

INTEGRATED FRAMEWORK AND METHODOLOGY FOR CAPABILITY PRIORITY DECISIONS

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Abstract: As the defense paradigm of advanced countries evolves from platform-to network-centric warfare and the development of respective capabilities, Korean Air Force is making efforts to convert its structure into a capabilities-oriented force able to deal with diverse security threats across a spectrum of operations with varying intensity. However, currently available capacity to integrate requisite concepts and set priorities in capability development is insufficient. Accordingly, the purpose of this research is to propose an integrated capability framework which simultaneously treats capabilities at different organizational levels, the current force operation view, and the future force development view. In addition, based on the integrated capability framework, we propose a quantitative methodology for prioritization of capability requirements that accounts for the correlation between operations and capabilities. It is applied to the case of air missile defense and can serve as a basis for setting priorities in the development of the future Korean Air Force.

Keywords: Integrated capability framework, operational view, force development view, functional capability, primitive capability, capability prioritization.

Introduction

The defense paradigm of advanced countries is in the process of evolution in three main directions: First, from platform-centric to network-centric warfare (NCW); Second, from threat-based to capability-based force structure intended to react effectively against various threats, including terrorist attacks; Third, from the bottom-up requirements generation system, suitable for the platform-centric warfare, and threat-based force structures towards a top-down requirements generation system, suitable for network-centric warfare, and capabilities-oriented force. For this purpose, defense establishments of advanced countries introduced capability-based force development and a related operational concept. The essence of such concept is to anticipate various types of operations in an uncertain future, to deduct the capabilities required to conduct each type of operation, and to develop resources (DOTMLPF) for these

capabilities based on the integrated concept and utilizing synergistic effects. Besides, the US Department of Defense (DOD) has developed Joint Capability Areas (JCA)—the common languages to increase joint capabilities—and a Universal Joint Task List (UJTL); other countries are also developing requisite concepts.

The Korean Military has been making attempts to develop and introduce the capability-based force to take account of diversifying security threats and the need to conduct a continuum of operations, and also has developed JCA and UJTL. However, due to lack of understanding of the concept of integrated capability, the method of development, and methods to prioritize capability requirements, Korean Military is currently facing some difficulties in constructing its capability-based force.

The purpose of this research is to propose an integrated force framework which represents the overall capability of both upper and lower organizations from current and future points of view required in constructing the capability-based force, and eventually turn that framework into the basis of analysis for integrative capability of any organization, respective investment decisions, capability portfolio management, force development and operational planning. In addition, this research is expected to assist the efforts of the Korean Air Force (KAF) to construct its capability-based force development system by proposing a methodology for defining capability priorities – a step that must precede deliberations on determining priorities in system development. To meet these objectives, our research starts with covering relevant concepts. Then we propose an integrated capability framework and, lastly, suggest a methodology for defining capability priorities.

Related Work

Capability and JCA

Capability can be defined as the ability to achieve a desired effect under specified standards and conditions through a combination of means and ways across doctrine, organization, training, materiel, leadership and education, personnel, and facilities (DOTMLPF) to perform a set of tasks in executing a specified course of action.¹ Joint Capability Areas (JCA) are used since 2005 by the Pentagon as a common language to structure diverse activities. Activities are functionally grouped to support capability analysis, strategy development, investment decision making, capability portfolio management, and capabilities-based force development and operational planning.

Figure 1 presents the latest US structure of JCA that, at the top level, examines nine capability groups: Force Support, Battle Space Awareness, Force Application, Logistics, Command and Control, Net-Centric, Protection, Building Partnerships, and Cor-

porate Management and Support. These first-level capabilities are further classified into 25 subordinate capabilities, composing the 2nd class. Currently, up to 7th class are classified and, though the JCA Management System (JCAMS), respective capabilities are mapped to UJTL.

Universal Joint Task List (UJTL)

UJTL is a collection of tasks providing a basis for capability-based planning across the range of military operations. It provides support for integrated capability-based planning, integrated force development, combat readiness reports, experiments, integrated training and education, and tasking. It is also used as the language for developing the Joint Mission-Essential Task List (JMETL) and Agency Mission-Essential Task Lists (AMETL). In addition to UJTL, each branch of the military maintains a standard for designating tasks, e.g. the Army Universal Task List (AUTL), the Universal Naval Task List (UNTL), the Air Force Task List (AFTL), etc. The combination of these task lists becomes an integrated menu for functional tasks, conditions, and measurements providing support for standards at all planning levels within the US defense establishment.

The US UJTL is structured into 4 sections, examining respectively Strategic National (SN), Strategic Theater (ST), Operational (OP), and Tactical (TA) tasks. First and second levels of the UJTL structure are shown in Figure 2. These tasks are mapped to the capability of each class of JCA shown in Figure 1.

