

Company Command Support System CS²

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Abstract—The increase in unconventional, urban warfare situations in US military operations creates the need for reliable data networks allowing military commanders and their troop's maximum communication capability in urban environments. Currently, military commanders at the higher echelons are afforded decision support tools utilizing robust data and voice communication networks. Decision-making in smaller operational units, such as Platoons and Squads, could benefit from improved communication and situational awareness capabilities. The CS² team objective is to design and evaluate a mobile command support system to maximize communication between Platoon leaders and their Squads. The team's study uses simulation programming environments to model the capacity and connectivity of wireless network communication in urban operations. The design alternatives to be modeled consist of various network topologies with different bandwidth capacities. Human factors and physical system requirements are evaluated analytically. The results of this modeling and analysis will be used to identify the most effective and reliable design alternative

I. INTRODUCTION

Military decision making process (MDMP) is a proven method by which United States Army units analyze, develop, and compare courses of actions which need to be taken to achieve mission success. The MDMP assists the operating commanders to organize their planning activities, share a common understanding of the mission and commander's intent, and consequently develop an effective plan and orders.

A. Problem Definition

The Military Decision Making Process requires a significant amount of information transfer different levels of command. The amount of information the military commanders and staffs must process has increased tremendously, while the amount of time available for decision-making has decreased dramatically. This, in turn, has greatly increased the requirements on the cognitive capacity of the commanders and staffs. In order to reduce the demand placed upon the

commanders' and staffs' mental faculties, special decision-making aids are being designed.

B. Statement of Need

There is growing complexity of battlefield analysis and decision-making process in United States Army at lower echelons such as Company level which operate in a target intensive environment, combined with increased data input of many new sensor technologies which are developed by different contractors and also reduced decision-making time for staff members and commander to make his/her decision. Therefore the battlefield can benefit from computerized decision-making aid in a format of Company Command Support System (CS²) which can structure, generate, and organize the retrieved information from different sources to assess the different hypotheses and options needed to conduct an effective tactical maneuver.

C. Stakeholder Description

The design and implementation of the CS² system would have both direct and indirect stakeholders. The direct stakeholder that would be effected of the CS² system consist of the, Company commander and the Company staff. Also the primary stakeholders of the CS² mobile device include the Company Commander, Company Officers, Platoon and Squad Leaders. The Company Commander and below are the primary users of the mobile device. The indirect stakeholders of the system would be the higher level commanders and staff members such as Brigade that will be implementing the system. Also the system would indirectly affect the soldier's families and an American population at large. The CS² system has such a wide variety of direct and indirect stakeholders because of its ability to alter and change soldier's lives.

D. Project Scope

CS² is intended to aid communication between the soldier, staff and commander in the Company level. CS² is designed specially for the Company commander and scarcely takes into consideration any level below it. The system design will take into account the seven different levels of staffs and will also address the manual difficulties that are faced by the squad, platoon and company leaders. CS² will focus primarily of the flow of information and the ability of the users to both push and pull information by using the system. Along with focusing on secure data/information flow the CS² design will take into account all system architectures while maintaining complete functionality.

E. Concept of Operations

The Company Command Support System (CS²) will be developed as a cognitive aiding tool to support the decision maker in an unstructured, dynamic, uncertain, and

information intensive environment. Battlefield information will be modeled as a context-dependent and an action-oriented object that will adapt to a defined system goal or a mission statement. The CS² philosophy will be applied to a graphical display which will consist of maps and GPS capabilities.

F. System Design

a. User Interface

CS² will be designed and implemented for the use of the Company Commander, Company Staff and Ground Troops.

b. Display Interface

CS² will provide display preference and display ability options. Display preference will be categorized in two main groups which includes display modality and command modality. The display ability function will allow the user to identify his/her tasks and its criticality. The main component of CS² is the decision support concept which will give the user the capability of identifying the information received with its particular type, source, criticality and dynamic nature.

C. Human Factors Analysis

Human factors play an integral role of both the productivity and efficiency of the Command Support System (cs²). Human rather than technical failures now represent the greatest threat to complex and potentially hazardous systems. Therefore, we have designed a mock screen that will be both efficient and user friendly. Human factors are a critical aspect of value for our stakeholders. Soldiers often work in fast up-tempo, rigid and dangerous work environments, which require them to have user-friendly systems in which they can operate, navigate and complete their assigned tasks easily. According to users requirements we have designed a mock screen of the cs² interface. We evaluated the interface by having various military officials including ex-commanders on the field use the system. We gave the test users all the same mission and asked them to complete this mission within a time interval. Once the tests were conducted, the four different officials took a survey, that evaluated productivity, functionality, efficiency and ease of use of the cs².

