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The Case for Consolidating Tactical and Operational Systems

William R. Clemons

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The Case for Consolidating Tactical and Operational Systems

by William R. Clemons

CW3 William R. Clemons joined the Army at 18. After a tour in Germany as an M-1 mechanic, he attended Army flight school, graduating as an AH-1 Cobra helicopter pilot. He was then assigned to Fort Hood, Texas, until an AH-64A Apache transition sent him to the 82d Airborne Division. While there he earned a baccalaureate degree in history and went on to tours in Korea, Fort Carson, Colorado, and back again to Korea. In conjunction with his second tour in Korea, he attended the Army Electronic Warfare Officer (EWO) Course. During his next assignment he served as the troop EWO; these duties led to his becoming the brigade EWO and, eventually, the brigade tactical operations (TACOPS) officer. In his role as the brigade TACOPS officer, he served as the commander's subject matter expert on electronic warfare, personnel recovery, Army airspace command and control, joint air operations, Army Battle Command Systems and aviation mission planning. After more than four years in Korea he was assigned as the brigade digitization project officer. Using his extensive knowledge of Army tactical systems, he upgraded the 6th Cavalry tactical operations center into a modern command-and-control center. Currently serving as the TACOPS officer for 1-351st Regiment at Fort Stewart, Georgia, he is also finishing his master's degree in computer resource and information technology management.

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Foreword

This research paper examines the background of the major warfighting applications—such as the Joint Automated Deep Operations Coordination System (JADOCS), Portable Flight Planning System (PFPS), Force XXI Battle Command Brigade and Below (FBCB2) and Command and Control Personal Computer (C2PC)—used by the Army and other services. It demonstrates how these applications are duplicated in functionality, and how they are unnecessarily divided between tactical and operational systems. By showing how the various applications use the same maps, drawing functions, three-dimensional viewing functions, and common operational picture display functions, the author illustrates the logical necessity for change and proposes a single application to resolve these issues.

The author reviews why it is not necessary to divide the systems along tactical and operational lines by showing that there are no differences between how the systems are used, just that they are used at different scales. He then explains how this application can be developed in an incremental and spiraling manner, demonstrating the functionality it would provide. He goes on to explain the benefits of common systems and training, and how this would facilitate joint operations.

As the Army transforms to the Modular Force, it is not enough simply to restructure units and field new systems. It is crucial that operational tools and procedures be streamlined as well, and this paper offers one possibility for change that could prove effective on many levels and for a variety of reasons.

GORDON R. SULLIVAN
General, United States Army Retired
President

September 2005

The Case for Consolidating Tactical and Operational Systems

Introduction

The list of applications used by the Department of Defense (DoD) for tactical and strategic military operations is an alphabet soup of acronyms that would fill a small book. The overall purpose of these systems is the same as the business applications used by today's corporations—to achieve the greatest possible competitive advantage over the opposition. Information technology (IT) has proven to be an effective and dynamics-changing component for the business community and the United States military. The military's new force structure depends upon IT proving itself to be a force multiplier. If it fails, there will not be enough Soldiers or Marines to fight a more old-fashioned and conventional war.

These days in DoD, there are multiple applications for every job specialty, just as there were in the beginning of the business world's digitization. In business today, these applications have largely been consolidated into a single application or a suite of applications, reducing cost and improving ease of use. The typical case study for business application consolidation begins with a multinational corporation that has more applications than it can count and no idea what the total cost of ownership (TCO) amounts to. A consultant comes in, consolidates these applications, improves the companies' productivity and saves money in the range of millions of dollars.[1] There is much room for a similar consolidation in DoD, and in the Army in particular. This paper will examine the background of the major applications used by the military, how they are duplicated in functions, and how they are unnecessarily divided between tactical and strategic systems. The reader will come to understand why it is not just a good idea to make this change to a consolidated system, but why it is required for DoD's transformation to Network-Centric Warfare (NCW). While this may appear as a theoretical argument, how DoD will conduct and manage this thought-provoking change will be explained in detail. At the conclusion, the reader should understand that this new concept is not such a far-fetched rhetorical ideal, but rather a practical solution that is both cost-effective and logical.