Round Trip Matrix (RTM)

Round Trip Matrix (RTM) is a tool for a more simple grasp of complex linkages between main notions in the planning process. Figure 3 is a two-dimensional form of the US RTM representing interlinks among organizations, mission thread, capability, system and DOTMLPF.²

The organizational view covers concrete organizations like the Joint Staff, as well as generic organizations such as “military service,” “defense agency,” “Combat Command,” and “Joint Task Force.” Organizations link to other RTM views via the so called ‘mission thread,’ defined as a “consecutive procedure providing support for execution of mission through information system and organization,”³ consisting of a series of activities and events. Then the Round Trip Matrix shows the correlation between mission threads and capabilities required to conduct the missions, identifying in addition the need, insufficiency and excess of capabilities in conducting the mission thread. At this stage, the capability is an ability composing of the lowest of a number of classes of JCA. ‘Capability’ has a correlation with systems – the physical substance delivering the capability, and the RTM identifies gaps in delivering re-

quired capabilities. Unmet capability requirements thus lead to a consideration of potential acquisition projects. The RTM then presents the correlation between a system solution to a capability requirement and the components of DOTMLPF – doctrine, organization, training, material, leadership, personnel and facilities, i.e. both material and non-material factors necessary to deliver a required capability. Depending on the purpose of the RTM and its range of application, present and future status of organization, mission thread, capability, system, and DOTMLPF views may be added or removed depending on the intended use of the matrix.

Integrated Capability Framework

The integrated capability framework is based on analysis of current status and concept of the US capability, RTM, joint capability and capability-based force structure. It indicates the overall capability of organizations at present and in the future as indicated in Figure 4. In addition, it was developed as a tool for more simple grasp of the linkages between factors impacting the integrated defense capabilities. The framework covers the lifespan of the national defense force including planning, developing, deploying, employing, and sustaining the force structure. The left part of this framework presents the current force structure, while the right part views the development of the future force. Such integrated framework treats both operations and force development simultaneously.

Components of Integrated Capability Framework & Relations

The components of the framework are ‘organization,’ ‘operation,’ ‘integrated capability,’ ‘system’ and ‘resource,’ all addressing force operation and force development.

1. Organization

The organization can be defined as “A social arrangement which pursues collective goals, controls its own performance, and has a boundary separating it from its environment.”⁴ It encompasses the top hierarchical level, as well as its subordinate organizations. For instance, the upper organizations are the Ministry of National Defense and the Joint Chiefs of Staff, and the subordinate organizations are Army, Navy, Air Force, and other organizations.

2. Operation

Operation is a “military action or the carrying out of a strategic, tactical, service, training, or administrative military mission,”⁵ concentrated on the performance of military activities. The form of operation can be divided into current operation in the view of force operation and future operation in the view of force development. For in-

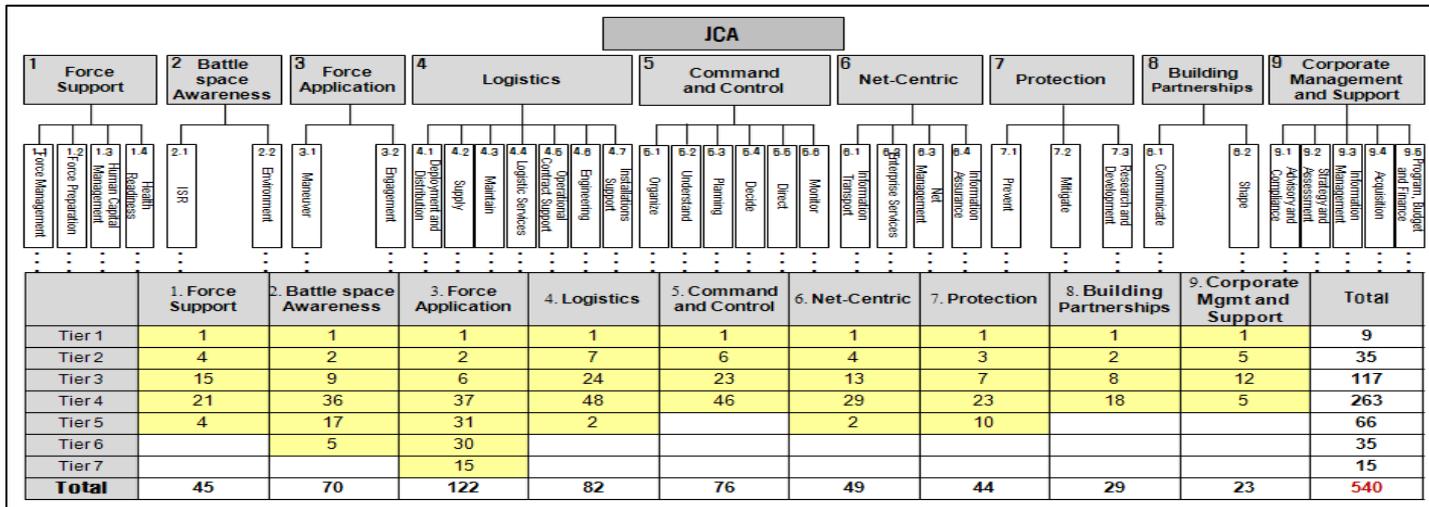


Figure 1: Joint Capability Areas used by the US defense establishment.

