Dynamic Decision Support – A War Winning Edge

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ABSTRACT

Introduction

Every operational commander wants to go to war with a winning edge. For the past 50 years the west has relied upon its advantages in hardware and professional expertise. With the rise of many developing countries, able to afford the latest in hardware and investing heavily in their professional military, this edge is diminishing. A new war winning edge must be found.

Dynamic Decision Support (DDS) can provide that edge. By utilising advances in real artificial intelligence (AI) simulation can now fully manage forces and plans. By incorporating this capability into the military appreciation process we can enable operational commanders to make quicker and better decisions and thus to gain and retain the initiative on the battlefield.

Description

This presentation will make the case for utilising simulation to provide dynamic decision support (DDS) to the operational commander. It will:

- *outline the difference between dynamic and set piece decision support*
- *explain how dynamic decision support will enable the operational commander to gain and retain the initiative on the battlefield*
- *explain why this is so important in the strategic context*
- *provide an overview of the requirements for a DDS system, including:*
    - *the hardware configurations required for a deployable command centre*
    - *the need for a new generation joint warfare simulation tool (JOWST) that uses generic AI to fully automate the management of forces and plans*
- *explain the process of how the DDS would work, utilising a demo based on the Command Ops engine*
- *explain the cost effectiveness of such a system*
- *provide an opportunity for participants to ask questions and discuss aspects*

The presentation will draw on the findings of a number of studies conducted for the Australian Defence Simulation Office (ADSO) including:

- *COA Analyser Scoping Study*
- *DSSP 017 JASE Requirements (Joint Amphibious Synthetic Environment)*

Conclusions

The main conclusions are that the military should:

- *adopt dynamic decision support*
- *invest in the development of a new generation joint warfare simulation tool (JOWST)*
- *designate an operational command to trial the DDS system*
- *subsequently introduce it into service*
- *do so as a matter of priority*

1.0 WHAT IS DYNAMIC DECISION SUPPORT (DDS)

Students of military history will be aware that over the last 150 years the military have evolved mandrolic decision support systems to assist commanders make sound decisions. In Western military organisations this is known as the Joint Military Appreciation Process (JMAP). It is designed to ensure that all factors are considered and that the best course of action (COA) is selected.

At the operational level of warfare this is a complicated process, requiring dedicated staff to analyse the plethora of situational data and a myriad of options. At its basic level it comprises an assessment of the operational situation, identifying the most likely COAs for the enemy and friendly forces, wargaming out the COAs, selecting the best COA, committing this to an operational plan and issuing orders.

Increasingly the tempo and complexity of modern operational warfare leaves little time for this process. In practice, at the Brigade/TG level the staff rarely get the time to consider more than one or two COA once operations are underway. At the outset of a campaign there is scope to explore more options.

The two Gulf wars saw the use of simulations to assist in developing the plans for the opening phase of each campaign. These involved using operational warfare sim tools such as WARSIM, JSAF and JCAT. These are traditional attrition bases sim tools that rely on scenario specific scripting and require a large pool of expert staff to run them. The scripting takes significant expert effort and time to prepare. Once a scenario is being wargamed any changes to scripts also takes a similar effort and time.

It can be argued that these tools were of value in assisting the decision making at the beginning of the campaign – ie for the set piece opening phase. They allowed for a better analysis of the COAs and, when wargamed out, highlighted shortcomings that could be addressed prior to the start of operations. In effect they provided useful set piece decision support.

However, the shortcomings of these sim tools, mitigate against them being used to provide decision support on a daily basis once operations are underway – ie to provide dynamic decision support. These tools are high overhead in terms of both resources and time. It can take hours to work up scripts for a Bde/TG operation, let alone to wargame the COA. A mobile Bde in a high intensive battle would typically need to issue orders several times a day. To be effective a DDS needs to be able to conduct the JMAP in 2 to 3 hours. This is just not possible with these traditional sim tools.

Moreover, they lack a powerful generic artificial intelligence (AI) capable of realistically managing subordinate forces. Given a set of orders, a generic AI is able to develop plans regardless of the situation it finds itself in – ie regardless of the scenario context. From its orders it can identify, prioritise and cull objectives as the battle unfolds. It is situationally aware and able to interrogate the terrain, develop routes, identify threats and avoid or target them as appropriate. It is able to identify and select the best COA, develop realistic plans and issue orders. It can then react to developments as they occur, including taking

cover and returning fire. It can also reassess its plan and modify it if the situation warrants, such as bypassing a newly located enemy. It is also scalable in that it can do this at each and every level of the command chain.

