews (AAR), and
- Learn from operations.

Note – some of these goals are similar to the higher level goals but are under different contexts at this level.

It was determined that regardless of whether the BG CO was located at the Main CP or in the TAC CP the *raison d'etre* of the CO was commanding and leading their troops. Interviewees quickly discriminated between staff functions who manage and help control the BG from command which is the lawful authority vested in the BG CO. The major sub-goals for the *Accomplish the Mission* goal of the BG CO in the TAC CP were distilled to the following: (Figure 11).

- Build, Maintain and Manage the Commander's Operating Picture,
- Develop Plans to Effectively Execute the Mission(s),
- Communicate: Receive and Forward Information, Provide Direction and Decisions and,
- Effectively Execute Mission(s).

Figure 11: Overview of the GDTA

These goals are continuous and can occur simultaneously over the course of a battle. Throughout a battle the BG CO may be addressing sub-goals of each of these major goals. Each of these main goals has a number of sub-goals associated with them. In order for the BG CO to achieve these goals there are a number of decisions that need to be made based on information requirements that the BG CO needs. These sub-goals, decisions, and information requirements will be discussed in more detail in later sections. In some cases the decisions and information required are identical across a number of sub-goals. If this is the case, the decisions and information required will be explained once at the earlier goal and then referenced in later goals.

When each major goal and sub-goal are introduced the differences between what is done at the Main CP and what is done at the TAC CP will be examined. Additionally, the information required to support these goals will be stated, as well as, the communication links as to how this information is currently passed. Finally, after each major goal and sub-goal is explained a list of potential tools that would aid the BG CO achieve these goals while away from the Main CP will be provided.

3.4 Build, Maintain and Manage the Commander's Operating Picture

One of the major goals identified by the SMEs was *Building, Maintaining and Managing the Commander's Operating Picture*. This is the need of the commander to make sense of the situation. The Commander's Operating Picture is distinct from the Common Operating Picture (COP) which is a product of the Main BG CP. Based on their intuition, unique experience and understanding of the battlefield, commanders may have a different mental model of events in their Area of Operations (AO) than their staffs. Common Operating Pictures (COP) are compiled and promulgated by the Main CP daily if not more often. One SME reported that based on his experience a new COP is produced twice daily. The need to rationalize the commanders operating picture with the staff's COP when the CO is remote from the Main CP will be seen as an important sub-goal in the section that follows.

The sub-goals identified under the main goal *Building, Maintaining and Managing the Commander's Operating Picture* were: *Acquire knowledge of the operational environment and situation, Monitor area of operations and identify changes to the situation, Assess the impact of changes in AO, and Manage the information received from all sources*– see Figure 12. Each sub-goal will be described in detail in the following sections.
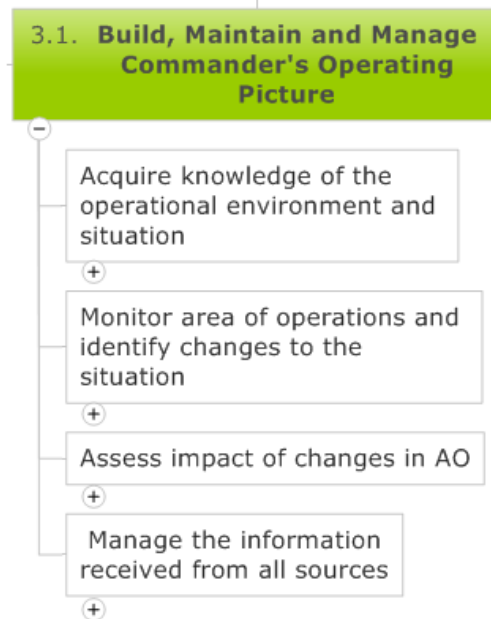
Figure 12: Building, Maintaining and Managing the Commander's Operating Picture branch of the GDTA Hierarchy

3.4.1 Acquire knowledge of the operational environment and situation

SMEs identified three sub-goals of *Acquire knowledge of the operational environment and situation*, these included:

- Master the mission context,
- Build/receive a picture of the situation, and
- Receive information/knowledge generated by staff, the BG or other assets.

SMEs identified the need to understand the mission context when discussing goals. They noted that prior to deployment considerable effort is expended getting themselves and the BG familiar with the battlespace. When the SMEs were presented the scenario a common question was raised among the SMEs, 'What is the problem? What is my mission? What is the context in which the BG was deployed?' In order to understand the problem, in the context of understanding the entire battle field, SMEs indicated that they need to receive higher's intent and the overall mission intent. This allows the CO to identify the overall goal of the mission and thus select the best course of action/ activities for the BG. Currently the intent of the Brigade Commander is passed through communication channels to the Operations Officer (Ops O) and then relayed to the BG CO. When the BG CO is away from the Main CP and in the TAC CP this transfer of information is still the same but instead of the Ops O verbally communicating the message in person it is passed over the CNR. A number of SMEs indicated that they would prefer to have a direct channel to the brigade while they are in the TAC CP and not have to wait for information to be passed through the Main CP. The SMEs did note the use of Satellite phones in Afghanistan. Ideally future UCOM would have this as an integral capability.

Participants noted that they have to build or receive a picture of situation. Typically this is through the use of geo-referenced data. Currently staff in the TAC CP perform this task manually on a map board while the CO keeps his own map up to date as much as possible. If the CO leaves the TAC CP

(for meetings, etc…) they have to quickly gain an understanding of the disposition of forces and what has happened in their absence when they return. The desire for automatic updates and a portable device that displays force dispositions and other information was desired by the participants. The need for portability was recognized as being essential for COs of light Infantry Battalions and all-arms advisors. SMEs identified the need to have maps available at different levels of detail – 1:10,000 to 1:100,000, etc. The participants noted that a current issue with the in-service BattleView system is that when moving between different map resolutions the maps physically change. The SMEs identified the need to seamlessly move through different map resolutions.

Another means of building the commander's operating picture was through the use of reports and returns. SMEs indicated that they receive Commander Update Briefs (CUBs), Battle Update Briefings (BUBs), Situation Reports (SITREPS), Consolidated SITREPS as well as receiving adhoc products developed by the staff. Currently, CUBs and BUBs are presented each day. The major difference between the two is that when a CO is present it is considered a CUB and when he is not present it is a BUB. The Ops O builds the CUB at the Main CP with inputs from the staff and the combat teams. The purpose of the CUB is to inform the CO on high priority information requiring immediate attention, complex information, and information requiring elaboration and explanation. Typically CUBs summarize the tactical situation over a period of time. CUB briefings could be oral or more frequently they involve the use of power point slides. Depending on the CO the sequence of speakers at the CUB could be the Int O, Ops O, personnel officer, Log O and Plans O. The CO usually is an active participant in the CUB. The CUB provides the CO a venue for asking further information and allows the CO to focus staff attention at issues of concern. While the CO is on the move all of this information is given by voice over CNR via SITREPS and consolidated SITREPs. Currently, the CUB provides the most up-to-date common operating picture (COP). The CUB is also presented to the Deputy Commanding Officer (DCO) at the Main CP while the BG CO is in the TAC CP listening via CNR. Staff create and participate in BUBs throughout the day (three times per day) at which time their overlay traces are updated. The SMEs suggested that another potential means of receiving information from the CUB while on the move would be over the use of digital radio so they are not using the CNR over a long period of time. Some other SMEs suggested that the CNR would be best communication source because it is all informed and the information presented at the CUB / BUB should be heard by everybody. The UCOM system needs to have the ability to send and receive overlays, as well as handle power point slides and other products of the Main CP.

Another source of knowledge acquisition of the operational environment and situation is through the use of imagery, e.g. pictures and Unmanned Aerial Vehicle (UAV) video footage. The BG CO has a number of assets at their disposal (i.e. UAVs and recce platoons) that are capable of collecting live video footage of the battlefield. One option is to send all of the raw video footage to the BG CO while in the TAC CP. This would have to be presented on a screen within the BG COs vehicle. An alternative option is that all the raw video footage is sent back to the Main CP where it is processed and analyzed. Then only relevant information from the videos that meet the BG COs Commander's Critical Information Requirements (CCIRs) are then forwarded to the TAC CP for the BG CO to view. The majority of the BG COs suggested that they did not need to view the raw real-time video imagery. Some of the SMEs were familiar with the Sensor Command and Control Planning Suite (SC2PS) which is a real-time, multi-sensor application to exploit data from UAVs. SC2PS displays images caught in the UAV's camera and a moving map display showing the location of the asset – see Figure 13. A few SMEs identified the utility of being able to have access to S2CPS.

Figure 13: Sensor Command and Control Planning Suite (SC2PS)

A majority of SMEs expressed concern over the BG CO viewing real-time imagery, as the fear is that they will be focused on the current battle instead of focusing on the planning for the next battle. Instead of real-time imagery the BG COs suggested the capability of viewing near real-time imagery that has already been analyzed by the staff back at the Main CP. Regardless, if the BG CO views real-time imagery or near real-time imagery the TAC CP requires an UCOM input of video feeds and a platform to view it on. Similarly the BG CO needs the ability to view pictures and other still images at the TAC CP.

A few SMEs noted the desire to access the ORION wiki database while in the TAC CP. Access to the database could be of benefit during peace support and COIN operations, for example accessing pictures of local mayors or police chiefs before entering into a negotiation, accessing background information on local problems, retrieving notes on previous incidents, etc. The SMEs noted that maintaining the ORION database was a challenge and that the information in the database grew over the course of the 12 year mission in Afghanistan. The SMEs noted that it was probably acceptable to take a copy of the database with them as they left the Main CP rather than always using the bandwidth to keep the database live. Another approach explored was simply querying the database held in the Main CP. A few SMEs expressed the desire to access the internet while in the TAC CP. One SME reported that it was quicker for him to do the research on a technical issue then having the request be processed through the Main CP. The use of accessing the insecure WWW was a concern to the users. In addition to accessing database information, the SMEs noted that they also had to add their own notes and comments to databases, e.g. add notes after a "Shura" (consultation or meeting with Afghan locals). The future UCOM system should have a capability to access a wiki-like database.

3.4.2 Monitor area of operations and identify changes to the situation

During the course of the battle the BG CO must continuously monitor their area of operations (AO) and the battlespace geometry of their subunits including the lines of exploitation, phase lines, objectives, battle positions, control measures, forward lines, thrust lines, etc. Activities in the BG AO are reported using CNR, using SITREPs, Contact Reports, etc. At present, changes in disposition are noted on map boards. When the BG CO is in the TAC CP this information is given over CNR from the Main CP and then updated on a physical map by the staff in the TAC CP (signallers, Battle Adjutant, etc.). The CO monitors not only friendly forces but also enemy, other coalition allies,

civilians, etc. The BG CO also monitors the terrain, mobility and weather factors that affect operations in the AO. SMEs demanded Situational Awareness (SA) on their own troops (Blue SA), the enemy troops (Red SA), the ground (Brown SA), Coalition Forces (Green SA), and SA on local communities and leaders (White SA). Each SA will be described in more detail below:

Blue SA: Currently the BG CO gets updated on the location and actions of their own troops through a CUB when at the Main CP or through a consolidated SITREP while they are in the TAC CP. When in the TAC CP the information is provided by the Ops O at the main via CNR where the TAC CP staff plots the locations on a map. The BG CO is also briefed, via the Ops O, on the potential availability of certain assets (i.e. air support) from the Fire Support Coordination Centre (FSCC). All SMEs were asked what information on the Blue SA they would like access to while in the TAC CP. The vast majority of the SMEs suggested they would like information on the centre of mass location of the sub-sub unit level (2 levels down (platoon level)) so that they can order the sub-unit. The SMEs also wanted to see the certain recce detachments and Special Forces units operating in their AO.

There was some discrepancy amongst the SMEs on whether information down to the section and soldier should be made available to the BG CO. Some SMEs were concerned that it is not the job of the BG CO to command down to the section level. However, the majority of the SMEs indicated that this information should be made available to the BG CO. One format of presenting this information to the BG CO was in the form of tablet device where a geo-referenced map provides the locations of the centre of mass of the sections. The BG CO will then be able to aggregate and de-aggregate these sections by hovering over the centre of mass icon. This will allow the BG CO to access certain information that they feel is necessary at certain instances without the information being constantly present. A number of SMEs indicated that other than the location of their own troops they would also like to know the combat status, combat effectiveness, gun state, and ammunition state of the sections. This information is relevant to the BG CO because not only are they thinking of this battle but they are preparing for the next battle. Theoretically, this information would be presented to the BG CO through the consolidated SITREP but some SMEs indicated that it would be ideal if this information was presented with the centre of mass icon on the tablet where they can click and access the information. One possible way of presenting this information is using a stop light system where green indicates good-to-go, yellow indicates caution, and red indicates a no go. Some SMEs suggested that this information could be included as the BG COs CCIRs, or Essential Information on Friendly Forces (EIFF) and they would be notified by the Ops O when certain thresholds are crossed (i.e. section running out of 7.62 mm ammunition). The SMEs identified the need for the automatic updating of blue force position data (blue force tracking). The rate at which position data should be updated was not explored.

Red SA: One of the main questions the BG CO needs to answer is what is the enemy doing? What is their intent? And what are their most likely and most dangerous courses of action? In order to answer these questions the BG CO needs to be presented with the most up-to-date information on the enemy. When the BG CO is at the Main CP the Intelligence Officer (Int O) provides the intelligence summary to the BG CO which contains all of the enemy information. This is presented on a PowerPoint slide which includes maps and text. This intelligence summary is collated from information from the recce detachments, contact reports, and reports from brigade or higher HQs. When the BG CO is in the TAC CP this information is passed over CNR from the Int O to the CO, battle adjutant or TAC CP staff which travels with the BG CO. This information is then plotted on a map and presented to the BG CO.

Each group of SMEs were asked what type of information they would like to be given on the red SA and how they would like this information presented. The majority of SMEs indicated that they would like to know the strength, location, equipment, thrust lines, most likely and most dangerous routes and actions, and the intentions of the enemy. Most SMEs agreed that this information should be processed and analyzed at the Main CP and then sent to the TAC CP but still give the BG CO the opportunity to access the raw information (i.e. each contact report). A number of SMEs indicated that while in the TAC CP they would like to receive two updates from the Main CP on the enemy. One of these updates would be a trace of each of the confirmed contacts with the enemy while the second update would be a trace that had the main analysis. The BG CO is then able to compare his analysis on the detailed contact reports with the Main CP analysis and discuss with the Int O, the Ops O, the DCO, and the engineer and gunner elements.

Similar to the Blue SA the SMEs suggested receiving the Red SA in the form of traces viewed on a tablet device where the BG CO can view the information on a map and aggregate and de-aggregate the information available. SMEs also suggested the ability to turn on and turn off traces from the map as means of reducing clutter. The SMEs reported that updates to the red trace should be automatic.

