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Coalition Command and Control in the Networked Era

C^2 Team Collaboration Experiment II – A Study on Teams in a CPoF environment

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Abstract

Sweden and Singapore have an ongoing C2 development research collaboration and the purpose of this second command and control team collaboration experiment (TCX 2) was to compare 3-level and 2-level integrated mission (frago) planning. Participants from Sweden and Singapore formed a Force HQ, an Army Brigade Staff and two Mechanized Battalion staffs and planned two different missions using two different applications of the new Swedish Armed Forces Integrated Planning Under Time-pressure (I-PUT) model, aided by new C2 technology. The scenario was a UN peace enforcement operation and TCX2 was part of a larger tri-service demonstration exercise held by the SwAF. The experiment showed that the 3-level integrated planning condition resulted in a higher level of mutual understanding of intent and a higher level of commitment across echelons, earlier in the planning process compared to the 2-level integrated planning at a time condition. Moreover, 3-level integration also resulted in considerably faster planning without compromising the quality of the plan compared to traditional planning output, and maybe most important of all, a considerably earlier start of execution out on the field. The participants also rated the 3-level integrated planning model as more time-efficient and effective for use under realistic planning conditions.

Introduction

The merits of parallel planning across echelons of command have long been recognised by many armed forces. Military planning manuals produced by the US Army (2005) and Multinational Planning Augmentation Team (2006) advocate the use of parallel planning between echelons of command, with the main motivation being to provide maximum planning time and flexibility to subordinate units. The Singapore Armed Forces (SAF) conducts parallel planning through the issuance of Warning Orders, as well as co-ordination meetings between a Command Headquarters and its subordinate units. The commanders and principal staff officers of the subordinate units sit in at the higher HQ for these scheduled briefs to better understand the enemy picture and Commander's intent prior to being issued with a formal Operations Order. This mode of parallel planning allows the Commander and his staff to bring this information back to their respective units early so as to gain a time advantage which can be better used to facilitate preparatory work for the eventual Operations Orders.

With the advent of network-enabled forces, it is possible today for military headquarters at different levels of command to be equipped with commercial collaborative tools, allowing them to look at the same situation map, discuss, draw, and conference with one another as if they were located in the same room. This has paved the way for a more *integrated* planning process, allowing staff at the different echelons to *plan at the same time without the need for Operations Orders*, all while remaining with their respective units such that command responsibility can still be exerted while interacting with the higher HQ. The SAF Centre for Military Experimentation (SCME) has conducted an experiment that implements integrated parallel planning across two echelons. This experiment (Cheah and Fong, 2006) built upon the work done in Team Collaboration Experiment (TCX) 1 (Cheah, Thunholm, Chew, Wikberg, Andersson & Torbjörn, 2005) which was jointly conducted with the Swedish Armed Forces (Sw AF), and elucidated some benefits of two-level integrated parallel planning as compared to the traditional hierarchical process with issuance of Operations Orders.

The primary benefit of integrated parallel planning is invariably the compression of the planning cycle, thus creating the increasingly precious resource of *time*. The additional time available for planning, especially at the lower echelons, could in turn be invested in detecting

weak signals and developing different interpretations of enemy intentions based on their disposition, as well as an own course of action with sufficient flexibility and robustness to support alternatives. Klein (2003) developed a particular technique known as the Pre-Mortem for the purpose of drawing on the *divergent views* of a team to critique their plan before execution as a way of anticipating surprise. This technique may payoff especially in an integrated parallel planning process, as staff at different echelons would view the plans through their individual lenses coloured by their respective experiences, concerns, and expert knowledge, thus providing the base for potentially rich discussions.

Another benefit of integrated parallel planning is in achieving a higher degree of *common ground* between echelons in terms of their understanding of commander's intent, as well as the developing situation and enemy intent. The underlying assumption is that there is some transfer loss during the short verbal exchange of Operations Orders and clarification between echelons that could perhaps be mitigated through the integrated parallel planning process. The integrated parallel planning process aims to maximise the opportunities for the alignment of command intent as described by Pigeau and McCann (2000), namely to trigger increased externalisation (through questions asked) of implicit intent, as well as to create opportunities for extended dialogue between echelons to share explicit intent such that a common understanding is achieved through the planning process. We believe that with better common ground between echelons early on in the planning process, the fighting units (ie: the Battalions) would be better prepared and committed to the battle ahead of them.

Armed with these promising benefits of integrated parallel planning, the next question in our minds was: could we perhaps stretch the model of integrated parallel planning and extend these benefits across three levels of command? The idea of three-level integrated parallel planning would, of course, have to be applied as an exception rather than a rule since it would be difficult to conduct integrated planning with so many sub-teams. A Force HQ (FHQ) Command with three Brigade Command Teams, each in command of three Battalion Command Teams, quickly adds up to a total of thirteen disparate Command Teams. It would be very difficult, and probably not desirable, to conduct integrated planning with this number of disparate teams. Furthermore, how would the Battalion Commander fit into the integrated planning process when the FHQ/Division is just at their initial planning stages and have not yet decided on the boundaries and task allocation to subordinates, i.e. the Brigade HQ?

One application, and perhaps a condition, for three-level integrated planning is when the Battalion(s) have been in the theatre of operations for quite some time and are experts regarding the ground conditions as well as the adversary and neutrals. Another condition is that there is a special task for the Battalion that requires it to be directly under the command of the FHQ for a period of time before it is returned back to the Brigade Command, for example, in securing a position to defend against the enemy reserves from interfering with a Brigade fight. A third condition, perhaps, is when a Battalion Command would be given a staff responsibility of a Brigade planning team since the Battalion is really not needed in the planning process as yet. For example, the first battalion command team could augment the Brigade S3's role in developing several courses of action, and the second battalion command team could augment the Brigade S2's role in developing several enemy courses of action, and the third battalion command team could augment the Brigade Fire Officer's role in developing several strike and fire packages. All three conditions would give rise to greater commitment by the battalion's staff in three-level integrated planning since they would be stakeholders in the discussion.

The three conditions articulated above could possibly be applied to even today's C2 warfare. It would thus be beneficial to develop an experiment to discover the intricacies of three-level integrated planning, which would hopefully lend greater clarity as to how it may be applied to improve the current process of military planning. Team Collaboration

Experiment (TCX) 2 was thus developed to investigate whether a three-level integrated planning process has similar or improved merits over the tested two-level integrated planning process as described above.

Team Collaboration Experiment 2

TCX 2 was part of a larger Swedish Armed Forces Network-Based Defence demonstration exercise (NBD Demo 06 Spring), which is held twice per year. NBD Demo 06 Spring included staff units and platforms from all services of the Swedish Armed Forces, involving about 400 participants in total. A Singapore Battalion (Bn) staff was invited to participate in Demo 06 Spring, and the TCX 2 portion of the Demo involved (1) a part of the Force Head Quarter (FHQ) comprising Land Forces planning and coordination function representatives, (2) a part of a Mechanized Brigade (Bde) HQ (Chief of Staff, Plans, and Tactical Operations center representatives), (3) a Swedish Mechanized Bn staff, and (4) a Singapore Armored Bn Staff.

The purpose of TCX 2 was to investigate whether it was feasible for the three levels of the command team (FHQ –Bde –Bn) to plan integrated, or if it would be more effective for the command team to plan integrated only two levels at a time (i.e. FHQ - Bde would discuss first and thereafter Bde – Bn discussion is conducted for the Bde to translate and cascade each step of the planning process to the Bn), using the Integrated Planning Under Time-pressure (I-PUT) model. The experiment used the context of a realistic UN-mission peace enforcement scenario, with a need for the Bn to come up with a Fragmentary Order (FRAGO) in time-pressured conditions, as is often the case in real life operations. It is important to note that the I-PUT model, besides a new planning process technique, also takes into consideration the new technical advancements in the C2 area. The methods section will describe the I-PUT model as well as the two different integrated planning applications.