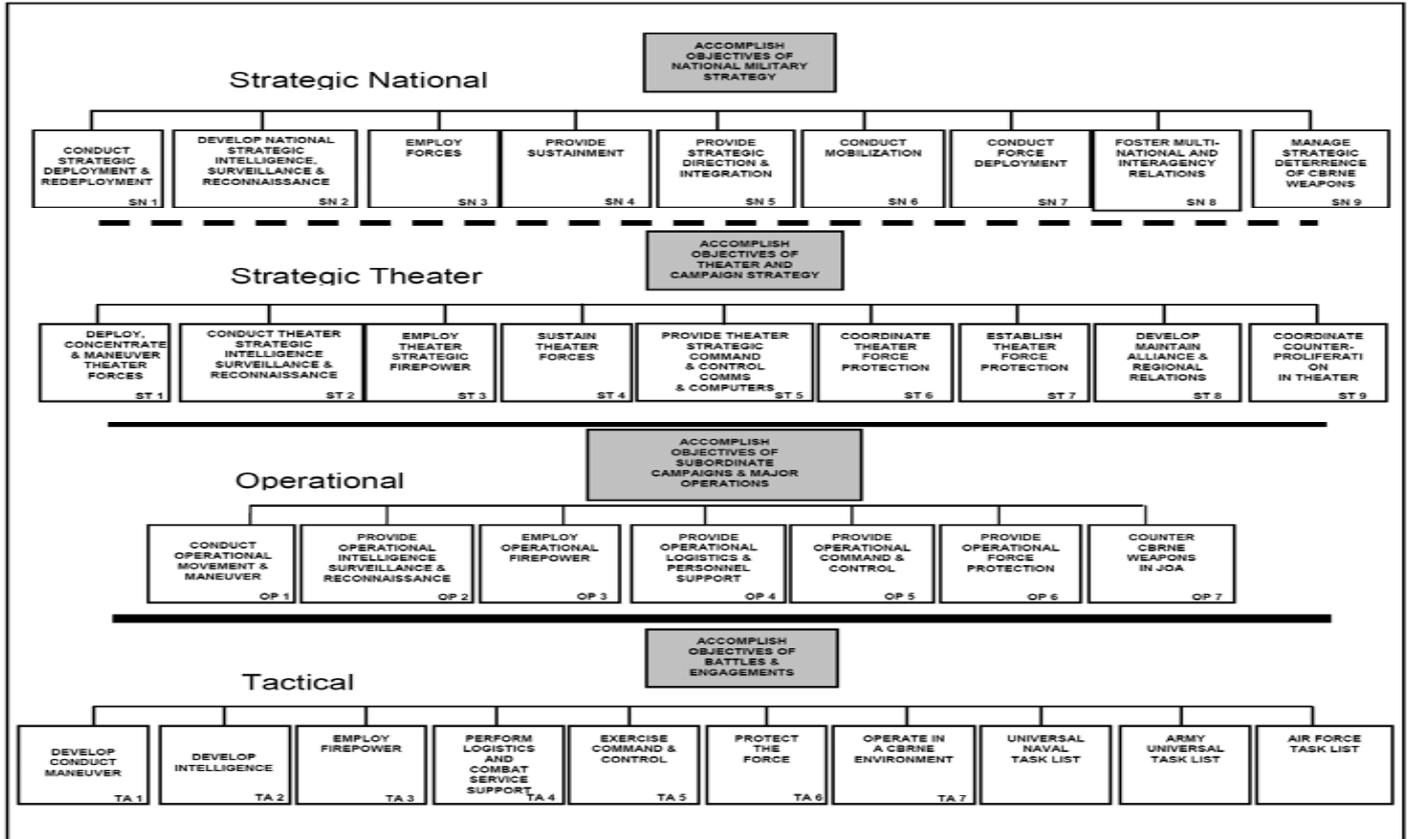


Figure 2: The United States UJTL.

Joint Task Force	Joint Staff	Services	Defense Agencies	Joint Activities	Combatant Commands																															
x			x		x	Close Air Support																														
x				x		Joint Time Sensitive Targeting																														
x		x			x	Joint Blue Force Sit Awareness																														
	x	x	x		x	Joint Integrated Fires																														
	x			x		Integrated Air & Missile Defense																														
1. Organization)						2. Mission Threads						3. Capability																								
5. Resource						4. System						Battle Space Awareness	Net Centric Operating Environment	Network Operations	Interagency Coordination	Public Affairs Operations	Information Operations	Protection	Force Management	Homeland Defense	Strategic Deterrence	Shaping and Securing Cooperation	Stability Operations	Civil Support	Non-Traditional Operations	Maritime Littoral Control Operations	Space Control Operations									
		x			x	Joint Tactical Radio System												x		x																
x						NCES														x	x										x					
			x	x	x	GIG BE												x	x																x	
x						GCCS														x	x														x	
x		x		x	x	DJFAC												x	x		x														x	
						JBMC2												x		x																x
Doctrine	Organizational	Training	Material	Logistics	Personnel	Facilities																														

Figure 3: The United States Round Trip Matrix (RTM).