Background

To understand how the Army was delivered into the situation it now faces, one must understand the difference between operational theory and tactics. First, the "operational level of war is the level at which campaigns and major operations are conducted and sustained to accomplish strategic objectives."[2] Tactics on the other hand, is how the battle will be fought. The former is the big arrow the general draws on the map; the latter is the plan the lower-level commanders put together to implement it. The operational level of war consists of engagements at the tactical level.[3] Operations at its highest level in the campaign melds into strategy (see figure 1). Most classical books on military strategy are actually discussing the operational level of war, i.e., how a campaign should be conducted. The great books on strategy (operations) stretch back thousands of years, but books on tactics come and go with the wind. This is because the strategic and operational levels of war concern human interaction more than weapons interaction.[4]

In everyday use, operational information systems are referred to as strategic. This is done to draw a clear definition for those not well versed on the three levels of war. The business community, where this technology is developed, unwittingly reinforces this misnomer, as they do not have an operational level but only strategic and tactical levels. This paper will continue that tradition for the sake of clarity.

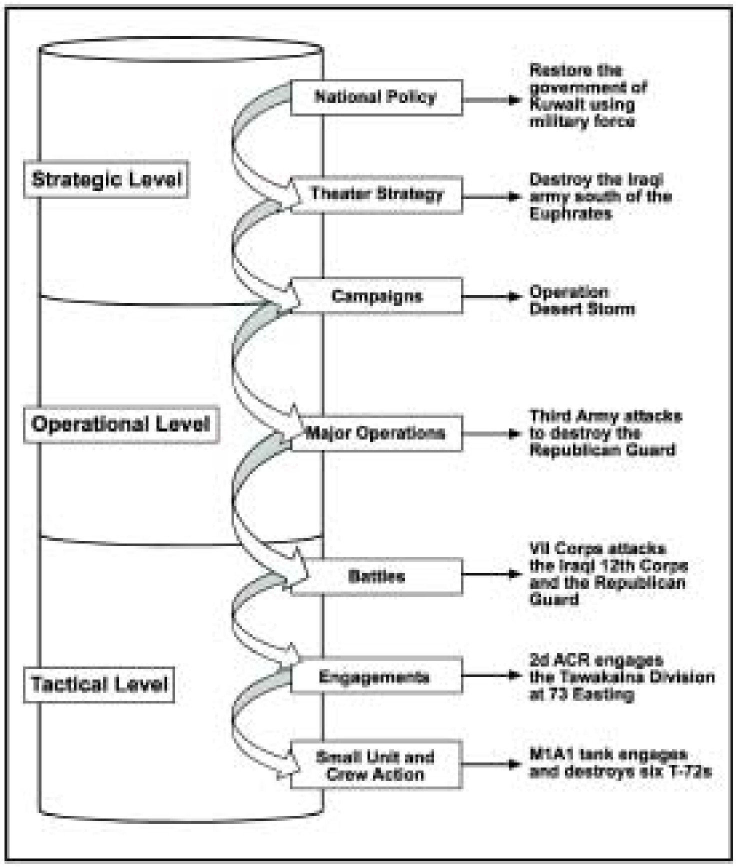


Figure 1. The Levels of War (from U.S. Army Field Manual 3-0, *Operations*)

Tactical and strategic systems were developed under the definitions taught to Army officers for decades. It appears that no one talked about the differences when it came to information technology. This apparent slip has led to the development of two types of applications—tactical and strategic—for military use.

In the business world there are applications thought of as strategic and tactical. The strategic systems are the executive management systems used to monitor overall businesses performance. Their versions of tactical systems are the user applications that accept the input of the data. When it came to developing military applications, it seemed natural to use the schoolhouse definitions reinforced by the practical application of the business world. However, this model is wrong. The key to understanding where it went wrong lies in examining where the data is entered and where it goes. In the business community, user input is usually made into a database, consolidated and then given to the executive management system for display. However, with military applications input is made along the entire chain of command and is distributed to both higher and lower. The only difference is the level of detail contained in the data. For instance, major boundaries are made at the three-star general level and disseminated down. Then a coordinated fire line is added at several different levels and disseminated to everyone. The division, brigade and battalion add their own graphics that are then sent up, down and to adjacent units. These graphics, referred to as control measures, are common at every level of command.