**Brown SA**: An important element that all BG COs would like to know is information about the ground and terrain. The Engineer staff performs the terrain analysis and provide the information to the BG CO. At the Main CP this is given to the BG CO during the CUB while at the TAC CP it is given to the BG CO over CNR via the engineer element of the TAC CP. The majority of SMEs indicated that they did not need the raw terrain data and only need to know the analyzed data (i.e. safe mobility routes).

The majority of SMEs indicated that the Brown SA should be presented to the BG CO at the TAC CP via a trace viewable on a tablet. The SMEs mentioned that they don't need real time updated information of the Brown SA but only changes to the Brown SA or any show stoppers to the battle. One of the suggestions from a SME was that the changes to the Brown SA could be over a CHAT function that would cue the BG CO to look at the trace on the tablet to view the changes. Other capabilities that the SMEs would like for the Brown SA are the ability to zoom in and zoom out, the ability to perform a 3D terrain analysis (virtual recce) of the land, and an automated Features, Lanes, Objectives, Canalizing Terrain, Avenues of Approach, Rating of Approaches, Key Terrain / Vital ground (FLOCARK).

**White SA**: An important aspect to COIN operations is the information on the communities and the key leaders of these communities. Currently, this information is updated by the All Source Information Centre (ASIC) through a searchable wiki based tool named ORION. The BG CO has access to all this information if they have connectivity to the software. At the Main CP the BG CO also gets brief update on the white SA during the CUB from the Civil-Military Coordination (CIMIC) staff. While in the TAC CP many SMEs indicated that the BG CO studies this information prior to leaving the main. If the BG CO requires more information while in the TAC CP they would use CNR to call back to the Main CP to request additional information.

The SMEs presented a couple of different options of presenting the white SA to the BG CO while they are in the TAC CP. One option is that all of the white SA would be made available to the BG CO through a wiki type database application that is accessed via their tablet device. Another option is that the when the BG CO leaves the Main CP they bring an updated external hard drive that contains all of the white SA data. The benefit of this option is that is

doesn't use up any bandwidth, however, it is not updated in real time. For each of these options the SMEs indicated that they would like access to information of key leaders and key infrastructure that is geo-referenced. Similar to the Blue SA and the Red SA, the SMEs indicated that they would like a map background where they would then hover over an entity (i.e. village) and a pop-up would appear where the BG CO can then click on it to extract the information. There were a number of SMEs that indicated that the BG CO does not need to access any white SA while they are in the TAC CP because they would already have gotten this information prior to leaving the Main CP.

Green SA: Currently the Green SA (knowledge of other coalition forces, national police elements, etc.) is collated from one Main CP communicating with another Main CP or by briefings from liaison officers. This information is then presented to the BG CO either through a CUB or via CNR if they are in a TAC CP. Similar to the other SA, the SMEs indicated that they would prefer the Green SA to be analyzed at the Main CP with an updated Green SA trace sent to them on their tablet.

In addition to monitoring the BG's AO SMEs also identified the need to be alerted to changes in the situation. Currently only CNR is used to alert the entire BG for major changes or activities. The SMEs reported that they focused their attention on the situation when Troops in Contact (TICs), Improvised Explosive Device (IED) reports or Casualty Evacuations (CASEVACs) verbal reports were sent over CNR. BG COs are alerted to changes in the situation by the staff at the Main CP through the use of SITREPS and Warning Orders. Given that a CO may not always be listening to the CNR, alternate means of cuing the CO are needed.

3.4.3   Assess the Impact of Changes in the AO

SMEs reported that they had to understand how changes in the situation impacted their mission(s). SMEs identified four sub-goals of *Assess the Impact of Changes in the AO*. These include:

- Comprehend changes,
- Project changes due to activities and environment,
- Assess threats, and
- Identify the need to adjust the mission or BG tasks.

The BG CO and advisors in the TAC CP must analyze and judge the information received to comprehend its meaning and understand its potential impact on operations. Participants reported that staff at the Main CP may not have the experience or up to date knowledge to accurately interpret what the enemy is actually doing or intending to do and that the CO by virtue of his experience, training and battlefield knowledge is in the best position to fully comprehend what is happening on the battlefield.

The CO and the all arms advisors in the TAC CP must project what is happening in the battlefield to identify challenges and opportunities. By getting inside the decision – action loop of the enemy, the CO can adjust the battle plan to exploit the changes in the situation. The scenario employed in this task analysis utilized the notion of blown bridges to prevent the CO from returning to the Main CP. Knowledge of the ground and changes to the mobility trace will help the CO to project probable friendly and enemy movements. Knowledge of the enemy's doctrine will help the CO identify probable objectives and enemy tactics. While dealing with known enemy forces is challenging, locating and estimating what the follow-on enemy forces are doing is more challenging. Staff will support the CO's analysis of the situation by forwarding assessments of imminent and emerging threats. The presence of civilian non-combatants is another factor with which the CO must contend

with. In the scenario the enemy forces are invading the country and civilian refugees may be clogging roads, bridges, etc. hampering the BG's movements. The presence of cultural buildings, schools, hospitals, religious temples, etc. will affect the CO's ability to freely target enemy forces.

The SMEs noted that a number of tools could assist them while they were analyzing the situation. A Features, Lanes, Objectives, Canalizing ground, Approaches, Rate, and Key terrain and vital ground (FLOCARK) tool could help the CO quickly assess the ground (terrain analysis) and coupled with enemy doctrine could help identify probable axes of advance. FLOCARK assessments are performed manually and currently are a product of the Main CP or the Engineer advisor at the TAC CP. A few SMEs identified the potential use of 3D maps to help visualize the battlefield; conversely other SMEs reported that CO's were well versed in comprehending contour lines and the band width required for 3D maps did not justify their use. CO's must estimate the impact of time and space on operations. At the Main CP staff will analyse how long it will take a unit to move to a different location using movement tables. The CO's identified the utility of a quick movement estimation tool akin to civilian GPS systems which estimate how long it will take to get to a targeted location.

Based on the scenario presented, once the CO has analyzed the information they must determine if the fight they are currently facing is the main enemy effort or if it is just a diversionary effort. Once the CO has assessed the situation he must confirm or adjust the BG's mission and tasks.

3.4.4   Manage the Information Received

One of the recurring themes in this study was the desire of SMEs to manage what and how information should be received in the TAC CP. The SMEs strongly noted that even with the provision of new digital capabilities, the TAC CP was not a replacement of the Main CP. The Main CP generates, collects, processes and analyzes data as well as disseminating information products. Information overload was a significant concern to all SMEs. SMEs identified three sub-goals of *Manage the information received from all sources*, these included:

- Filter information received and forwarded to others,
- Selectively attend to critical information, and
- Relay the commander's view of the operational picture.

One responsibility of the BG CO is to determine relevant information for combat sub-units? The BG CO needs to shield the sub-units from information that is irrelevant for their roles. In order to achieve this goal the BG CO needs access to the current COP and then decide which information is passed along to the sub-units and also to clarify conflicting information. The SMEs did mention that a possible tool would be a separate communication channel other than CNR to communicate with the brigade and the Main CP that would not be all informed to the combat teams. This way not all information would be passed along to the combat teams and the BG CO would only pass along relevant information.

In order to maintain situational awareness, the CO in the TAC CP must have access to the information available at the Main CP and the ability to monitor information of their choice. Depending on the situation or phase of battle the CO may wish to monitor changes in the Blue SA, while in other phases the CO may want to review and analyze products forwarded by their staffs. The SMEs frequently discussed the notion of trace management – turning on and off Brown, Red, Green, White and Blue traces. As described above in Section 3.4.2, the SMEs reported that they want the ability to aggregate and de-aggregate the details to reduce clutter. Display clutter was a common concern of the SMEs.

Once the CO has analyzed the information they must relay their view of what is happening on the battlefield to their staff. Currently the CO uses the CNR to relay the interpretation of the situation. The SMEs reported a need for a digital voice and collaboration tool having both voice and visual capabilities. While voice is a powerful communication tool, pictures can more easily and quickly represent complex information. A visual representation allows others to see the complex relationships amongst sub-units, commander's intent, etc. When presented with different possibilities for a collaboration tool, the SMEs supported a more sophisticated approach but only if the bandwidth permitted. This collaboration tool could include the following capabilities:

- Voice over Internet Protocol (VoIP) communications,
- Screen sharing,
- Web cameras for participants,
- Video,
- Remote pointer/ drawing control,
- Public chat,
- Private chat,
- Whiteboard,
- Drawing functions,
- Sharing documents, and
- Recording meetings.

The SMEs noted that the collaboration tools need to be validated to determine utility and to determine essential features.

3.4.5   Build, Maintain, and Manage Commander's Operating Picture Capabilities

The SMEs proposed a number of tools and capabilities that would improve their ability to make sense of the battle and monitor their area of operations. The tool / capabilities are presented below in no particular order:

- Digital communication (Voice Over Internet Protocol (VoIP) back to brigade,
- Digital collaboration tool,
- Tablet Device with map background and zoom / pan functionality,
- Common maps and the ability to selectively change resolution,
- Blue PA/SA updated automatically,
- Geo-referenced traces of the Blue, Red, Brown, Green, and White SA,
- Ability to receive and view staff products,
- Ability to turn on and turn off traces,
- Ability to aggregate and de-aggregate information,
- Searchable wiki based program for White SA,
- Virtual 3D terrain recce capability,
- Automated movement time estimator, and
- Automated FLOCARK.

3.5   Develop Plans to Effectively Execute Mission(s)

One of the major goals identified by the SMEs was *Develop Plans to Effectively Execute Mission(s)*. The BG CO is in charge of the planning process of the battle group. Many steps in the planning process are time and personality driven. The sub-goals identified under the main goal *Develop Plans*

were: *Conduct Mission Analysis, Prepare Plans, and Prepare Orders*– see Figure 14. Each sub-goal will be described in detail in the following sections.
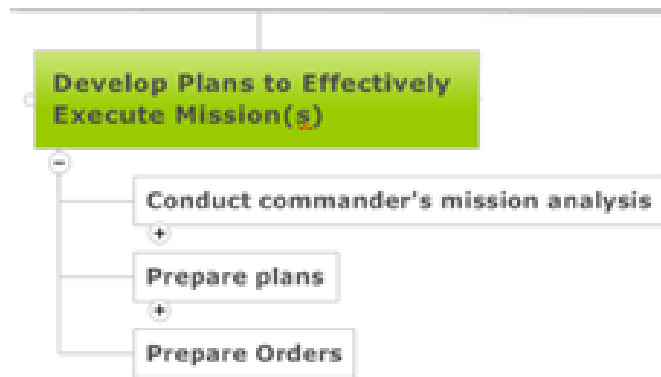

Figure 14: Develop Plans branch of the GDTA hierarchy

3.5.1   Conduct Commander's Mission Analysis and Planning Guidance

Prior to providing their planning guidance the BG CO must conduct a mission analysis. The mission analysis is the first step in the planning process. SMEs identified four sub-goals of *Conduct Commander's Mission Analysis*, these included:

- Receive or assume mission or task,
- Conduct mission analysis,
- Visualize the end state, nature and design of the operation to accomplish the mission, and
- Prepare commander's planning guidance.

CO's will either receive a mission from their higher HQs or assume a mission based on their interpretation of the situation. In the TAC CP, the CNR is currently the main means of receiving orders from the Main CP. The SMEs noted that COs had other communication channels back to higher Headquarters during operations in Afghanistan. The SMEs noted that having another non-CNR duplex digital communication channel is required. This system will allow the CO and the Main CP to receive orders and associated information products needed for preliminary planning from higher levels. When the CO assumes a mission or a change from a current operation he must inform his own staff and higher headquarters.

In the Main CP the BG CO along with the DCO, the RSM and Ops O will conduct the mission analysis with input from the artillery and engineering staff advisors. Mission analysis has two main objectives: determine the nature of the problem, and confirm the results to be achieved. Mission analysis begins with understanding the purpose of the mission and understanding the superior commander's intent (if the mission was received). In order for the mission analysis to achieve goals dictated, the BG CO and the command staff must be provided with information critical to the mission at hand. This information includes the current combat effectiveness and location of their own forces, understanding of the adversary (red SA), terrain analysis, time and space, etc. Staff accesses the information as they conduct the mission analysis. Rather than reviewing all of the information available, the CO focuses on factors that critically affect the mission. A number of SMEs reported that they did their own preliminary mission analysis before involving others, while other SMEs

reported that they worked collaboratively with their advisors, (i.e. the Engineer advisor concentrated on analyzing terrain factors, the artillery advisor assessing fire support options). SMEs reported that currently the CO and the TAC CP advisors co-locate in the CO's vehicle to conduct the collaborative mission analysis when away from the Main HQ. One SME noted that while this is possible in a permissive environment it may not be advisable when fighting a near peer threat with indirect fire capabilities (i.e. stay under armour and not leave their vehicle to travel to the CO's vehicle). The SMEs reported the fielding of a collaboration tool and a digital duplex conferencing tool would greatly assist mission analysis and preliminary planning at the TAC CP.

The BG CO conducts the mission analysis based on the latest COP they have and what they are seeing on the ground. Therefore, the BG CO needs to be presented with the latest up-to-date COP that the Main CP can provide. The majority of the SMEs suggested that the BG CO would need a tablet like device that can provide the current COP on a map. The SMEs also suggested a separate voice channel back to the main that is not CNR to transfer the mission analysis.

Mission analysis results in a gross overview of how the CO intends to fight the battle. At the Main CP this picture is frequently a hand drawn sketch on butcher paper with accompanying instructions. SMEs reported that a digital drawing/collaboration tool will allow the CO to visually communicate his mission intent while remote from the Main CP. The mission intent statement provided to the staff includes the following information (Department of National Defence, 2007):

- Who (what types of forces) will execute the action?
- What type of action (for example, attack, defend) is contemplated?
- When will the action begin?
- Where will the action occur (area of operations and objectives)? and,
- Why (for what purpose) will each force conduct its part of the operation?

Before any planning process takes place and before an operation is started the BG CO will provide planning guidance to orient the staff. This is frequently done after the BG CO conducts his mission analysis. Currently in the Main CP the BG CO gives his planning guidance to Ops O, Planning Officer (Plans O), DCO, Gunner CO, Engineer CO, Int O, Senior Duty Officer (SDO), and Duty Officer (DO) by sketching and tracing on a map board. The BG CO planning guidance usually contains:

- the commander's mission analysis,
- the commander's mission statement and intent,
- confirmation of the Area of Operations, Area of Influence and Area of Interest,
- the commander's critical information requirements,
- direction on COA development,
- latest date/time for issuing the Ops O, and
- other information as required (such as the strategic command and control relationship).