The main menu buttons of the cs² were designed for the immediate needs of the soldiers which include tools, battlefield visualization, mission planning and preparation, information exchange and emergency log off. The subsequent menu items were designed to the user needs. Due to intense and critical situations soldiers sometimes encounter, we designed the emergency log off feature. Once this feature is accessed the CS² will automatically logoff preventing pertinent information from falling into the wrong hands. The image below shows the main menu of the cs².

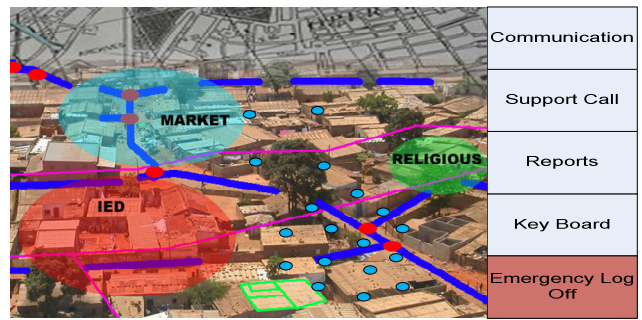


Figure 1. PDA Screen Display

G. Value Hierarchy

The value hierarchy identifies the major values of the stakeholder and the weights associated with each individual function. performance as the most important aspect of the CS² system therefore received a weight of .5 The rest of the weights that round out the value hierarchy are in the chronological order of security (.3), data characteristic/ Operations with (.2).

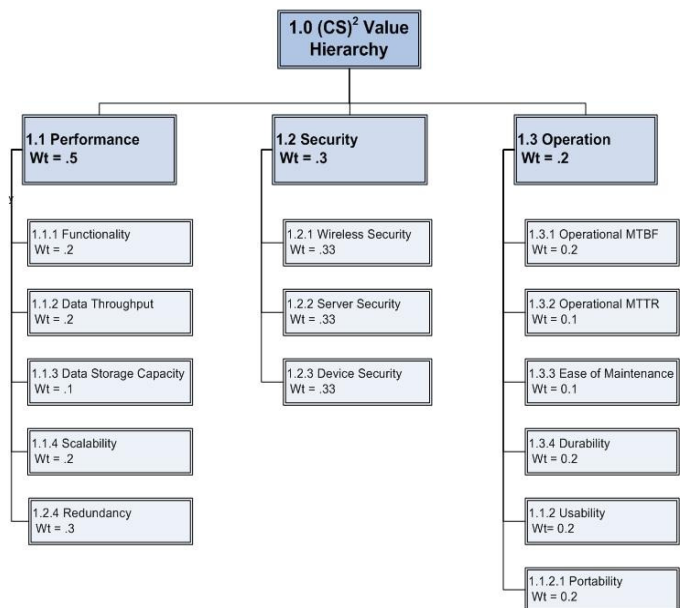


Figure 2. Value Hierarchy

H. Simulation Plan

a. Simulation Method

The CS² system is used by Company Commanders, Platoon leaders and Squad leaders to provide situational awareness to the lowest tactical levels of the military. All CS² devices are capable of wireless communication with each other as well as the Platoon Access Point located in the Company Headquarters. Company Commanders push down mission-relevant information to Platoon and Squad leaders. In turn the CS² users at lower levels act as sensors relaying information back to the Platoon and Company commanders to maintain a real-time common operational picture on the ground. In order to evaluate minimum hardware requirements and performance, our group used the ARENA simulation environment, developed by Rockwell Software, to model the flow of typical information through the CS² system.

b. Simulation Assumptions

We define CS² system input at every level as being a randomly distributed series of data packets, representing graphics, audio messages, video messages, and text files. These represent overlays, command orders, video surveillance, and reports necessary to accomplish a certain mission.