Application Review

Of what must be nearly 100 applications, six will be discussed. These systems were picked because of their widespread use both in the Army and in the other services. They comprise strategic and tactical systems and one that is used in both capacities. One application, still in development, is used to display the path DoD is following for modernization.

The first system is Command and Control Personal Computer (C2PC). This strategic system is the main component of the Global Command and Control System-Army (GCCS-A). GCCS-A was developed and still used by the Marine Corps—the Army uses this system at the division level and higher primarily for situational understanding.[5] Situational understanding is provided by the Common Operational Picture (COP). This is done by showing control measures collected over the network on a digital map and, more important, displaying enemy and friendly positions. The purpose of the COP is "to ensure there is functional consistency among the different views."[6] The threat locations are collected by way of databases throughout the network. Friendly locations are usually input manually by the unit, or through databases that supply the information as part of the air picture when collected through radar, or through the Blue (friendly) Force Tracker database.[7] It is a difficult and unwieldy system and not well suited for planning.

Better suited for planning is the Joint Automated Deep Operations Coordination System (JADOCS), used at several levels for both tactical and strategic planning. JADOCS has several functions critical to conducting operations that should not be overlooked, although they will be only lightly touched upon here. The main display for JADOCS is a digital map that displays control measures, threat information and COP feeds. What sets this apart from C2PC is the added functionality of several plug-in type subsystems. With these subsystems it is possible to conduct planning down to the company level; unfortunately, it is not optimized for planning at these lower levels. For example, while it is capable of plotting an air corridor, it does not do it as well as the Portable Flight Planning System (PFPS), which will be discussed later. However, unlike PFPS, JADOCS is capable of deconflicting the route made. This function makes the new Army Battle Command System (ABCS) Tactical Air Integration System (TAIS) obsolete anywhere except an air traffic control unit. Another JADOCS feature used with some difficulty is the three-dimensional (3-D) viewer. This feature overlays a digital map or satellite image on a 3-D rendering of the terrain. This, in turn, is used to visualize the terrain and to allow the tactician to evaluate his or her position by comparative analysis. Finally, JADOCS uses a chat/e-mail subsystem for communicating between locations. The versatility of this system is one reason why JADOCS is used by the Navy, Air Force and Army.[8]

Force XXI Battle Command Brigade and Below (FBCB2) is one of the newer applications that falls under the general heading of Blue Force Tracker (BFT). BFT is architecture used to track friendly forces in near real-time; FBCB2, one of the applications that displays this information, is used to provide situational awareness from the individual Soldier level through the theater commander level.[9] This information is displayed on a digital map with graphic control measures. It has an e-mail/chat function using templates and comes loaded on a ruggedized computer that is mounted in a vehicle or remoted into a tactical operations center (TOC). The architecture for this system contributes significantly to the COP; however, the FBCB2 application is not normally used at the division level or higher.

The Advanced Field Artillery Tactical Digital System (AFATDS) is a ruggedized computer application that runs on the UNIX operating system. This system is designed for use by Army and Marine Corps field artillery units and the fire support officers (FSOs) assigned to all tactical headquarters.[10] AFATDS is used to perform the difficult computations required to direct fires by a battery of artillery pieces; it is also used by the FSOs to coordinate and request fires. One of its more dynamic features is its ability to observe the counterfire fight along with displaying control measures on digital maps.[11] The functions used by the FSOs can easily be replicated by JADOCS. These functions include calls-for-fire, close air support coordination and range fan plotting. Unfortunately, some functionality required by the artillery batteries—such as the number of powder bags to use, gun angle and azimuth—are not available with JADOCS. This is not a deficiency in JADOCS; it simply was not designed for that purpose.