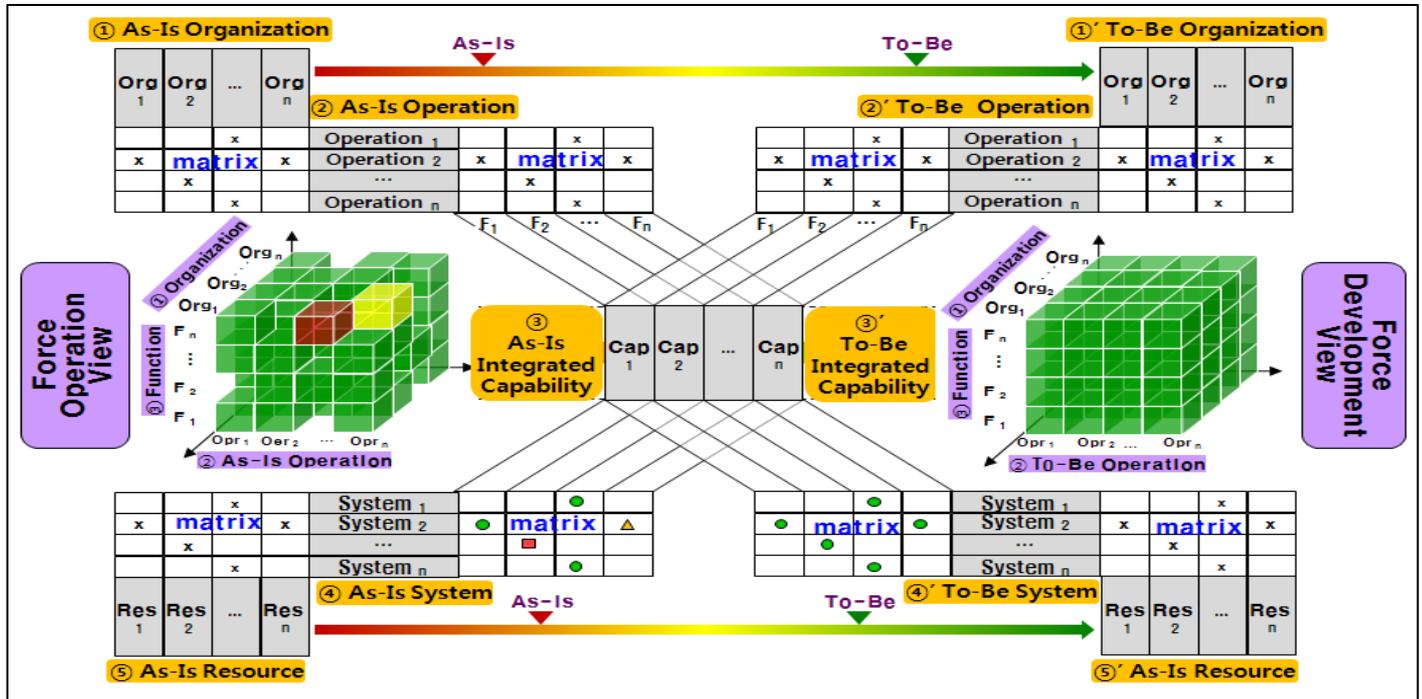


Figure 4: Integrated Capability Framework.

stance, the current operation includes the wartime operation plan 5027, and the future operation includes short-term future operation known as mission thread and the Joint Operation Concept (JOC) for the long-term future operation, through which the joint military commander explains how the military operation should be performed in 8 to 20 years timeframe.

The organization & operation matrix indicates the relationship of organization and operation.

3. *Integrated Capability*

Integrated capability is the overall capability of upper and lower organizations; it can be defined as integrated capability entirely including joint capability in the aspect of upper organization and capability of each military unit in the aspect of subordinate organizations. For instance, the capability of a superior organization would be JCA of the Joint Chiefs of Staff, and capability of subordinate organizations would be the capabilities of the Air Force.

As shown in Figure 5, the integrated capability can be described by an integrated capability model and an integrated capability class diagram. The integrated capability model is described by ‘function,’ ‘operation,’ and ‘organization.’ It is a function-based capability calculating the functional capability to conduct diverse operations. The integrated capability class diagram is designed to provide more detailed description of the integrated capability model. It describes detailed ‘Sub-Capability’ (SC) of the middle class and ‘Primitive Capability’ (PC) of the lower class based on the Functional Capability (FC) of the uppermost class.

The integrated capability class is defined according to a consistent breakdown structure of functions. It must be mutually exclusive and collectively exhaustive, including the overall capability of military without any duplication or gaps in national defense capacity, while classes are mutually exclusive at the same time.

The 1st class of the integrated capability class diagram is the uppermost class, or the highest-level capability. The functions ($F_1 \sim F_n$) in the integrated capability model relate to functional capabilities ($FC_1 \sim FC_n$). The 2nd class is a subordinate class in the breakdown structure subordinate to the 1st class and it consists of sub capabilities ($SC_{11} \sim SC_{nn}$). The n-th class is the lowest primitive capability ($PC_{11} \sim PC_{nn}$) which cannot be broken down any further; capability at this level is defined by task, condition and standard and can be mapped to the task lists.