With a powerful generic AI you can fully automate the simulation. This means that with relatively few inputs you can set up scenarios to wargame out a number of COA in relatively short order. The DDS system should be linked to the HQ command system, taking direct data feeds for terrain, friendly and enemy intel. At the end of the process, once the commander commits it should be capable of sending the new operational plan for the command system to issue orders.

The aim would be to conduct the JMAP, from Commander's intent to COA selection and plan commitment, for a Bde level HQ in 2 to 3 hours.

2.0 WHY DYNAMIC DECISION SUPPORT SHOULD BE EMBRACED

So why should we embrace DDS? There are a number of reasons, but the prime one is to provide a war winning edge.

Every commander who takes to the battlefield wants to have a winning edge over their adversary. For the past 50 years NATO and other Western powers have relied on their superior quality of hardware and military personnel. This in turn has been underpinned by strong economies and the political will to fund the research and development and training programmes. Indeed a strong economy is a fundamental foundation for a strong strategic capability.

With the rise of many developing countries willing and able to invest funds into their military, this edge is being eroded. By way of example the official Chinese military budget has grown from an annual expenditure of $20bn in 2002 to $106bn in 2012. The SIPRI military expenditure database puts actual Chinese military spending at $166 bn in 2012, second only to the US. It also saw Russia military spending rise to $90 bn making it the third biggest military budget.

(Ref http://en.wikipedia.org/wiki/List_of_countries_by_military_expenditures).

At the same time the Western developed economies are under strong pressures to restructure. Strategically it is imperative that they do give priority to rebuilding their economies. During this process it is unlikely that they will be able or willing to commit the quantum of resources necessary to redress the erosion of their military edge. If this process continues then it is only a matter of time before potential adversaries have parity in the quality of their hardware and personnel.

Traditional wisdom says that if you lack quality you need to offset this with quantity. But the same economic imperatives are going to mitigate against this option. Western developed Governments are looking to cut not expand military forces and budgets. So we have a real need here to provide a war winning edge without having to spend a great deal of money.

This is where a DDS system comes into its own. For relatively little money, a DDS system can not only improve the quality of decision making but reduce the time it takes to make those decisions. The former is a bonus worthy of pursuing in its own right but the latter is a tangible war winning edge.

If your force can make decisions and implement these quicker than your opponents, then over time you will end up at least one full decision cycle ahead of your adversary. This has the effect of making the enemy continually react to your plans. In short you have gained the initiative. With the initiative you can achieve operational surprise. With it, a smaller force can defeat a larger one.

By way of an example on the Eastern Front in WW2, the Germans launched their offensive in June 1941 with arguably inferior hardware than the Soviets and definitely with fewer total forces. Their personnel were better trained on the whole but the real edge they had was their ability to make reasonable operational decisions quicker than their Soviet counterparts. German officers were trained to come up with a reasonable plan quickly rather than spend time developing the best plan. In so doing they were able to prevail in the opening two years of the conflict against a vastly superior enemy force. They maintained this edge at the tactical and operational levels throughout the war. It was not enough to offset the sheer imbalance in numbers at the strategic level but it was a real advantage at the tactical and operational level.

3.0 REQUIREMENTS

So what are the requirements for a DDS?

In 2011 I conducted the COA Analyser Scoping Study for the Australian Defence Simulations Office (ADSO). This examined the requirements for a low overhead COA Analyser simulation suite that would support military planning and analysis. The detailed requirements were set out in the COA Analyser Functional Performance Specification v1.0.2 (Reference A).

In 2012 these were expanded upon in another study I conducted for ADSO. Here the focus was on providing a decision support capability for the Joint Amphibious Task Group (JATG). It was referred to as the Joint Amphibious Synthetic Environment (JASE). The detailed requirements were set out in the JASE Computing and AI Requirements v1.0 (Reference B).

The following requirements are in broad terms. Detailed specifications are in References A and B. For access to References A and B please contact ADSO.

3.1 Software

At the broad level the software suite must be able to:

- Conduct realistic simulations of joint operational warfare
- Support the development of plans, via the Joint Military Appreciation Process, and specifically enable the development, wargaming and analysis of Course of Action (COA).
- Model doctrine.
- Be easy to learn and use.
- Create and edit simulation data, including the ability to convert standard environment (GIS, hydro and weather) and force (unit, equipment, supplies and ORBAT) data into the specific simulation data formats required by the respective tools
- Configure server setup and operations, including the ability to create and manage multiple instances of operating systems for the wargaming of COA
- Configure data, including managing source, simulation and test data sets and managing backups
- Provide after action review (AAR)
- Provide data logging
- Provide network connectivity to battle management systems and other federated simulation tools.
- Provide voice comms to users.
- Provide standard office productivity software to users, including email, word, spreadsheet and presentation tools

In order to provide a low overhead solution the software must be able to:

- Fully automate Forces – ie utilise an Artificial Intelligence (AI) that is powerful enough to manage subordinate forces.
- Generically Develop Plans – ie the ability to develop plans without scenario specific scripting.