The Portable Flight Planning System was originally an Air Force system used to plan missions at the flight or individual level. It has since been expanded and is now used by the pilots of all four services for mission planning. It is also used extensively at battalion and squadron level, in conjunction with other systems, to conduct detailed planning. At the heart of the system lies FalconView, a digital map that displays control measures and allows for the building of air corridors. Air corridors are very different from other control measures even though their outward appearance may be similar. What makes an air corridor different is that it has a minimum and maximum altitude and that certain parts of the route are given unique identifiers. This control measure must also have detailed information, such as airspeed and time, added to it to facilitate deconfliction. In fact, so much information must be added to this control measure that for PFPS there is a plug-in application—the Combat Flight Planning System (CFPS)—designed specifically to build air corridors. While JADOCS may have the ability to plan air corridors, it cannot generate all the products needed by individual pilots, nor can it load a data-transfer cartridge for moving the information from a computer to an aircrafts navigation and weapons systems (see figure 2). There are more than a dozen other applications that provide this type of functionality as part of the PFPS suite.[12]

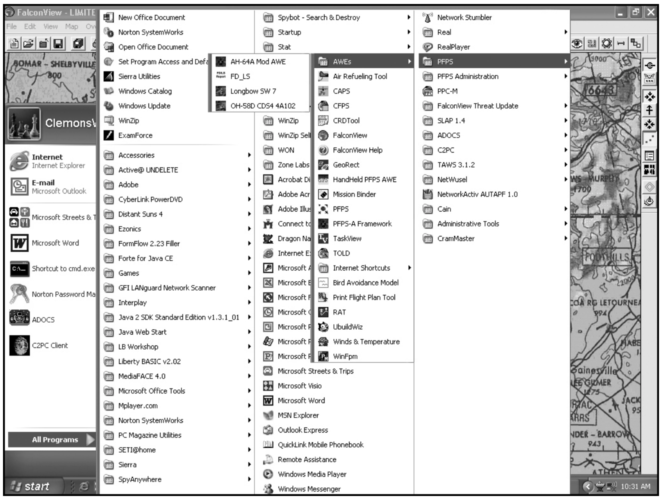


Figure 2. Portable Flight Planning System

The last plug-in that will be mentioned here is Skyview, a tool that allows a user to see a 3-D representation of the terrain with either imagery or a digital map overlay similar to that discussed earlier with JADOCS. The user may add control measures and drawings as another layer to enhance situational understanding. This capability allows a planner to visualize the engagement area and check visibility. An interesting point to note is that the Marine Corps Statement of Work for C2PC required a "3-D view of C2PC map display from the perspective of ground locations as is available with FalconView."[13] Of all the applications, PFPS is considered the most user-friendly and visually appealing application.

The last application to be reviewed is the Joint Mission Planning System (JMPS), which is still in the development stage. It is used here to show the direction in which DoD is heading in software development and capabilities. JMPS appears to be an updated version of PFPS with a little bit of C2PC mixed in. However, underneath the hood is a completely different application using Microsoft's eXtensible Markup Language (XML). This allows it to interface with ABCS and to eliminate current problems of compatibility between systems for such things as air corridors. Like other systems, its main feature is a digital map with control measures layered on top. It is capable of displaying both the COP and threat graphics.

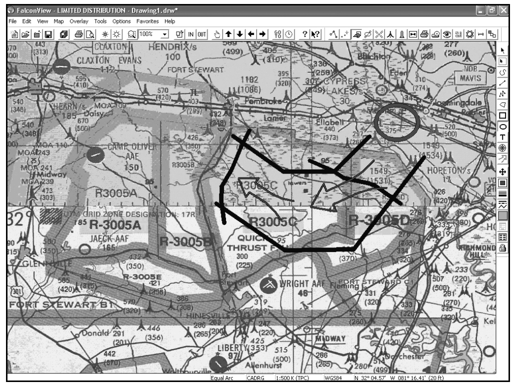
Redundancy

From the foregoing one can begin to discern certain commonalities among the systems. Indeed, one of the ways ABCS assists warfighting is by enhancing "interoperability through a common "look and feel" design that reflects the adoption of common procedures to execute common tasks."[14] First, they are all displayed against a digital map supplied by the National Geospatial Agency (NGA) on a compact disk. The maps are all the same, but each has its own directory, making it unavailable for use by other systems.