The BG CO gives their intent and the Ops O delegates the roles of the staff based on the needs and requirements of the plan (i.e. develop courses of action). The guidance provides updated direction and enables both the sub-unit commanders and staff to begin their preliminary preparations (Department of National Defence, 2007). Concurrently, the BG CO will issue warning orders to the sub-unit commanders, via CNR, so that they can initiate their preparations. If the sub-unit commanders foresee any potential issues with the warning orders they will radio back to the Main CP and notify the Ops O who will try to resolve the issue. If the issue cannot be resolved by the Ops O then the BG CO is notified. There are times when the BG CO will provide possible schemes of maneuver for the staff to work on. This is time dependent. If there is a lot of time the BG CO will provide the scheme of

maneuver and the staff will come up with possible courses of action (COA). If there is not a lot of time the BG CO will provide a single COA for the staff to work on.

While the BG CO is in the TAC CP his planning guidance is given over CNR to the DCO who will then relay the information to the Ops O using the map board. The BG CO will again give warning orders to the sub-unit commanders via CNR.

In order for the BG CO to give planning guidance they need the most current up-to-date COP, the assets available to them, and the windows of opportunity for these assets (provided by the FSCC). This will necessary information to the BG CO to be incorporated in his planning guidance depending on what sort of effect they want to achieve. The following factors are analyzed by the BG CO prior to providing planning guidance:

- Area of Operations,
- Enemy (EN) force capabilities,
- Own force capabilities,
- Time and space,
- Assigned tasks,
- Implied tasks,
- Command and Control,
- Logistics and movement,
- Rules of engagement,
- Conflict termination, and
- Risk.

The SMEs suggested a number of different capabilities that aid them in providing planning guidance to the staff. One suggestion was the ability to draw an overlay trace on a geo-referenced map on a tablet device. This would then be sent to the staff back at the Main CP. The BG CO could then guide the staff through the sketch in real-time. There was debate about whether the trace provided by the BG CO be geo-referenced and the majority of SMEs suggested that it not be. Only the map needs to be geo-referenced. The SMEs also suggested that the capability be collaborative where both the BG CO and the staff can interact with the trace. Another capability that the SMEs suggested would be a separate digital (larger range, better encryption) planning net for voice communication. This would reduce talk time on the CNR which is susceptible to interception. Some SMEs suggested have a face-to-face video teleconference capability so that the BG CO could see the faces of the staff while instructions are given.

The commander provides planning guidance to the staff and identifies what information is critical to him in the upcoming mission (Commanders Critical Information Requirements or CCIRs). Currently commanders only have CNR to communicate planning guidance and mission intent with the staff at the Main CP. The SMEs identified the need for collaboration and duplex communication services to interact with their staff during this critical phase of planning. The SMEs acknowledged that fighting a near-peer would not allow them to communicate extensively over the CNR and thus there is a need for other means.

Mission analysis culminates with the briefing to the staff. This brief orients the staff to the mission so that they share a common vision of the intent and the results that are to be achieved.

3.5.2   Prepare Plans

One of the sub-goals of *Develop Plans* for the BG CO is to prepare orders and prepare the plan. The SMEs identified three sub-goals of *Prepare Orders*, these included:

- Develop plan (if time is short),
- Monitor plan development, and
- Monitor rehearsal.

The deliverable of this sub-goal is to consolidate, collate, and manipulate information into a complete, coherent, and clear expression of the plan. Planning and decision making process at lower formation levels normally utilizes the Combat and Battle Estimate process. The combat estimate includes the evaluation of the aim, limitations on achieving the aim, evaluation of factors (ground, enemy, friendly, time and space), assessment of tasks, assessment of Courses Of Action (COAs), and selection of the COA. SMEs reported that if time was extremely tight, they would do a Combat Estimate at the TAC CP and have the Main CP staff complete the coordinating instructions of the orders. The SMEs reported that the all arms advisors at the TAC CP would assist the CO on COA evaluations.

Most SMEs reported that they used a blended OPP – Combat Estimate planning process. The OPP is currently used at Brigade and higher HQ. As detailed in CFJP 5.0 (2008) pg 3-1 "The CF OPP is a coordinated process to determine the best method of accomplishing assigned operational tasks and to plan possible future tasks. Planning may be inhibited by inadequate information, insufficient time and limited resources. The planning process is designed to optimize logical, analytical steps of decision making in conditions of uncertainty and ambiguity".

After the BG CO provides planning guidance the staff begins preparing the plan of attack. The choice between OPP and combat estimate is also personality driven. Some COs prefer to do a full OPP while some COs give direction on a single COA to proceed. The level of detail of the planning process is usually provided in the mission statement and the planning guidance. This section will briefly explain the steps that were indicated by SMEs as to the planning process at the battle group level. It is not intended to be a full review of the planning process.

If there is sufficient amount of time (48 – 72 hours) a full OPP may be conducted. When the time is available COA development follows the planning guidance stage. The number of COAs developed is dictated by the CO in the planning guidance. The SMEs indicated that there are normally three COAs developed. As previously mentioned, when the BG CO is at the Main CP the planning guidance is given over a map board and then the staff (under direction of the Ops O) produces the COAs. Activities undertaken in the OPP include but are not limited to the following:

- Initiation,
- Orientation,
- Mission Analysis,
- Mission Statement,
- Commander's Planning Guidance,
- Courses of Action Development,
- Develop and refine COAs,
- Staff analysis,
- Information brief,
- Final staff checks,
- Decision brief,
- Brief to higher HQ,

- Endorsement by higher HQ,
- Plan Review,
- Wargame,
- Course of Action Evaluation, and
- Commander's Decision and Development of the Operation Plan.

The output of the OPP is a plan or operations order. This planning process is staff intensive and many of the SMEs did not believe it was normally suitable for combat operations at the BG level. SMEs did report that staff prepared contingency plans using the OPP when time was available.

If time was available, then CO's monitored the development and refinement of the plan. Depending on time the BG CO may suggest that the information brief be conducted following the wargaming and the completion of the decision matrix. The BG CO is not involved in the wargaming. This is typically carried out by the Ops O and Int O. Following the results of the wargaming the staff produce the decision matrix of the COAs and the BG CO is provided with a decision brief. The decision brief presents the results of the war gaming and involves the Ops O, DCO, FSCC, ESCC, Engineer CO, and Artillery CO (if performed at the Main CP). The decision brief is presented to the BG CO over a map. The BG CO will then evaluate all of the information and select the best COA. If the BG CO is on the move the DCO will be the one that is briefed on the results of the COA development. Based on the BG CO planning guidance the DCO will choose the best COA and then get the BG CO approval via voice confirmation using CNR. Some SMEs indicated that when the BG CO is on the move the Ops O will use CNR to brief the BG CO on the COAs. The BG CO will then review them with his advisors at the TAC CP. The BG CO would then provide further guidance on the COAs. The SMEs again reported the utility of a conferencing and collaboration tool that would allow the CO to mark-up an existing COA. A number of SMEs noted that when time is short the Information and Decision briefs are combined into one brief.

After the decision brief the staff revise the COA and wargame it again. At this time the decision support template and the control measures are developed by the staff based on the BG CO planning guidance. This is a staff function and the BG CO is not involved in this. The staff will begin developing the operation orders. Once the Ops O and Plans Officer (if available) develop the full set of orders they would brief (Planning Brief) the BG CO either in person (if at the Main CP) or via CNR (if in the TAC CP).

Once orders are given the sub-unit commanders complete their own estimate and develop their own plan. The sub-unit plans are then briefed to the Main CP and CO. The next step in the mission planning process is the mission rehearsal. In the OPP this is the formal Rehearsal of Concept (ROC drill), while in the Combat Estimate process, rehearsal is part of battle drill. The ROC drill is a map based step by step rehearsal of friendly unit action based upon the scheme of manoeuvre dictated by the plan. Using a map as a visible reference, sub-unit commanders identify where their units will move in the first phase of the operation, what roads they would use, critical tasks, actions and decisions. Once the first sub-unit is complete with their first move the other sub-unit commanders would demonstrate and describe what and how they will be conducting their moves in the first phase. The rehearsal process continues until all the phases are complete. The rehearsal drill can identify problems with the coordination and synchronization of the plan, (e.g., two units using the same road at the same time). Changes to the plan are thus identified and forwarded to the CO for approval. The CO either monitors the rehearsal or is briefed on the rehearsal results. The SMEs noted that mission rehearsal was extremely important and was the means of insuring that everyone understood the CO's intent and the agreed scheme of manoeuvre. SMEs discussed the use of digital tools to support the mission rehearsal; they identified the need to have unit icons that the sub-unit commanders could

freely move over a digital map (visual metaphor). It should be noted that according to one SME the BattleView system is not a successful rehearsal tool. Just like a chess-board the sub-unit commanders could position where they will have their troops and when. This rehearsal tool would be coupled with other collaboration tools that would allow the CO and other players to adjust a sub-unit commander's plans. If the BG CO wanted to be a part of the ROC drill they could attend in person if they were at the Main CP. However, if the BG CO was away from the Main CP and in the TAC CP this would prove challenging. The SMEs suggested that the TAC CP could have a shared virtual space (i.e. 3D rehearsal map) where the BG CO could see the movements of the unit icons in real-time during the ROC drill. Due to the length of time it takes to perform the ROC drill (2 -3 hours) the SMEs indicated that this activity should be kept off of CNR and requires a separate digital communication channel (i.e. VOIP). There were also a number of SMEs that indicated that they do not need to be involved in the ROC drill and it is up to the staff and combat teams to coordinate their schemes of maneuver. In this instance it would be up to the Ops O to notify the BG CO on the outcome of the ROC drill either in person (if the BG CO is at the Main CP), or via CNR (if the BG CO is at the TAC CP).

As time becomes more constrained an abbreviated OPP is followed. When the planning guidance is given the BG CO will indicate which steps in the planning process will be followed or reduced (e.g., combining the information brief and the decision brief, or eliminate the ROC drill). When time is short the BG CO may use a form of recognition primed decision making to select a COA to follow and plan for. If the BG CO just picks a COA the staff would then prepare the supporting instructions.

A number of capabilities were identified to help the BG CO during the development of plans while in the TAC CP. One capability was a virtual shared space where the BG CO can watch as the ROC drill is being performed. This would be on a tablet device and show the picture that the main is using. Another capability would be a digital communication channel back to the Main CP to discuss the COAs and for the BG CO to take part in the information and decision briefs. Lastly, SMEs suggested that the BG CO at the TAC CP needs the ability to open various file types (e.g., PowerPoint) in order to review the COAs developed by the main CP.

Once the plan is finalized the staff amend the preliminary orders if required (normally just the coordinating instructions). SMEs reported the need to have rudimentary word processing tools to help the TAC CP prepare the CO's section of the orders. The SMEs were divided on the CO's involvement in preparing the physical orders. Some CO's dictate their sections to the staff in the TAC CP, others draft sections of the Orders while others simply review what has been drafted by the Main CP. Orders are currently promulgated over the CNR. The SMEs suggested that only Fragmentary Orders (FRAGO) should be given over CNR and detailed orders should be given over a digital means (i.e. VoIP). Another capability that would aid the BG CO while in the TAC CP is the ability to receive the orders from the Main CP in the same format as they are developed. If the BG CO can view these orders on a tablet device it may be more efficient and effective.

3.5.3   Develop Plans Capabilities

The SMEs proposed a number of tools and capabilities that would improve their ability to develop plans. The tool / capabilities are presented below in no particular order:

- Digital communication channel back to the Main CP and to the Brigade,
- Digital communication channel to the combat teams,
- A tablet device with a map background with sketch and send capability,
- Drawing tool,
- Collaboration and conferencing tool,
- Rehearsal tool,

- Ability to view various document formats on tablet,
- Digital planning net for voice communication, and
- Geo-referenced traces of the Blue, Red, Brown, Green, and White SA.

3.6 Communicate: Receive and Forward Information, Provide Direction and Decisions

One of the major goals identified by the SMEs was *Communicate: Receive and Forward Information, Provide Direction and Decisions.* The BG CO requires tools and systems to effectively communicate with his staff, his BG and the higher HQ. SMEs identified four sub-goals of the main goal *Communicate: Receive and Forward Information, Provide Direction and* – see Figure 14. Each sub-goal will be described in detail in the following sections.
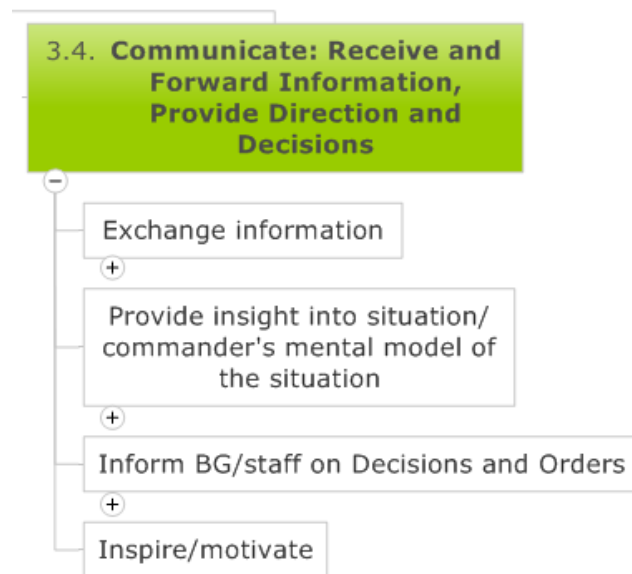

Figure 15: Communicate branch of the GDTA hierarchy

3.6.1 Exchange Information

In order for BG COs to command effectively from the TAC CP they need reliable and secure communications with the BG and higher HQ. SMES identified three sub-goals of Exchange Information:

- Receive and exchange information with BG assets,
- Retrieve and enter information from/into existing databases, and
- Receive and exchange information with Higher HQ.

As noted in *Build, Maintain and Manage the Commander's Operating Picture* sub-goal the CO must receive information from the Main CP. The information received from the BG Main CP includes positional updates of BG forces, imagery, staff summaries, reports, returns, briefings, etc. The SMEs noted that positional updates and changes in situation traces must be automatically pushed to the CO.