We defined two typical CS² system squad-level usage scenarios: low frequency of communication but large packet size of data, and high frequency of communication but small packet size of data. The first scenario could represent the situation following the identification of an Improvised Explosive Device, where all soldiers are on constant alert, but there is no active combat. Another typical situation for this scenario could be running patrols through an urban neighborhood where local demographic information collection is a major part of situational awareness. In these circumstances, surveillance and data gathering are critical. We assumed in these cases users would be transmitting surveillance data through large videos, pictures, and voice reports. The second scenario would be a combat situation where users would not have time to communicate large data files but would instead be transmitting enemy locations and status updates continuously in the form of voice messages, text messages, and support requests. This situation would be typical of a heavy combat environment involving much movement, surrounding enemy locations, ammunition needs, casualties, and any other time dependent information.

Since Arena is not explicitly built for modeling network data flow, we had to make some assumptions regarding the network behavior of our system. We assumed all network communication occurred in 2 dimensions with soldiers being assigned coordinates representing their 2-dimensional positions. Although line-of-sight could be greatly affected with most wireless protocols in urban situations, for the

purposes of our simulation we assumed it to not be an issue. At any given time the distance between any two soldiers was calculated. Based on this distance, the strength of a soldier's wireless connection to another soldier or access point were determined. The amount of information capable of being transferred is directly proportional to the strength of the network link between the two communicating parties.

The most critical assumption of the CS² system is that the more information received at any level increases the commander's situational awareness. With increased situational awareness the commander/leader is then ultimately more prepared to make better battlefield decisions. Hence, the greater the amount of successful communications across the CS² network, the better the decision making at the Squad, Platoon, and Company levels.

C. Simulation Analysis

Individual CS² devices have specific storage capacities as well as data processing capabilities. These metrics were taken from commercial PDA properties and assigned to the respective process elements within the Arena model to simulate the behavior of the CS² devices according to real PDA capabilities. Assuming the input of data is consistent with appropriately defined distributions and assuming that the more information received at all levels improves the ability for the commander to make a decision; we then defined the overall system performance as a function of successful communications system-wide. This performance metric was then combined with our swing weight analysis of other commercial PDA characteristics: cost, weight, storage, and processor speed. We then evaluated the total aggregate of these metrics for each mission scenario and came up with our final performance vs. cost analysis.

ACKNOWLEDGMENT

We would like to thank Dr. George L. Donohue for his guidance for first half of senior design seminar. The CS^2 team is grateful for all the support and advice and constant guidance from Dr. Kathryn Laskey member of C4I center and Colonel Kleiner the lead sponsor of CS^2 team. We would like to also thank Dr. Andrew Loerch for all the support and constant offer to assist the team with needed research.

REFERENCES

- [1] Wade, Norman M. *The Battle Staff. Doctrinal guide to Military Decision Making & Tactical Operations Smart book.* Florida: The Lightning Press, 2005.
- [2] Colonel Kleiner. *An Introduction to the Decision making Environment of Army Company Commanders. Version 2.0; Presented to the National Army Leadership Coalition.* Washington DC. November 14 1997.
- [3] *MILITARY DECISION MAKING PROCESS.* "MDMP." 25 Sept. 2006
<<http://www.ngms.state.ms.us/185th/Training/Military%20Decision%20Making%20Process.htm>>
- [4] R. D. Badinelli. "Decision Support Systems." *Department of Business Information Technology.* 2 Aug. 2006. 26 Oct. 2006
<http://www.bit.vt.edu/dss_index.html>.
- [5] "Decision Support System." *Webopedia.* 26 Oct. 2006<http://www.webopedia.com/TERM/D/decision_support_system.html>.
"Expert Systems, Decision Support Systems and Computer-Assisted Instruction for Water." *Resource Management (I).* 26 Oct. 2006
<<http://www.nal.usda.gov/wqic/Bibliographies/qb9362.html>>.
- [6] "Decision Support Systems." *All Decision Support Systems Articles.* 20 Feb. 2006. 3 Nov. 2006
<<http://www.informit.com/articles/index.asp?st=41405&rl=1>>.
- [7] "Operation "Defend Base" Using MDMP." *Common Process Framework (CPF).* 9 Sept. 25
<<http://www.aiai.ed.ac.uk/project/oplan/cpf/stevep/cpf/mdmp.html>>.
- [8] Prof. L. Wald, Lucien. "Welcome to Data Fusion." *Data Fusion.* 19 Nov. 2006 <<http://www.data-fusion.org/>>.
- [9] "Data Fusion Products." *Objectivity.* 17 Sept. 2006
<<http://www.objectivity.com/data-fusion.shtml>>.