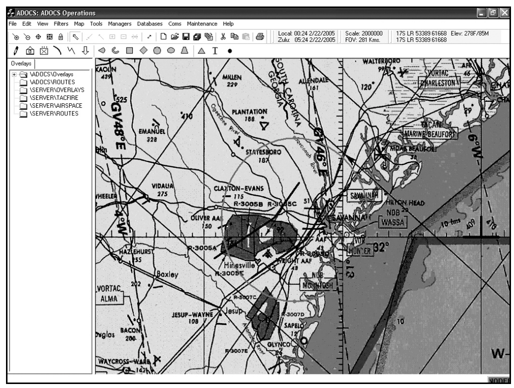
The second most common function is drawing and displaying control measures (see figure 3). For the strategic systems these control measures are at the macro level; at the tactical level, they are at the micro level. Regardless, they are lines on a map that must be available for display to anyone on the network. For these lines to be understood as control measures they must be created as such.

Systems such as FBCB2 can draw these symbols and make them available by their type, but PFPS cannot, and JADOCS can do so only to a small degree. Air corridors, for example, must be recognized as three-dimensional objects, with time adding a fourth dimension. While some systems are unable to make this distinction, others—such as PFPS—are capable of doing it very well. The JADOCS system does reasonably well in this category and, unlike PFPS, it is able to coordinate airspace for planned routes semi-automatically.

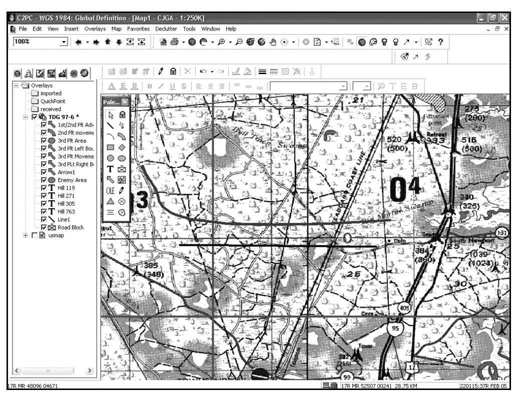
Many systems have a 3-D fly-thru capability to assistant in terrain visualization and planning (see figure 4). These viewers usually open in a new window and allow the user to maneuver around



Portable Flight
Planning System

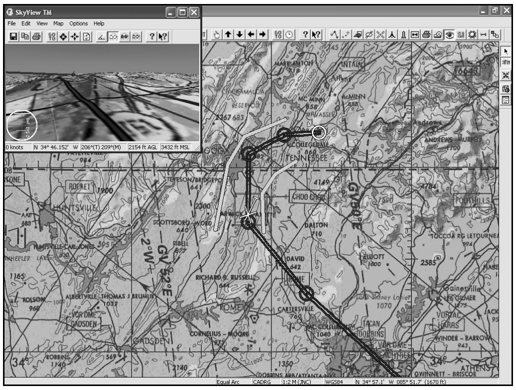


Joint Automated Deep Operations
Coordination System

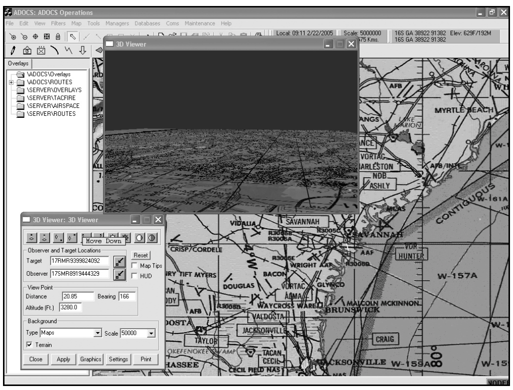


Command and Control
Personal Computer

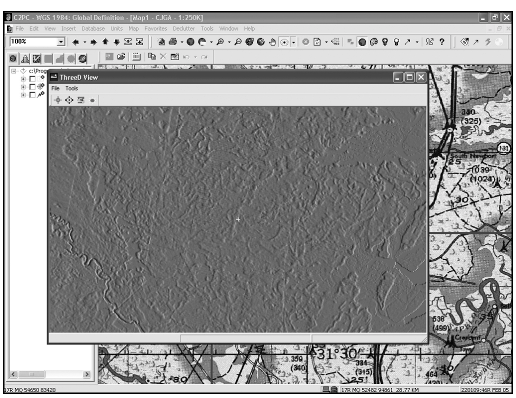
Figure 3. Drawing Redundancy



Portable Flight
Planning System



Joint Automated Deep Operations
Coordination System



Command and Control
Personal Computer

Figure 4. 3-D Viewer Redundancy

a 3-D area, as mentioned earlier. Several systems also provide a moving map display using the global positioning system. This system, similar to the one used by FBCB2, allows users to track their progress en route to their objective.