The software suite shall require the following tools:

- Joint Operational Warfare Simulation Tools (JOWST)
- Generic Data tools – ie tools to create, edit, view and manage generic or common data, specifically environment and force data
- Specific Data tools – ie tools to create, edit, view and manage data specific to a particular application, including scenario editors for JOWSTs.
- AAR and Data logging tools (if not incorporated into a JOWST)
- Network tools
- Voice communication tools
- Office productivity tools

3.1.1 JOWST

At the heart of the DDS system is the JOWST. It must provide a realistic simulation of operational warfare. For performance reasons, it shall model units as aggregates where appropriate - eg infantry platoon with individual ship and aircraft. It shall be an event driven simulation with high temporal and spatial fidelity - eg a time interval of 1 minute and a terrain grid of 30 to 100m.

In order to provide effective decision support the JOWST shall model the following steps:

- Receive commanders intent,
- Develop friendly and enemy courses of action,
- Wargame out the matrix of COA scenarios,
- Analyse the results,
- Present results to the commander,
- Receive the commander decision on which COA to adopt
- Relay final plan to battle management systems (BMS)

Commander intent shall be input by setting objective tasks and control graphics. This can be done directly by the commander or by an operator.

In order to provide fully automated forces, which is a prerequisite to automating the wargaming and hence providing a low overhead solution, the JOWST shall be capable of generating and selecting COA for all forces at all levels.

The user shall be provided with the option to:

- Manually develop the COAs by settings tasks and control graphics
- Seed a COA by loading a pre-saved contingency plan
- Edit an automatically generated COA.

COA wargaming would entail the simultaneous running of multiple scenarios on high end servers. Eg 3 friendly COA x 3 enemy COA = 9 scenarios.

Server configuration software shall create an instance of an operating system, load a copy of the JOWST application, load the designated COA scenario, run it, analyse it and send the results back to the controlling PC. It shall also be capable of streaming a replay of the scenario to the PC, should it be required.

Analysis of each of the COA scenarios would be in accordance with the JMAP. It shall be done automatically by the JOWST with the option to manually edit the results for presentation to the commander.

The commander shall be able to review the analysis on a PC, including watching a replay of the scenario. The commander shall be able to then revise his/her intent or revise the actual COA plan and start another cycle of wargaming. The commander shall be able to select the desired COA plan and either approve it as a contingency plan or commit it as a current order or reject it. Upon commitment, the JOWST shall communicate with the BMS to effect the issuing of orders.

In terms of performance the JOWST shall be capable of running one day of a JATG operation, comprising 200 units, in one hour of real time on a high end PC. This performance level would enable a minimum decision support cycle of 2 hours:

- Commander intent (manual input) - 15 minutes
- COA development (manual/auto) - 15 minutes
- COA wargaming (auto) - 60 minutes
- COA analysis (manual/auto) - 15 minutes
- Commander review and decision (manual) - 15 minutes

3.2 Data

A key requirement for an effective DDS is access to accurate and up to date data, including environment, entity, scenario, plan and intel data.

Guiding principles:

- Minimise amount of data eg. Use estab or common data augmented by instance data
- Conform to standards so multiple tools can share the same data
- Select data sizes and formats that facilitate speed

3.3 Hardware

It should be possible to run the DDS suite from a single high end laptop. The commander and staff will each use a laptop to interface the DDS. However, to meet the 2 to 3 hour performance requirement for completing the JMAP, multiple COA scenarios will need to be wargamed concurrently on blade servers. For a deployable JATG the following hardware is recommended:

- 20 x hi-end laptops (min 4 processor cores)
- 2 x Server Chassis (eg HP C3000) each holding 8 x half-size blade servers, capable of running on standard AC (240v) or DC power
    - 6 x full-size Blade Servers each running 4 x 8 core CPUs (eg HP BL660)
    - 2 x half-size Storage Server each with 24 Tb of HD space
    - 2 x half-size PCI Blade server with hi end graphics card

Note that one server chassis would be devoted to decision support and the other to running other tools. Each server chassis is 6 rack units (RU) high.