In addition to retrieving information from the Main CP, the SMEs noted the use of Chat, accessing the ORION database, and access to the internet. For example, the text-based communication tool TransVerse Chat was used extensively in Afghanistan – see Figure 16. This tool includes a number

of tactical discussion and information exchange rooms – see Figure 17. The number of concurrent users is limited to the capacity of the system. The SMEs reported that reviewing the operations Chat room was an effect means of reviewing and staying informed on operational activities.
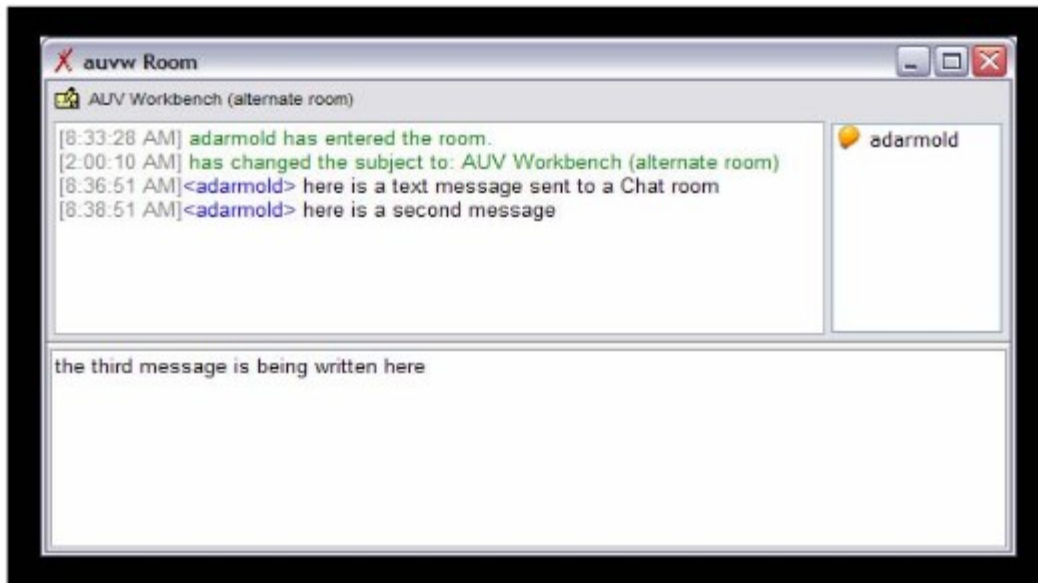

Figure 16: Chat interface (From Arnold, 2006)
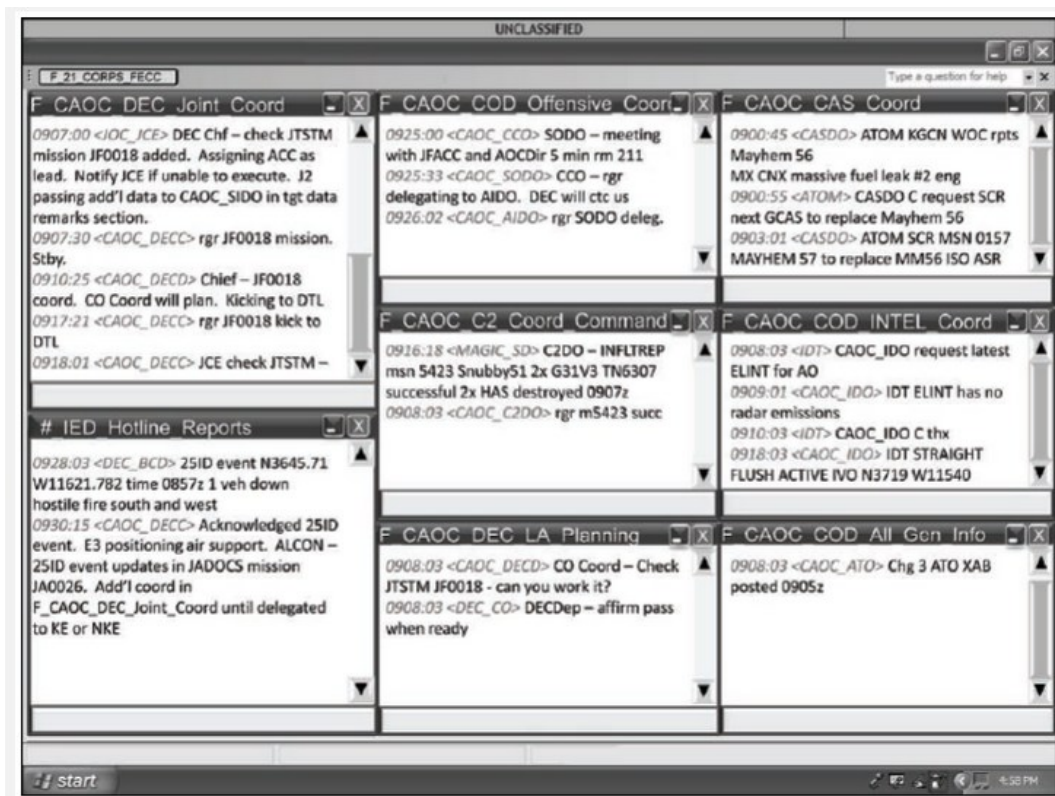

Figure 17: Sample of eight different chat rooms (FM 6-02.73, 2009)

Chat rooms have been used as a non-voice means for personnel to communicate with each other. While some CO's would like to be able to review entries in the different chat rooms in the TAC CP, many did not feel they would have the time to read volumes of messages. The SMEs did believe that chat could save on transmission time when messages are sent in a burst transmission. The SMEs noted that switching to the Chat channel of communication requires the use of a verbal protocol, i.e. "switch to Chat means", etc. It was noted that the Canadian Chat system was not compatible with other coalition Chat systems. Additionally, the SMEs noted the need for UCOM word processing capabilities, ability to upload images, sketches, videos, etc.

Receiving and exchanged information directly with the Higher Commander is also required. In addition to using CNR, the SMEs reported the use of Satellite phones. The SMEs noted the need for secure and private communication UCOM capabilities.

3.6.2   Provide Insight into Commanders Understanding of the Situation

One of the generic goals of communication is to promote understanding between the parties. The Main CP supports the commander. In order to be effective, the commander's assessment of the situation and the commander's information needs must be understood by the Main CP's staff. This process may require the staff and CO to pose and answer questions. "In communication, clarification involves offering back to the speaker the essential meaning, as understood by the listener, of what they have just said. Thereby checking that the listener's understanding is correct and resolving any areas of confusion or misunderstanding." (SkillsYouNeed, 2014). In this process there is a dialogue between the BG CO and his staff or between the BG CO and the Higher Commander to ensure a shared message. SMES identified two sub-goals of Provide Insight into Commanders Understanding of the Situation, these included:

- Support the BG CO's understanding of the information provided by the staff and the staff's understanding of the BG CO's direction, and
- Support the BG CO's understanding of the direction and information provided by the Higher Commander and the Higher Commander's understanding of the BG CO's plans.

The BG CO interacts with his staff at multiple occasions. While the CO is building his picture of the battlefield, they will receive products produced by the staff and situation reports. The CO may ask questions or will seek further clarification from the staff. This interaction could be verbal or it could be a review of comments annotated on shared maps, sketches, etc. The SMEs noted that they frequently question projections of enemy movements to ascertain the reliability and age of the information in the projection. The SMEs noted that this discussion should not take place on CNR but rather another UCOM voice communication channel.

During the Commander's mission analysis, the CO at the TAC CP will normally work with their all arms advisors. This collaborative process involves both oral and written exchanges of information. The SMEs identified the efficacy of communicating the results of the commander's mission planning by use of a sketch accompanied by oral instructions.

During the course of battle, BG COs must continuously provide their intent to their staff. The intent provides an understanding of the battle field and the BG COs assessment of the battle field both up and down the chain of command. The BG CO also transmits 'What' they are trying to achieve. The Commander's Intent also provides the expected end-state of the troops and terrain, and the purpose and key tasks for the operation. Currently, the BG CO provides their intent to the DCO who then updates the Ops O who initiates any processes or tasks that need to be carried out. The intent provided by the BG CO is just a broad overview of the intended operations. If the commander's intent is provided while at the Main CP or given to higher it is usually done using LCSS with the Team

Viewer option. This is a multi-collaboration option where the BG CO can give his intent by outlining a trace on a geo-referenced map that can be seen in real-time by others who are physically dislocated from the BG CO. In most cases when the BG CO is in the TAC CP they lack the connectivity to use LCSS so they must communicate their intent via CNR. In order for the BG CO to provide their intent they must first know the intent of the brigade, division, or even higher. They also require the most current up-to-date COP and the SA of all of the elements (Red, Blue, Green, Brown, and White). This information should be provided to the BG CO using the same methods explained in Section 3.4.2. The SMEs indicated that best way to provide their intent is through a tablet device with a map background where they can quickly sketch their intent and send it to a number of staff. Since the Commander's Intent is just a broad overview of operations it does not need to be geo-referenced.

Using the sketch of the commander's intent as a guide, this information exchange is frequently oral in nature and is done to focus the limited planning resources of the Main CP. If required, clarification is sought until the commander's intent and concept of operations is understood. If information is available the staff may identify known issues which may alter the commander's concept, e.g. if the commander intended to conduct a blocking defence but chose unsuitable ground due to recent flooding, the staff could identify this issue and suggest other options to meet the CO's intent.

Given that non-verbal communication can be as strong if not stronger than verbal communication, the use of video-teleconferencing systems was discussed by the SMEs. Some SMEs used video teleconferences in Afghanistan and while deployed with American units. SMEs praised teleconferencing for the ability to see facial expressions, eye contact, fatigue levels, posture, etc. Other SMEs questioned the resolution possible for teleconferencing in the TAC CP; if the resolution was poor then the SMEs recommended the use of a collaborative space (white board) accompanied by voice. The utility of seeing a low resolution image of a face did not justify the bandwidth usage. The utility of video teleconferencing should be further investigated.

As stated in a previous section, during the planning process the BG CO is briefed by the staff at multiple stages (information brief, decision brief and planning brief). The SMEs recommended the use of sketches and a collaborative planning tool to facilitate this information exchange. The SMEs reported that this exchange would be oral and written in nature (hand drawn sketch amendments). Again, the SMEs stated that the UCOM system should provide another non-CNR communications channel.

The BG CO interacts with his Higher Commander at multiple events. If the BG CO is located at the Main CP they are able to directly communicate with higher. SMEs noted the use of private communication channels to discuss issues with the Higher Commander. When the BG CO is away from the Main CP they may at times have to relay their information through the Main CP. The SMEs suggested that there should be a direct link from the TAC CP to the Brigade separate from CNR.

3.6.3   Inform BG/Staff on Decisions and Orders

One of the generic goals of communication is to provide direction. The CO must issue orders and instructions to his staff. Besides issuing orders and instructions the CO also guides and counsels their staff to do the task correctly. The CO guides their staff so that their individual efforts supports the BG's interests. While direct supervision at the Main CP is exercised by the BG's DCO or the Ops O, the CO provides leadership and direction. SMEs identified two sub-goals of Inform BG/Staff on Decisions and Orders, these included:

- Inform staff and Higher HQ on BG CO's decisions and directions, and
- Deliver orders.

During plan development at the Main CP the staff present recommendations for the BG CO's approval. A number of SMEs reported that if they were unavailable at the Main CP the BG DCO would or should make these decisions. The scenario utilized in this process would not allow the CO to delegate his responsibility and thus decisions had to be made by the CO. The SMEs reported that planning decisions would be undertaken using the non-CNR voice net. When queried about the use of text-only communications, the SMEs were concerned that messages would be missed or lost. The SMEs reported that there may be times when a CO has to brief the Higher Commander on their decisions. Again SMEs suggested the use of another non-CNR communications UCOM channel to support commander to commander discussions.

The responsibility of the BG CO for authorizing fires in the targeting process was discussed at length. The SMEs reported that targeting, as experienced in Afghanistan, was conducted at the Formation level and not at the BG level. The enemy targets presented in the scenario were dynamic targets and subject to the Rules of Engagement and were not a product of the formal Targeting Board. The SMEs reported that in the scenario of engaging a near peer, dynamic targeting authority would be delegated to subordinates.

During the course of operations the CO will provide orders to his BG. Orders can be detailed or expedient in nature. The SMEs noted the universal use of mission command in the Canadian Army. CO's identify what effect has to be achieved (commander's intent) but not how it has to be achieved. Outside of formal orders the CO may provide supplementary or fragmentary orders to his BG. All orders are currently given over the CNR. The SMEs did note however that orders, over CNR, could reference the availability of supplementary sketches available on the BG's information database.

3.6.4   Inspire and Motivate

One of the superior goals of a commander is to inspire and motivate their BG. The CNR is an all stations net that allows the BG CO a venue to influence their subordinates. The commander's tone, pitch, volume and pace provide listeners with clues as to the commander's mood and confidence. Too quick a pace could reflect a CO who is overexcited while to slow could reflect a CO who is too slow and cautious. During the heat of battle the CO's voice provides the calming influence, reassuring the BG that the battle is well at hand.

3.6.5   Communication Capabilities

The SMEs presented a number of tools and capabilities that would improve their ability to communicate. The tool / capabilities are presented below in no particular order:

- Digital communication channel back to the Main CP and to the Brigade,
- Command and control joint target manager program where information on all targets is kept and capable of being updated in real-time,
- A tablet device with a map background with sketch and send capability,
- Digital planning net for voice communication, and
- Face-to-face video teleconference.

3.7   Effectively Execute Mission

One of the major goals identified by the SMEs was *to Effectively Execute the Mission.* Once the battle has started the BG CO may have to deftly adjust his plan to accomplish the mission. It should be noted that the Mission Command philosophy means that the BG CO is the "conductor of the BG orchestra" and they should let their subordinate Combat Team leaders, command and direct their sub-

units. One SME reported that the CO is like a bus driver who applies small corrections on the steering wheel keeping the BG on course. While the Combat Team commanders are fighting the current battle, the CO is focussed on where and what the enemy follow-on forces are doing, e.g. where are the follow-on forces. The CO's job is to prevent the BG from becoming overly focused on the first battle and thus miss the enemy's more dangerous activities. During the battle the CO assesses imminent and emergent threats, battle rhythm, decision and trigger points, availability of on-call assets and battle damage.

SMEs identified five sub-goals of the main goal *Monitor location and status of the BG assets involved in the battle, Assess the progress of the battle, Direct warfighting functions, Directly influence the battle and Monitor the AO.* – see Figure 18. Each sub-goal will be described in detail in the following sections.
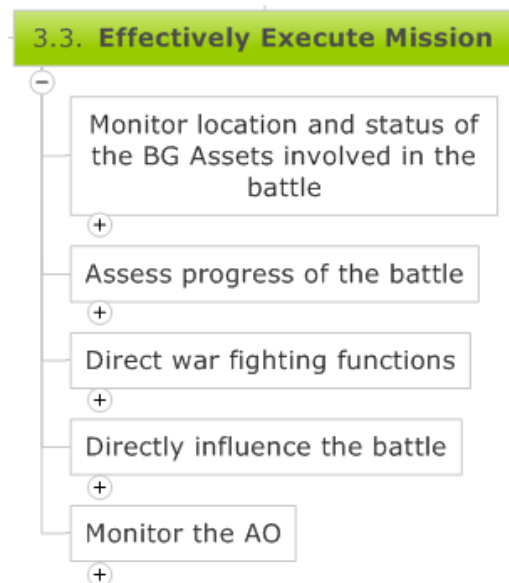

Figure 18: Effectively execute the mission branch of the GDTA hierarchy

3.7.1   Monitor location and status of the BG assets involved in the battle

The BG CO is responsible for assessing the current battlefield status of his troops. SMEs identified three sub-goals of Monitor location and status of the BG assets involved in the battle, these included:

- Monitor battlefield geometry,
- Monitor blue force dispositions, and
- Monitor combat power/capabilities of BG subunits.

