

Applications and Advances of Command, Communications, Control, and Intelligence (C3I) Framework

Om Prakash Shukla

Assistant Professor, Department of Defense Studies, University of Lucknow, Lucknow- 226007

Abstract: *Advances in weapon systems and in electronics have added whole new dimensions to warfare by increasing the range, speed, accuracy and lethality of weapons whereby no region of a nation is secure from an aggressor's direct attack. This leads us to a situation where the need to be able to command and control the resources available to successfully fight the aggressor assumes greater importance. To achieve this purpose it is necessary to obtain intelligence that is, to gather information about the enemy, process it in real time for decision making and communicate them through a robust and effective communication network. Note that c3i is a concept that responds to the user and may do as much or as little as needed. The subject of design is thus very interesting so it is proposed to review the impact of three new techniques aspects i.e., quantification of information availability in terms of combat effectiveness, data fusion and use of AI techniques which will play very important part in enhancing the effectiveness of future c3i systems.*

I. Introduction

Military operations in future whether limited warfare or strategic exchanges, are likely to be fought under conditions, the like of which have never been experienced before. The concept of integrating the elements of information gathering sensors, information processing computers and the back bone communication network to fulfill the objective of optimizing the resources has been termed c3i i.e., Command, Control, Communication and Intelligence. Though AI has been practiced as far back as the prehistoric man in his hunt for animal prey physically stronger than him, interest in this as a formal concept emerged. It primarily calls for the user to state clearly the requirements to be met, in particular a clear enunciation of the different threat scenarios that are likely to be faced. The system designer has to translate these into specifications for the sensors, the data fusion and processing capabilities, the communication network and the software that will enable the system of function as a fully distributed system.

AI AND C3I SYSTEMS

The likely advantage of using AI techniques in data fusion gives us an opportunity to examine whether this can be employed in other areas of c3i systems. The large scale use of computers in future CI systems will result in increased traffic flow between the different nodes which goes against the requirement that the system should operate with least degradation in the face of intense and extensive Electronic Warfare (EW) in the 1990s. Attempts are on hand at a large number of research institutions to develop natural language processors which will accept queries, commands, statements or data in natural language with all the ambiguities associated with them and convert them into necessary steps, data searches, manipulations and inferences in the more formal language of the computer to obtain the desired information. To realize these savings in communication traffic, in a distributed data-base system, multiple language processors front-end each data base so that the natural language queries received from a distant point can be interpreted. It also requires a natural language processor back-ending the user terminal to help determine which data base system to send the data request.

COMMAND

In a Command Control Communication Intelligence (C3I) system, the term "command" refers to the authority, control, and decision-making processes involved in managing and directing military operations, emergency response efforts, or other complex organizational activities. The command element within a C3I system is responsible for formulating strategies, setting objectives, and overseeing the execution of operations.

The command function within a C3I system involves several key aspects:

1. **Leadership and Decision-Making:** Commanders at various levels of the organizational hierarchy provide leadership and make critical decisions based on the information and intelligence available through the C3I system. They evaluate the operational environment, assess risks, and determine appropriate courses of action.

2. **Orders and Instructions:** The command function uses the C3I system to communicate orders and instructions to subordinate units, individuals, or entities involved in the operation. These orders may include mission objectives, tasks, and specific guidance on how to accomplish them.
3. **Situational Awareness:** The command element relies on the C3I system to gather and analyze information from various sources, such as sensors, intelligence reports, and surveillance systems. This information provides commanders with situational awareness, allowing them to understand the current state of the operational environment and make informed decisions.
4. **Monitoring and Control:** The command function within a C3I system enables commanders to monitor the progress of operations, track the status of units or individuals, and maintain control over the execution of tasks. This involves receiving real-time updates, evaluating performance, and making adjustments as necessary.
5. **Coordination and Collaboration:** Commanders use the C3I system to coordinate and collaborate with other units, organizations, or entities involved in the operation. This may include sharing information, synchronizing activities, and ensuring effective communication channels.

CONTROL

In a Command Control Communication Intelligence (C3I) system, “control” refers to the ability to direct and manage the execution of operations, tasks, and resources. The control function within a C3I system involves monitoring, guiding, and regulating activities to ensure the desired outcomes are achieved. Here are key aspects of control in a C3I system:

1. **Execution Monitoring:** The control function enables real-time monitoring of the progress and status of ongoing operations. Through the C3I system, commanders can receive updates, track the movement of units, and assess the completion of tasks. This monitoring allows commanders to maintain situational awareness and promptly address any issues or deviations from the planned course of action.
2. **Command and Feedback Loop:** Control involves establishing a command and feedback loop between the command element and subordinate units or individuals. Through the C3I system, commanders can provide instructions and orders, while receiving feedback, status reports, and situational updates from the field.
3. **Resource Management:** Control in a C3I system includes the effective management and utilization of resources. This involves monitoring the availability and allocation of personnel, equipment, supplies, and other assets.
4. **Task Assignment and Tracking:** The control function within a C3I system facilitates the assignment of specific tasks and responsibilities to units or individuals. Commanders can allocate tasks based on the capabilities, availability, and situational requirements.
5. **Rules of Engagement and Compliance:** Control in a C3I system involves establishing and enforcing rules of engagement and compliance with operational procedures. Commanders can communicate these guidelines through the system, ensuring that all units and personnel adhere to standardized protocols.