Other hardware requirements are:

- 1 x A3 printer
- 1 x Multi-Function Device
- 1 x Gb switch
- 1 x VPN Router
- 1 x networked Interactive screen capable of displaying 1920 x 1080 resolution
- 1 x Field generator to provide power to servers, laptops and other hardware
- 1 x Uninterruptable Power Supply (UPS) system
- Gb Ethernet cabling
- Ruggedised containers for:
  - server chassis, to include air conditioning unit
  - laptops
  - other hardware

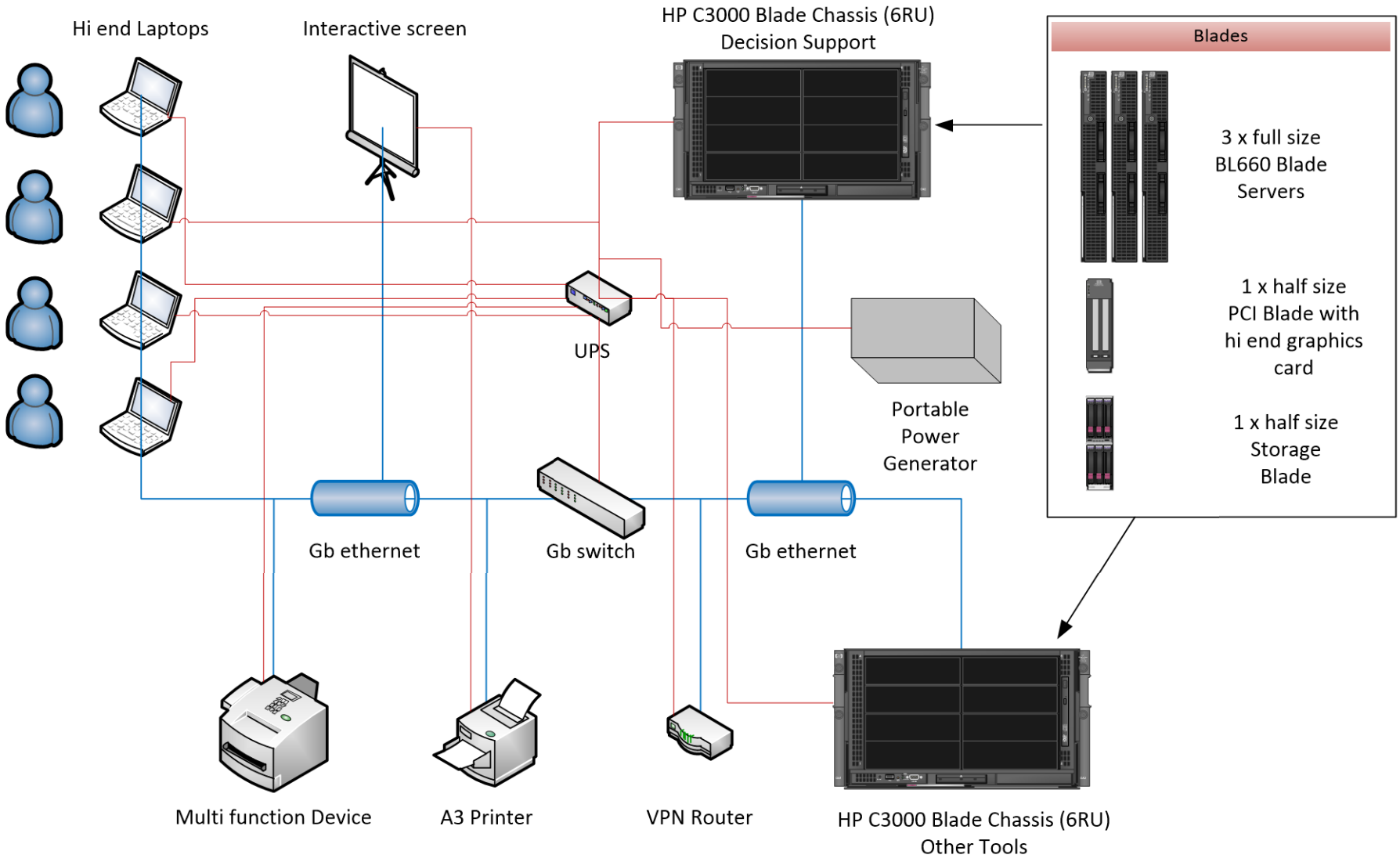
3.4 Staff

With a low overhead JOWST, the DDS can be run, if need be, by just one user (ie a Commander). Under normal use, the DDS would be run by the future plans staff of the HQ.