Based on inputs (SITREPS) from the combat teams and the brigade this information is updated at the Main CP. The BG CO listens on the CNR to the SITREPS produced by the Combat Teams and the consolidated SITREP forwarded by the Main CP. Use of blue force tracking would allow the CO to visualize forward edge of his troops and the Combat Teams area controlled by fire and observation. While there are inter-visibility tools that could potentially allow the CO to see arcs of fire and visibility fans (see Figure 19), the SMEs reported that they did not want or need to go to the individual vehicle level.
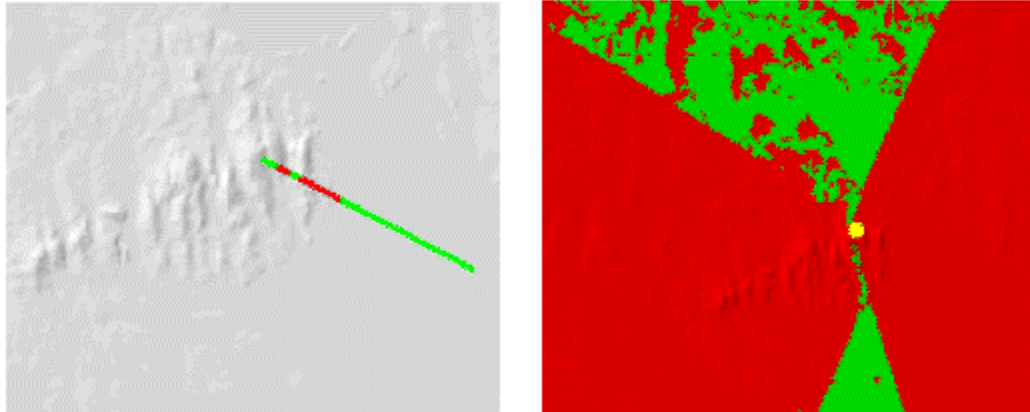
Figure 19: Line of sight and masked area plots (from esri.com)

The SMEs reported that the CO or higher HQ should not be able to monitor and thus direct individual soldiers and vehicles. The CO currently receives updates on the status of his sub-units through reports over the CNR and indirectly via returns collated at the Main CP. While some SMEs reported that this was sufficient, a number of other SMEs suggested that a stop-light system of combat effectiveness for the combat teams should be employed. These SMEs pointed out that even during the midst of the current battle making plans to exploit the vulnerabilities of the EN and knowledge of the status of sub-units is key for plan formulation. SMEs also suggested the BG CO receive an up-to-date COP on a tablet device where the BG CO can aggregate and de-aggregate each of the combat teams to see their status. The SMEs also noted that if the CO could aggregate and de-aggregate each of the combat teams he could get a more precise view of the combat team's platoon or troop status, e.g. are losses evenly spread out or was one troop or platoon hit hardest.

3.7.2   Assess progress of the battle

The BG CO analyzes the progress of the battle is going and maintains battle rhythm. Battle rhythm is the "process where the commander and his staff synchronize the daily operating tempo within the planning, decision, execution and assessment (PDE&A) cycle to allow the commander to make timely decisions" (Duffy, Bordetsky, Bach, Blazevich and Oros, 2004). Some authors equate battle rhythm with the BG CO's Observe, Orient, Decide and Act (OODA) Loop. BG CO's must "continually visualize the battlefield and consistently, effectively, and quickly move through his decision cycle (OODA loop) during tactical mission execution" (Alex, 1998 pg 8). SMEs identified four sub-goals of assess (or visualize) the progress of the battle, these included:

- Assess progress of the plan and battle rhythm,
- Monitor decision template and trigger points,
- Monitor assets of in-support assets, and
- Monitor battle damage assessment.

The CO thus compares the current state of the battlefield to the prepared plan and based on recommendations or intuition adjusts/ reallocates resources as needed. In the Main CP the staff monitors the battle and consolidates information and updates the battle board. During the plan development the CO will have developed tactical options to address differences in what the enemy is doing and what was forecast (different enemy courses of action). These tactical options or "audibles" are based on a number of trigger or decision points. Decision points are events or

locations on the battlefield where tactical decisions are required during mission execution (FM 5-0, 2005). These decision points were identified in the plan development and are detailed in a Decision Support Template (DST). The DST is a tool which identifies where the BG CO anticipates making a decision on a friendly COA, e.g. *"Enemy COA A: If the enemy crosses at bridge code named RABBIT the BG will defend from BP 301 and 401 with A Company forward, B Company to move to BP 501 in depth. If enemy crosses report line HAMMER, B Company to counter attack from the west. Enemy COA B: If enemy crosses at bridge code named TIGER, BG twill defend from BP 101 with B Company and a platoon from A Company at BP 301. If enemy crosses report line STEEL, A Company (minus) will counter attack from the east".* See Figure 20 for a depiction of the the defensive plan audible.
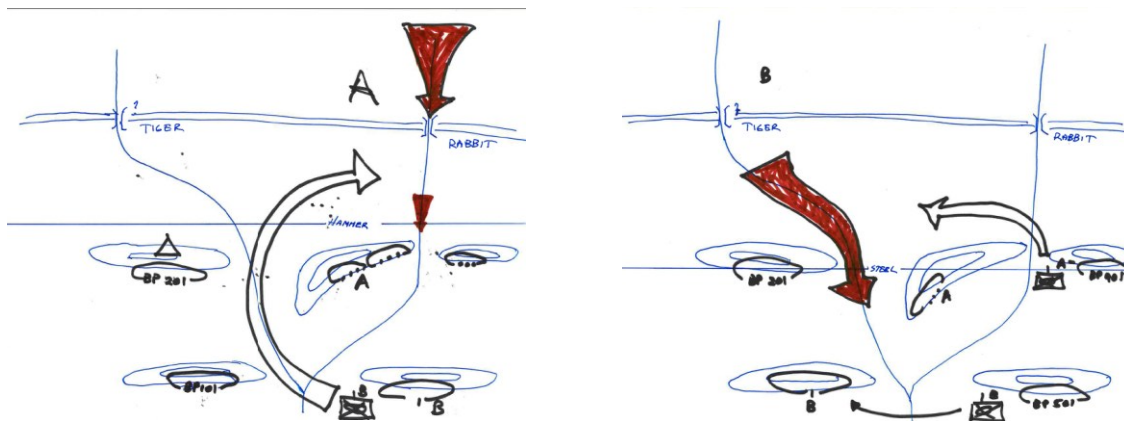

Figure 20: Depiction of defensive plan A and audible B

The DST addresses a number of alternative enemy actions. If the enemy does something unexpected the BG CO and staff must react. Some SMEs indicated that staff will likely recommend minor adjustments to the plan when the CO is either in the Main CP or in the TAC CP. However, if events unfold that require major changes to the plan, an expedient battle plan must be developed. The SMEs reported that in this case the CO will direct the execution of a new COA. The staff at the Main CP will attempt to coordinate as best as possible. Communications and knowledge sharing with the TAC CP during the battle occurs over the CNR and positional data is updated by the battle adjutant or the signals operators. The SMEs noted the provision of blue force tracking and the ability to sketch and communicate this new plan to the BG will allow BG COs to quickly react to the fog of war.

The BG CO is constantly assessing the imminent and emerging threats that are posed to their BG. Imminent threats are gathered from SITREPS from the combat teams or from contact reports. This information is analyzed by the staff at the Main CP and based on the BG CO CCIRs it may be presented to the BG CO. As the BG CO assesses the threats to their assets and resources they may require dynamic adjustments to the plan and a reallocation of resources. When the BG CO is in the TAC CP they must assess imminent threats from SITREPS from the combat teams or from reports from the Ops O or Int O from the Main CP. In both cases this information is passed to the BG CO over CNR. In addition to analyzing what the enemy is doing, the BG CO continually assesses the state of their BG to see if it was capable for exploitation activities. While some SMEs identified the need to see gun state, vehicle state, personnel state, ammunition remaining, etc.; other SMEs just wanted to see if the sub-units were combat capable (e.g. the traffic light concept). Other SMEs suggested just hearing the combat effectiveness from the combat team commanders was sufficient. SMEs were concerned that providing too much information was focusing the CO's attention away

from leading the fight. SMEs indicated that the BG CO could develop CCIRs that would detail when the CO should be notified when certain changes to the combat effectiveness of the combat teams occurs. The SMEs suggested a number of different tools that would aid them in assessing any imminent or emerging threats. One tool would be an analyzed report of the EN intelligence. There was debate on whether the BG CO would require the raw contact reports for their own analysis. There was a group of SMEs that indicated that they wanted the raw contact reports of the EN and there was a group that indicated that they would prefer the analyzed report from the Main CP. A compromise among the SMEs was that the Main CP would provide two overlay traces to the BG CO, one being the analyzed assessment of the EN and the other being the raw EN contact reports.

In addition to his own resources the BG CO typically has in-support assets made available from the Higher HQ. In-support assets may have windows of availability (on station times), sorties available, effects available, etc. that need to be tracked. While staff at the Main CP will monitor the availability of in-support assets, a number of SMEs suggested that they would like to know in the TAC CP when windows of opportunity will run out; this could be a table of assets and relevant timing information. This could be provided as a real-time updated table that can be viewed on a screen in the TAC CP. There was some debate on whether this information was pertinent for the BG CO in his vehicle or that it just has to be available in the Artillery Battalion COs vehicle in the TAC CP. SMEs reported that BG CO's should at least be informed when in-support assets are no longer available (i.e. another CCIR element).

During the course of a battle the BG CO is constantly assessing battle damage i.e. "the timely and accurate estimate of the damage resulting from the application of military force, either lethal or nonlethal, against a predetermined objective" (USJFCOM, 2004, pg I-4). Information supporting Battle Damage Assessment (BDA) is captured by friendly forces on the ground and airborne assets (UAVs, helicopters, aircraft.). This information is analyzed by the staff and forwarded to the CO via SITREPS by the Ops O. The SMEs were prompted on the utility of using live UAV feeds to assist in BDA. The majority of the SMEs were against providing the BG CO with the ability to see full motion – real-time video. SMEs reported a large number of negative incidents in Afghanistan where leaders became focussed on watching the video and not on commanding. Some SMEs also reported that UAV feeds were intentionally removed in an effort to stop the tunnel vision from happening. While SMEs were not supportive of live feeds they were supportive of viewing video clips or imagery forwarded by the staff based on their BDA. The majority of SMEs did not feel that BDA was a priority during a battle and that BDA was an activity left to the After Action Review (AAR). A number of SMEs thought BDA was a staff function and even if the CO could do BDA, it should be left for the staff.

The BG CO will also monitor and assess the collateral damage associated with the battle. During the planning phase culturally significant buildings, schools, religious institutions, etc. will be identified. Rules of Engagement (ROEs) are utilized to minimize effects. In the BG CO Commander's Intent and Planning Guidance, the ROEs will be reviewed and the BG COs will stipulate the type of effects they want to achieve. The force enablers will develop the plan to accomplish this effect. At the Main CP the BG CO is presented with Collateral Damage Assessments (CDA) via powerpoint slides and video clips. If required the BG CO will require the same ability to view these file types at the TAC CP. Rather than using the CNR, this post action briefing will require the use of a secondary communications channel.

During directed targeting (i.e. UAV missile strikes) there are capabilities available that could allow the BG CO to view a live feed of the potential target and the surrounding area to aid in the assessment of the collateral damage. Some SMEs indicated that since the collateral damage is the responsibility of the BG CO they want to see a live feed for themselves. There was consensus among the SMEs that

the BG CO should not see all the raw footage but instead an analyzed segment of the raw footage. Some SMEs also indicated that this feed is presented in the TAC CP in one of the all arms advisor vehicles so it is not necessary for it to be streamed to the BG COs vehicle. The utility of seeing video feed in the CO's TAC CP may be personality driven and thus the option for providing it in the UCOM system must be made available.

3.7.3 Direct warfighting functions

Once the plan has been put in place and the orders are given the BG CO is in charge of monitoring and controlling the execution of the plan. Battles rarely go according to expectation and the CO is faced with an ever changing operating environment. SMEs identified four sub-goals of direct warfighting functions, these included:

- Communicate tactical readjustments,
- Communicate the execution of pre-planned events,
- Communicate information demands and changes to CCIRs,
- Authorize dynamic target engagements, and
- Authorize pre-planned target engagements.

During the battle the BG CO and the staff will identify opportunities and threats to the BG's accomplishment of its mission. When opportunities or threats are identified the CO must seize the initiative to turn the opportunity or threat into an advantage. Unlike the detailed planning process the CO will use a recognition primed, or intuitive decision making approach. The new plan must be quickly communicated and understood by their BG. The SMEs identified the use of the collaborative planning tools and the ability to quickly sketch a CONOP as being essential in this dynamic environment. The SMEs reported the use of overlay orders which combines a sketch (trace) and a minimum set of written orders as being a necessity. If developed at the TAC CP, then the CO needs the ability to attach a sketch with a minimum set of hasty orders. Ideally the overlay orders should resemble those produced today with overlay orders.

If the battle has been going to plan the BG CO and staff will consult the DST to identify when to execute options/ tasks. Currently the execution of a battle option is announced over the CNR through the use of a code word with the major sub-units acknowledging its receipt. SMEs strongly believed that orders should be given over the CNR but that text messages should follow as a redundant back-up, especially if grid references and complex timings are announced.

Battle Group Commanding Officer's may also update their information priorities, i.e. CCIRs and PIRs based on how the battle is progressing. Currently this can only happen over CNR and thus the SMEs identified the need for a new digital communications network.

During the course of the battle the BG CO may have to make decisions on dynamic target engagements. Unlike the deliberate targeting board process, dynamic target engagement includes effects based operations/engagements against targets of opportunity based on ROEs. The authority for this targeting is typically delegated but there may be unique instances where targets because of their proximity to sensitive sites may require authorization from the BG CO. Typically the BG CO will receive a mission request from his staff or advisors over the CNR. Dynamic targeting is different from deliberate targeting which prosecutes planned targets. Deliberate targeting includes a number of stages, including but not limited to: target development and target prioritization assessments, capabilities assessment, force assignment and mission planning. A targeting board exists at the brigade of force HQ and the target list is promulgated to all major sub-units. If the BG CO is present at the Main CP they will often give approval for an attack or they would have this authority delegated

to the member of the staff (DCO or Chief of Staff (COS)). When the BG CO is in the TAC CP it is common for the BG CO to delegate the targeting authority to a member of the staff. Dynamic targeting occurs during the execution of battle and is more concerned with localizing the enemy and engaging with available assets. The BG CO has the legal responsibility for all engagements and thus may wish to closely monitor and authorize engagements. The SMEs reported that the scenario utilized was more like conventional warfare against a near-peer and thus the engagements were more dynamic in nature than operations in Afghanistan. The SMEs reported that they would listen to the recommendations of their staff when authorizing fires and only in rare conditions would they want to see evidence on the location of targets. The SMEs reported that it was the job of the staff to undertake target analysis. The SMEs were asked again whether or not they would ever want to see raw UAV footage of a potential target so that they could give the approval for an attack. There was no clear consensus as a number of SMEs suggested that this is a staff responsibility to confirm that the ROE were being obeyed, while a number of SMEs wanted to see the raw footage since they are the ones who are ultimately responsible. This depended on the amount of the risk the BG CO wants to take on. The majority of the SMEs indicated that they trusted their staff when they recommend attacking a target. As for capabilities that would aid the BG CO on the move for targeting included a communication channel back to the Main CP and to the Brigade. A number of SMEs suggested the capability to view raw footage from a UAV feed or pictures from the combat teams would be advantageous. In a "Joint" fires situation there is an increasing need for a common understanding of the targets. Therefore, a number of SMEs also suggested a command and control joint target manager program where information on all targets is kept and capable of being updated in real-time. This program would synchronize all ISTAR material in one location and give the BG CO all the information they require to provide direction and make the decision on targeting for both strategic and deep targets, as well as, lower level targets. This would also provide information on available target prosecution systems (from FSCC) as they become available and be shared across all coalition forces.