COMMUNICATION

Communication in a Command Control Communication Intelligence (C3I) system refers to the exchange of information, instructions, and intelligence between various units, entities, and individuals involved in an operation. It is a vital component of the C3I system, facilitating the flow of data and enabling effective coordination and decision-making. Here are key aspects of communication in a C3I system:

1. **Data Transmission:** The C3I system facilitates the transmission of data and information in various formats, such as voice, text, images, and video. It provides the infrastructure, protocols, and technologies necessary for reliable and secure communication channels.
2. **Command and Control:** Communication in a C3I system supports the command and control function by enabling commanders to communicate instructions, orders, and directives to subordinate units or individuals. It allows commanders to convey mission objectives, operational plans, and strategic guidance to ensure coordinated actions and unity of effort.
3. **Situational Awareness:** Communication in a C3I system plays a crucial role in establishing situational awareness. It allows for the collection, analysis, and sharing of information from various sources, such as sensors, surveillance systems, intelligence reports, and field observations.
4. **Collaboration and Coordination:** The C3I system facilitates collaboration and coordination among different units, organizations, and entities involved in an operation. It provides communication channels for sharing information, synchronizing activities, and ensuring a common operating picture.
5. **Secure Communication:** Communication in a C3I system emphasizes security measures to protect sensitive information. It incorporates encryption, authentication, and other security protocols to prevent unauthorized access, tampering, or interception of data.

INTELLIGENCE

Intelligence a Command Control Communication Intelligence (C31) system refers to the collection, analysis, and utilization of information and data to generate actionable insights that support decision-making and enhance operational effectiveness. It involves gathering, processing, and interpreting various types of intelligence to provide commanders with a comprehensive understanding of the operational environment. Here are key aspects of intelligence in a C31 system:

1. **Data Collection:** Intelligence in a C31 system involves collecting data from a wide range of sources, such as sensors, surveillance systems, human intelligence, open-source information, and signals intelligence.
2. **Data Processing and Analysis:** The C31 system employs advanced analytical tools, algorithms, and techniques to process and analyze the collected data. This may involve data fusion, pattern recognition, anomaly detection, and other methods to identify trends, correlations, and actionable information.
3. **Situational Awareness:** Intelligence in a C31 system contributes to situational awareness by providing commanders with an accurate and up-to-date understanding of the operational environment. By analyzing and synthesizing data from multiple sources, the system helps identify threats, assess risks, and identify opportunities in real-time.
4. **Targeting and Mission Planning:** Intelligence in a C31 system assists in target identification, selection, and mission planning. By analyzing data on enemy activities, vulnerabilities, and potential targets, the system helps identify high-value targets and plan operations to maximize mission success.
5. **Early Warning and Indications & Warnings (I&W):** Intelligence in a C31 system plays a critical role in providing early warning and indications of emerging threats or potential crises. By monitoring and analyzing data, the system can detect patterns, anomalies, or changes in the operational environment, allowing commanders to take proactive measures and initiate timely responses.

II. Conclusions

Command Control Communication Intelligence (C31) systems are indispensable in today's information-driven and interconnected world. By enabling efficient communication, enhancing situational awareness, and supporting decision-making processes, C31 systems empower leaders across various domains. As technology advances and new challenges emerge, it becomes increasingly crucial to invest in the development, integration, and security of C31 systems. By doing so, organizations can harness the power of information, optimize resource allocation, and ensure effective responses to evolving operational requirements.

References

- [1]. Armstrong, J. E. (1994). Designing, testing, and using command control, communications, computers and intelligence (C4I) systems: What causes the disconnects and what can be done about them. Newport, RI: Naval War College.
- [2]. AIR FORCE MATERIEL COMMAND WRIGHT-PATTERSON AFB OH. (1995). FY96 Command Control Communications and Intelligence C3I Technology Area Plan.
- [3]. Back Jr, J. F., Barbone Jr, A. F., Crocker, G. K., Johnson Jr, L. M., Jones, L. D., & ARMY WAR COLL CARLISLE BARRACKS PA. (1987). Artificial Intelligence: Expert Systems for Corps Tactical Planning and Other Applications. NTIS, SPRINGFIELD, VA(USA), 1987, 133.
- [4]. Deodhare, D., Rakshit, S., & Sitaram, N. (2003). Some key technologies in artificial intelligence for defence applications. IETE Technical Review, 20(2), 157-164.
- [5]. Enyart, J. N., & ARMY WAR COLL CARLISLE BARRACKS PA. (1983). Artificial Intelligence Applied to the Command, Control, Communications, and Intelligence of the US Central Command (p. 0081). US Army War College.
- [6]. Harris, C. J., & White, I. (Eds.). (1987). Advances in command, control & communication systems (No. 11). IET.
- [7]. JOINT ADVANCED DISTRIBUTION SIMULATION/JOINT TEST AND EVALUATION ALBUQUERQUE NM. (1997). Testing and Training in a Command, Communications, Control, and Intelligence (C31) Framework.
- [8]. Sandy, R. J., & NAVAL WAR COLL NEWPORT RI. (1994). Command, Control and Emerging Technologies: Implications for the Operational Commander.