Earlier studies on integrated parallel planning as referred to in the introduction, formed the base for some formal hypotheses. We expected that three level integration (FHQ –Bde – Bn), when the Bn CO/Staff can participate from the beginning of the planning process together with the Bde CO/Staff and the FHQ Staff, as compared to two-level at a time integrated planning would result in:

- Faster planning, i.e. it should take less time in total for the Bn to come up with and issue its FRAGO, (Hypothesis H1).
- Higher sense of plan confidence based on the fact that all levels have been able to discuss and wargame the plan together, (Hypothesis H2).
- Bn Cdr's should have better, and earlier, understanding of the intent of the Force Commander because they can communicate directly with the Force Commander (or his representatives in the FHQ) without the Bde as a "filter". This advantage actually works two-ways, because the FHQ will also get a better understanding of the intent of the Bn Commanders. We define this as common ground and hypothesize that common ground will be improved as a result of 3-level integration during planning, (Hypothesis H3).
- Bn Cdr's should also be more committed to the plans developed at an earlier time because the constant dialogue with the FHQ and Bde would allow new directions to be communicated and committed to quickly, (Hypothesis H4).
- More divergent views within the planning team that arise from the staff members' increased understanding of plans across echelons. The dialogue across three echelons would also provide a means for them to influence the team to consider the differing views. (Hypothesis H5)

We also expected the participants to find the three level at a time application of I-PUT as more effective during the scenario conditions that require a FRAGO to be issued as soon as possible, (Hypothesis H6). We did not however expect to find any differences in the quality of

the plans, in particular concerning the tactical content, clarity, and completeness of the plan. These factors should not be related to how integrated the planning process is between different hierarchical levels, but are determined more by other factors such as the command team's level of experience and habit.

Method

Participants

The participants comprised a composite team of SwAF and SAF officers. The 15 participants were assigned to staff the key roles within the FHQ (2 participants), a subordinate Bde (3 participants), and two subordinate Bn (5 participants in each). The same group of 15 participants went through both experimental conditions resulting in n = 15. Due to technical problems, we could not always register data from all participants and this is the reason why some of the statistical tests (at the individual participant level) have less degrees of freedom than it should have been if all participants were included in the tests. The participants' mean age was 36.1 years (min = 26, max = 51, SD = 7.1), and they reported an average of 15.8 years in the armed forces (min = 2, max = 32, SD = 7.7). The participants who staffed the FHQ for the purpose of this experiment did not have any prior experience with planning at FHQ level. The participants who staffed the Bde reported having been involved in an average of 35 planning processes at the Bde level (min = 15, max = 55, SD = 20), the most recent being 3.1 months ago (min = 0.25, max = 6, SD = 4.1). The participants who staffed the Bn reported having been involved in an average of 31.8 planning processes at the Bn level (min = 1, max = 150, SD = 47.0), the most recent being 33.8 months ago (min = 1, max = 120, SD = 44.0). 5 of the participants also reported real-life experience in peace-keeping or peace-enforcement operations, including Bosnia-Hercegovina, Kosovo, and East Timor.

This group of participants are generally experienced at the level of planning they were tasked to do for the experiment, with the exception of the FHQ participants. The inexperience of the participants who role-played the FHQ for this experiment was somewhat mitigated by having them function as part of a larger FHQ that was staffed with other Demo participants.

Design

The study was designed as an experimental comparison with repeated measures. The *independent (experiment) variable* was an application of the I-PUT model with two different planning conditions.

Condition 1 – was for the participating staff units to follow the Integrated Planning Under Time-pressure (I-PUT) model and plan, two levels at a time (FHQ-Bde and Bde-Bn), in a more traditional application of parallel planning. Higher levels should "think ahead" and develop a draft as a base for dialogue before interacting with subordinates. No interactions between Bn-FHQ were allowed and the Bn could not "listen in" on the dialogue between the FHQ and the Bde. Both conditions are further detailed in the I-PUT model section.

Condition 2- was for the participating staff units to apply the I-PUT manual and plan with all three levels integrated. The idea was for all participating staff levels to concentrate on the needs of the Bn Cdrs. Focus during the planning process should be for the higher HQ's to support the Bn in their production of Bn orders, with less emphasis on the higher levels' orders production.

Dependent variables were (a) planning and execution tempo, (b) plan confidence, (c) mutual understanding of intent and plan, (d) commitment towards the plan, (e) dissent, (f) planning model application and evaluation, and (g) plan quality. The measurements taken on these seven main dependent variables are described in detail in the measurements section. Some background variables and confounding variables were also included in the design and

measurements on those are also described in the measurements section. The study design included (I) a formal training session on the I-PUT and the C2-system of 1 + 2 days, (II) an applied scenario-based training session of 1.5 days for the Singapore Bn and 3.5 days for the Swedish FHQ, Bde and Bn, and finally, (III) two runs or test-sessions, (planning and execution of plan) of 1 + 1 day. This design allows for a formal experimental comparison between the two different applications of the I-PUT model. The weakness of the design is that the participants may "mature" between Run 1 and Run 2, resulting in so called "maturation effects". This threat to the validity of the results was countermeasured in two ways. First, by investing a considerable amount of time on training before Run 1, including familiarization with all questionnaires and routines of the measurements. Secondly, by increasing the complexity of the scenario between Run 1 and 2, but still keeping the same level of uncertainty, information and available time for planning in the two scenarios.

Measures

The variables were measured using a set of participant questionnaires and observer protocols. The observers comprised both SwAF and SAF military personnel as well as civilians from SCME.

Background variables. At the end of Run 1, the participants answered a questionnaire on general background factors. They were asked to provide information regarding their age, number of years in service in the armed forces, level of experience with planning at the FHQ/Division, Bde, and Bn levels, and if they have any real life experience in peace-keeping or peace-enforcement operations.

Confounding variables. The two major confounding variables measured during the experiment were the *realism of the scenario* as well as *system failure*. Participants answered questions on both these confounding variables at the end of each experiment run. Four questions were asked to determine the degree to which the participants believed that the scenario was realistic with regard to (a) the story, (b) the amount of information presented, (c) the amount of time provided for planning, and (d) the level of uncertainty. Each item was judged on a six-point Likert scale ranging from 1 (Less than realistic) to 6 (More than realistic). Participants were also asked if they encountered any significant problems with the systems used during the run. If so, they were asked to briefly describe the problems.

Dependent variables. A description of how each of the dependent variables was measured is given below. The experimentation team took care to administer the respective questionnaires at comparable stages in the planning/execution phases across the experiment runs.

- Planning and Execution Tempo - Eight observers used observer protocols to document the starting and ending time of the major steps defined by the I-PUT model, in particular the interactions across echelons regarding the preliminary end-state, the development of Concept of Operations (CONOPS), and issue of FRAGO.
- Plan confidence – At the end of each experiment run, the participants were asked to judge on a six-point Likert scale how satisfied they were with their team's plan across six factors: (a) tactical solution, (b) feasibility, (c) thoroughness, (d) necessity of accomplishing the mission as the team intended to do it, (e) ease of convincing a subordinate commander, and (f) ease of convincing superior commander. The response alternatives ranged from 1 (not at all satisfied) to 6 (very satisfied).
- Mutual Understanding – The degree of common ground amongst staff at the different echelons was measured based on their understanding of the intent and concept of operations developed by the FHQ, Bde, and both Bns. A questionnaire that elicited the participants' free text response to questions regarding the respective intent and concepts of operations was administered twice during each experiment run. The participants were also

asked to rate their confidence level regarding their understanding of each unit's intent on a six-point Likert scale ranging from 1 (Not at all confident) to 6 (Very confident).

- Commitment – The level of participants' commitment to the plans developed was probed twice during the planning phase. During each probe, the participants were asked to rate on a six-point Likert scale (a) the state of development of the plan, (b) the cost of changing the plans given the investments made, and (c) the feasibility of changing the plans given the perceived time pressure.
- Dissent – The participants were asked twice during the planning phase if they held differing views regarding the team's plans. Their inclination to raise divergent views was also assessed by asking the participants if, supposing they indeed held a different opinion regarding the team's plan, they would attempt to influence the team to adopt their view. The participants had to respond on a six-point Likert scale ranging from 1 (It would not be productive to the team to raise the issue now) to 6 (I would attempt to influence the team now).
- Planning model application and evaluation – In addition to noting down the time profile of the I-PUT as conducted under both experiment conditions, the observers also used observer protocols to document the participants' performance according to the prescribed experiment conditions. The observer protocol also required the observers to note which units participated in the periods of interaction, who initiated the interaction, and if each unit contributed to the discussion or merely listened in.

  The participants were also asked at the end of each experiment run if they considered the application of I-PUT that they had just experienced as time-efficient and effective under realistic field conditions. They were asked to respond on a six-point Likert scale ranging from 1 (Very inefficient) to 6 (Very efficient), as well as provide any comments they may have.

  In addition, the planning process was further assessed by having the participants complete a questionnaire at the end of each experiment run that asked them to make a subjective evaluation of the experiment condition they had just experienced. The participants were also asked to comment on each step of the I-PUT, and to explain any deviations from the prescribed process and interactions.
- Plan quality – The Bn participants were also asked at the end of each experiment run on how they thought they succeeded in producing a good FRAGO. They were asked to rate the quality of the FRAGO in terms of (a) tactical content, (b) clarity, and (c) completeness. Each item was judged on a six-point Likert scale ranging from 1 (Much lower than can be expected) to 6 (Much higher than can be expected). The FRAGOs were also judged in the same manner by an independent rater at the Sw NDC (a teacher in army tactics).

