CHAPTER 9

# Trends and Issues in the Development of C4ISR Systems for Integrated Warfare in the ROK Armed Forces

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## Introduction

Modern C4ISR Systems provide unprecedented advances in military capability. C4ISR systems are now necessary needed to win in a war. Success in modern warfare is also a matter of location, so the development of a COP for integrated air and ground operations is a basic objective. The C4ISR systems are necessary to create a comprehensive picture of the environment for the purpose of conducting both military and civilian command and control functions. For better illustration of the functions of the C4ISR, the author relies on the Boyd's OODA model of command and control processes.

Next, the author briefly explains the status of C4ISR systems development in the ROK armed forces. The author first attempts to define the terms related to interoperability. Because it is important to distinguish between several fundamentally different concepts, failure to do so sometimes confuses the debate over interoperability. Then, he presents several examples designed to clarify the interoperability concept. Further, he discusses the problems of joint and combined interoperability. Lastly, he emphasizes that in order to achieve combined interoperability, the ROK armed forces will have to resolve not only technical problems, but also military and political problems.

Without advances in ISR capabilities, the ROK armed forces will not be able to take full advantage of advanced C4I systems. The ISR systems are not only difficult to acquire technologically but they are also expensive. So it is imperative for the U.S. and ROK armed forces to cooperate in this field. The burdensome and lengthy acquisition process makes C4ISR systems more costly than needed. The systems quickly become obsolete, especially when compared to those in the commercial world. The author discusses several ideas aimed at improving the systems acquisition process in the C4ISR area.

**Overview of C4ISR Systems**

The C4ISR system under discussion in this chapter is a collection of subsystems that create a comprehensive picture of the environment for the purpose of conducting military and civilian command and control functions. The geographic areas involved are typically large and can be a nation or a larger theater of operation. Therefore, the subsystems are connected by the means of a communications network, typically a WAN, and communication links, which feed information into and out of the command communication and control system. The necessary data is collected from a variety of sources, including intelligence, surveillance, and reconnaissance (ISR), and analyzed and acted upon by a decision-making process. Decisions are made based upon the data provided in the command and control center, and tasking for resources is directed as a result of those decisions.

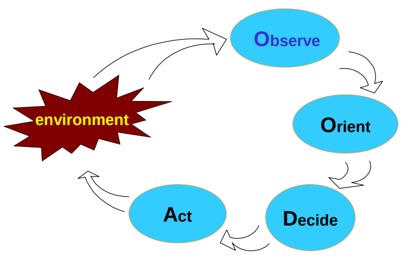



***Figure 9.1. John Boyd's OODA Model***

*Observe*, *orient*, *decide*, and *act* effectively describe the C4ISR mission cycle, which is illustrated in Figure 9.1. During the *observe* phase, ISR resources collect the data necessary for a complete assessment of the environment and adversaries. During the *orient* phase all collected raw data is processed, correlated and fused into useable format to create a mission focused understanding of the adversary and the battlespace. During the *decide* phase, commanders use the information and understanding of the adversary to decide on an execution plan. During the last phase, *act*, the plans are executed.

*The Observe Phase of C4ISR*

During the *observe* phase, ISR sensors gather necessary data. The sensors are deployed in many platforms to detect acoustic, electromagnetic, visual and infrared data. The need for continuous and timely data to drive the decision-making process especially requires modern, effective ISR systems. The effectiveness of a C4ISR system directly impacts three major factors: (a) the quality and timeliness of the data provided by the ISR systems, (b) the quality of the information created from the data, and (c) the quality of the decision-making process. The ROK armed forces has invested the least in this field. In particular, strategic ISR assets rely mostly on the U.S. Forces Korea and Combined Forces Command.

*The Orient Phase of C4ISR*

During the *orient* phase corresponding to "process and compare" in Lawson's C2 model, the sensor data and other data are converted into a correlated and fused COP. Ultimately, a layered picture must be developed and disseminated, which is geospatially registered and in a format understood by users.

*The Decide and Act Phases of C4ISR*

The *decide* and *act* phases complete the C4ISR process. Figure 9.2 shows another C2 model developed by Lawson.