The DDS shall be supported by one simulation support officer (SSO). This shall be a technical position whose roles shall be to provide the following support:

- Maintenance of the DDS hardware
- Setup hardware and software
- Administer the DDS network
- Back up all data
- Assist users

Joint Amphibious Synthetic Environment (JASE) Architecture



4.0 ROADMAP

The need for a DDS is high. Dynamic decision support offers a new capability that could prove decisive in achieving success in operations.

The current crop of operational warfare simulation tools are inadequate at providing decision support except where there is plenty of time to setup and conduct wargaming. Even then they are handicapped by their lack of a powerful AI and their reliance on scenario specific scripting. Hence, they need to have continual expert manual input. They are high overhead sim tools and not suitable for providing DDS.

Therefore a low overhead JOWST needs to be developed to provide effective decision support.

The development of complex state of the art simulation systems requires expertise, funding and time. With adequate funding more expertise can be committed but there is a law of diminishing return and a point at which assigning additional people has a negative effect. Small teams are best. Regardless, it will take considerable time to develop. This involves considerable original R&D. So there is an element of risk for which time contingencies need to be made.

The most advanced low overhead op war sim tool engine currently available is the Command Ops engine. It has been designed for the commercial wargaming market and is focussed on modelling WW2 land operations. It will need extensive development to meet the requirements of modern joint warfare operations. But it does have the fundamentals to fully automate forces.

It is estimated that it will take several years before it can be fully developed. This can be staged so that a partial solution can be offered probably within 2-3 years (subject to resourcing) and a full solution in 5 years.

The following foundations need to be put in place to support all sim tools in the DDS:

- Further analysis and complete the requirement specifications
- Develop an environment data system (EDS)
- Develop a force data system (FDS).
- Develop an intel data system (IDS).

Ideally the EDS, FDS and IDS should be developed prior to the development of the low overhead JOWST. However, these could be developed concurrently if the EDS, FDS and IDS can be at beta stage of development within one year. With adequate resourcing that should be possible.

So the steps would be:

- Finalise requirements (3 months)
- Seek approval (3months)
- Develop data systems (EDS, FDS and IDS) to beta stage (12 months)
- Develop JOWST to alpha stage (12 months)
- Develop data systems to Phase 1 release (12 months)
- Develop JOWST to beta stage (6-12 months)
- Develop JOWST to Phase 1 release (6-12 months)
- Develop JOWST to Phase 2 release (12 months)
- Develop JOWST to Phase 3 release (12 months)

5.0 COSTS

The following ball park estimates are provided:

Software Development	**FTE**	**Cost**
Finalise requirements (3 months)	0.5	250,000
Seek approval (3months)		
Develop data systems (EDS, FDS and IDS) to beta stage (12 months)	4.0	1,000,000
Develop JOWST to alpha stage (12 months)	12.0	5,000,000
Develop data systems to Phase 1 release (12 months)	4.0	1,000,000
Develop JOWST to beta stage (6-12 months)	12.0	5,000,000
Develop JOWST to Phase 1 release (6-12 months)	12.0	5,000,000
Develop JOWST to Phase 2 release (12 months)	12.0	5,000,000
Develop JOWST to Phase 3 release (12 months)	12.0	5,000,000
Total Software Development		**$27. 25m**
Other Software Licensing and Purchase		$1.0m
Hardware per DDS Suite	**Number**	**Cost**
Laptop	20	80,000
HP C3000 Server Chassis (each with 3 x BL660 blade servers, 1 x storage blade and 1 x PCI blade)	2	200,000
Other Hardware	-	120,000
Total Per Suite		$0.4m
Total Hardware (3 suites)	**3**	**$1.2m**
Total Costs		**$29.45m**

The above cost estimates for the JOWST include licensing fees and a contingency allowance of 15%. The contingency allowance is needed as this development involves a significant amount of original R&D and hence there is some risk of slippage.

6.0 CONCLUSION

There is a real need for a new war winning edge. DDS can provide this. It is feasible. The Command Ops engine already achieves the high risk fundamental requirements of being able to fully automate forces and generically develop plans. It can be developed for a relatively modest price of $30m. That's about the cost of six M1 tanks or one fifth of a joint strike fighter. If adopted soon it can be developed within 5 to 6 years.

The main conclusions are that the military should:

- adopt dynamic decision support
- invest in the development of a new generation joint warfare simulation tool (JOWST) based on the Command Ops engine.
- designate an operational command to trial the DDS system
- subsequently introduce it into service
- do so as a matter of priority