  A questionnaire was also administered to the participants twice during execution in order to gauge how well the planning process had prepared them to deal with the challenges faced during execution. The participants were asked to rate on a six-point Likert scale if (a) the plan had changed significantly since execution started, (b) changes in the situation have necessitated a change of the command intent, (c) there was sufficient discussion during planning as to what might go wrong, (d) the plan is handling the adversary and situation well, (e) the planning process has enabled the team to co-ordinate well during execution, and (f) if the plan was developed to a sufficient level of detail. In light of the execution phase, the participants were also asked to state reasons why the planning process was inadequate to address the problems that they were facing.

Scenario

The Demo 06 Spring exercise scenario was based on the VIKING 05 scenario. VIKING 05 was a multinational exercise on civil-military cooperation conducted in Sweden, December 2005. This paved the way for a realistic and well-proven peace-keeping/peace-enforcement scenario as a base for TCX 2. The outline of the scenario is as follows:

Responding to a United Nations Security Council request (UNSCR), the North Atlantic Council (NAC) has authorised a NATO-led CJTF peace operation in order to implement the Bogaland Peace Agreement (BPA). Commander Bogaland Peace Force (COMBFOR) has been tasked to implement the military aspects of the BPA, in accordance with JFC´s Initiating Directive.

The political and military desired End State is complete implementation of the (fictitious) BPA and UNSCR 2450. The COMBFOR mission in the designated Joint Operations Area is to take command of assigned forces, assume responsibility for the implementation of the UN embargo, and enforce the military aspects of the BPA, including the immediate termination of the hostilities in Bogaland, establish Zone of Separation (ZOS) and thus, creating a secure environment in which civil structures can function effectively, in order to contribute to the consolidation of peace in the area. All forces have deployed in ZOS at the start of Run 1.

The scenario inject developed to trigger the FRAGO planning in Run 1 concerns artillery shooting from a Bn belonging to one of the warring factions. The development of events soon indicates that it is a large artillery unit shooting from positions just outside of ZOS, protected by armored units. This triggers the FHQ to initialize planning with the Bde and the Bde decides to use two of its mech Bn's in collaboration in order to solve the mission of silencing the "enemy" artillery unit. Run 2 had exactly the same starting position as Run 1. This time the inject developed to trigger the FRAGO planning concerns a suspected "ethnic cleansing" in a smaller village just outside the ZOS. There is also a high risk of the conflict spilling over to neighboring villages and there are regular Bn-sized units belonging to one of the warring factions deployed close to the villages. This situation triggers the FHQ to initialize planning with the Bde and the Bde decides to use two of its mech Bn's in collaboration in order to solve the mission of hindering further ethnic cleansing, restore calm in neighboring villages, and locate a suspected illegal prison camp being run by the majority group. The order of battle for BFOR is according to Figure 1.

The functions of an Operational Head Quarters (OHQ) as well as the functions of the adversary, non-governmental organisations and subordinate units to the BFOR were played by an integrated exercise control staff. The staff used a Common Operational Picture tool and a semi-automatic game application to run the exercise in order to provide a realistic but still controllable exercise environment for the participants. This means that the experimenters had full control over injects and other important inputs that were given to the participating units during the experiment.

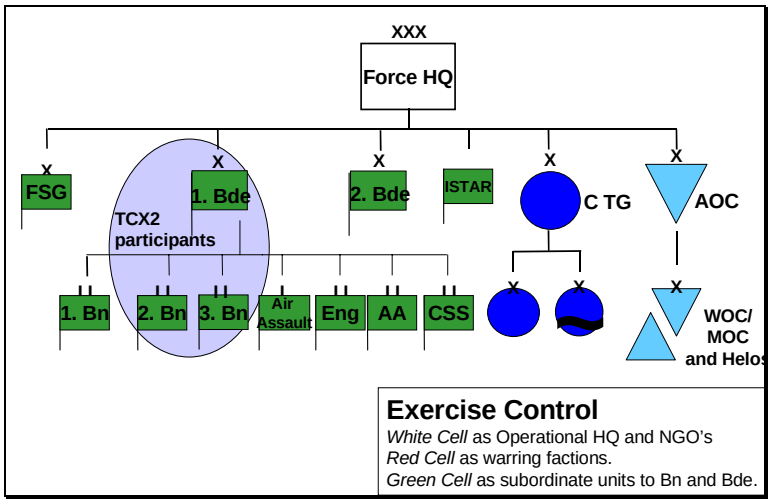

Figure 1. BFOR order of battle with units participating in TCX 2 in the shadowed area. Parts of the FHQ also participated in TCX 2. Exercise control worked as an integrated control unit.

Task

The task for the participating staff units was the same for both runs. An inject would be issued to the FHQ so that it could initiate planning with its subordinate HQs within the overall mission of the BFOR. The temporary task organisation should include the Bde and its 2 mechanized Bn. The instruction was for the FHQ and Bde to develop a CONOPS and for the two Bn to develop a FRAGO consisting of 1. Situation (only 1.a Enemy Forces, 1.b Own Forces); 2. Mission; 3. Execution (3.a Concept of operation including 3.a 1 Commander's Intent, 3.a 2 Endstate, 3.a 3 Criteria for Success, and 3.a 4 Phases and timings; 3.b Tasks, 3.c Firesupport, 3.d Coordinating instructions); 4.Combat Service Support; 5. Command and Signal, (5.a Command and Control).

There was no explicit time-line for the planning, but the participants knew that the scenario run was scheduled to end at 16.30. The participating staffs were tasked to apply different versions of the I-PUT model for each run (for details see the I-PUT section).

Command and Control System

The system used in the experiment was the Swedish Demo System Generation 2 (DSG2) Applications. It is a C4I-system used to create situation awareness and facilitate the command team in mission planning across a range of operational activities such as intelligence updates, courses of actions, co-ordination measures, fire support and logistics.

For TCX 2, the key requirement was for the DSG2 to facilitate collaboration across both 3-levels and 2-levels integrated planning. The DSG2 system was used to collaborate within and between staffs, such as to create situation awareness, to evolve the Common Operational Picture, and to discuss and decide as a team. Collaboration was facilitated by the following interfaces/applications: (1) The Communicator enabled one-to-many chat (all chat is logged). It could also be used for one-to-one audio and video conferencing. (2) X-lite was used to enable telephone conference, one-to-many speech, and as an operational net. (3) A portal was used to facilitate file management. (4) Ground map and tactical drawings were used to facilitate the presentation and discussions of the plans.

The planning model applications

During TCX 2, the I-PUT model was used by the participating staffs as described in Appendix I. A full description of this model can be obtained from the first author.

The I-PUT is a Swedish tactical level military decision-making model. The I-PUT is based on the Planning Under Time-pressure (PUT) model developed by Thunholm (2003,

2005, 2006). The difference between I-PUT and PUT is that I-PUT describes parallel or integrated planning between an unspecified number of hierarchical levels of command while the PUT describes a generic planning process for only one level. The purpose behind the PUT and I-PUT models is to accomplish a planning situation where a preliminary solution to the received mission can be identified early, and communicated to subordinate commanders so that they can start their own planning process. This preliminary solution is then further detailed, tested through wargaming, refined and finally formally decided by the commander. The perspective in the PUT and I-PUT is to come up with a *good-enough* solution early and then refine it instead of developing and comparing detailed different own courses of action in order to find the *best possible* one as prescribed in most traditional planning models (e.g. US Army, 1997). Testing with the PUT model (Thunholm, 2003) has indicated significantly quicker decisions without loss of decision quality, lower perception of time-pressure and high usability ratings of the model for use in realistic battlefield conditions.

The I-PUT model is organized around three main questions or stages. The first stage is to answer the question "What *must* be achieved in order to accomplish the mission?" The second question is "How *can* this mission be accomplished?" The third question is "How *shall* this mission be accomplished?" Each of the three stages is then divided into steps, giving rise to a total of eight steps.