***Figure 9.2. Lawson's C2 Model***

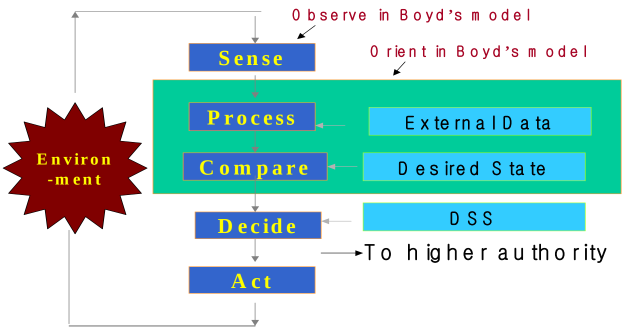



Figure 2. Lawson's C2 Model

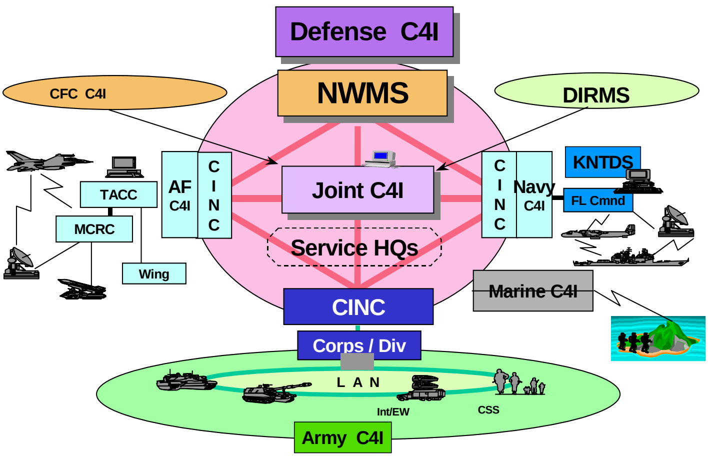
## Development of C4ISR Systems in the ROK Armed Forces

The theater automated command and control information management system developed by the CFC launched its initial operational capability in July 1991. Its terminals were installed in the Korean JFC) and the service's headquarters in December 1991. Global command and control system Korea, upgraded from TACCIMS, is an automated information system for developing an understanding of the battle-space and control of the situation. It is now in use in the ROK. The command post automated system was fielded in 1999 and is now in use by echelons above the corps. The master control reporting center (MCRC) system was fielded in 1986 and is now in use by the ROK Air Force for air operations. Now the second batch MCRC system is developed, and it should be in IOC in 2003. The Korean Navy tactical data system was fielded in 1996 and is now in use by the ROK Navy for naval operation. Now the second batch KNTDS system has been developed, and it should be in IOC in 2004.

The ROK armed forces used three different approaches in the development of C4ISR systems. First, the ROK Air Force developed its MCRC System in a grand approach - one step and fixed. Second, the ROK Navy developed KNTDS in an incremental approach -- many steps but fixed. Third, the ROK Army is developing its tactical C4I systems in an evolutionary, or spiral, approach - in many steps and flexible. The ROK Navy and Air Force will also develop their tactical C4I systems in the evolutionary, or spiral, approach.

The ROK objective joint C4I systems are shown in Figure 9.3. The ROK Army tactical C4I system is under development, and it will be fielded through 2004-2006. The ROK Navy tactical C4I systems and the ROK Air Force tactical C4I systems are in the development planning stage.

***Figure 9.3. The ROK Objective Joint C4I System***



Although the ROK armed forces plan to build their C4ISR systems, they lack experience in developing C4ISR systems. Therefore, they usually benchmark foreign advanced systems and attempt to minimize their trials and errors by using lessons learned from an advanced country's developing experiences.

For example, interoperability is the most significant issue in the U.S. armed forces. The ROK armed forces also recognize the importance of interoperability and are now trying to resolve the interoperability problem. Furthermore, they are trying to develop their own COE with referencing that of the U.S. But no organization exists to drive the interoperability issues within the ROK armed forces yet. There are no standards, no plans and procedures for their COE development. COE is the term given for an "open /scaleable" architecture which uses standards to facilitate interoperability and reuse of components. In other words, the emphasis on a scaleable architecture has dictated the use of a COE. COE is a technological approach for achieving the needed capability in an interoperable and cost effective fashion.

**Interoperability Problem**

In recent years, interoperability has been the most significant issue in the C4I community. Joint and combined forces must be fully interoperable in the conduct of land, sea and air operations. The underpinnings of interoperability provide for the common understanding of information. The U.S. Department of Defense has made encouraging progress in the area of joint information interoperability since the Joint Staff (J6) created the "C4I for the warrior" program nearly 10 years ago. In spite of that, major deficiencies still remain in joint information interoperability that could significantly impede highintensity joint operations by the U.S. armed forces. These deficiencies illustrate the fundamental issue that the services' C4I systems typically are not "born joint." Therefore, the ROK armed forces have to address the interoperability problem seriously. But before we discuss the interoperability problem, we have to define the terms related to interoperability.

*Defining the Terms Related to the Interoperability*

*Joint Publication 1-02* defines interoperability as "the ability of systems, units, or forces to exchange services and ... operate effectively together." The following concepts are related to interoperability:

"Integration" is generally considered to go beyond mere interoperability to involve some degree of functional dependence. For example, a mission planning system might rely on an external intelligence database, or an air defense system -- on an acquisition radar. While interoperable systems can function independently, an integrated system loses significant functionality if the flow of services is interrupted.