One of the most important functions performed by these systems is the display of threat forces. The size, strength and position of these forces are collected by various means, consolidated into several databases, and are available from these locations in the network when required. Most tactical and strategic systems are capable of displaying the majority of these objects.

The ABCS Information Server (AIS) and Near Real Time Server (NRTS) are applications that consolidate these different pieces of information and distribute them as directed. In reality, they are simply databases that can communicate only with systems that have been built to query them.

Incompatibility

Incompatibility among these systems leads to a lack of confidence by, and frustration for, warriors who must retype mountains of grid coordinates to add control measures created on another system. With the exception of JADOCS, most of the systems will not exchange data with any system other than its own. Communicating is one of the most critical functions performed by these software applications.

DoD's Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) Cooperative Research Program put it like this:

> The ability of an enterprise to share information across functional areas can enable resource allocation decisions to be made that maximize value from an overall enterprise perspective rather then a purely functional perspective.[15]

For network-centric warfare to work, these systems must talk transparently to each other. Even if an application existed to translate one file type to any other file type, it would still take knowledge and time to go through all the files that would need to be read by a different system. The current method of trying to work through this issue is providing a function in each application to allow for the use of XML and Shapefiles. However, in practice the resultant file is a usually displayed with different characteristics than the original (i.e., thinner, different color lines, etc.) and sometimes even the loss of embedded data. Additionally, many systems are unable to comprehend air corridors as a 3-D control measure. The planned solution is the integration of Shapefiles as mentioned above, with the long-term solution being the use of XML. With XML, certain input fields can be tagged as "altitude" or "airspeed" so other systems can read and understand the data. The nature of XML will allow for custom file formats that can be shared and viewed by different applications. The JMPS program, which uses XML as its native file format, is