Step 1 of the I-PUT process is to *understand the mission* given by a higher headquarters and to visualize that mission. A (preliminary) end state (ES) is developed and visualized on a map overlay, using the Tactical Drawing tool in the DSG2. The preliminary ES is then communicated through the Communicator to subordinated CO's and dialogued. Step 2 of the process is to assess the situation for both the current state and the predicted or possible future situation. This includes updates of situation maps, terrain analysis, force comparisons and generation of simple options for the adversary. Step 3 is to generate own forces (simple) concept courses of action but not in the same detailed and time-consuming way as prescribed in traditional models. Also, no selection of one option as is done in traditional planning models should be made at this stage. The products of Step 2 and 3 are then posted in the C2 system Portal for subordinates to access as a base for their own planning process.

Step 4 of the process is to define situation-specific success criteria or *elements of success* that need to be a part of the final plan. These elements have already been derived from the beginning of the planning process and through all steps, but now they are finally settled as a base for the next step in the process. These elements are also posted in the C2 system Portal to share with subordinates. The I-PUT model prescribes that if a commander (CO) is already able to come up with a concept course of action in Step 1 of the planning process, then Step 2 - 4 could be excluded and the staff can proceed directly to develop a concept of operations (CONOPS, which is otherwise Step 5). In such cases the sub-steps of Step 2 and 4 of the process could be used as control for the CONOPS.

Step 5 of the process is to develop one (graphically described) concept plan or CONOPS, based on the best understanding of the goal/ES, the current and possible future situation, and the elements of success. Step 5 is the second formal occasion for integration across echelons prescribed by the I-PUT. Using the same system applications as when disseminating and dialoguing the ES, the CONOPS is presented on a map overlay, complemented with elements of success and other key factors, and dialogued with the subordinate units' staff.

Step 6 of the I-PUT is to wargame the plan against one or more possible enemy plans. This is the third moment of formal interaction between levels in the I-PUT and it is often done as action-reaction enactment of the plan, led by the responsible (highest-level) HQ. The subordinate CO's should participate and role-play themselves in the wargaming.

Step 7 of the I-PUT process is for the CO to make a formal decision, communicate it to subordinates through the system and after that, complete and issue operational orders, using

the Orders and Reports tool in the C2 system. In this experiment the FHQ and the Bde developed only CONOPS and the Bn´s developed Fragmentary Orders (FRAGO). After, or rather in parallel with issuing of orders the staff should continue to develop a decision support plan and prepare contingency orders in order to speed up the execution phase of the plan. This is Step 8 of the process. For more details on the basic I-PUT process, see Appendix 1.

I-PUT Application 1: ”Two levels at a time”

The first application of the I-PUT tested in this experiment could be called ”Two levels at a time”. This application resembles the current I-PUT manual. This model requires participants at each level of command (each staff) to initiate some thinking in advance, *before* contacting directly subordinate commanders (DSC) and starting the dialogue. In this experiment, after the first dialogue between the FHQ and the Bde HQ, the FHQ continues the next stage of the planning process according to I-PUT and contacts the Bde HQ staff for more dialogue when it has reached another moment of interaction according to the I-PUT manual. The Bde HQ level in turn initiates its own planning process and has a dialogue with its Bn staff according to the I-PUT manual. After that, the Bde continues with the planning process. The guiding principal here however is that all unit levels “think ahead” of their subordinates and present some product/solution to them as a base for dialogue. This application of integrated planning could be modelled as a waterfall, as the process pours down from the higher level to the DSC level as the higher level proceeds in its planning process. This application also reduces integration time for subordinate units as they are not supposed to participate in their own HHQ dialogue with its’ HHQ. This application of integrated planning is illustrated as Condition 1 in Figure 2.

I-PUT Application 2: “Three levels at a time”

The second application of integrated planning could be called “three levels at a time”. This application means that three hierarchical levels plan simultaneously, as far as possible. Moreover, the HHQ levels do not “think in advance” nor do they produce a draft as a base for dialogue. Participants from all levels should enter the dialogue with an open mind and be prepared to solve the planning problem together. The first part is thus to agree on a timeline for planning and a timeline for the operation. After that, a preliminary End State (ES) will be developed. After establishing a preliminary ES, the different staffs may need to work internally in order to assess the situation, and then, once again meet virtually to develop the CONOPS. The analogy used here is to view the entire planning team as “the” planning team, responsible for developing an integrated and overall solution, and not as disparate staff teams at different echelons. The focus here is on the lowest level unit’s need for guidance/directives in order to come up with a FRAGO to its’ subordinate level. If this is a chain of FHQ – Bde – Bn´s that plans integrated, focus should be on the need of the Bn COs in order to produce a FRAGO. The FHQ and BDE representatives should view themselves as resources or support to the Bn´s. This should however not imply transfer of responsibility from the HHQs! This application of integrated planning is illustrated as Condition 2 in Figure 2.

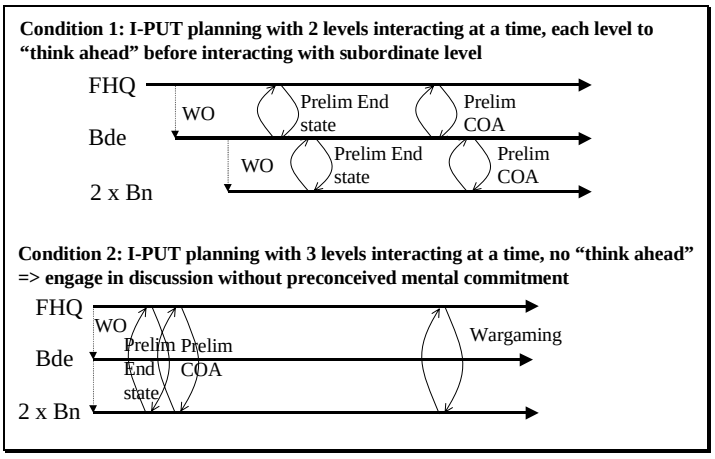

Figure 2. Illustrating the two experiment conditions

Procedure

Preparations. The Swedish participants joined the Demo 06 Spring exercise one week earlier than the Singapore participants, so the Singaporeans received their training separately. The participants were prepared for the experiment through 1+2 days of formal integrated training on the I-PUT and the DSG2 system. Then applied training took place during 3.5 days for the Swedish participants and 1.5 days for the Singapore participants. During that training all Swedish participants went through two sessions of planning and execution with situation updates and execution injects. The Singapore Bn however, due to limitations in the amount of time they could stay in Sweden, did not go through a complete planning and execution session before starting Run 1. All participants in TCX 2 were informed about the purpose of the experiment, briefed on the two I-PUT applications they were supposed to use and also briefed on all measurements in detail one day before the start of Run 1, in order to avoid novelty effects. The participants were also given some time to prepare for Run 1 the evening before it was conducted. Both Run 1 and 2 started at 8.30 in the morning, by an inject from OHQ (exercise control) informing the FHQ on some significant events that the FHQ needed to act on. It was not a formal mission but the FHQ were informed by the experimenters that this was the inject that was supposed to trigger TCX 2. The planning session was not limited by any restrictions imposed by the experimenters but both runs included both planning and execution. Both Run 1 and 2 ended at 16.30 and was followed by about 0.5 hour of filling in questionnaires and 1.5 hours of oral evaluation of what did and did not work well during the experiment run and an overall evaluation of 2-level and 3-level integrated planning.

The physical set-up of the experiment was similar during the two runs. The setup was indoors in the Sw Armed Forces Command and Control training facility. All participants had access to a computer and the staff had the same access to the DSG2 system during both runs, although not every participant had access to all applications.

Data collection. Both the experiment runs (not including the FHQ participants) and the subsequent evaluation sessions were video taped. Also, each of the two runs included collection of questionnaire data during and after the run. Questionnaire Q1 (on commitment) and Q2 (on mutual understanding of the intent and dissent) were administered online about 2.5 hours into planning, and again after another 2.5 hours of planning. Q3 (on plan quality) was administered online about 1 hour into execution of the plan, and again after another hour. The participants completed Q5 (on plan quality, completion of process and confounding variables) directly after the end of each run. After Run 1 the participants also completed Q4 (background variables). During each of the two runs, five military and three civilian observers

documented the process in the O1 observer protocol (on completion of process, integration and process timings).