"Compatibility" is something less than interoperability. It means that systems or units do not interfere with each other's functioning, but it does not imply the ability to exchange services. In two IBMs – compatible PCs, for example, it is difficult to exchange between MS Word documents and Arirang documents. Interoperable systems are by necessity compatible, but the converse is not necessarily true. Mere compatibility between information systems is inadequate to enable network-centric operations because it does not facilitate information sharing. In sum, interoperability lies in the middle of an "integration continuum" between compatibility and full integration.

*System Interoperability and Interaction*

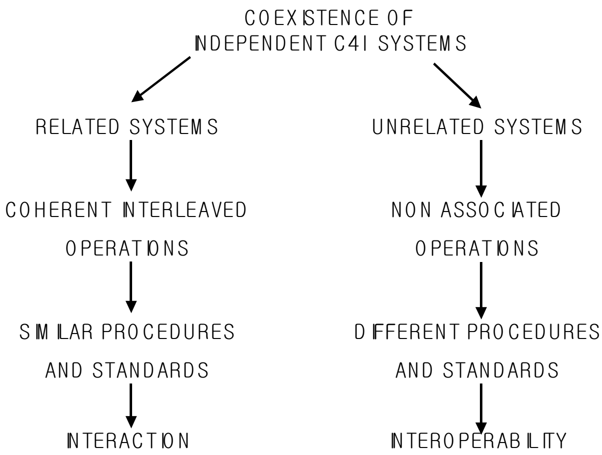
Initial C4I systems were designed to solve a particular set of problems confronting an organization, but the users soon found out that no C4I system can operate completely independently without relying on external information sources. Examples of these can be found in all types of C4I systems, whether military, commercial, or industrial. Take, for example, the process of seat reservations in the airline industry whereby the airlines enter into code-sharing agreements with other airline companies in order to enable the transfer of passengers. It is not designed for the passenger to book his flight itinerary with each individual company; it is the obligation of the first company to provide that kind of transfer service. Likewise, in banking, C4I systems are designed to transfer money from one bank to the other: it is not the responsibility of the customer to deposit directly his checks only to the issuing banks. These examples show how independent systems are enabled to perform similar functions because of their mutually dependent relations.

On the other hand, there are models of cooperation whereby two associated systems have no common functional relationship. When two unrelated C4I systems have to operate together, the common operation is termed "interoperability." For instance, a totally independent C4I system for air traffic control must stay in touch with a totally independent C4I system of a weather bureau. In the military sphere, for example, a ground force has to be associated with air support through a C4I system. In these examples, not only does each C4I system operate independently but it may also be designed in a completely different configuration with different techniques and procedures from the others.

For the interoperability of any two systems to succeed, these two systems must be able to communicate with each other. In other words, the output of one system must be able to serve as the input of the other system. Interoperability is much more than simple communication between two independent computers. Under the condition of interoperability, one system must be able to regard the other system as one of the sources of its data input required for its decision-making. Both systems must be able to send and receive information as they need it, with an online connection and with a real-time response. In other words, the two systems must not only be able to communicate with each other but also to operate together.

System interaction must not be confused with system interoperability. On the one hand, in both cases the systems must be able to operate independently, as seen in Figure 9.4. On the other hand, interacting systems are related and have both a direct or indirect effect on each other; using similar techniques and common equipment, whereas interoperable systems are completely unrelated. The only common media between them is that each system possesses information that can assist the operation of the other system.

***Figure 9.4. Common Operation of Independent C4I Systems***




The design of system interaction is much easier and simpler than that of interoperability. Bearing in mind the master system design, the transfer of data between each of the subsystems is defined by one organization. That is, the organization determines what information is to pass between the subsystems, how it is to be transferred, who is authorized to update the files, and who is authorized to see what is in the files. In a banking C4I system, for instance, the head office has full control of the branches' decisions and is provided with means for nullifying all local transactions.

With system interoperability, the situation is completely different. Each system does not only operate independently but is also controlled by different organizations and may even be located in different countries. It is accepted that with interoperability there is a need for exchange of information between the systems, but this does not allow one system to update the files of another, not to mention that one system must not be allowed access to the files of the other system. The interoperability systems may even belong to competitive organizations. Take for example two airline companies, which are associated in providing the passenger with a service of extended flights with both companies. This does not mean that one airline company has the right to change the operations of the other company. With system interoperability, each system must define what information can flow between companies and introduce strict security measures to ensure that this right is not unduly exploited. Furthermore, special recording logs must be inserted in both systems to register all transactions for possible later analysis. Security measures in both systems need not be identical, as each can follow its own procedures.