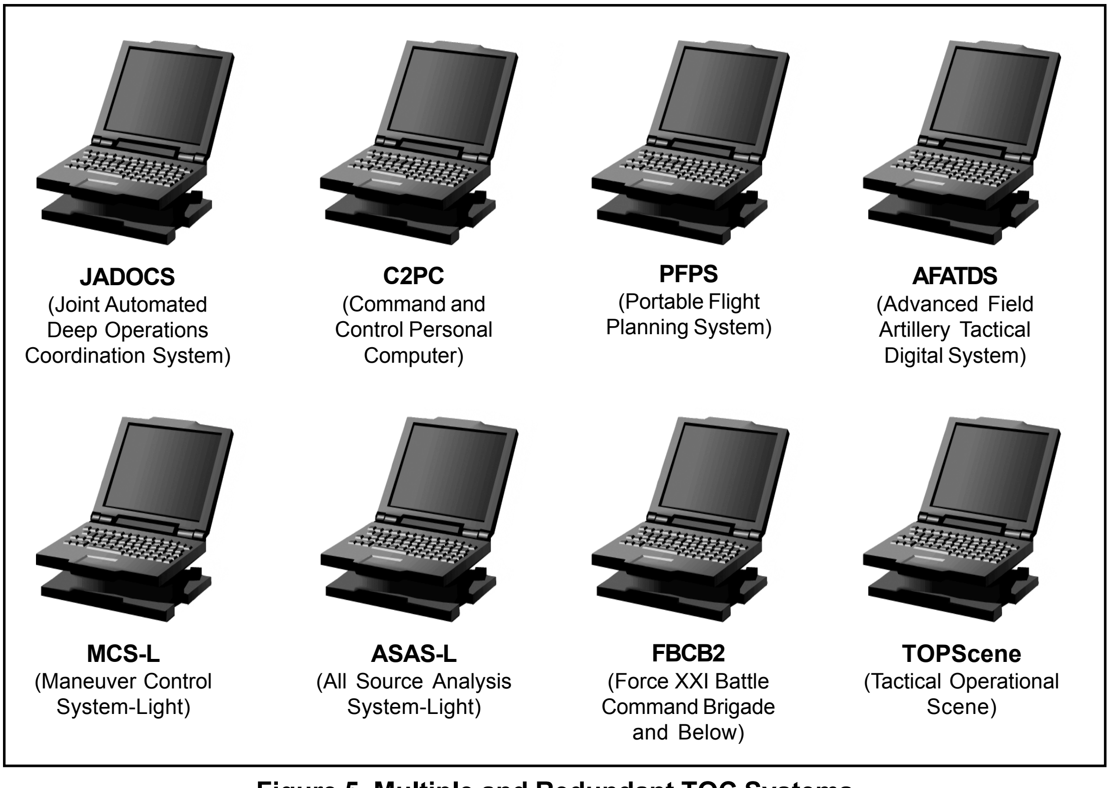


Figure 5. Multiple and Redundant TOC Systems

positioned to improve the situation by consolidating "the various flight planning systems, permitting easier and more accurate sharing of data among different platforms that might fly in a joint mission, from bombers and fighters to unmanned aerial vehicles, cruise missiles, and more."[16] XML is also the native file format for Maneuver Control System—Light (MCS-L) and appears to be working well.

Personnel Issues

It should be clear by now how redundant many military applications have become. Indeed, staff members are usually trained in at least two of the systems. Many are trained with three or even four. This training is required to teach a Soldier how to do the same task but with different systems. Without this training, or with only limited training, a TOC is left with personnel who cannot operate all of the systems in their operations center (see figure 5). This proves to be a decrease in flexibility. Often, only one or two personnel are trained to operate a system; when they are not available, that system is as good as down.

The AFATDS provides a fitting example of this: Every tactical battalion and brigade has a fire support officer (FSO) and noncommissioned officer (FSNCO). The system they operate is the AFATDS, which provides a communications link for artillery fire missions and serves the purpose of sectioning off airspace to prevent friendly-fire accidents. With only two slots in the headquarters, one often goes unfilled due to personnel shortages. This leaves one individual who may be incapacitated, or otherwise unavailable to meet demands for 24-hour operations. With no trained operator, the AFATDS sits idle. While it may be possible to send others to the weeklong training required to learn this system, one must remember that there are several other systems in the TOC in a similar situation. To train everyone on every system is very expensive and impractical.

While everyone in the TOC may learn a system or two, it is unlikely that they will all have fresh knowledge of all systems. Furthermore, Soldiers tend to move on, dealing with new systems or being promoted out of user positions. With personnel turnover it is difficult to build a depth of knowledge in the organization for exploitation of all applications to their fullest abilities. A lack of detailed knowledge among operators also tends to reduce confidence in the system, and thus make Soldiers reluctant to rely on it. A true "common operating environment" would ease this training burden by allowing consolidated training and building a depth of knowledge among all Soldiers. Someone in the TOC should know how to use each feature. With a common system new users could learn from the experienced users instead of calling a help desk.

Solution

The best solution to redundancy, incompatibility and duplication of effort is a single, consolidated, system that can perform strategic functions along with the various tactical functions. Combining the strategic and tactical functions should be quite easy. Theoretically, the two are worlds apart, but in the world of technology it is simply a matter of scale.

According to emerging NCW theory: "NCW is applicable to all levels of warfare and contributes to the coalescence of strategy, operations, and tactics."[17] Combining the tactical functions of the disparate Battlefield Functional Area (BFA) systems would be much more complicated. However, it is clear that the duplication among these functions would allow for a common basic application. From here applications could be built as plug-ins similar to the modularity system used by the forthcoming JMPS.[18] If the basic application is written at the lowest level, to the smallest size, it could be loaded on personal data assistants and other legacy devices. It might even be added to the systems already installed in aircraft or vehicles.