Results

Confounding variables

Descriptive statistics for the four scenario realism variables (realism of the scenario, realistic amount of information provided, realistic amount of time provided for planning, and realistic level of uncertainty in the scenario) indicated that the participants on average found the scenario to be satisfactorily realistic in every important aspect (M between 3.5 – 4.6 on a six-step scale, SD between .48 - 1.49). For three of the four scenario evaluation items no significant differences in evaluation between the two runs were perceived. However, the item on whether the realism of the scenario was sufficient showed a statistically significant difference between the two runs ($t_{(13)} = -3.23$, $p < .01$, $M_{Run\ 1} = 4.0$, $M_{Run\ 2} = 4.57$). This indicates that the participants rated the Run 2 scenario as slightly more realistic than the scenario of Run 1. However, the mean values for both scenarios indicate that both scenarios had a sufficient level of realism and the difference was not very substantial. Overall, this indicates that the manipulation worked. We wanted to make the Run 2 scenario a bit more complicated because we wanted to counteract maturisation effects from Run 1. This is possibly reflected in the slightly higher ratings of scenario realism obtained after Run 2. Concerning the other confounding variable, “system failure”, analysis revealed that a few minor system failures happened during the runs. These were however not of the kind that substantially affected the ability to plan. Also, there were no traceable differences regarding the level of minor system failures between the two runs. The conclusion is that the confounding variables that were measured had the same low-level impact on the experiment during both of the runs and should thus not have any confounding effects on our results.

Planning and execution tempo

There were substantial differences in timing between the two runs. The main point of interest here was the interaction on an end-state (ES), and on a CONOPS, because these moments were when the Bn received the inputs necessary to start their own planning processes. The point when a Bn FRAGO is issued was also of interest because it related to the time when execution can fully commence. In Run 1 (2-level at a time) the first interaction on a preliminary Endstate (ES) involving the Bn´s commenced 1 hour and 45 minutes after the inject was received at the FHQ. In Run 2 the corresponding event occurred after 45 minutes. This was of course due to the difference in conditions, because Run 2 should involve all three levels simultaneously, but in Run 1 the 2 Bn had to wait for the FHQ-Bde to interact before the Bn’s became involved. This means that in the 3-level integration condition the Bn CO’s could start their own planning 1-hour earlier than during the 2-level at a time interaction. This also resulted in an earlier start of the execution because some immediate actions could be taken as the planning processes at the Bn’s were initialized. However, the Bde ES is not enough information for the Bns to be able to finalize their own planning. Vital details are still missing and will not be available until the Bde has developed its CONOPS.

The second point of interest was the interaction on a CONOPS. In Run 1 this interaction involved the Bn´s 3 hours and 45 minutes after game start, but during Run 2 a preliminary discussion on a CONOPS took place 1 hour and 45 minutes after start. In Run 2 an updated CONOPS interaction then followed 3 hours from game start. This means that the Bn´s in the 3-level interaction condition received vital input to their own planning process 2 hours earlier. The Bn´s used the dialogue on a preliminary CONOPS as a starting point for their own detailed planning and the updated CONOPS interaction that took place later did not change

any vital information for the Bn´s. The differences in pattern of interactions between the FHQ-Bde-Bn´s reflect the instruction in the 3-level condition not to "think ahead" before going in to interaction. First there was an open discussion on a preliminary CONOPS, where the Bn CO's could provide input to the Bde and FHQ. Then the FHQ and Bde consolidated and then came back to the Bn´s with a final CONOPS.

The third point of interest from a planning process timing perspective was the time when a written FRAGO was released. During Run 1 it took on average 6.67 h ($M_{Run\ 1}$ = 400 minutes, SD = 50.91) for the two Bn´s to issue a FRAGO to their Company Commanders. During Run 2 it took 3.87 h ($M_{Run\ 2}$ = 232.5 minutes, SD = 67.18). This is a difference of 167 minutes or 2.79 hours. Both Bn's used substantially more time during Run 1 than during Run 2. This indicates that when the Bn´s could participate or plan together with the FHQ and the Bde from the beginning they saved more than 2.5 hours to produce and issue a FRAGO compared to when they had to wait for the FHQ and Bde to interact before they could interact with the Bde. Although this difference in mean values for issuing Bn orders for the two conditions is very substantial, it still was not statistically significant at the 5%-level ($t_{(1)} = 2.01$, $p = .29$). But t-tests with only 1 degree of freedom almost never produce significant results at the 5%-level so we also used Power analysis and it showed an effect size (Cohens' d) of 2.81 which should be considered a very large effect. However, the Singapore Bn in particular developed their FRAGO much earlier during Run 2, and the subsequent evaluation indicated that their large difference in FRAGO production time was *partly* due to an increase in systems and process familiarity from Run 1 to Run 2.

As also indicated earlier, execution tempo was affected by the two different planning conditions. During Run 1 execution did not start until almost 4 hours after game start and this was related to the CONOPS interaction with the Bde. During Run 2 execution started already after about 1 hour and this was related to 3-level ES interaction. Here start of execution refers to increasing readiness to march and to send out reconnaissance, but those actions were followed by more substantial orders. This means that execution of the plan started substantially earlier during Run 2.

Based on the substantial differences in timings between the 2-level at a time and 3-level integrated conditions and on the magnitude of the effect size, we can conclude that our hypothesis (H1) on less time needed for the Bn to produce their FRAGOs in a 3-level integrated planning condition was supported. There is also no doubt that the 3-level integration resulted in earlier involvement of the Bn and an earlier start of the execution of the plans out on the field.

Plan Confidence

The measurement of plan confidence meant to capture differences in level of satisfaction with the plan as a result of differences in pattern of interactions among FHQ-Bde-Bn between the two runs. Analysis of the five items concerning the staff members' subjective perception of plan confidence indicated that the participants on average were quite confident that the plans were good ($M_{Run\ 1}$ between 3.07 – 4.86, SD between .66 – 1.55, overall $M_{Run\ 1} = 4.46$; $M_{Run\ 2}$ between 3.50 – 4.86, SD between .73 – 1.38, overall $M_{Run\ 2} = 4.34$). The difference between the two overall mean values was not statistically significant ($p = .73$). These results indicate that the different planning conditions did not result in higher planning confidence among the staff members. This was true also when only the Bn staff members were included in the analysis. The results do not support Hypothesis H2, that 3-level integrated planning would result in higher plan confidence. Perhaps the result would have been different if we took the measurement directly after the plan was finalized and not after the execution.

Common Ground

The degree of common ground amongst staff at the different echelons was measured based on their understanding of the intent and concept of operations developed by the FHQ, Bde, and both Bn´s. The participants' responses regarding their understanding of intent and concepts of operations were assessed by comparing the text responses against salient points of the collective articulation of the units' plans. Each participant's responses were scored between 0 (did not articulate any of the main points of the unit's plans) to 1 (articulated all the main points of the unit's plans) to reflect his understanding of the respective plans of the FHQ, Bde, and both Bn´s. Two indices were then computed for each participant to reflect his understanding of the plans one echelon and two echelons up/down. For instance, the index for a Bde participant's understanding of plans one echelon up/down was computed by averaging how accurately he articulated the FHQ's and Bn´s plans. The index for a Bn participant's understanding of plans two echelons up was similarly computed by averaging how well he articulated the FHQ's intent and concepts of operations. Two additional indices were computed for each participant by averaging the relevant confidence ratings to reflect his confidence level regarding his understanding of the plans one echelon and two echelons up/down. A two-tailed paired-samples t-test was then applied to the set of indices to test for the development of understanding across echelons and confidence level over time within an experiment run, as well as for differences across both conditions.

The degree of understanding of the plans was expected to increase between the first and second probes within each condition, although this was not shown to be statistically significant (p between 0.484 – 0.934). This could be due to various factors – the relatively coarse resolution of scoring the participants' understanding of plans based on three to four salient points of intent and concepts of operations might not have been sufficient to bring out the more finely graduated increase in understanding, especially since the intent and concepts of operations did not change much during the planning phase. However, a simple comparison of the degree of understanding over time shows that a high percentage of staff increased or maintained their (relatively high) level of understanding of plans. In two-level planning, 68.75% of staff increased/maintained their level of understanding of plans one echelon up/down, while 53.85% of staff increased/maintained their level of understanding of plans two echelons up/down. In three-level planning, 64.29% of staff increased/maintained their level of understanding of plans one echelon up/down, while 72.73% of staff increased/maintained their level of understanding of plans two echelons up/down. The differences were not statistically significant ($p = 1.0$).