System interoperability constitutes a major design issue. The designer knows only what information he needs to receive or transmit to operate. Each system may keep its own procedures secret from associated systems. It follows that while the designer must provide means for free information transfer between the systems, he must at the same time ensure that the transfer is limited only to the information agreed upon by both systems. This indicates another difference between interaction and interoperability. Whereas designs for interaction are based on standards, those for interoperability are based only on mutual agreements. A good practical example highlighting the difference between interoperability and interaction can be found in a bank merger between the Kookmin Bank and the Housing & Commercial Bank in the Republic of Korea. Prior to the merger, the two banking systems were interoperable, but after merging they became interactive.

In order to achieve joint interoperability, the Joint Forces Command needs to play a leading role in the development of services' tactical C4I systems. But, the ROK armed forces reduced the JFC C4I division to departmental status in September 2002. The CPAS will need to be upgraded in the future in order to achieve combined interoperability with the U.S. armed forces at the strategic level in the Korean theater. However, the question "How much interoperability is enough?" remains. The answer to this question is political in nature and will be determined by the level of information sharing and collaboration between two nations. Therefore, combined interoperability is not only a technical problem, but also it contains a lot of potential military and political problems.

**ISR Assets**

Recent experiences in Bosnia, Kosovo, Somalia, and Afghanistan have demonstrated the need for improved information superiority in order to achieve full situation awareness in conducting successful campaigns. One can expect an even greater requirement for information superiority in future conflicts. The information must provide a complete and timely picture of the adversary across the full spectrum of threats.

With a strong appreciation of the value of ISR, the U.S. armed forces invested heavily in ISR capabilities. As a result, they lead the way in ISR in the global arms modernization process. In contrast, the ROK armed forces are badly under-invested in this field. Recently, the ROK armed forces have fielded a signal intelligence system named *BaekDoo* and imagery intelligence system named *KeumGang*. This notwithstanding, strategic ISR assets still rely on U.S. Forces Korea and the CFC.

Without advances in ISR capabilities, the ROK armed forces will not be able to obtain full advantages with advanced C4I systems. ISR systems are not only difficult to acquire technologically but are also expensive. So there is a pressing requirement for the ROK armed forces to cooperate with the U.S. armed forces in this field.

**Acquisition Process Improvement**

The burdensome and lengthy acquisition process makes C4ISR systems unnecessarily costly. The systems acquired over many years quickly become outmoded and obsolete and lose their appeal among the services, especially when their capabilities are compared to the ones available in the commercial world. These legacy systems are difficult to use and maintain. Since all systems progress through a life cycle, at some point all of them will need to be retired or upgraded

Since difficulties stem from rapid advances in the underlying information technologies, a process needs to be established and continually improved to determine and manage change. Part of this process must involve some mechanisms of liaison and coordination with the commercial development world of information technology.

Commercial investment and the speed of technology development in the IT field of greatly exceed military R&D and acquisition processes. From a commercial point of view, issues of interoperability, cost, and technology upgrades are essential. These issues are of increasing importance to the military, too, but the ROK armed forces have a poor record of addressing these issues in a timely and constructive fashion. The ROK Ministry of Defense should thoroughly study how commercial telecommunications industry, in addition to commercial military industry, can contribute to the services' IT architectures and systems.

Affordability requirements demand the use of commercial standards that will enable interoperable systems and components. The open-system architecture will enable plug-and-play insertion of new components as technology matures. Manning requirements must be reduced to enable the attainment of national objectives within reasonable budgets.

In C4I development, interoperability compliance should be a go/no-go criterion for acquisition decisions. Mechanisms should be established to facilitate identification and resolution of interoperability issues between services and agencies during the development process.

**Conclusion**

This chapter discusses trends some issues in the development of C4ISR systems in the ROK armed forces. When the ROK armed forces are developing C4ISR systems, they have to emphasize the need to maintain a required balance between C4 and ISR.

Now we are in the midst of information warfare where IT advances have increased the ability to gather, process, store, display, and transmit information. This means that the preponderance of technical advances that offer new opportunities for improving military effectiveness are information-based.

In the past, different nations had different approaches on how to best take advantage of new technologies for the conduct of war. The winners were those armed forces that developed appropriate operational concepts and made the organizational changes necessary to get the maximum military effectiveness from new technologies in military systems. Therefore, the ROK armed forces should consider new concepts of operations and organizational relationships in their exploitation of new C4ISR capabilities. They are well advised to shift the focus of organizational and operational concepts from platforms to networks. To organize a military service around a highly distributed, horizontally integrated and bandwidth-unlimited information and ISR architecture would certainly be revolutionary.