The plug-in applications could include an air corridor planner, a 3-D fly-thru tool, a fire support tool and a synchronization matrix tool. These applications would be stacked like a wedding cake: The bottom layer would be the most basic map display application. The next layer would be something used by several branches of the military, such as the 3-D fly-thru or a range and bearing tool. Installed on top of the second application would be a mission-specific third layer such as an air corridor planning function. This new system would eliminate the problem of sharing files between the various systems because they would all be in the same format. A small translation program could be written to convert flat files back and forth to legacy systems, thereby providing backward compatibility. This compatibility is desired for Network-Centric Warfare:

> Shared battlespace awareness requires that the information collected by sensors be put in a form that makes it possible for other battlespace entities (but not necessarily all others) to fuse appropriate information, place it in context, and understand its implications.[19]

This would also ease the current training burden because the system could be taught at the most generic level, eliminating the need for additional classes. This would lead to an increased depth of knowledge among the users and assist in ensuring that there is always a qualified operator close at hand. It would also permit greater flexibility and, over time, allow for significant cost savings.

Development Model

The task of developing an application of this magnitude would be daunting but achievable. Of the four standard software development models from which to choose, a combination of similar iterative and incremental models would provide the best chance of success. The baseline application that displays the map and graphics would be developed using the incremental model, as would the individual plug-in type sub-applications. Because of the length of time required to develop all the sub-applications, it would be practical to release the first version before all the sub-applications are completed. The sub-applications would continue to be developed under the incremental model, but the completed baseline application and completed sub-applications would then be cycled through the complete process again from the beginning. This would begin the redefining of requirements and redesign of the application to meet the changing needs of the warfighter, thus beginning the iterative model.

The iterative model is itself similar to the prototyping method used by JADOCS during its advanced concepts technology demonstration. By coding, testing and releasing JADOCS in small increments, new tools were released and adapted as requested by users to the point where it was changing to meet the next simulation or field training exercise. This method conforms to NCW theory because we "are now entering a period where we will not know the answer at the start of the process."[20] The timing of the current development process used by the Army is two years between versions. By reducing this to six months it would be possible to adapt software to the current fight, making it almost dynamic in a sense. In *The Principles of War in the Information Age*, Robert R. Leonard makes the point that "accelerated development and application of prototype technology will be one of the keys to success in the future."[21]

The reduced timeline would obviously not allow for the major changes normally seen with a new version, but the cumulative changes of four versions would equal one regular change, with the added benefit of customization. The most excellent part of this consolidation is that the best part of every program can be used, allowing for an overall improved, easy-to-use system of systems. Leonard also makes the point (albeit in discussing manufacturing production lines) that "Production lines will strive more for adaptability in retooling, rather than for mass quantities."[22] The comparison between software development and his hypothetical production line are reasonable and self-evident.

Programming

This application will be used on the new Global Information Grid (GIG), which ties together the entire U.S. military network for the conduct of operations. While conducting combat operations, individual units, vehicles, aircraft and ships will randomly disconnect from the network, only to rejoin it somewhere else. This creates several challenges that must be dealt with. The approved path for dealing with this is Net-Centric Enterprise Services (NCES).[23] Using NCES allows an application to discover what resources are available and configure itself to use them. While legacy systems will be updated to use NCES, full realization of the benefit will require an application written for it. If the military retains the current system of a separate application for each BFA, there will always be services unavailable to Soldiers because developers may not know all requirements beforehand. With the building-block approach proposed here, users could add the modules (sub-applications) that use the services they require, if they are not already installed. Several trials have shown, and the author's personal experience supports the notion, that technology is often used in unexpected and unusual ways that cannot be captured beforehand in a capabilities requirement document. A new, modular application is needed to harness these new capabilities and provide the versatility the modern warfighter needs.

Conclusion

It should be understood that consolidating the capability requirements for this task would be challenging. While it may not be difficult to differentiate between tactical and strategic thought and systems, it is not apparent that they can be consolidated without detailed examination. By showing the common and redundant features of each system, one can comfortably conclude that consolidation is practical and feasible. Developing the program in small, incremental steps will make it adaptable and allow for spiraling technology development and, ultimately, to a stronger and improved national defense.

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