The participants' understanding of plans across echelons was higher for three-level planning compared to two-level planning early on in the planning process (one echelon up/down: $t_{(14)} = 3.806$, $p = 0.002$, $M_{\text{Run 1}} = 0.375$, $M_{\text{Run 2}} = 0.582$; two echelons up/down: $t_{(11)} = 2.399$, $p = 0.035$, $M_{\text{Run 1}} = 0.264$, $M_{\text{Run 2}} = 0.435$). There was however no significant difference in the final degree of understanding of plans two echelons up/down between runs ($t_{(10)} = 1.907$, $p = 0.086$, $M_{\text{Run 1}} = 0.288$, $M_{\text{Run 2}} = 0.490$). The participants' confidence levels associated with their understanding of the plans two echelons up/down was however significantly different across the experiment conditions ($t_{(22)} = 2.404$, $p = 0.025$, $M_{\text{Run 1}} = 3.630$, $M_{\text{Run 2}} = 4.614$). In two-level planning, the participants were also more confident of their understanding of the plans one echelon up/down than that of two echelons up/down ($t_{(25)} = 2.646$, $p = 0.014$, $M_{\text{1-echelon}} = 4.153$, $M_{\text{2-echelons}} = 3.327$). In three-level planning, the participants indicated a similar level of confidence in their understanding of plans one echelon and two echelons up/down ($t_{(22)} = 1.033$, $p = 0.313$, $M_{\text{1-echelon}} = 4.826$, $M_{\text{2-echelons}} = 4.614$). These results partly support Hypothesis H3, namely that three-level planning gives rise to the participants attaining common ground *faster*, but the results do not support that a *better* level

of understanding across echelons were achieved. These statistical findings are supported by anecdotal evidence from the participants, specifically the Singapore Battalion staff: "During the planning using I-PUT, the Bn HQ was able to understand the intent of Higher HQ at the earliest possible time. The dialogue on the preliminary end-state, when integrated across 2 or 3 levels created a sense of awareness that facilitated the creation of a quick and cogent plan."

Commitment

The participants' level of commitment to the plans developed was probed twice during the planning phase for each experiment condition. As expected, there were significant differences in the participants' rating of the state of plan development over time for each condition (Two-level planning: $t_{(15)} = 8.062$, $p < 0.001$, $M_{1st\ probe} = 2.56$, $M_{2nd\ probe} = 5.00$; Three-level planning: $t_{(13)} = 5.785$, $p < 0.001$, $M_{1st\ probe} = 3.93$, $M_{2nd\ probe} = 5.50$). There was also a significant difference in the rating of the state of plan development across the first probes of both experiment conditions ($t_{(14)} = 3.898$, $p = 0.002$, $M_{Run\ 1} = 2.47$, $M_{Run\ 2} = 3.93$). There was, however, no significant difference in the rating of the state of plan development across the second probes of both experiment conditions ($t_{(13)} = 1.710$, $p = 0.111$, $M_{Run\ 1} = 5.07$, $M_{Run\ 2} = 5.50$).

The participants' rating of the cost of changing the plans reflects the perceived state of plan development. Again, there were significant differences over time for each condition (Two-level planning: $t_{(15)} = 3.085$, $p = 0.008$, $M_{1st\ probe} = 2.00$, $M_{2nd\ probe} = 3.31$; Three-level planning: $t_{(13)} = 2.895$, $p = 0.013$, $M_{1st\ probe} = 3.21$, $M_{2nd\ probe} = 4.29$). There was also a significant difference across the first probes of both experiment conditions ($t_{(14)} = 3.29$, $p = 0.005$, $M_{Run\ 1} = 1.87$, $M_{Run\ 2} = 3.33$), but no difference between the second probes across conditions ($t_{(13)} = 1.808$, $p = 0.94$).

The participants' rating of the feasibility of changing the plans given the perceived time pressure showed a different, but consistent, trend with the other measures of commitment. There was a significant difference only between probes for the two-level planning ($t(15) = 2.293$, $p = 0.037$, $M_{1st\ probe} = 2.69$, $M_{2nd\ probe} = 3.81$). There was no difference between probes for three-level planning ($t_{(13)} = 1.722$, $p = 0.109$), nor across the experiment conditions ($t_{(28)} = 0.952$, $p = 0.349$).

These results all support Hypothesis H4, and suggest that while the final level of commitment to the plans developed was reported to be similar for both conditions, three-level planning was reported to result in more developed plans across echelons at an earlier stage, which resulted in a higher level of commitment being expressed by the participants across echelons earlier in the planning process. While it would seem advantageous to be earlier committed to one's plan, the flipside to commitment is a potential lack of flexibility to alter the plans even in the face of sudden changes in situation, enemy disposition, resources etc. This was reflected in the findings on participants' perceived cost in changing the plans at that point in time, with a greater cost felt in the three-level condition. However, when participants were probed on the feasibility of changing plans given time pressure ("deadline for completing plan is very near"), there was no significant difference between either condition, suggesting that despite earlier commitment to plan in three-level planning, they were not any more or less willing to change their plans.

At the time of the later probe however, the levels of commitment to plan in both planning conditions were comparable i.e. not statistically significant, suggesting that participants eventually became similarly committed to their plans near the end of planning. The state of plan development at this time corroborated these findings, being of a similar state of completeness. Again, this is in line with the hypotheses, as there was no expectation that either planning condition would give rise to more complete plans and greater commitment at the end point of planning.

Dissent

The measure of divergent views within the team was taken at the same time as the level of commitment. Although we had hoped for a greater amount of divergent views to be expressed in three-level planning given the staff members' increased understanding of the plans across echelons, and the opportunities for dialogue with the superior/subordinate units, this clearly did not take place. The participants did not in fact report any differing opinions of the team's plans during the probes administered during each experiment condition.

We had anticipated that the level of dissent might be low; hence, we had also developed another probe to fall back on. The participants were asked to assume a hypothetical divergent view in order to assess their willingness to influence the team to adopt their differing opinion, as a surrogate measure for dissent. As expected, their willingness to influence the team decreased significantly over time for both experiment conditions (Two-level planning: $t_{(15)} = 3.204$, $p = 0.006$, $M_{1st\ probe} = 5.19$, $M_{2nd\ probe} = 3.56$; Three-level planning: $t_{(13)} = 2.188$, $p = 0.048$, $M_{1st\ probe} = 4.50$, $M_{2nd\ probe} = 3.21$). However, there was no significant difference across conditions (1st probe: $t_{(14)} = 1.517$, $p = 0.152$; 2nd probe: $t_{(13)} = 0.434$, $p = 0.671$).

The results from this study do not support Hypothesis H5, as there was no difference detected between the conditions in terms of the amount of dissent, nor the willingness of the participants to influence the team to adopt their divergent views.

Planning model application and evaluation

The results of the detailed analysis of how the planning process was applied by the different staffs would take more space to relate than is available here. As such, our discussion here will focus mainly on the area of greatest interest, that is, whether or not the staff followed the two different applications of the I-PUT and how they evaluated the different types of integration (2-level or 3-level integration). The overall result from the planning process analysis is that the participants managed to apply the different applications of the I-PUT model largely as prescribed. Some of the important observations on the process application are described below.

First it was interesting to note that in both of the scenario runs the staffs basically followed the quick I-PUT, where the concept course of action (COA) was already identified very early in the process, as soon as the preliminary end-state was developed. Quick I-PUT is to proceed directly from Step 1 of the I-PUT to Step 5. After identification of a concept COA the process was mainly driven by the Bde rather than by the FHQ and this was anticipated because the scenario demanded ground forces and no joint actions were called for. This does not mean that the FHQ was irrelevant. It still could provide resources like air surveillance and contacts with NGO's. After identifying a concept COA, the Bde staff started to transform it to a more detailed CONOPS on a map overlay. In that process they used some of the I-PUT Step 2 (Assess the Situation) sub-steps as control against their CONOPS. The Singapore Bn also had a similar process but the Swedish Bn did not use the sub-steps of Step 2 as a control for their CONOPS development. Some of the sub-steps of Step 2 where not attended to by any staff, at least not formally. These were 2.5 Terrain, Weather and Visibility and 2.6 Force Comparison.

Secondly, concerning application of the 2- vs. 3-level interaction, all participants reported that they managed to follow the different applications except for some of the Singapore Bn staff members. They thought that much of the interaction during the 2-level at the time integration was rather one-way, because the Bde mainly presented its products without much discussion. This was however largely in line with the instructions because the higher level was supposed to "think ahead" and develop a draft as a base for any formal interaction with subordinated units. During the 3-level interaction run, the Bde observer noted that although all

staffs participated in the formal interaction moments without the higher levels "thinking ahead" and presenting a draft solution, there was still seldom a really free discussion on endstate and CONOPS. The interaction often started with idea presentation from the FHQ or Bde and then followed some comments from the Bn´s. After that though, there seemed to be a need to take a short time-out to discuss internally, within the staff, instead of having the discussion among the integrated planning team members. This means that although both the 2- and 3-level interactions worked formally, they did not work exactly as we had hoped to see during the 3-level integration. The own staff formed a stronger team than did the integrated planning team also in the 3-level interaction condition.