3.7.4   Directly influence the battle

During the execution of the battle the BG CO's task is to lead his BG. The CO must motivate his BG and influence battlefield activities. As the leader, the SMEs reported that the BG CO will normally gravitate to the operational "centre of gravity", the decisive point in the battle which effectively defeats the enemy. This belief was challenged by one SME who felt that the best place for the BG CO was where they could best influence the battle. In Afghanistan this SME reported that it was at the Main CP where he could best influence the battle versus being in the current TAC CP with no digital links to the Main CP. This same SME reported that if the digital products and improved networking capabilities were fielded then the CO could influence the battle effectively from a future TAC CP. SMEs identified three sub-goals of directly influence the battle, these included:

- Lead in person,
- Fight, and
- Motivate the BG over the CNR.

The majority of SMEs reported that the commander normally makes their physical presence felt in combat zones, i.e. taking up a battle position one tactical bound behind the forward edge of troops but still seen by the soldiers fighting. The CO positions the TAC CP so that he can get direct eyes-on the battle so they can make their own judgement as to how the battle is progressing. The SMEs also reported that the TAC CP has to be able to fight if required; one SME reported seizing an objective during a training exercise using his TAC CP as the ground was critical to the battle and his TAC CP was the closest asset available.

As discussed earlier one of the superior goals of a commander is to inspire and motivate their BG. The CNR provides the BG CO with a direct communication channel to all his forces. Both the message and how the message is delivered will influence the BG.

3.7.5   Monitor the AO

During the execution of the plan the BG CO must maintain constant situational awareness of the entire battlefield. The role of the BG CO and the information required to fulfill this goal have already been explained in Section 3.4.2.

3.7.6   Execute Mission Capabilities

The SMEs presented a number of tools and capabilities that would improve their ability to execute the mission. The tool / capabilities are presented below in no particular order:

- Digital communication channel back to the Main CP,
- Analyzed intelligence report of the EN (both raw and analyzed),
- Ability to view the location of their own troops and the combat status, combat effectiveness, gun state, and ammunition state of the sections;
- Stop-light system of combat effectiveness for the combat teams,
- Ability to view various document formats on tablet,
- Ability to view near real-time video feeds,
- Table of available enablers and their combat effectiveness, and
- Current geo-referenced traces of the Blue, Red, Brown, Green, and White SA.

4. SA Requirements

The BG CO requires a large amount of information in order to effectively command the battle group. SA requirements were extracted from the data (SME interviews) and information about what SA requirements support which decisions were inferred from the data.

In accordance with Endsley's classic three level model of SA (1995), there are three levels of SA requirements: Level 1 SA corresponds to perception, Level 2 SA corresponds to comprehension, and Level 3 SA corresponds to projection Hoffman (2005). Endsley's (1995) three-level model of SA further describes these three levels of SA as follows:

- Level 1 SA – Perception of cues and elements related to the current situation.
- Level 2 SA – Comprehension of the current situation by integrating and interpreting the perceived information.
- Level 3 SA – Projection of understanding of current events into the near future.

In the SA requirements list below, the level of SA required is specified. When a particular SA requirement is likely used to support a decision, a "1", "2", and/or "3" is entered to indicate the relevant levels.

The following is a complete list of SA requirements identified:

- Impact of target on operation *(3)*,
- Target Lists (targeting board) *(1)*,
- Attack Guidance Matrix (AGM) *(1)*,
- Target areas of interest (TAI) *(1)* ,
- Named areas of interest (NAI) *(1)* ,
- Knowledge of asset platforms (availability, inventory, disposition) *(1)* ,
- Battlefield Damage Assessment (BDA) *(1,2,3)*,
- Munitions effect assessment *(3)* ,
- Collateral damage estimate *(2,3)* ,
- Current and planned disposition of Blue Force *(1,3)* ,
  - o Unit types,
  - o Experience level,
- Current and available Blue Force resources *(1)* ,
  - o Availability of fires,
  - o Priority of fires,
  - o Combat multipliers available,
  - o Timing of support,
  - o Specifics of pre-planned fires,
- Combat effectiveness of Blue Forces *(1,2,3)*,
  - o Projected fatigue (mental and physical),
  - o Supply level,
  - o Ammo state, vehicle state, gun state, troop state, and
  - o Projected casualties.
- Local situation *(2)*,
- Political considerations *(3)* ,
- Legal guidance *(2,3)* ,

- Current and anticipated Rules of Engagement (ROEs) *(2,3)* ,
- Own doctrine *(1)*,
- Civil/Military Coordination (CIMIC) guidance *(2,3)*,
  - Projected civilian behaviour;
  - Projected civilian response,
  - Potential for escalation,
  - Presence of agitators,
  - Proximity to sensitive sites,
  - Level of organization, and
  - Religious and political beliefs.
- Risk and threat assessments *(2,3)*,
- Commander's intent and guidance *(3)* ,
- End state *(3)*,
- Stated objectives *(3)*,
- Operations plan *(3)* ,
- Command / Battle Update Briefs (CUBs / BUBs) *(1)*,
- Operations order *(3)*,
- Prioritized friendly COAs *(1,2)*,
- Prioritized threat COAs *(1,2)*,
- Information Briefs *(1,2)*,
- Decision Briefs *(1,2,3)*,
- Mission rehearsal results *(1,2,3)*,
- Campaign design *(1,2,3)*,
- Operational design (i.e. control measures, decision points) *(1)*,
- Current and planned disposition of enemy forces *(1,2,3)*,
- Enemy capabilities *(1,2,3)*,
  - Enemy posture,
  - Enemy vulnerabilities,
  - Projected enemy casualties,
  - Likelihood of attack,
  - Enemy level of resistance,
  - Enemy combat power,
  - Projected enemy breach points,
  - Likely enemy avenues of approach,and
  - Enemy patterns of movement.
- Enemy doctrine *(1)*,
- Enemy force structure *(1)*,
  - Centre of gravity.
- Enemy force composition *(1)*,
- Enemy C2 systems *(1)* ,
- Enemy weapons systems *(1)* ,
  - Location,
  - Numbers,
  - Types of weapons,
  - Amount of ammunition, and
  - Types of vehicles.
- Meteorological Data (1,2,3),

- Terrain assessment *(1,2,3)*, and
  - Effects of terrain on communications,
  - Time required for movement,
  - Safety of routes,
  - Type of terrain,
  - Features, high ground, conditions, etc…, and
  - Projected areas of enemy detection.
- Vital Ground *(1)*.

4.1   Potential Tools and Capabilities

The SMEs have suggested a number of capabilities that would aid the BG CO to and command and lead more effectively and efficiently while they are away from the Main CP and in the TAC CP. Each capability cannot override the ability to fight the vehicle. Each of the capabilities is listed below:

- Tablet device with the following capabilities,
- Digital map,
- Static and Dynamic Sketch function with zooming capabilities,
- Possible integration of pattern recognition software to aid in planning,
- Ability to view different overlays of SA traces (red, blue, green, brown, and white),
- Stop-light like system for combat status,
- Ability to aggregate and de-aggregate combat icons for more information,
- Ability to zoom in and zoom out of a map (similar to Google Earth / Maps),
- Shadowing for features and elevations,
- Private text messaging system,
- Video tele-conferencing (VTC) (high definition and secure),
- Ability to open up several types of documents (.doc, pdf, excel),
- Portable and easy to use,
- Ability to send and receive information,
- Collaborative planning function with a shared screen and shared pen to the Main CP and the other vehicles of the TAC CP,
- Ability to access saved files (i.e. doctrine, templates, reference documents, handbooks, etc…),
- Access to Internet,
- Geographic Information System (GIS),
- Pop-up alerts for incoming messages or updated traces,
- Ability to receive and review formal orders,
- Ability to participate in a collaborative rehearsal (ROC Drill),
- Table of asset availability,
- Ability to perform a 3D virtual terrain analysis, and
- Ability to assess ground, time, and space.
- Digital Voice Communication Channels (i.e. VOIP)
- Planning and Administration channel,
- Multi-node communication,
- Duplex communication, and
- Ability to communicate to the Brigade or higher echelons.

4.2 Cross Reference of Decisions, SA Requirements, and Potential Design Concepts

The decisions the BG COs faces, the SA requirements needed to make those decisions and the potential design concepts that could aid the BG CO in making those decisions while in the TAC CP are presented in Table 1. The design concepts provided are general design concepts described in section 4.1 with all the capabilities outlined in section 4.1.

Table 1: BG CO Decisions, SA Requirements, and Design Concepts

Decisions	SA Requirements	Design Concept
What is the ammo state of my troops?	• Blue Forces Resources • Combat Effectiveness of Blue Forces	• Tablet Device
What is the vehicle state of my troops?	• Blue Forces Resources • Combat Effectiveness of Blue Forces	• Tablet Device
What is the gun state of my troops?	• Blue Forces Resources • Combat Effectiveness of Blue Forces	• Tablet Device
What is the COM of my combat teams / platoons?	• Disposition of Blue Forces • CUBs / BUBs	• Tablet Device • Digital Voice Communication Channels
What are the weaknesses of my troops?	• Disposition of Blue Forces • Blue Forces Resources • Combat Effectiveness of Blue Forces • Operations Plan • CUBs / BUBs	• Tablet Device • Digital Voice Communication Channels
What are the vulnerabilities of my troops?	• Disposition of Blue Forces • Blue Forces Resources • Combat Effectiveness of Blue Forces • Operations Plan • CUBs / BUBs	• Tablet Device • Digital Voice Communication Channels
What are my capabilities?	• Knowledge of Asset Platforms • Disposition of Blue Forces • Blue Forces Resources • Combat Effectiveness of Blue Forces • CUBs / BUBs	• Tablet Device • Digital Voice Communication Channels
What sensors are available?	• Disposition of Blue Forces • Blue Forces Resources • Availability of Combat Multipliers	• Tablet Device
Where is the main effort?	• Disposition of Blue Forces • Blue Forces Resources • Availability of Fires • Availability of Combat Multipliers • Timing of Support • Specifics of Pre-planned Fires • Combat Effectiveness of Blue Forces • Local Situation • Political Considerations • Legal Guidance • Rules of Engagement • Projected Civilian Behaviour • Potential for Escalation • Presence of Agitators • Proximity to sensitivity sites	• Tablet Device • Digital Voice Communication Channels

Decisions	SA Requirements	Design Concept
	• Civilian Level of Organization • Civilian, religious, and political beliefs • Risk and Threat Assessments • Commanders Intent and Guidance • End State • Stated Objectives • Operations Plan • CUBs / BUBs • Operations Order • Disposition of EN Forces • Enemy posture • Enemy vulnerabilities • Projected EN Casualties • Likelihood of attack • EN level of resistance • EN combat power • Projected EN breach points • Likely EN avenues of approach • EN patterns of movement • EN doctrine • EN Centre of gravity • EN force composition • EN C2 systems • EN Weapons Systems (location, numbers, types, amount of ammo, types of vehicle • Effects of terrain on Communications • Time required for movement • Safety of routes • Type of terrain • Features, High Ground, Conditions, etc… • Projected areas of EN detection • Vital Ground	
What is the end state?	• Risk and Threat Assessments • Commanders Intent and Guidance	• Tablet Device • Digital Voice Communication Channels
Who is going to perform which tasks?	• Knowledge of Asset Platforms • Disposition of Blue Forces • Blue Force Resources • Combat Effectiveness of Blue Forces • CUBs / BUBs	• Tablet Device • Digital Voice Communication Channels
What is required to fulfill the command intent?	• Knowledge of Asset Platforms • Own Doctrine • Commander's Intent and Guidance • CUBs / BUBs	• Tablet Device • Digital Voice Communication Channels
What capabilities do these sensors have?	• Knowledge of Asset Platforms • Combat Effectiveness of Blue Forces	• Tablet Device
What assets do I have available?	• Knowledge of Asset Platforms • Availability of Fires • Availability of Combat Multipliers • CUBs / BUBs	• Tablet Device • Digital Voice Communication Channels

Decisions	SA Requirements	Design Concept
When are the assets available?	• Knowledge of Asset Platforms • Priority of Fires • Timing of Support • CUBs / BUBs	• Tablet Device • Digital Voice Communication Channels
What is the priority of the assets available?	• Knowledge of Asset Platforms • Priority of Fires	• Tablet Device
What COAs would best achieve the desired end state via the commander's intent?	• Own Doctrine • Commander's Intent and Guidance • Prioritized Friendly COAs • Information Briefs • Decision Briefs • Mission Rehearsal Results	• Tablet Device • Digital Voice Communication Channels
Are the needed resources available?	• Availability of Fires • Availability of Combat Multipliers • CUBs / BUBs	• Tablet Device • Digital Voice Communication Channels
What are the effects that need to be achieved?	• Attack Guidance Matrix • Battlefield Damage Assessment • Munitions Effects Assessment • Collateral Damage Assessment • Risks and Threats Assessment • Commander's Intent and Guidance • End State	• Tablet Device • Digital Voice Communication Channels
What is higher's intent?	• Commander's Intent and Guidance	• Tablet Device • Digital Voice Communication Channels
What is higher's planning guidance?	• Commander's Intent and Guidance	• Tablet Device • Digital Voice Communication Channels
Is the target valid?	• Target Lists • Attack Guidance Matrix • Target Areas of Interest • Legal Guidance • Rules of Engagement	• Tablet Device • Digital Voice Communication Channels
Is the target legal?	• Target Lists • Attack Guidance Matrix • Legal Guidance	• Tablet Device • Digital Voice Communication Channels
Is the desired effect on the target legal?	• Impact of Target on Operation	• Tablet Device • Digital Voice Communication Channels
What is the estimated target payoff?	• Impact of Target on Operation	• Tablet Device • Digital Voice Communication Channels
What is the collateral damage?	• Battlefield Damage Assessment • Collateral Damage Assessment • Local Situation	• Tablet Device • Digital Voice Communication Channels