With regards to the procedure of integrated capability development, the role of organizations and their subordinate structures is initially decided based on the decision of the mission of each organization. Then comes the decision on operation. The op-

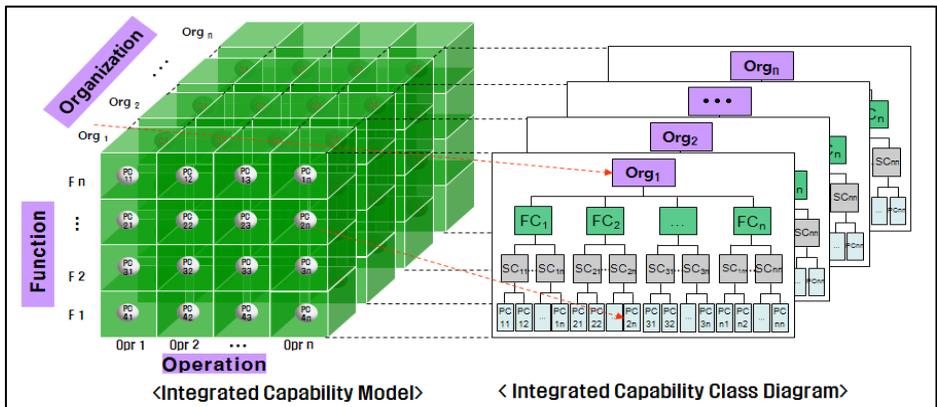


Figure 5: Integrated capability: Integrated Capability Model and Class Diagram.

eration is a relatively variable concept, deduced from the concept of joint operations. The operation is focused on performing military activities such as main theater operation, nuclear war and a special operation. The view of development and operation is based on the current operation and the view of force development is based on the future operation. The third procedure is decision. Its function is a relatively lasting concept concentrated on allowing military activities such as command and control, logistics and force operation. For instance, the functional decision is in possession of a joint functional concept describing how the United States would perform military functions required by the joint military in the future 8 to 20 years. The fourth procedure identifies the primitive capability which is the minimum function-based unit. The fifth procedure, based on the primitive capability of n -th class developed and the function of 1st class decided, completes the integrated capability through the development of an integrated capability class diagram.

The operation & integrated capability matrix indicates the relationship between operation and integrated capability. Thus, it identifies the relationship between current operation and current integrated capability in the view of force operation, and it also identifies the relationship between future operation and future integrated capability in the view of force development.

4. System

The system is a “combination of two or more interrelated pieces of equipment (or sets) arranged in a functional package to perform an operational function or to satisfy a requirement.”⁶ The system view relates both to force operation and force development. The system in the view of force operation is a system currently in possession and the system in the view of capability development is a future system required to

achieve effectiveness. Depending on the standards, systems can be divided into weaponry system and non-weaponry system or sensor, command and control, and shooter system.

The integrated capability & system matrix indicates a relationship between integrated capability and system. For instance, as shown in Figure 6, Capability Based Assessment (CBA) is used to analyze the relationship between integrated capability and the systems necessary to provide this capability and categorize status as major deficiency (red square), deficiency (yellow triangle), and sufficiency (green ellipse) in the left section of the matrix. Ideally, with the acquisition of systems in the force development process all integrated capability requirements will be satisfied (as indicated in right hand side of Figure 6).

5. Resource

As shown in Table 1, a resource is “material/non-material factor for the development of combat”⁷ and it evaluates current resources in the view of force operation, and it also identifies future, force development-related resource requirements.

The US model designated as DOTMLPF structures the resources in the major groups of doctrine, organization, training, materiel, leadership and education, personnel and facilities. Materiel, personnel and facilities are classified as ‘means,’ while doctrine, organization; training and leadership are non-material, or also ‘ways’ factors. The purpose of the ‘means factor’ is to resolve issues through material solutions, and the purpose of emphasizing the ‘ways factor’ is to save time and budget from development of weaponry and equipment through implementation of non-material solutions.

The UK model⁸ known as ‘Defence Lines of Development’ (DLODs), or TEPID-OIL, examines doctrine, organization, training, equipment, personnel, infrastructure, logistics and information.

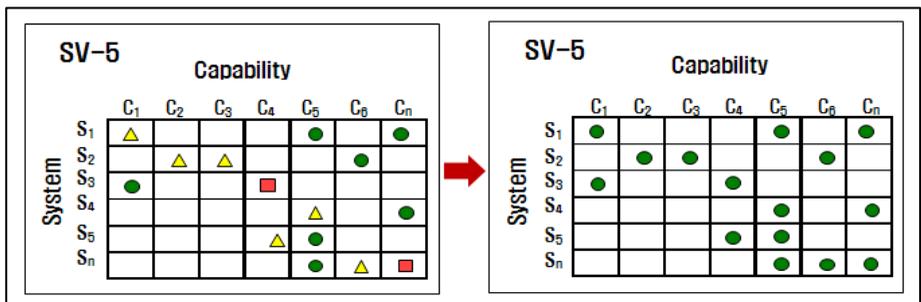


Figure 6: Traceability Matrix with Related Systems and Capabilities.