Thirdly, there was one substantial difference in model application between the two runs. During Run 1 there was no interaction between the staffs on wargaming the plan. The only staff that conducted formal wargaming based on their own plan was the Singapore Bn. During the second run however, the Bde conducted formal wargaming based on the Bde CONOPS, with all other units participating.

The participants also rated on a 6-step Likert scale the two applications on time-effectiveness and overall effectiveness as a field-planning model. Concerning time-efficiency of the planning process the participants on average found both applications quite time efficient ($M_{2\text{-level}} = 4.00$, $SD = 1.36$; $M_{3\text{-level}} = 4.86$, $SD = .67$). This difference is rather substantial in favour of the 3-level integration application, and it was also statistically significant at the 5%-level ($t_{(13)} = -2.12$, $p = .05$). Concerning overall efficiency of the two applications as field models, for use under realistic field conditions as defined by the participants, both models received quite high ratings, with higher ratings for the 3-level interaction application of the I-PUT ($M_{2\text{-level}} = 4.50$, $SD = .85$; $M_{3\text{-level}} = 4.79$, $SD = .58$). This difference was also statistically significant ($t_{(13)} = -2.28$, $p =.04$).

This result supports our hypothesis (H6) that the 3-level interaction application of the I-PUT should be regarded as more effective in a scenario like the one we used in this experiment. That is (1) not many units involved in the planning, (2) overall situation well known, (3) experienced commanders and staff participating in the planning process, and (4) a strong need to react quickly and come up with orders on how to handle the situation.

When analysing the written comments given by the participants on the advantages and disadvantages of integrated planning vs. traditional planning, the two by far most common advantages mentioned by 90% of the participants were that (1) integration saves time for earlier start of execution and (2) that it leads to a better understanding on the lower levels of the higher level commanders intent or an overall better mutual understanding. The most common disadvantage mentioned by 50% of the participants is that interaction takes time and might hinder the lower level CO from executing an ongoing task. Another disadvantage mentioned by a few participants is that this type of interaction-centered planning demands experienced commanders to make it work.

Another possible disadvantage with a 3-level interaction compared to a 2-level or no interaction situation that was noticed by the observers of the Bde staff was that during Run 2 there was a strong pressure on the acting Bde CO to quickly come up with a concept COA so that the Bn´s could get something to start their planning on. During the 2-level interaction the Bde had more time to think about this because they had a separate interaction with the FHQ without the BN CO's listening in. In the 3-level interaction condition however, the Bde had no such time because all levels were participating in the planning process at the same time.

Plan quality

Although we were not expecting differences in the quality of the FRAGO's produced in the different conditions, we were still interested to check what level of quality they would have based on a subjective comparison with a "normal" FRAGO. Plan quality was measured

in three different ways. First, participants were asked to individually rate their plans on the basis of tactical content, clarity and completeness; secondly, an independent military rater was asked to do the same; thirdly, the participants were asked to individually rate how well the plan could handle the execution phase. The third measure was a new way of analyzing plan quality that we wanted to test and we did not develop any formal hypothesis related to it.

The analysis showed no statistically significant differences between the two runs in any of the three criteria used to rate the plans. This was also in line with our expectations because we expect the tactical content of a FRAGO as well as its level of completeness and clarity to be related to the command team's experience and habits more than to the way of integrating command levels during planning. The analysis also indicated that the Bn staff participants were quite satisfied with their FRAGO's (Tactical content: $M_{Run\ 1} = 4.10$, $M_{Run\ 2} = 4.22$; Clarity: $M_{Run\ 1} = 4.30$, $M_{Run\ 2} = 4.67$; Completeness: $M_{Run\ 1} = 4.00$, $M_{Run\ 2} = 3.55$). As stated in the methods section a rating of 3 indicates a plan with a "normal" quality. The independent subject matter expert who rated the FRAGO's on the same criteria as the participants themselves did not rate them too differently from the participants, although his ratings were slightly lower on Completeness for both runs (he rated them as 3). Note that the ratings were done for both of the Bn´s together as a set because we were not interested in comparing the Swedish and the Singapore Bn staff. The no-difference result concerning Bn FRAGO quality between the two conditions was expected.

Overall, the participants also found their plans to work well during execution. The mean values for all six criteria ((a) if the plan had changed significantly since execution started, (b) if changes in the situation have necessitated a change of the command intent, (c) if there was sufficient discussion during planning as to what might go wrong, (d) if the plan is handling the adversary and situation well, (e) if the planning process has enabled the team to co-ordinate well during execution, and (f) if the plan was developed to a sufficient level of detail), were between 4.33 – 5.63 (on a six-step Likert scale) for both runs. The exception was for criteria (c) where the mean value was 2.85, (SD = 1.31) for the two measurements on Run 1 and 4.18. (SD = 1.26) for Run 2. This result indicate that the participants did not think that the 2-level at a time integrated planning process during Run 1 included a sufficient amount of discussions on what might go wrong. The observer protocols also support this conclusion. The difference in this respect was statistically significant ($t_{(7)} = -2.96$, $p = .02$).

Discussion

The purpose of TCX 2 was to evaluate and compare the effects of two different applications of integrated mission planning, based on the SwAF's new Integrated Planning Under Time-pressure (I-PUT) model (Thunholm, 2003; Josefsson, 2005) across three echelons of command. The main question was to investigate whether it was feasible for three levels of the command team (FHQ –Bde –Bn) to plan integrated, or if it would be more effective for the command teams to plan integrated only two levels at a time. This was evaluated in the circumstances of a realistic, well tested, UN-mission peace enforcement scenario, with a need for the Bn to come up with a FRAGO under time-pressured conditions, as is often the case in real life operations. The two different applications of the I-PUT model was hypothesized to affect the planning and execution time, the level of mutual understanding of intent and plans (also called Common Ground), the level of confidence in plans, the level of commitment to plans, and the level of dissent expressed during the planning process. We also expected the three level application of the I-PUT process to be considered as more effective during the scenario conditions of time-pressure, experienced commanders, few units involved in the planning process and an in-depth knowledge of the situation on the field. We will now discuss our main findings and how they could impact military planning.

The main findings in this study showed that it was crucial for the Bde and Bn to receive or develop the intent and end-states of the FHQ as early as possible, as that would result in faster planning tempo and quicker response out on the field i.e. earlier start of the execution. The 3-level integrated planning accomplished this concept when the FHQ, Bde, and the two Bns started their dialogue very early upon receiving the first inject. Upon receiving the inject, the FHQ quickly called for a conference with his executive staff, which included the Bde Commander and his staff and the 2 Bn Commanders. They dialogued together as a team to develop a common end-state desired by the FHQ and even by the Bde HQ. As compared to the 2-level at a time integrated planning, the 3-level integrated planning resulted in a quicker alignment of mutual understanding of each other's intents between the Bns and the FHQ, as well as a higher level of confidence about that understanding. Having an earlier understanding of both higher and lower HQ, allowed the Bde and Bn HQ to develop plans much earlier in the planning process. The overall effect is a quicker completion of the plan by the Bn HQ, leaving more time for elaboration and additional working through of the developed plans. These results are intuitively easy to understand but have not previously been shown in a scientifically controlled study. Another important finding was that the level of commitment to the plan also increased early in the planning process and this can also be seen as a consequence of the Bn's early involvement in the higher echelons' planning process.

The study showed that the different staffs managed to follow the two different applications of the I-PUT with little difficulties. The I-PUT is a simplification compared to traditional military planning models, but this simplified model did not pose any troubles for the participating staffs. They never expressed any need for more mission analysis or more course of action comparison, and that is also in line with several earlier findings on military planning (Cheah, et al. 2005; Schmitt & Klein, 1998; Ross, Klein, Thunholm, Schmitt, & Baxter, 2004; Sirret, Catchpole, Roddy, Phipps, Cremin, & Thunholm, 2004). They even simplified the model further and used the Quick I-PUT in both scenarios and still produced orders of good quality.

Some results were anticipated but not found in our analysis and some of these no-results deserve some comment. First, we expected the level of mutual understanding between command levels to be overall higher in the 3-level integrated planning situation. This was not the case although a higher level of understanding was achieved much earlier during 3-level planning. We expected that the ability to communicate between FHQ and Bn together with the Bde would result in higher overall mutual understanding. In retrospect, a higher level of mutual understanding was not really very important as compared to faster alignment of mutual understanding. After all, the intent and plan of the FHQ and the Bde will finally reach the Bn through the formalized CONOPS and it is possible that oral communication does not add anything more in terms of understanding than can be achieved with the formal CONOPS. This interpretation is supported by earlier findings by Thunholm (2005) who found that free (oral and e-mail) communication as opposed to only e-mail communication between two echelons (Bde and Bn) did not result in better understanding of the higher CO's intent or in better plans. Maybe this would be different when the task is really complicated and it is also complicated to state clearly in a CONOPS what the intent and the plan is.