Decisions	SA Requirements	Design Concept
What is the composition of the EN?	• Disposition of EN Forces • EN Posture • EN Centre of Gravity • EN Force Composition • EN C2 Systems	• Tablet Device
What is the most likely EN COA?	• Prioritized EN COAs • Information Briefs • Decision Briefs • Mission Rehearsal Results	• Tablet Device • Digital Voice Communication Channels
What is the most dangerous EN COA?	• Prioritized EN COAs • Information Briefs • Decision Briefs • Mission Rehearsal Results	• Tablet Device • Digital Voice Communication Channels
What is the EN gun state?	• EN Posture • EN Combat Power • EN Weapons Systems (location, numbers, types, amount of ammo, types of vehicles)	• Tablet Device
What is the EN vehicle state?	• EN Posture • EN Force Composition	• Tablet Device
What is the EN battle rhythm?	• EN Posture • EN patterns of movement • EN doctrine • EN Centre of gravity	• Tablet Device
What is the EN intent?	• Disposition of EN Forces • EN Posture	• Tablet Device
What is the EN COM?	• EN Posture	• Tablet Device
What are the EN strengths?	• Disposition of EN Forces • EN Posture • Enemy Vulnerabilities • EN Combat Power • EN Patterns of Movement • EN Centre of gravity • EN force composition • EN C2 systems • EN Weapons Systems (location, numbers, types, amount of ammo, types of vehicles)	• Tablet Device • Digital Voice Communication Channels
What are the EN weaknesses?	• EN Vulnerabilities • EN Combat Power • Projected EN breach points • EN Patterns of Movement • EN Centre of gravity • EN force composition • EN C2 systems • EN Weapons Systems (location, numbers, types, amount of ammo, types of vehicles)	• Tablet Device • Digital Voice Communication Channels
What are the ROEs?	• Rules of Engagement	• Tablet Device • Digital Voice Communication Channels

Decisions	SA Requirements	Design Concept
What are the EN patterns of movement?	• EN Patterns of Movement	• Tablet Device • Digital Voice Communication Channels
What is the EN past behaviour / movements?	• EN Patterns of Movement	• Tablet Device • Digital Voice Communication Channels
What are the EN vulnerabilities?	• Disposition of EN Forces • EN vulnerabilities • EN Combat Power • Projected EN Breach Points • EN Patterns of Movement • EN Centre of Gravity	• Tablet Device • Digital Voice Communication Channels
What are the projected areas of enemy attack?	• Disposition of EN Forces • Enemy posture • Enemy vulnerabilities • EN level of resistance • EN combat power • Projected EN breach points • Likely EN avenues of approach • EN patterns of movement • EN doctrine • EN Centre of gravity • EN force composition • EN C2 systems • EN Weapons Systems (location, numbers, types, amount of ammo, types of vehicles)	• Tablet Device • Digital Voice Communication Channels
What is the civilian behaviour?	• Local Situation • Projected civilian behaviour • Projected Civilian response • Potential for escalation • Presence of Agitators • Civilian religious and political beliefs	• Tablet Device
What is the civilian level of organization?	• Local Situation • Civilian Level of Organization	• Tablet Device
What are the civilian political affiliations?	• Local Situation • Civilian religious and political beliefs	• Tablet Device
What are the civilian religious beliefs?	• Local Situation • Civilian religious and political beliefs	• Tablet Device
Who are the key leaders?	• Local Situation • Civilian Level of Organization • Civilian religious and political beliefs	• Tablet Device
What targets have been detected?	• Target Lists • Attack Guidance Matrix • Target Areas of Interest • CUBs / BUBs	• Tablet Device • Digital Voice Communication Channels
What are the locations of the targets?	• Target Lists • Attack Guidance Matrix • Target Areas of Interest • CUBs / BUBs	• Tablet Device • Digital Voice Communication Channels

Decisions	SA Requirements	Design Concept
What are the activities of the targets?	• Target Lists • Attack Guidance Matrix • Target Areas of Interest • CUBs / BUBs	• Tablet Device • Digital Voice Communication Channels
What are the movements of the targets?	• Target Lists • Attack Guidance Matrix • Target Areas of Interest • CUBs / BUBs	• Tablet Device • Digital Voice Communication Channels
Effect of terrain on communication?	• Effects of terrain on communication	• Tablet Device • Digital Voice Communication Channels
Estimated time required for movement?	• Time required for movement • Meteorological Data	• Tablet Device
Safety of mobility routes?	• Safety of routes • Meteorological Data	• Tablet Device
Routes of ingress and egress?	• Named Areas of Interest • Collateral Damage Assessment • Disposition of Blue Forces • Blue Force Resources • Combat Effectiveness of Blue Forces • Local Situation • Risk and Threat Assessments • End State • Stated Objectives • Operations Plan • CUBs / BUBs • Prioritized friendly COAs • Prioritized EN COAs • Operational Design (Control Measures / Decision Points) • Disposition of EN Forces • Enemy posture • Enemy vulnerabilities • EN level of resistance • EN combat power • Projected EN breach points • Likely EN avenues of approach • EN patterns of movement • EN doctrine • EN Centre of gravity • EN force composition • EN C2 systems • EN Weapons Systems (location, numbers, types, amount of ammo, types of vehicle) • Effects of terrain on Communications • Safety of routes • Type of terrain • Features, High Ground, Conditions, etc • Projected areas of EN detection • Vital Ground • Meteorological Data	• Tablet Device • Digital Voice Communication Channels

Decisions	SA Requirements	Design Concept
What type of terrain?	• Type of Terrain	• Tablet Device
What are the features of the ground?	• Features, High Ground, Condition, etc…	• Tablet Device
What is the area of operations?	• Commander's Intent and Guidance • Stated Objectives • Operations Plan • Operations Order • Operational Design (Control Measures / Decision Points)	• Tablet Device • Digital Voice Communication Channels
What are the key terrain / vital ground?	• Vital Ground	• Tablet Device
What is the weather impact?	• Meteorological Data	• Tablet Device
What should the gross control measures be?	• Risk and Threat Assessments • Commander's Intent and Guidance • End State • Stated Objectives • Operations Plan • CUBs / BUBs • Operations Order • Prioritized friendly COAs • Prioritized EN COAs • Information Briefs • Decision Briefs • Mission Rehearsal Results • Campaign Design • Operational Design (Control Measures / Decision Points)	• Tablet Device • Digital Voice Communication Channels

5. Discussion

The goal of this tasking was to conduct a CTA to identify potential tools and capabilities that would allow the Battle Group Commander command and lead more efficiently and effectively while away from the Main CP and in the TAC CP. To accomplish this goal a Goal Directed Task Analysis approach was used, in conjunction with a scenario, to extract the required information from the subject matter experts. A total of 74 SMEs from 1, 2, and 5 Canadian Mechanized Brigade Group and the Command and Staff College took part in this tasking.

This project utilized a GDTA approach to help identify tools etc. that could help the BG CO command more effectively. This method was chosen as GDTA are not tied to how the CO currently operates. Given that the CO has extremely limited connectivity at the TAC CP the need to avoid tying what the BG CO uses now was not an issue. The Applied Cognitive Task Analysis (ACTA) method may have been an equally effective approach to determining tools that could help the Commander in the TAC CP as ACTA could follow the OPP and battle procedure currently used by commanders. When conducting a GDTA the first step is to identify the overall goal and the major goals that are involved in achieving the overall goal. Determining the goals of the BG commanders was not as straight forward as one may suspect. Research on commanders quickly led to articles on leadership, command style, etc. but not to what are the commander's superior goals. After considerable discussion and thought the overall goal of *Command and Leading* was identified. Underneath this main goal the preliminary sub-goals such as *Sense-making / Monitoring, Provide Direction, Develop Plans, Execute Plans, and Assess and Analyze* were proposed. These goals and sub-goals were developed and validated in the first block of interviews. Some SMEs suggested using the OODA loop processes (Observe, Orient, Decide and Act) as major sub-goal categories but the processes embedded in the OODA were captured in the sub-goals of the proposed GDTA. Given the nature of GDTA the first block of SMEs could have indicated a set of different sub-goals such as, *Provide Stability and Support Operations, Conquer the Objective, Minimize Casualties, and Negate the EN threat,* etc. Even with these different starting points it is likely that the final goals and sub-goals may have been similar to ones identified. The structure of the GDTA hierarchy evolved over the course of the GDTA; for example the original sub-goal of assessing and analyzing is not a goal unto itself but an activity in a goal. GDTA is a tool to help the investigator support the goal of the research and GDTA did permit the identification of tools that could help the BG CO command more effectively.

Currently, the BG CO has very limited access to digital information while commanding in the TAC CP; the BG CO only has access to physical maps, manually updated traces and the Command Net Radio (CNR). Once the BG CO leaves the Main CP, the maintenance of the CO's understanding of the Common Operating Picture (COP) is challenging and labour intensive. A major element that differentiates that Main CP from the TAC CP is the number of personnel manning the two CPs. There are relatively large numbers of personnel at the Main CP that perform the information collation, data analysis, coordination and planning activities for the BG CO. The staff manning the TAC CP is very small in number and as a result the TAC CP depends on the Main CP for many of the BG's command and control functions. Due to the digital divide, digital products produced at the Main CP must be converted to analog products for consumption and use at the TAC CP and BG sub-units. While the Tactical Battle Management System (TBMS) will improve digital connectivity at the combat team level, a number of the collaborative tools identified in this study are not part of the TBMS project. The fielding of LCSS-LE must include the TAC CP as well as sub-unit HQs and other vehicles.

The SMEs also identified a significant amount of trust between the BG CO and their staff to perform all of the command and control functions. It is not unexpected that the tools selected by the SMEs suggests the major role of the BG CO while in the TAC CP is to monitor the AO and only provide brief direction and guidance while allowing the staff to do the more detailed work. It is unknown whether the BG CO would rely as heavily on the staff if the Canadian Army was engaged in more conventional warfare and the size of the Main CP was reduced. This is primarily why the scenario during the interviews had a backdrop that was similar to more conventional warfare in an attempt to dissuade the tendency to identify the needs of the BG CO only during COIN operations.

The SMEs identified the need to retain a mobile TAC CP, one with a signature that is similar to other mechanized platoon-sized units. The SMEs were not supportive of fielding specialized TAC CP vehicles that were noticeably different from the common vehicles in their BG. The need for a tool that could be used with any vehicle and could be used when the CO was on foot and away from his vehicle was identified. While a tablet-sized system was suggested, the size, battery requirements etc. was not addressed in this study.

This CTA identified differences amongst the SMEs as to the level and detail of information that they would like pushed to the TAC CP. Anecdotally, the more experienced officers (with increased BG experience) tended to leave most of the analysis to the staff at the Main CP and demanded more processed information at the TAC CP. This was contrary to the more junior officers who requested more raw data and had a tendency to do more analysis themselves while in the TAC CP. Given the limited numbers of COs or previous COs who participated in this study, the results may be skewed to more rather than less functionality. The UCOM program should verify and validate the results of this study.

The researchers in this study explored the command style of the SMEs was by issuing a command style questionnaire. This questionnaire required the SMEs to indicate their command style across 13 different traits on a bipolar 7-point scale. The results of this survey suggest that there are recognizable differences in command styles within the CF. Therefore, any tool / capability developed for the BG CO while in the TAC CP should have a level of adaptability that will accommodate a range of different command styles.

After conducting interviews with 74 past, current, or future BG COs two recurring tools were identified that would aid the BG CO to command and lead their battle while in the TAC CP. One of the tools identified was tablet device that would have a screen size the same as most current tablet devices (i.e. 9" – 10") with SOTM capability. The SMEs indicated that this tablet device would be the primary means of receiving information from the Main CP and the means that the common operating picture that is present at the Main CP is sent to the TAC CP. The tablet would allow the BG CO to view all the overlay traces needed for their current SA and allow the BG CO to relay their intent and guidance back to the Main CP and down to the combat teams. All of the SMEs indicated that the tablet device must be portable, easy to use, have the ability to draw free hand sketches on a whiteboard or over a map, have a collaboration application, and able to send and receive data. These capabilities should become mandatory requirements for any tools given to the BG CO while in the TAC CP. The second tool that was unanimously selected was a new non-CNR digital voice/data communication channel. Currently, the only means of communication to the TAC CP is through CNR. The SMEs noted that the CNR is not effective for operations against a near peer. Due to the staff-centric Main CP the SMEs identified a number of instances where the BG CO needs to communicate with voice for extended periods of time for planning and administrative tasks. Due to security concerns communicating over CNR for extended periods of time is not suitable and it also potentially increase the cognitive workload at the combat team level due to over exposure of information that is not relevant to their task. A digital means enables improved capabilities for multimode communication and collaboration, such as web conferencing. The majority of SMEs did

indicate that the BG CO requires a collaborative working environment between the TAC CP, the Main CP, and the combat teams. In order for this collaborative workspace to be fluid and seamless a common platform for information sharing should be established.

The key capability that the BG CO requires when they are away from the Main CP is access to updated information. Currently BG position updates are performed manually at the TAC CP. The UCOM project should provide blue force position updates. The consensus among the SMEs was that the UCOM project should support the commander's SA needs, i.e. the system should overlay traces of the enemy troops, the features of the terrain, location of coalition forces, and information on the civilian population. The SMEs identified the need to manage what and how this information should be viewed, the need to turn on and off traces, aggregate and de-aggregate units, etc. There were varying opinions on what information should be pushed to the TAC CP. There were a number of SMEs that suggested that all of the information present at the Main CP should be pushed to the TAC CP and leave the responsibility of filtering it to the BG CO and the staff at the TAC CP. Another option that was suggested by a group of SMEs was that the BG CO should only be pushed information that had already been analyzed at the Main CP. This would reduce the overall workload of the TAC CP but will also eliminate any potential inferences of the raw data from the BG CO and the staff at the TAC CP. Lastly, it was suggested that the information sent to the TAC CP be analyzed to a certain degree with the capability of the BG CO to access the raw information if they needed to. Therefore, all of the information isn't constantly being pushed to the TAC CP but it is still available to be pulled from the Main CP if the BG CO needs to access it. Further studies should assess the impact of differing the levels of information presented to the BG CO in the TAC CP has on his ability to command, lead, and maintain situational awareness of the battlefield.

Another capability that was unanimously agreed upon by the SMEs was that a collaborative tool has to be fielded by the UCOM project. There was no clear indication as to the level of collaboration that this tool should have, some SMEs indicated that the collaboration should be in the form of a 'shared pen' where when one user is altering the shared white screen the others can see and update it simultaneously. Other SMEs suggested that it should not be a 'shared pen' but instead have the initial user send their information to the other users who could then update and send back. This example does not allow anyone else to view the real-time changes until the initial user is finished. Finally, another level of collaboration that was suggested by the SMEs is composite of both prior options. In this case only one user is able to modify the screen while the others can only watch until the user is finished. This option tended to be the preferred level of collaboration for most of the tasks since it prevents multiple people from working on the same thing at the same time and it is more efficient than the method of sending updated information. However, since there was no clear consensus on the level of collaboration the impact of the different levels needs to be further evaluated.