Table 1: Resource models.

	USA	UK	Australia	ROK
Name	DOTMLPF	DLODs (TEPID-OIL)	FIC	DOTMLPF
1	Doctrine	Doctrine		Doctrine
2	Organization	Organization	Organization	Organization
3	Training	Training	Collective Training	Education, Training
4	Material	Equipment	Major Systems	Weapon, Equipment, Material
5	Leadership		Command & management	Human Resources
6	Personnel	Personnel	Personnel	
7	Facilities	Infrastructure	Facilities	Facilities
8		Logistics	Support	
9		Information	Suppliers	

Australia's FIC (Fundamental Inputs to Capability) model⁹ includes organization, collective training, major systems, command and management, personnel, facilities, support and suppliers.

Republic of Korea's DOTMLPF model¹⁰ includes doctrine, organization, formation, education, training, weaponry, equipment, materiel, human resources and facilities.

The so called "System & Resource" matrix signifies the relationship between the system and the resources necessary to make that system fully functional. It analyzes System through its relationship with Resource – a factor composing the system, and indicates factors for future improvement. As shown in Figure 7, by using the integrated capability framework proposed up to this point, when topics related to "Advanced Air and Air Defense Capabilities" are applied to the framework, the fields requiring advancement for air defense can be viewed at once.

First, "Organizing air forces for future operations; organizational challenges of network centric warfare" corresponds to the organizational view of the framework. Secondly, "Roles, missions and required operational capabilities of air, air defense, space and other related organizations" corresponds to the operational view of the framework. Thirdly, "Definition of priorities for technology insertion in the air force" corresponds to the capability view of the framework. Fourthly, "Technologies for ad-

vanced air, air defense, and space capabilities” corresponds to the system view of the framework. Lastly, “Novel air doctrine and tactics” corresponds to the ‘doctrine’ component of the resource view of the framework. As a result, the topics proposed for development of air defense include all five major factors of the integrated capability framework.

As part of this research, in the following section of this publication we will present a methodology for decision of priorities in capability development, used to treat the third of the five topics for development of air defense, namely “Definition of priorities for technology insertion in the Air Force.”

Methodology for Deciding on Capability Priorities

“Definition of priorities for technology insertion in the Air Force” can be restated as a decision on priorities in developing required forces prior to decisions on acquiring a system. In this process, depending on the decision on capability requirements and the priorities of such capability requirements, decisions can be made within a constraint budget. Towards this purpose, this section of the paper presents results of comparative analysis of methodologies used in advanced countries to set priorities for the capability development process and suggests a methodology applicable to the needs of the Korean Air Force.

Initially, to set priorities for capability—of the five components of the integrated capability framework—the correlation between operation and capability must be analyzed and its basic tenets must be understood. As described in the Operation & Capability Relationship shown in Figure 8, when an operation is analyzed, its purpose is allocated and formed into a task. Such operation is a military action providing support for the mission; it consists of tasks. In addition, the capability consists of subordinate capabilities at many levels. A task, the final stage composing the operation, is mapped to the lowest capability with mutual relevance and this signifies that there are a number of capabilities counted in performing a particular operation.

The ‘Operation & Capability’ matrix indicated in Figure 9 shows the correlation of two factors based on the understanding of such operation and capability. “Capability” on the horizontal axis can commonly be required across operations, which sets a ‘functional capability’ as a relatively static concept that further consists of subordinate functional capabilities. Of the functional capability taxonomies developed by individual countries, we selected for application the JCA used by the United States.

“Operation” on the vertical axis is a relatively dynamic concept; it consists of operations necessary in performing particular missions and details tasks assigned to subordinate organizations. From the task lists developed by individual countries, we selected UJTL for application by the Korean Air Force.