In connection to the findings on mutual understanding or common ground, it is also note-worthy that the 3-level interaction did not result in higher plan confidence than was achieved after 2-level at a time interaction. This probably has the same reason as explained earlier. That is, oral communication with the FHQ representatives directly does not add value such as having more dialogue for exchange of ideas as compared to a formalized (written) CONOPS, and thus does not result in higher plan confidence. One possible explanation why this could be so was that there were not so much of free discussions observed within the hierarchical planning team. The Bde still felt it as its duty to present a draft or an idea to the Bns to

comment on rather than asking them what they wanted to do in order to solve the situation. These are of course matters of training and habit, but also a matter of familiarity with the other team members. The participants did not know each other well between the teams and that could have prevented them from having a free discussion. Perhaps a more free discussion would have added to a higher plan confidence of each others plans and intent?

How valid are these results? TCX 2 is based on a realistic and well-tested scenario with a realistic amount of information and uncertainty, and a realistic task for a peace-enforcement mission, not least proven by our recent history. Our analysis showed that the scenarios were deemed to be equal in every important aspect, except for the Run 2 scenario being somewhat more complicated, but that was intentionally made that way in order to counteract maturation of the participants. We had the fortune of having experienced officers in most positions and we invested a lot of training in order to take the participants to a good starting level on the I-PUT and the C2 system, and to minimize learning effects between the two runs. Unfortunately, we did not succeed completely with the Singapore Bn in this respect because they did not have opportunity to participate in all the training, and thus expressed some learning effects between Run 1 and 2. However, all taken together, we see little reason why these findings should not be able to generalize to other FRAGO development situations.

What are the implications from this study for future military planning situations? First, we expect to see an increase in integrated planning in the future, as C2 systems become more capable of providing virtual conference room meetings between commanders and staffs, despite being physically distributed. Our results also show that 3-level integrated planning can be made effective if a context and conditions permit it to be so. Perhaps in the future there will not be a need for written orders above the Bn level? The ability to interact constantly could make the lower level staff to be viewed as an extension of the higher HQ, the same way as a Land Component Staff is a part of an Operational HQ today. This will reduce the need for written orders and might also reduce the need for personnel in the mid-level staffs, which in turn would reduce the unnecessary time budget found in today's traditional planning model.

Another important implication should be that the ability to exercise mission command will increase if 3-level interactions become more normal. Our findings show that 3-level interaction was related to better understanding two echelons up (and down) the command chain early on in the planning process and there was a clear tendency of overall better understanding too. Many Army Tactics manuals emphasize the importance of understanding of intent two levels up as a prerequisite for mission tactics.

Future studies should be designed to evaluate when 2-level integration and 3-level integration is applicable. We hypothesize that the 2-level at a time application of integrated planning should be suitable when extensive planning is needed and/or when several hierarchical levels and a variety of units are involved, because 2-level at a time planning coordination is done with only one other level at any time.

The 3-level application seems to be more suited if there are only a few units involved at each level. It would probably be too difficult to even have a few units conducting integrated planning with each unit comprising of the CO and his staff. The team would comprise just too many personnel. Perhaps, it would be more feasible to only include in the process an officer from each unit, preferably the CO, with a mandate to decide. Another pre-requisite for making 3-level integrated planning effective should be that the mission under planning is not very complex, and that the situation on the field is well known to the participants when the planning is initiated. These two circumstances make it possible to identify a solution at an early stage in the process, maybe already in the first step, during the development of a preliminary end-state. Another pre-condition for success for this application of integrated planning concerns the mindset of the participants. The CO's of the FHQ and the Bde must be

able to take a supporting position instead of a commanding/directing one, towards the Bn CO's, even though the responsibilities are not altered.

Further studies should also be done to evaluate if 3-level interaction can also be effective during initial mission planning and not only under FRAGO planning, especially when the Bn Commander and his staff could play a staff function within the Bde HQ.

References

Cheah, M., Thunholm, P., Chew, L.P., Wikberg, P., Andersson, J., & Torbjörn, D. (2005). C^2 Team Collaboration Experiment – A Joint Research by Sweden and Singapore on Teams in a CpoF environment. *Proceedings to 10th International Command and Control Research and Technology Symposium*. McLean, VA, June 13-16.

Cheah, M., & Fong, G. (2006). Towards realising Parallelism for Echelons of Command. *Proceedings to Command and Control Research and Technology Symposium 2006*. San Diego, CA, June 20-22.

Josefsson (2005). Integrerad Dynamisk Ledning (IDC2) [Integrated Dynamic Command and Control.] Utkast till nytt ledningskoncept. HKV Skrivelse 09100:60 779. Swedish Armed Forces Head Quarters

Klein, G. (2003). How to Spot Problems Before They Get Out of Hand. *Intuition at Work: Why Developing Your Gut Instincts Will Make You Better at What You Do*. New York, NY: DoubleDay.

Multinational Planning Augmentation Team (2006). CH C5 Annex H – Detailed Planning Process. Retrieved April 13, 2006, from http://www2.apan-info.net/mpat/index.aspx?ct=20.

Pigeau, R. & McCann, C. (2000). Redefining Command and Control. In C. McCann & R. Pigeau (Eds.), *The Human in Command: Exploring the Modern Military Experience*. New York, NY: Kluwer Academic/Plenum Publishers.

Sirret, P., Catchpole, L., Roddy, K., Phipps, D., Cremin, D., & Thunholm, P. (2004). *An evaluation of the 7 Questions and RPM planning processes*. QinetiQ/KI/CHS/TR40414.

Thunholm, P. (2003). Military Decision Making and Planning: Towards a New Prescriptive Model. Doctoral dissertation at Stockholm University. Edsbruk: Akademitryck

Thunholm, P. (2005) *Kommunikation och kvalitet – Har muntlig kommunikation mellan chefer någon betydelse?* [Communication and plan quality – Does verbal communication matter?) Experimentrapport i projekt Chefens Vilja, FHS Skrivelse 508/5:1. Försvarshögskolan, Krigsvetenskapliga Institutionen.

Thunholm, P. (2006). A New Model for Tactical Mission Planning for the Swedish Armed Forces. *Proceedings to Command and Control Research and Technology Symposium 2006*. San Diego, CA, June 20-22.

US Army. (2005). *Field Manual 5-0: Army Planning and Orders Production*. Washington, D.C.: Department of the Army.

US Army (1997). *Field Manual (FM) 101-5. Staff Organization and Operations*. Department of the Army, Washington, DC.

Appendix 1. The Basic I-PUT model

Stage 1: What <u>must</u> be accomplished in order to accomplish the mission?		
1. Understand the Mission	Conclusions about: 1. Available planning time 2. Capabilities/options the enemy must not be allowed to have and capabilities we must possess 3. Restrictions in freedom of action to solve the mission 4. Significant/important uncertainties/needs for information 5. Immediate actions needed 6. Need for Collaboration 7. Elements of success	*Preliminary End State* and time schedule for planning are developed through dialogue aided by C2 system tools. Dialog is lead by the CO. *End State by phase* can be developed at this stage.
Stage 2: How <u>can</u> this mission be accomplished?		
2. Assess the situation 2.1 Civilian situation 2.2 Own and friendly units situation 2.3Adversary situation 2.4 Third actor situation 2.5 Terrain, weather and visibility 2.6 Force comparison 2.7 Adversary possible concept COA's	Conclusions concerning 3. – 7. above are added or modified. Additional conclusions are drawn concerning: 1. When the ratio of forces is most advantageous. (Moments of change) 2. The adversarys' most dangerous COA against our capability to reach the End State.	Planning documents are posted on the C2 Portal
3. Generate own concept COA's		Posted or dialogued
4. Define elements of success 4.1 Understand the mission and situation holistically 4.2 Develop elements of success	Conclusions concerning situation specific elements of success and their priority	Post on the C2 Portal
Stage 3: How <u>shall</u> this mission be accomplished?		
5. Develop a Concept of Operations (CONOPS)	Should be based on the elements of success. Conclusions concerning weaknesses of the plan are made.	*Preliminary CONOPS overlay* is dialogued through the C2 System.
6. Wargame the plan		Dialogue
7. Decide	Decision about: 1. Ratifying the Opplan 2. Begin the execution of the first step of the plan	Issue decision
8. Develop Operational Orders and start contingency planning	Decision Support Plan should be dialogued	NATO order format