The GDTA identified a number of tools that could allow the CO to command more effectively. The utility of supplying TransVerse Chat, ORION database links, access to the internet, UAV video display, FLOCARK tool, movement tool, and a rehearsal tool needs to be validated in further studies.

5.1   Limitations

No research study is performed without limitations. One of the limitations to this study was that formal pilot interviews were not conducted. It was the intent to pilot our interview method with a subset of SMEs prior to conducting the formal interviews. Due to time constraints and scheduling this was unable to occur but the initial interviews were treated as pilot, as well as, a formal interview. The initial interviews at CFB Edmonton formed the foundation of the structure of the interviews that were conducted at the subsequent bases. Similarly, once the formal interviews were conducted no

validation of the GDTA was conducted. Again, due to scheduling and time constraints there was no time to conduct any validations interviews. Therefore, the interviews at the Command and Staff College served both validation and formal interview purposes. However, across the 70+ interviews there was a large amount of consistency on the goals and tasks that a BG CO conducts while they are away from the Main CP and in the TAC CP. Therefore, each subsequent interview acted as a validation of the previous interviews. Whenever you conduct a study there is always the risk that the participants you have recruited are not representative of the entire population. Due to the consistency of the responses to our interview questions and the consistency amongst the recommended tools and capabilities there is confidence that the SMEs were representative of the entire population of BG COs in the CF. Given the experience level of some of the participants especially in training for operations against a near-peer, the tools recommended in this study should be validated.

6. Conclusion

As a result of conducting over 70 interviews with past, present, and future BG COs it was confirmed there are tools that could make the BG CO more effective while operating out of the TAC CP. At present there is a digital divide between the TAC CP and Main CP at the BG level. The SMEs identified a number of tools or capabilities that would help them command more effectively and efficiently while on the move.   These capabilities can be summarized in no particular order as follows:

- Tablet device with the following capabilities,
- Digital map,
- Static and Dynamic (hand drawn) sketch function with zooming capabilities,
- Possible integration of pattern recognition software to aid in planning (pattern recognition for icon shapes),
- Ability to view different overlays of SA traces (red, blue, green, brown, and white),
- Stop-light like system for displaying combat status,
- Ability to aggregate and de-aggregate combat icons for more information,
- Ability to zoom in and zoom out of a map (similar to Google Earth / Maps),
- Shadowing for features and elevations,
- Private text messaging system (TransVerse),
- Video tele-conferencing (VTC) (high definition and secure),
- Ability to open up several types of documents (.doc, pdf, excel),
- Portable and easy to use,
- Ability to send and receive information,
- Collaborative planning function with a shared screen and shared pen to the Main CP and the other vehicles of the TAC CP,
- Ability to access saved files (i.e. doctrine, templates, reference documents, handbooks, etc.),
- Access to Internet,
- Access to databases (Orion wiki),
- Geographic Information System (GIS),
- Pop-up alerts for incoming messages or updated traces,
- Ability to receive and review formal orders,
- Ability to participate in a collaborative rehearsal (ROC Drill),
- Table of asset availability,
- Ability to perform a 3D virtual terrain analysis, and
- Ability to assess ground, time, and space (Flocark, movement time estimator, etc.)
- Digital Voice Communication Channels (i.e. VoIP)
- Planning and Administration channel,
- Multi-node communication,
- Duplex communication, and
- Ability to communicate to the Brigade or higher echelons.

6.1　Future Direction

Even though the SMEs identified only two tools that would be beneficial to the BG CO there were a number of capabilities identified with various options of implementation. For example, one of the capabilities identified was a collaborative planning function but the level of collaboration can be scaled from just having a shared screen to full collaboration with a shared screen, shared pen, with virtual face-to-face tele-conferencing. Similarly, the digital voice communication channel was suggested to be multi-node but the impact of multi-node versus dual node on bandwidth was not been studied. Therefore, further studies are required to assess the impact these tools with varying capabilities has on the cognitive workload of the BG CO and their ability to maintain a high degree of situational awareness of the battlefield. These studies should evaluate the capabilities through a wide spectrum of operations (i.e. from peace keeping mission to near-peer conventional warfare). Similarly, the capabilities should be evaluated across all of the different tasks that the BG CO performs. This should allow a more thorough analysis of the capability and provide a more judicious recommendation for future capabilities.

7.   References

Alex, C. (1998). Process and Procedure: The Tactical Decision-making Process And Decision Point Tactics. Retrieved on 25 March 2014 from www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA383921 .

Arnold, A. (2006). XML Tactical Chat (XTC): Extensible Messaging and Presence Protocol For Command And Control Applications. Retrieved on 25 March 2014 from http://www.dtic.mil/dtic/tr/fulltext/u2/a456926.pdf.

Department of National Defence (1996). Land Force: Volume 3: Command. B-GL-300-003/FP-000; 1996-07-21. Ottawa: DND Canada.

Department of National Defence (2002). Joint Doctrine Manual: CF Operational Planning Process. B-GJ-005-500/FP-00; 2002-11-06. Ottawa: DND Canada.

Department of National Defence (2007). Land Operations 2021: Adaptive Dispersed Operations – The Force Employment Concept for Canada's Army of Tomorrow. Ottawa: DND Canada.

Department of National Defence (2007). Command in Land Operations.. B-GL-300-003-FP-001. Ottawa: DND Canada.

Department of National Defence (2008). Land Operations. B-GL-300-001-FP-001. Ottawa: DND Canada.

Department of National Defence (2008). Command Support Operations. B-GL-331-001-FP-001. Ottawa: DND Canada.

Department of National Defence (2008). Staff Duties for Land Operations. B-GL-331-002-FP-001 Ottawa: DND Canada.

Department of National Defence (2008). The Canadian Forces Operational Planning Process (OPP) Change 2. B-GJ-005-500/FP-000. Ottawa: DND Canada

Department of National Defence (2009). Bounding the Force Employment Concept. DRDC CORA TM 2009-003. Ottawa: DND Canada.

Department of National Defence (2009). Toward Land Operations 2021: Studies in Support of the Army of Tomorrow Force Employment Concept. B-GL-310-001/AF-001. Ottawa: DND Canada.

Department of the Army (2012). ADRP 5-0 The Operations Process. Washington, DC, United States of America.

Department of the Army (2009). Tactical Chat: Multi-Service Tactics, Techniques, and Procedures for Internet Tactical Chat in Support of Operations. Retrieved on 25 March from http://publicintelligence.net/tactical-chat/. Washington, DC, United States of America.

Department of the Army (2006). Field Manual 6-22 Army Leadership: Competent, Confident, and Agile. Washington, DC, United States of America.

Department of the Army (2005). Field Manual 5-0 Army Planning and Orders Production. Washington, DC, United States of America.

Duffy, L., Bordetsky, A., Bach, E., Blazevich, R. and Oros, C. (2004) A Model 0f Tactical Battle Rhythm. Retrieved on 25 March 2014 from www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA466128 .

Endsley, M.R. (1995). *Theoretical underpinnings of situation awareness: A critical review*. In Proceedings of the International Conference on Analysis and Measurement of Situation of Awareness. Daytona Beach, FL, Embry-Riddle University.

ESRI (ND). A Multicomputing Software Environment for ArcInfo Visibility Analysis. Retrieved on 25 March 2014 from http://proceedings.esri.com/library/userconf/proc02/pap1253/p1253.htm.

Hoffman, R. (2005, May). *Protocols for Cognitive Task Analysis.* Online article available at: http://www.ihmc.us/research/projects/CTAProtocols/ProtocolsForCognitiveTaskAnalysis.pdf.

Jones, D.G., & Endsley, M. R. (2005). Goal Directed Task Analysis. In R. Hoffman, *Protocols for Cognitive Task Analysis* (pp. 77 – 89). Retrieved from http://www.ihmc.us/research/projects/CTAProtocols/ProtocolsForCognitiveTaskAnalysis.pdf.

Jones, R., Connors, E., Mossey, M., Hyatt, J., Hansen, N., Endsley, M. (2010). Modeling Situation Awareness for Army Infantry Platoon Leaders Using Fuzzy Cognitive Mapping Techniques. Retrieved on 27 March from http://cc.ist.psu.edu/BRIMS2013/archives/2010/papers/10-BRIMS-139%20Jones.pdf.

McDermott, P. and Allender, L. (2010) Advanced Decision Architectures for the Warfighter: Foundations and Technology. Retrieved on 26 March 2014 from http://bldr-webtest.alionscience.com/AdaCta/Chapters/FM%20Files/20Strater.pdf .

Public Works and Government Services Canada (2013). Satcom On The Move (SOTM). W8486-134035/A). Retrieved from https://buyandsell.gc.ca/procurement-data/tender-notice/PW-RA-002-24119 .

Sajo, J. (1988) The Command Post: A Comparison of Tactical Command Post Doctrine of the US and Soviet Armies. Thesis. Naval Postgraduate School. Monterey, California.

Stewart, K.G. (2006). *Mission command: Elasticity, equilibrium, culture, and intent.* DRDC T No. 2006-254, Toronto, ON: Defence R&D Canada.

Thales Canada (ND). Tactical Battle Management System (TBMS). Retrieved on 25 March 2014 from http://partners.esri.com/PartnerDetail?id=a2T70000000TNgQEAW&solId=a2d70000000iTceAAE

Thales Canada (ND). Land Command Support System.). Retrieved on 25 March 2014 from http://www.spatialbridge.com/lcss/

United States Joint Forces Command Joint Warfighting Center (2004). Commander's Handbook for Joint Battle Damage Assessment. Retrived on 25 March 2014 from http://www.dtic.mil/doctrine/doctrine/jwfc/hbk_jbda.pdf
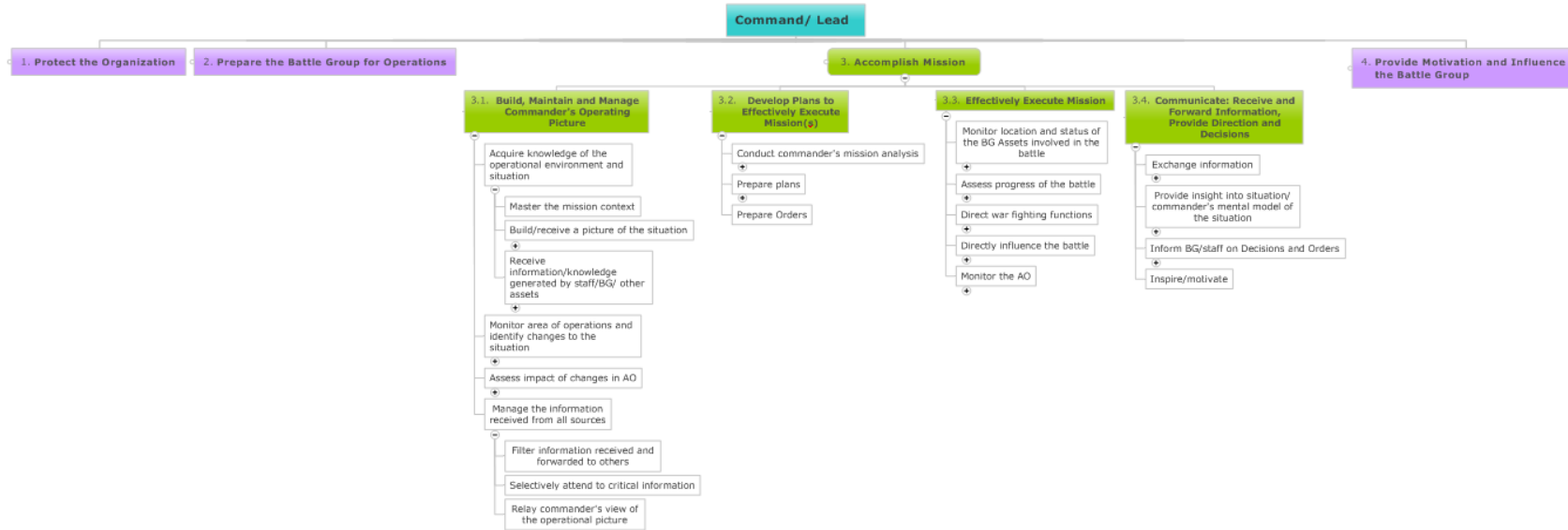
Annex A:

Figure 21: GDTA map of command on the move

This page intentionally left blank.

List of Acronyms/Abbreviations

ADO	Adaptive Dispersed Operations
AGM	Attack Guidance Matrix
AO	Area of Operation
ASCC	Airspace Coordination Centre
ASIC	All Source Intelligence Centre
BDA	Battle Damage Assessment
BG	Battle Group
BG CO	Battle Group Commanding Officer
BLOS	Beyond Line of Sight
BN	Battalion
BUB	Battle Update Brief
C2	Command and Control
CCIR	Commander's Critical Information Requirements
CDA	Collateral Damage Assessment
CDR	Commander
CF	Canadian Forces
CFB	Canadian Forces Base
CIMIC	Civil-Military Co-operation
CMBG	Canadian Mechanized Brigade Group
CNR	Combat Net Radio
COA	Course of Action
COIN	Counter-Insurgency
CONOPS	Concept of Operations
COP	Common Operating Picture
COS	Chief of Staff
COTM	Command On-the-Move
CP	Command Post
CTA	Cognitive Task Analysis
CUB	Commander's Update Brief
CVTB	Conceptual Vehicle Testbed
DCO	Deputy Commanding Officer
DO	Duty Officer
EIFF	Essential Information Friendly Forces
ESCC	Engineering Support Coordination Centre

EN	Enemy
FLOCARK	Features, Lanes, Objectives, Canalizing Terrain, Avenues of Approach, Ratings of Approaches, Key Terrain / Vital Ground
FRAGO	Fragmentation Order
FSCC	Fire Support Coordination Centre
GDTA	Goal Directed Task Analysis
GIS	Geospatial Information System
HF	Human Factors
HQ	Headquarters
IA	Iraqi Army
Int O	Intelligence Officer (G2)
JAG	Judge Advocate General
LCSS	Land Command Support System
MiTT	Military Transition Teams
NAI	Named Area of Interest
OC	Officer-in-Charge
OPP	Operational Planning Process
Ops O	Operations Officer (G3)
Plans O	Planning Officer (G5)
ROC	Rehearsal of Concept
ROE	Rules of Engagement
RSM	Regimental Sergeant Major
SA	Situational Awareness
SC2PS	Sensor Command and Control Planning Suite
SDO	Senior Duty Officer
SITREP	Situation Report
SME	Subject Matter Expert
SOTM	Satellite Communication On-the-Move
SOW	Statement of Work
TAC CP	Tactical Command Post
TAI	Target Area of Interest
TBMS	Tactical Battle Management System
TIMS	Tactical Information Management System
UAV	Unmanned Aerial Vehicle
UCOM	Unit Commander on-the-move
VOIP	Voice Over Internet Protocol
VTC	Video Tele-Conference
WWW	World Wide Web