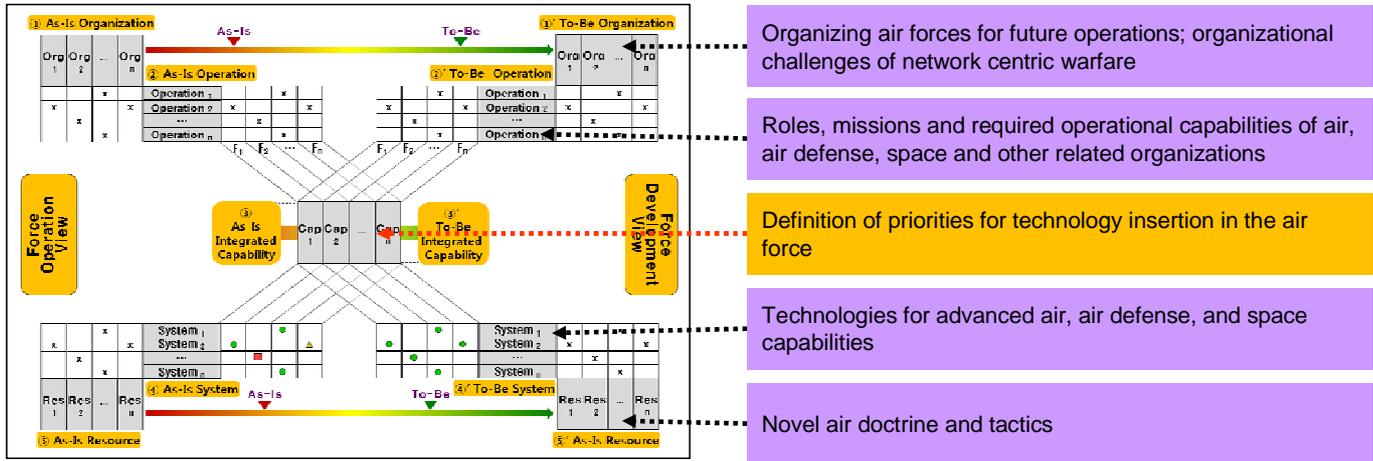


Figure 7: Air Defense Topics within Integrated Capability Framework.

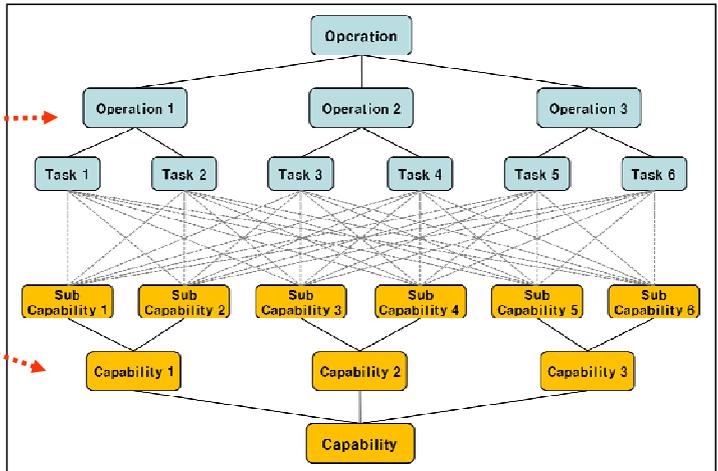
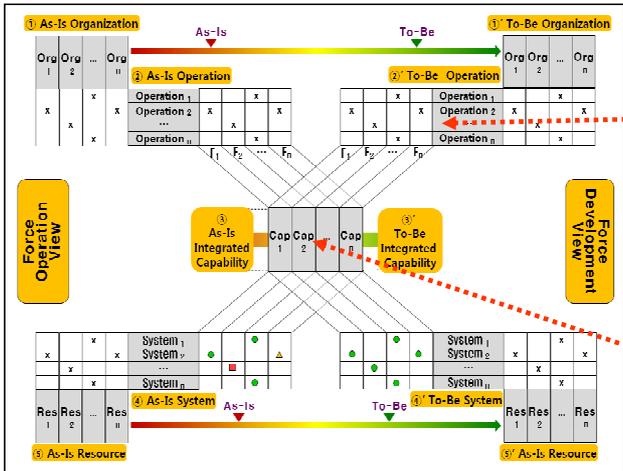


Figure 8: Operation & Capability Relationship.

Capability Operation		Capability 1		Capability 2		Capability 3		Total
		Sub Capability1	Sub Capability2	Sub Capability3	Sub Capability4	Sub Capability5	Sub Capability6	
Operation1	Task1							
	Task2							
Operation2	Task3							
	Task4							
Operation3	Task5							
	Task6							
Total								
Priority								

Figure 9: Mission & Capability Matrix.

In the Operation & Capability matrix, we used the criteria and weights shown in Figure 10 to specify and quantitatively measure the correlation of operation and capability. Initially, the criteria classifying the influence level of capability on the operation are occurrence and significance. Occurrence A (Always) means “This capability will almost always (80 % - 100 %) be required over the duration of the task.” Occurrence S (Sometimes) means “This capability will sometimes (20 % - 80 %) be required over the duration of the task.” Occurrence R (Rarely) means “This capability will rarely (0 % - 20 %) be required over the duration of the task.”

Significance High means “Mission failure” unless the capability is available. Significance Medium means “Mission restricted,” and Significance Low means that the capability under examination has “Minimal impact on mission success.” Finally, we recommend using the following quantification rules:

$$AH=1.0; AM, SH=0.7; AL, SM, RH=0.5; SL, RM=0.3; LL=0.1.$$

The prioritization of air missile defense is shown on Figure 11. It is based on application of cases related to air defense into the operation & capability matrix with addition of criteria and weights. A number of tasks and capabilities related to the operation could not all be expressed in this paper and, thus, the application had a limited scope. The purpose was to show the process of implementing the methodology to support capability priority decisions.

The operation is “Defense against enemy’s air missile attack on main target” and the task is “air trace exploration from air to long distance, transfer of detected trace information, analysis on trace information received, transfer of air defense warning,

Occurrence \ Significance		Always		Sometimes		Rarely	
		<i>This capability will almost always (80%-100%) be required over the duration of the task</i>		<i>This capability will sometimes (20%-80%) be required over the duration of the task</i>		<i>This capability will rarely (0%-20%) be required over the duration of the task</i>	
High	<i>Mission failure</i>	AH	1.0	SH	0.7	RH	0.5
Medium	<i>Mission restricted</i>	AM	0.7	SM	0.5	RM	0.3
Low	<i>Minimal impact on mission success</i>	AL	0.5	SL	0.3	RL	0.1

Figure 10: Criteria and Weights.

target allocation and pursuit of trace information.” The capability is “ISR Planning & Direction Collection, Processing & Exploitation, Analysis & Production, and ISR Dissemination.”

When specific capability and influence level of each task are substituted—after measuring them with the standards of Occurrence and Significance—respective values can be calculated. When respective values per specific capability are put together, ISR Planning & Direction is 3.8, Collection is 3.1, Processing & Exploitation is 4.5, Analysis & Production is 3.6, and ISR Dissemination is 2.6. Depending on the resulting values, the priorities of capabilities required for air missile defense operation are in the following order: Processing & Exploitation; ISR Planning & Direction; Analysis & Production; Collection; and ISR Dissemination.

When the results of capability priorities, gained through application of this methodology, are applied to the integrated capability framework, as shown in Figure 12, it can be found that the priorities of system development for technology insertion in the Air Force are in the following order: system 3; system 1; system 4; system 2; and system 5. This is further treated by CBA, while the related concept of specific cost will be explored in the authors’ further research and published in a follow-up paper.

Conclusion

Up to this point, we have proposed an integrated capability framework and a methodology for decision of capability priorities based on analysis of current status of capability, RTM and joint capability—based on the experience of the United States and other advanced countries—to overcome the encountered problems and assist the development of a capability-oriented force structure of the South Korean Air Force.

Battlespace Awareness Air Missile Defense	Intelligence, Surveillance and Reconnaissance										Total
	ISR Planning & Direction		Collection		Processing & Exploitation		Analysis and Production		ISR Dissemination		
Air trace exploration from air to long distance	AL	0.5	AH	1.0	SM	0.5	RH	0.5	SH	0.7	
Transfer of detected trace information	AH	1.0	SH	0.7	AH	1.0	SH	0.7	SM	0.5	
Analysis on trace information received	AL	0.5	SL	0.3	SM	0.5	SM	0.5	RL	0.1	
Transfer of air defense warning	AH	1.0	SH	0.7	AH	1.0	RH	0.5	SH	0.7	
Target allocation	AL	0.5	RL	0.1	AH	1.0	AM	0.7	RH	0.5	
Pursuit of trace information	RM	0.3	SL	0.3	AL	0.5	SH	0.7	RL	0.1	
Total		3.8		3.1		4.5		3.6		2.6	
Priority	2nd		4th		1st		3rd		5th		

Figure 11: Prioritizing Air Missile Defense.

The integrated capability framework presented here incorporates planning, developing, deploying, employing, and sustaining the force structure under examination. Components of the framework are Operation, Integrated capability, System and Resource. The framework utilizes integrated capability analysis and provides for capability-based investment decision, capability-based portfolio management, capability-based force development and joint capability which serve as the basis of operations planning in the current view and provide future views on the functions and capabilities of superior and subordinate organizations. The framework is also a tool to visualize and grasp the linkages among factors influencing the integrated capability.

The methodology for deciding on capability priorities, on the other hand, builds on the integrated capability framework. Through the operation and capability matrix, it utilizes judgment on Occurrence and Significance to set weights and quantify the correlation between mission, tasks and capabilities, and thus to prioritize capability requirements. Then we study a specific case—an air missile defense scenario—showing how capability priorities serve as a basis to set priorities of system development required for capability-oriented future Air Force.

In order to finalize system-related decisions, we need to account for eventual costs. The incorporation of costs in the integrated capability framework and the methodology for deciding on capability priorities is subject of ongoing research in support of system development for the Korean Air Force.

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Notes:

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- ¹ See the US Joint Staff definition in the Instruction CJCSI 5123.01E of the Chairman of the Joint Chiefs (17 April 2010), p. GL-4, <www.dtic.mil/cjcs_directives/cdata/unlimit/5123_01.pdf>.
 - ² See *Business Transformation Guidance*, version 1.1 (US DOD Business Transformation Agency, July 2007).
 - ³ *DOD Architecture Framework 1.0 Deskbook* (Washington, D.C.: DoD Architecture Framework Working Group, August 2003), p. D-4.
 - ⁴ See, for example, "Organization," *Wikipedia*, at <http://en.wikipedia.org/wiki/Organization>.
 - ⁵ See the US Joint Staff definition in the Instruction CJCSM 3500.04E of the Chairman of the Joint Chiefs (25 August 2008), p. GL-6.

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